OUT-OF-BASIN TRANSFER SUBCOMMITTEE REPORT

to the

RHODE ISLAND WATER RESOURCES BOARD

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Members of the Out-of-Basin Transfer Subcommittee
relax after presenting their findings to the Board's
Water Allocation Program Advisory Committee

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TABLE OF CONTENTS

SECTION I – INTRODUCTION

The Rhode Island Water Resources Board (RIWRB) is charged by the legislature to manage the withdrawal and use of the waters in Rhode Island, apportioning it as necessary (RI Gen. Laws §46-15.7). To this end, the RIWRB has created the Water Allocation Program Advisory Committee (WAPAC), an interdisciplinary, ad hoc committee that was undertaken the task of recommending an overall work plan with budget for the water allocation program. The WAPAC includes both state regulators and various stakeholders (water suppliers, watershed groups, academics, lawyers, students, water-related associations, etc.) and will be advised by subcommittees within the following component areas:

- Water Use Reporting;
- Stream flow Standards;
- Priority Uses;
- Water Rights/Regulatory Authority;
- Out-of-Basin Transfer;
- Fees/Water Rates/Alternatives;
- Education/Outreach/Public Relations;
- Integrated Water & Wastewater/Technical Assistance;
- Impact Analysis; and
- Joint Advocacy and Funding.

The overall mission of the WAPAC is to manage the amounts, purposes, timing, locations, rates, and other characteristics of fresh water withdrawals from ground or surface water to:

- Protect the health, safety, and general welfare of the people of the state of Rhode Island;
- Provide for the fair and equitable allocation of the water resources among users and uses;
- Promote the continued existence, diversity and health of the state's native wildlife and plant species and communities; and
- Insure that long-range, rather than short-range, considerations remain uppermost.

The Statement of Purpose for the WAPAC is as follows:

> To develop a set of recommendations through the subcommittee process for consideration by the RIWRB, covering each component area, consistent with the overall mission and guiding principles.

The guiding principles, as referenced in the WAPAC Statement of Purpose, state that management of fresh water resources of the state should be based on:

- Adequate data in order to determine the capabilities of the state's water resources to support various uses and users and the quantities of water needed for these uses;
- Long-range planning for, and conservation of, these resources;
- Fairness, equitable distribution, and consideration for all human uses;
- Matching the use of water with the quality of water necessary for each use, giving priority to those uses that require the highest quality water;
- Maintenance of native aquatic and terrestrial animal and plant species, populations, and communities and state-wide diversity;
- Continued upholding of and improvement in the quality of the environment and especially of the water resource itself;
- Careful integration with all other social, economic, and environmental objectives, programs and plans of the state;
- Allocation of water resources in a manner that provides for agricultural sustainability while recognizing the importance of other water users; and
- Optimizing reduction/conservation, reuse and recycling of water resources.

As a subcommittee to the WAPAC, the Out-of-Basin Transfer (OOBT) Committee has evaluated water and wastewater out-of-basin transfers within the State of Rhode Island, including interstate transfers. The committee developed various recommendations regarding the importance of OOBT in water management in the state. The mission statement for the OOBT Committee is as follows:

> Develop criteria for out-of-basin transfers that protect the reasonable needs of water basins.

As such, the OOBT committee has performed the following activities to help to advance the understanding of OOBTs in Rhode Island.

1. Performed a geographic information system (GIS)-based assessment of "interbasin movement of water" and an analysis of where such movement creates problems. This assessment has focused on the Chipuxet sub basin of the Pawcatuck River basin and to a lesser extent, on the Blackstone River basin—the two watersheds identified by the WAPAC for analysis.
2. Developed working definitions for "water basin", "interbasin transfer" and "geographic water accounting area."
3. Recommended actions to address OOBTs, where needed.

In addition, the OOBT Committee reviewed sections of the Regulated Riparian Model Water Code (Code), as it pertains to the transfer of water, the Massachusetts Interbasin Transfer Act and associated guidelines to evaluate their applicability to out-of-basin transfer of water in Rhode Island. The committee also reviewed publications from other states as well as national and regional water associations that addressed OOBTs to gain additional perspective.

- The objectives of this report are to describe the activities performed by the OOBT Committee and the findings and recommendations developed through these activities in a concise manner to support the subcommittee's recommendations to the WAPAC.

SECTION II – DEFINITIONS

Consumptive Use: A consumptive use is any use of water that is not a "nonconsumptive use" (see below), or that part of withdrawn water that is evaporated, transpired**,** incorporated into a product or crop, consumed by humans or livestock, or otherwise removed from the immediate water environment. A consumptive use diminishes the quantity or quality of water in a water source, thus impairing the sustainable development of a water source (adapted from section §2R-2-6 of the Regulated Riparian Model Water Code).

Basin of Origin (or Donor Basin): a water basin from which any water, including wastewater, is transferred.

Conveyance: The systematic and intentional flow or transfer of water from one point to another. Conveyance types include water distribution and wastewater collection.

Geographic Water Accounting Area: an area or water basin, designated by a state water management agency, in which comprehensive water-use information is accounted for periodically.

Nonconsumptive Use: any use of water withdrawn from the waters of the state in such a manner that it is returned to its waters of origin at or near its point of origin without substantial diminution in quality or quantity and without resulting in or exacerbating a low flow condition. (Adapted from section 2R-2-13 of the Regulated Riparian Model Water Code)

Out-of-Basin Transfer (OOBT): any transfer of water, including wastewater, by any means regardless of the quantity involved, out of a water basin.

Pre-application Conference: a review meeting of a proposed development held between applicants and reviewing agencies as permitted by law and municipal ordinance, before formal submission of an application for a permit or for development approval.

Reasonable Use: means the use of water, whether in place or through withdrawal, in such quantity and manner as is necessary for economic and efficient utilization without waste of water, without unreasonable injury to other water right holders, and consistently with the public interest and sustainable development. (Adapted from section §2R-2- 20 of the Regulated Riparian Model Water Code)

Receiving Basin: a water basin to which water, including wastewater, is transferred from another water basin.

Regulated Riparian Model Water Code: a code developed for, and published by, the American Society of Civil Engineers (1997) for the purpose of providing model legislation for adoption by state governments for allocating water rights among competing interests and for resolving other qualitative conflicts over water. (The Code reflects the needs and legal traditions of the eastern states; the proposed statutes allocate the right to use water based on whether the use is reasonable.)

urn Flow: Water that is returned to surface or groundwater after use or wastewater treatment.

Water Basin: an area of land from which all waters drain, on the surface or beneath the ground, to a common point or altitude.

ter Use Permits: a written authorization issued by the State Agency to a person entitling that person to hold and exercise a water right involving the withdrawal of a specific quantity of water at a specific time and place for a specific reasonable use as described in the written authorization.

SECTION III – National Research

The OOBT Committee attempted to research how other states manage the conveyance of water. This was not an easy task, and the research was not exhaustive. Among the findings of various professional organizations were the following:

American Water Works Association (AWWA)

AWWA legislative responses to OOBT fall into four categories:

- Prohibitions
- General permit requirements
- Permit conditions mandating water conservation
- Permit conditions mandating the payment of compensation

New England Water Works Association (NEWWA)

- Permit process must be streamlined and less costly for new source approvals, increased withdrawals, and source redrilling/relocation; set a timetable and identify data needs upfront
- A fair allocation should include quantification of all uses and losses (not just water supply) that may affect stream flow
- Increased storage is desirable—particularly offline storage—for supplemental water use

RI Water Works Association

*See Other Areas to Explore in the Recommendations section.

Council of State Governments

- Find the over users and analyze why they overuse
- Require major water users to file annual water use reports
- Designate areas that are in danger of over use
- Limit commercial withdrawals of water
- Require cities and counties to create water supply assessments for large development projects
- Pass legislation that links water supply with land use

MA Interbasin Transfer Act

Positive aspects:

- Comprehensive assessment (state NEPA process)
- Well coordinated among state agencies
- Strong policy message

Negative aspects:

- Overly regulatory (few applications approved)
- Extensive and burdensome application process
- Unintended consequences
- Coordination gaps at local level

Regulated Riparian Model Water Code (Code)

The Regulated Riparian Model Code was developed by the American Society of Civil Engineers to provide state government agencies with model legislation to address the allocation of water rights among competing user groups. Because eastern and western states continue to diverge with respect to laws governing public water supplies, two different models were developed. The Regulated Riparian Model Code addresses the legal traditions of the eastern states. A central concept of the Code is that water allocation decisions should be predicated on whether or not a proposed water use is “reasonable.”

Under the Code reasonable use is defined as follows: “the use of water, whether in place or through withdrawal, in such quantity and manner as is necessary for economic and efficient utilization without waste of water, without unreasonable injury to other water right holders, and consistently with the public interest and sustainable development.”

The OOBT Committee was guided by various principles embodied in the Code, both in terms of general provisions, as well as sections specific to OOBT. Among the key principles that guided the committee were the following:

- Plan for conservation: “A plan for conservation is a detailed plan describing and quantifying the amount and use of water to be developed by conservation measures in the exercise of a water right.”

- Sustainable development: “the integrated management of resources taking seriously the needs of future generations as well as the current generation, assuring equitable access to the resources, optimizing the use of non-renewable resources, and averting the exhaustion of renewable resources.”

- Standards for protected minimum flows: “The State agency shall establish a minimum flow or level as the larger of the amounts necessary for the biological, chemical, and physical integrity of the water source, taking into account normal seasonal variations in flow and need.”

Among the key sections that guided the committee were the following:

- § 1R-1-01

  The waters of the State are a natural resource owned by the State in trust for the public and subject to the State's sovereign power to plan, regulate, and control the withdrawal and use of those waters, under law, in order to protect the public health, safety, and welfare by promoting economic growth, mitigating the harmful effects of drought, resolving conflicts among competing water users, achieving balance between consumptive and nonconsumptive uses of water, encouraging conservation, preventing excessive degradation of natural environments, and enhancing the productivity of water-related activities.

- § 1R-1-02

  Pursuant to this Code, the State undertakes, by permits and other steps authorized by this Code, to allocate the waters of the State among users in a manner that fosters efficient and productive use of the total water supply of the State in a sustainable manner in the satisfaction of economic, environmental, and other social goals, whether public or private, with the availability and utility of water being extended with a view of preventing water from becoming a limiting factor in the general improvement of social welfare.

For a complete list of sections referenced in the Code for this report, please see the Appendix, OOBT MODEL WATER CODE REFERENCES.

SECTION IV – Legislation, Regulations and Plans Pertaining to Out-of-Basin Transfer in Rhode Island

The Problem

There are no state laws written with the express intent of regulating OOBT in Rhode Island. However, some regulations have been promulgated that address the potential environmental impacts of OOBT in certain coastal watersheds and in the freshwater wetlands of the state. The Committee discussed various permitting processes in which development occurs in the state, concluding that water quantity is not typically factored into local land use decisions in a meaningful way. The Committee agreed that local officials do not usually have the expertise to sufficiently evaluate water availability, and in many cases, are not obligated to consider impacts of a water withdrawal on the regional water supply. Additionally, applicants typically invest a significant amount of time and resources in the permitting process—which is inherently uncertain and sometimes politicized—or dodge the approval process altogether.

In trying to understand the existing regulatory process and assess the gaps or problems, the committee discussed and/or reviewed documentation regarding the following projects:

- Kingston Water District: permitting a public drinking water supply well, primarily under the purview of the RI Dept. of Environmental Management (DEM) - Wetlands program;
- Kent County Water Authority: planning for a new supply well for a major manufacturer primarily through DEM's Wetlands program and with guidance from the RI Water Resources Board (WRB);
- Ninigret Hamlet: permitting for an affordable housing proposal located in a coastal area as part of the RI Coastal Resources Management Council's (CRMC) Assent process;
- City of Taunton: permitting for a desalination project (multiple agencies and regulations);
- Town of Warren: Chace Farms: citizens challenging the town's zoning board in court, in part, based on the question of water availability;
- Private farm ponds and wells for agricultural use: an expedited permit process under the purview of DEM's Division of Agriculture;
- RI Div. of Public Utilities and Carriers (PUC): rate-filing process for regulated water suppliers wishing to expand their systems and requirements for permitting energy facilities.
- RI Economic Development Corp: expedited permit process for "Projects of Critical Economic Concern"

Additionally, the Water Allocation Program Advisory Committee hosted presentations on two, factual scenarios including:

- Town of Richmond, Richmond Commons: permitting for a proposed, mixed use development, primarily under DEM's sewage disposal regulations with guidance regarding long term water availability from "experts";
- Town of Burrillville, Ocean State Power: federal and state permitting for wastewater discharge with a requirement to maintain stream flow in the Blackstone River, together with the US Army Corps of Engineers and DEM.

LEGISLATION

Existing Provisions of RI General Law (RIGL) that Potentially Address OOBT in RI

1) Water Resources Board RIGL §46-15

Provisions in **Chapter 46-15-2** require approval of public water supply facilities, and may provide a means to controlling OOBTs. This statute gives the WRB–with the recommendation and approval of the director of the RI Department of Health and the RI Dept. of Administration, Division of Statewide Planning—authority to regulate the future distribution of water by public and private entities that distribute water for potable purposes.

Chapter 46-15-2 Approval of public water supply facilities. – (a) No municipal water department or agency, public water system, including special water districts or private water company, engaged in the distribution of

water for potable purposes shall have any power: (6) To supply water in or for use in any other municipality or civil division of the state which owns and operates a water supply system therein, or in any duly organized special water district supplied with water by another municipal water department or agency, special water district, or private water company, until the municipal water department or agency, special water district, or private water company has first submitted the maps and plans therefor to the director of the department of health, the state planning council and the board, as hereinafter provided, and until the water resources board, after receiving the recommendations of the director of the department of health and the division of statewide planning, shall have approved the recommendations or approved the recommendation with modifications as it may determine to be necessary; provided, however, this subsection shall not apply to any area presently served by any municipal water department or agency, or special water district.

Provisions in **Chapter 46-15.3**, Public Drinking Water Supply System Protection provide for water supply systems management planning, which allows for the lawful sale of water between suppliers and across state boundaries via water system interconnections. It may be feasible to add criteria for future management planning in this chapter that would address potential impacts of interbasin transfers in donor and receiving basins**.**

Chapter 46-15.2, Water Facilities Assistance Program, provides financing for such interconnections. As part of the negotiations for financing interconnections, consideration of the impacts of interbasin transfers of water could/should be required.

Finally, **Chapter 46-15.7** Management of the Withdrawal and Use of the Waters of the State, is a potential vehicle through which to regulate OOBT. This section of law could be amended to include authority to regulate transfer of water, as either water supply or wastewater. (Note: Adoption of the definitions of "water basin", "accounting basin", and "out-of-basin transfer" recommended by this committee, would give the WRB authority to manage OOBT in water basins of any size, and, in addition, would provide management of OOBT of wastewater, over which there currently appears to be little control. Such an amendment could be used to effectively limit the gradual expansion of wastewater collection systems that transport water out of a water basin, encourage water conservation measures in the donor basin, or both.)

2. Zoning Enabling Act RIGL §45-24

The committee engaged in a number of discussions regarding the integrity of local water withdrawal decisions which typically occur as part of the development review process under state zoning and land use laws. A review of several town ordinances and development plan review checklists revealed that not all municipalities take advantage of the "pre-application conference" provision. For those that do, the timing of the conference does not necessarily occur in advance of actual permitting, but rather after a developer has invested a significant amount of time and effort in architectural design and site planning. Additionally, not all municipalities have paid planners and many rely on volunteer boards and commissions. Usually, an applicant bears the burden of proof while some cities and towns hire consultants to verify a developer's assumptions. The committee discussed several different ways that the state could assist local decision makers in determining whether a proposed water withdrawal could be sustained over time. It was agreed that an unbiased multidisciplinary team might be a viable alternative to a reliance on developers. However, it also makes good economic sense for developers to incur the expense of determining sustainable yield potentially affected by their proposals, and then have their results reviewed by an unbiased multidisciplinary team.

CHAPTER 45-24-31, Zoning Ordinances
Definitions:
(54) Preapplication Conference. A review meeting of a proposed development held between applicants and reviewing agencies as permitted by law and municipal ordinance, before formal submission of an application for a permit or for development approval.

CHAPTER 45-24-48, Zoning Ordinances
§ 45-24-48 Special provisions – Preapplication conference. – A zoning ordinance may provide for a preapplication conference for specific types of development proposals. A preapplication conference is intended to allow the designated agency to:
(1) Acquaint the applicant with the comprehensive plan and any specific plans that apply to the parcel, as well as the zoning and other ordinances that affect the proposed development;
(2) Suggest improvements to the proposed design based on a review of the sketch plan;
(3) Advise the applicant to consult appropriate authorities on the character and placement of public utility services; and
(4) Help the applicant to understand the steps to be taken to receive approval.

3) Land Development and Subdivision Review Enabling Act RIGL §45-23

Likewise, the committee conducted a cursory review of the state's major land use law and conferred with staff at the RI Dept. of Administration, Division of Statewide Planning. State planners felt that the statute is adequate, in that it enables municipalities to factor water quantity into the decision making matrix as part of the development plan review process. However, the law is not explicit in terms of transferring water, including wastewater, out of a water basin; it may need to be amended in the future. Changes to state law would, consequently, trigger changes in local ordinances so that they are consistent.

Definitions
(34) Preapplication conference. An initial meeting between developers and municipal representatives that affords developers the opportunity to present their proposals informally and to receive comments and directions from the municipal officials and others. See § 45-23-35.

§ 45-23-35 General provisions – Pre-application meetings and concept review.
(a) One or more pre-application meetings shall be held for all major land development or subdivision applications. Pre-application meetings may be held for administrative and minor applications, upon request of either the municipality or the applicant. Pre-application meetings allow the applicant to meet with appropriate officials, boards and/or commissions, planning staff, and, where appropriate, state agencies, for advice as to the required steps in the approvals process, the pertinent local plans, ordinances, regulations, rules and procedures and standards which may bear upon the proposed development project.
(b) At the preapplication stage, the applicant may request the planning board or the technical review committee for an informal concept plan review for a development. The purpose of the concept plan review is also to provide planning board or technical review committee input in the formative stages of major subdivision and land development concept design.
(c) Applicants seeking a pre-application meeting or an informal concept review shall submit general, conceptual materials in advance of the meeting(s) as requested by municipal officials.
(d) Pre-application meetings aim to encourage information sharing and discussion of project concepts among the participants. Pre-application discussions are intended for the guidance of the applicant and are not considered approval of a project or its elements.
(e) Provided that at least one (1) preapplication meeting has been held for major land development or subdivision application or sixty (60) days has elapsed from the filing of the pre-application submission and no pre-application meeting has been scheduled to occur within those sixty (60) days, nothing shall be deemed to preclude an applicant from thereafter filing and proceeding with an application for a land development or subdivision project in accordance with § 45-23-36.

REGULATION

Existing Regulations that Potentially Address OOBT in RI

The Coastal Resources Management Council has promulgated regulations under "The Salt Pond Region: A Special Area Management Plan" (SAMP) to protect the nine coastal salt ponds whose watersheds collectively encompass Rhode Island's south shore between the towns of Westerly and Narragansett. The regulations address both wastewater and water supply scenarios with respect to land use classifications that were developed under the SAMP. The following regulations apply to OOBT between those portions of the nine salt pond watersheds that are classified as Self Sustaining Lands and Lands of Critical Concern:

1) RI Coastal Resources Management Council - Salt Ponds Region Special Area Management Plan (SAMP)

Section 920.1.A.2 and Section 920.1.B.2

(g) The installation of sewers is prohibited, unless all of the following conditions are met:
(i) the property meets the RIDEM regulatory siting requirements for the installation of a conventional ISDS,
(ii) the proposal is agreeable to both the town and the CRMC,
(iii) a deed restriction is attached to the property ensuring no further subdivision, and
(iv) the properties to be sewered are within 500 feet of an existing sewer line or are within a subdivision that abuts the sewer easement.
(h) Public water service is considered a low priority. When new public water supplies are proposed, the source wells and the distribution lines shall remain within a single watershed and not divert groundwater from one salt pond watershed to another.

In addition, the following regulation applies to portions of the nine watersheds that are classified as Lands Developed beyond Carrying Capacity:

Section 920.1.C.2 (d)

Public water service is a high priority for Lands Developed beyond Carrying Capacity because of the high incidence of poor groundwater quality in these densely developed areas. When new public water supplies are proposed, the supply wells and service areas for public water supplies shall be kept within individual watersheds. The export of groundwater from one watershed to another should be minimized. These regulations, especially those that prohibit OOBT of public water supplies, are designed to ensure that the groundwater resources which are critical to maintain the estuarine character of each salt pond is preserved for that purpose. They also represent the only case where a prohibition against OOBT occurs in Rhode Island.

However, despite their limited geographic application to certain coastal watersheds, the central strategy behind these regulations can be adapted to regulate OOBT in any watershed throughout the state. The SAMP recognizes that there is a complex relationship among the various components of the Salt Ponds ecosystem, and that a change to even one of these components – particularly critical resources – can have unforeseen and potentially significant impacts on the ecosystem. Groundwater was identified as a critical resource that had to be protected in order to preserve the ecological health of the Salt Ponds region's unique estuarine ecosystem. This central strategy of protecting an ecosystem's critical resources as the basis for protecting all of its various habitats and organisms is as applicable to an inland watershed as it is to an estuarine ecosystem. Using objective criteria to designate critical resources – as the SAMP does – provides a rational basis for developing stringent regulations, such as the OOBT prohibitions in the SAMP. This approach could be applied to a statewide permit system that regulates OOBT through an ecosystem-based, critical resource protection model.

It is important to note that while the OOBT prohibition in the SAMP applies to transfers of water from one sub-watershed to another within the boundaries of the Salt Pond region watershed, it does not address transfers of water into the Salt Pond watershed from sources outside the watershed. The SAMP recognizes that both "donor" and "receiving" basins within the region are vulnerable to environmental impacts such as changes to hydrology, salinity, aquatic habitat, and biodiversity, which can occur as a result of interbasin transfer via public

water systems to accommodate expanding development. While the SAMPs effectively prevent transfer of water from one salt-pond watershed to another, thereby protecting their unique estuarine ecosystems, the lack of a prohibition against the import of water *into* these watersheds from sources *outside* the SAMP watershed boundary, leaves every salt pond vulnerable to the very environmental impacts the SAMP identifies and is designed to prevent. In addition to amending the Salt Pond SAMP to address this issue, scientific studies may be needed as part of CRMC's assent process to demonstrate that no harm will be done to a Salt-Pond region watershed because of development. Methods to address new, or increases in, transfer of water from one basin to another—either for water supply or as wastewater—elsewhere in the state, should similarly include a provision to assure that such transfers will do no harm to the ecosystems of either donor or receiving basins.

2) RI Coastal Resources Management Council - Freshwater Wetlands in the Vicinity of the Coast program, and 3) RI Dept. of Environmental Management - Freshwater Wetlands Rules

The protection of freshwater wetlands is another scenario under which OOBT is addressed by state regulation in Rhode Island. Both CRMC and DEM have promulgated regulations that include the ability to deny a permit application if the proposed OOBT might alter a freshwater wetland. The CRMC and DEM freshwater wetland regulations are virtually identical, and they collectively address all freshwater wetlands in Rhode Island. Under the CRMC's *Freshwater Wetlands in the Vicinity of the Coast* program, if a proposed OOBT project does not comply with specified impact avoidance and minimization requirements, a permit application may be denied.

Rule 11.01 A.

All proposed projects which may alter the natural character of freshwater wetlands, area(s) of land within fifty (50) feet, riverbanks, and flood plains and their functions and values are subject to the review criteria contained herein. If the CRMC determines that a project submitted as a Request for Preliminary Determination does not comply with the impact avoidance and minimization requirements set forth in Rule 10.01 and/or does not comply with the review criteria contained herein, the CRMC may determine that the project represents a significant alteration to freshwater wetlands, area(s) of land within fifty (50) feet, riverbanks, and flood plains. If the CRMC determines that a project submitted as an Application to Alter does not comply with the impact avoidance and minimization requirements set forth in Rule 10 .01 and/or does not comply with the review criteria contained herein, the CRMC may deny approval for the project.

Finally, it is appropriate to mention OOBT in the context of the CRMC's Interstate SAMP for the Pawcatuck River Estuary and Little Narragansett Bay, which addresses OOBT on a cooperative basis with the State of Connecticut. Despite lacking the enforceable policies related to OOBT that are present in the Salt Ponds Region SAMP and both the CRMC and DEM freshwater wetlands regulations, the "Pawcatuck" SAMP does address controls on freshwater withdrawals:

Section 320.6 (c): The states should cooperate in the development of an appropriate policy and approach governing the withdrawal of water from the entire (fresh and estuarine) system for agricultural, industrial, and other purposes; it is recommended that the RIDEM make this a priority item. The policy should establish a regulatory program requiring permits for withdrawals, and establish maximum levels of withdrawals for commercial and industrial uses, as well as agricultural uses.

4. RI Dept. of Environmental Management - Water Quality Certification

Indirectly, water quality certifications and wetlands legislation administered by DEM may be used to control OOBTs in some instances. For example, applications to develop water supplies that would result in transport of water out of a basin may be denied if the water withdrawals can be expected to adversely impact wetlands. In other situations, provisions of the federal Clean Water Act may be invoked to constrain transfer of wastewater from one basin to another, if expected waste loads are too great for receiving water bodies to assimilate.

5. RI Dept. of Environmental Mgt. - RI Pollution Discharge Elimination System

DEM, under its RIPDES program, develops and enforces permit limitations for municipal and industrial wastewaters, storm water, and combined sewer overflows discharged directly to the waters of the state, as well as industrial wastewaters discharged to municipally-owned treatment facilities. If feasible, it would seem

appropriate to modify criterion for permitting wastewater discharges to include consideration of impacts of OOBT of this water on low-flow depletion of streams in the donor basins, together with the impacts on water quality in streams of receiving basins. This effort would dovetail with DEM proposals to establish minimum flow criteria for Rhode Island streams.

6. RI Dept. of Environmental Mgt. - Individual Sewage Disposal Systems (ISDS)

Improvements in the design of individual sewage disposal systems is resulting in the ability of these systems to greatly improve the quality of wastewater that is returned to the ground near points of use. DEM, in its role as overseers of the ISDS permitting system, should encourage the use of state-of-the-art ISDS treatment systems wherever feasible in new developments— particularly within those water basins in which local sources of groundwater constitute the principal source of water supply—as a means of conserving water within these basins. Construction of sewage collection systems to deal with the disposal of wastewater generally results in transport of water out of basins, thereby diminishing the availability of water to sustain wetlands, stream flows, and well yields. The OOBT Committee also noted that the Wastewater Treatment Facilities plan review checklist could be modified to require consideration of OOBT when approving new facilities, or expansions of existing facilities.

PLANS

RI State Guide Plan Elements

The Statewide Planning Program of the Department of Administration is charged by Rhode Island General Law 42-11-10 and 12 with preparing and maintaining plans for the physical, economic, and social development of the state. The State Guide Plan is prepared and maintained by the Statewide Planning Program as a means for setting and centralizing state policies concerning the natural resources of the State and the economic, physical and social development of the State. The SGP is not a single document but a collection of plans that have been separately adopted and updated over time. The SGP currently contains thirty elements, which are grouped into functional areas. The following is a list of SGP Elements that concern water resources management.

- Element 110: Goals and Policies
- Element 121: Land Use and Policies Plan
- Element 162: Rivers Policy and Classification Plan
- Element 721:Water Supply Policies for RI
- Element 722; Water Supply Plan for RI
- Element 723: Water Emergency Response Plan
- Element 724: Drought Management Plan
- Element 715: Comprehensive Conservation & Management Plan for Narragansett Bay*

  * This is the only element that explicitly calls out OOBT

The OOBT Committee thought it was important to make the connection between the potential impacts of transferring water out of a water basin and selected goals of the State Guide Plan. For example, among the relevant goals outlined in Element 121 are the following:

- Guide the development of land and water to produce a healthful, efficient, and aesthetically pleasing environment.
- Manage and develop surface and ground water supply resources in a coordinated and efficient manner on a state, local, and regional level, considering long-term needs and environmental impacts.
- Promote efforts to match the quality of water used by major consumers and/or water use sectors with the water quality level required for such uses in order to conserve our highest quality existing and potential drinking water supplies.

A policy statement in Element 162, Rivers Policy and Classification Plan reads:

- Water withdrawals shall be managed comprehensively within individual watersheds in accordance with this plan's classifications.

Policy goals identified in Element 721, Water Supply Plan:

- Municipalities shall balance the use of land and water resources in cooperation with local water supplier(s) serving their respective jurisdictions by considering:
    - balancing new development with available water supply;
    - encouraging development that utilizes the existing infrastructure;
    - considering cumulative impacts of development within watersheds and recharge areas;
    - considering safe yield and capacity of the water supply and delivery system within community comprehensive plans;
    - discouraging the formation of new small water systems;
    - efficiently utilizing existing supply sources;
    - protecting water quality through local land use and zoning or other appropriate means and methods.

To view regulatory and planning authorities over water and wastewater management in Rhode Island, please see the diagrams in the Appendix.

ction V – Current OOBT Practices in Rhode Island

Typical OOBTs include the import/export of both potable water and wastewater. An additional OOBT identified by the committee included the infiltration/inflow (I/I) of groundwater into sanitary sewer and storm water conveyance systems. Significant evaporative losses associated with the anthropogenic use of groundwater or surface water for irrigation purposes (both agricultural and residential) represents a significant water loss to the basin of origin and may be considered a form of OOBT.

Committee investigated the interconnections between water systems to evaluate the scope of existing out-of-basin transfers. Recognizing that watersheds transcend political boundaries, the committee attempted to determine the nature of transfers between states as well as between watersheds. In particular, the committee contacted the Town of Westerly and the Pawtucket Water Supply Board for the status of any interstate contracts for water supply. Pawtucket indicated that verbal agreements were in place for emergency purposes and that all other contracts for supply into Massachusetts had expired. The Town of Westerly operates a water system that supplies water in neighboring portions of Connecticut as well as the Town itself. Town officials indicated that virtually all of its water withdrawal is used within the watershed.

The Providence Water Supply Board is by far the largest utility in the state and has a long history of supplying other systems within and outside of its watershed. Approximately 20 communities receive water from the Providence system. In a similar manner, the East Bay water systems historically have transferred water from one watershed to another. Approximately seven communities receive water from Massachusetts in addition to their own local supplies.

In order to conceptualize the effects of out-of-basin transfers and improve water allocation in Rhode Island, the OOBT Committee looked at existing information regarding water and wastewater use and conveyance within the Pawcatuck River and Blackstone River basins, two basins identified by the WAPAC for analysis. The purpose of the evaluation was to look at a "real world" OOBT scenario to assist the committee in evaluating the need to develop regulations and a methodology for the long-term management of OOBTs. Data obtained from USGS draft reports on water use in these two basins provided most of the information reviewed, but additional information for the Pawcatuck basin was provided by a committee member, Henry Meyer, the manager of the Kingston Water District. This water district is located in the headwaters of the Pawcatuck basin. (Before completion of this report, the USGS Blackstone report was published as Water Resources Investigations Report 03-4190.)

OOBT in the Pawcatuck Basin: Kingston Water District Case Study

The growth of the Kingston Water District is representative of most water systems and demonstrates the evolving nature of a typical out of basin scenario. As the Kingston system grew, so did the amount of out-of-basin transfer—some as water supply, some as wastewater. Given the relatively small size of Rhode Island watersheds, it is likely that all major public water supply and wastewater collection systems involve some out-of- basin (or interbasin) transfers. As the Kingston community grew, so did the need for public sewers, which had the effect of increasing the volume of out-of-basin transfer in the form of wastewater. For instance, the public sewer system that serves the University of Rhode Island and the community of Kingston transports wastewater out of the Upper Pawcatuck River basin to Narragansett, where it is treated and discharged into Narragansett Bay.

Premise:

1. Most major public water supply systems operate on the fundamental assumption of using water at some distance from the source of supply.
2. As population and activities increase, so do the rate and the volume of withdrawals.
3. The distance between the source and point of use increases as the population expands.
4. In RI, transfers can take place in relatively short distances.

5. Transfers may occur between Sub basins within the same watershed.
6. Transfers may take place between watersheds.

In 1923, the Kingston water system was incorporated. The source of supply was a well on top of Kingston Hill. Public water was distributed to relatively few homes in the area of the Kingston Historic District. For all practical purposes, there was no out of basin transfer. Water was taken from and returned to the Chipuxet Sub basin.

After 1923, the public water system expanded down Kingston Hill into the Biscuit City Road area where a higher yielding well (really a surface water catchment) was developed. That source, located less than a mile from the original well, provided significantly more water than the original well, but was woefully inadequate for peak demand let alone fire flows. From 1923 to 1955, only small volumes of water were exported out of the donor basin (the Pawcatuck/Chipuxet Sub basin) to East Farm and discharged into the Saugatucket Drainage Basin, the receiving basin. In 1962, the transfer amounted to .004 MGD or less than 3 GPM. In the 1960s, the University's withdrawal was returned to the basin via a sewer treatment plant located along the White Horn Brook at the base of Kingston Hill.

In 1964, the water system turned to the gravel outwash area of the Chipuxet for its source of supply. Two wells were developed with a combined capacity of 1.44 MGD. Though much of the growth in the area took place within the Chipuxet Sub basin, substantial volumes (.1 MGD) of water were being exported to the Saugatucket via East Farm and a small number of homes along Kingstown Road and Old North Road. East Farm's use peaked in 1996 with a daily demand of .165 MGD.

During the late 1970s, the Town of South Kingstown installed sewers in those areas of Kingston in the immediate vicinity of URI as well as the areas along arterial roads leading to Wakefield. The Town's system was developed partially in response to a failed University owned sewer treatment plant that returned much of URI's withdrawal to the basin of origin. In 1995, the water and sewer lines were extended in the industrial zone of West Kingston. Where once the system served a handful of customers through a thousand or so feet of pipe, the system had expanded into twenty miles of pipes and a few thousand customers.

Ironically, the increased water demand associated with West Kingston was more than offset by a decrease in demand at East Farm. In 2002, East Farm used approximately .123 MGD along with others for a total transfer of .126 MGD to the Saugatucket. Those District customers serviced by the Town's sewer system transferred in 2002 approximately .150 MGD via the Town's sewer system to Block Island Sound. That combined with the Saugatucket transfer represents a total transfer of .276 MGD out of .404 MGD or 70% of the District's daily production.

Currently, approximately .96 MGD are returned to the Chipuxet Sub basin via the White Horn and Genesee Brooks, some distance downstream of the supply wells. This should be identified as return flow even though the points of withdrawal cannot match up with point of return for health reasons.

University of Rhode Island: 

Much the same sort of growth pattern could be said of the University's water system with one major exception. URI does not pump water directly out of the basin. All of the University's water use takes place within the Chipuxet Sub basin. Rather, URI transfers water out of the basin via the Town's sewer system.

According to its records, the University and the District pump similar volumes of water annually in spite of seasonal differences. During the summer, URI's production decreases after graduation. During the same interval, the District's production increases. During the winter, roles reverse with URI pumping more water than the District.

- Most major public water supply systems operate on the fundamental assumption of using water at some distance from the source of supply.

Year	Distance
1922	1,000'
1923	1.5 mi.
1955	1.5 mi.
1964	4 mi.
1998	8 mi.
2005	10 mi.

- The rate and volume of withdrawals increase with population growth and increased activities, especially fire fighting.

Year	Pop.	Cap. GPM
1923	NA	60
1955	300	60
1964	963	400
1983	1,800	1,000
2003	3,600	1,700
2005	3,900	2,100

- The distance between the source and point of use increases as the population expands.

Year	Pop.	Piping
1923	NA	<1 mi.
1955	300	2 mi.
1964	963	6 mi.
1991	1,800	15 mi.
2003	3,600	25 mi.

- In RI, transfers can take place in relatively short distances.
  - Kingston Village sits on the divide between the Saugatucket sub-basin and the Chipuxet sub-basin.
  - In 1923 through 1955, almost no transfers were made.
  - In 1964 and 1983, the District develops wells in the Chipuxet 2 miles from the Village while increasing the OOBT to current levels.
  - In 1977, the Town of South Kingstown, using less than two miles of pipes, begins pumping sewage out of the Chipuxet sub-basin.
  - In 1998, the District developed a 1.0 MGD well in the Genesee less than three miles from the Saugatucket.

- Transfers may occur between sub-basins within the same watershed.
  - The District has developed several wells that are in the Chipuxet sub- basin (as defined by USGS).
  - The Chipuxet sub-basin includes several smaller hydrologic units, which are subject to nearby withdrawals:
    - Chipuxet River
    - Mink Brook
    - Alewife Brook
    - Genesee Brook
    - Chickasheen River
  - Due to the proximity of the District, URI, and United Water RI (with its related wholesale accounts), water may move in and out of several watersheds and sub-basins.

- Transfers take place between watersheds.
    - The District transfers .126 MGD from the Chipuxet into the Saugatucket.
    - The District via the SK sewer system transfers .150 MGD from the Chipuxet to Narragansett Bay
    - URI via the SK sewer system transfers 0.[illegible]MGD from the Chipuxet to Narragansett Bay.
    - United Water RI transfers 0.[illegible] MGD from the Chipuxet to Narragansett Bay in 2002
    - United Water RI transfers 0.[illegible] MGD from the Chipuxet to the South Shore in 2002

OOBT in the Blackstone Basin

USGS report on water use in the lower Blackstone River basin of northern Rhode Island and south-central Massachusetts indicates that total water use, including both public and self supply, was 18.52 MGD during 1995-1999. Both public water supply and wastewater were imported as well as exported from the study area. An estimated 2.85 MGD of public water supply was imported and 12.33 MGD was exported, for a net export of 9.48 MGD. During the same period, 1.82 MGD of wastewater was imported for treatment and 4.09 MGD was exported for treatment for a net export of 2.27 MGD. Of the total water usage in the study area, 4.53 MGD (24.5 %) was consumed. Most of the consumed total (2.379 MGD) was piped from the Blackstone River to the Ocean State Power plant in northern Burrillville where it evaporated in cooling towers. Much of the remainder within the study area (11.56 MGD) was returned to streams as treated wastewater, or to the ground by way of septic systems (3.66 MGD).

In water-use studies of both the Pawcatuck and Blackstone basins, an automated water-data storage and retrieval system developed by the USGS was used to document comprehensive use and disposal of water. The OOBT Committee believes that this system, called the New England Water Use Data System (NEWUDS), would be especially useful in the water allocation process. The system has the capability of accounting for movement of water into and out of sub-basins as well as into and out of the study area as a whole. In the Blackstone study, for example, the source, use and disposal of water was accounted for in six sub-basins as well as within in the communities within these sub-basins. Table 5 from the Blackstone report illustrates the type of data recoverable from NEWUDS. Because the Blackstone study encompassed sub-basins and communities in Massachusetts, it is evident that the system can also track interstate movement of water supply and wastewater.

Table 5. Public-supply withdrawals, public-supply imports, public-supply exports, public-supply use, self-supply use, and total estimated withdrawals by minor civil division and subbasin in the lower Blackstone River basin, northern Rhode Island and south-central Massachusetts, 1995–99

[Numbers may not sum correctly due to rounding. All values in million gallons per day. <, actual value is less than value shown]

Minor civil division	5-year average estimates						
	Public-supply withdrawals	Public-supply imports	Public-supply exports	Public-supply use	Self-supply withdrawals	Self-supply use	Total withdrawals
Lower Blackstone River basin							
Chepachet River subbasin							
Burrillville	0.06	0.005	0	0.065	0.101	0.101	0.161
Glocester	.024	0	.003	.021	.229	.229	.253
Subtotal	0.084	0.005	0.003	0.086	0.33	0.33	0.414
Clear River subbasin							
Burrillville	.527	0	.049	.478	.435	[1]2.814	.961
Glocester	0	.004	0	.004	.055	.055	.055
Douglas	0	.058	0	.058	.065	.065	.065
Uxbridge	0	.022	0	.022	.012	.012	.012
Subtotal	0.527	0.085	0.049	0.562	0.568	2.947	1.093
Branch River subbasin							
Burrillville	.036	.035	0	.071	.274	.274	.31
Glocester	.014	0	.014	0	.033	.033	.047
North Smithfield	.06	0	.034	.026	.436	.436	.496
Smithfield	0	.003	0	.003	.001	.001	.001
Millville	0	.001	0	<.001	.006	.006	.006
Uxbridge	0	.009	0	.008	.004	.004	.004
Subtotal	0.11	0.046	0.048	0.108	0.755	0.755	0.864
West River subbasin							
Burrillville	0	.006	0	.006	.037	.037	.037
North Smithfield	.006	.026	0	.032	.299	.299	.305
Woonsocket	0	1.833	0	1.833	4.42	[2]2.041	[3]4.420
Blackstone	0	.29	0	.29	.029	.029	.029
Douglas	0	.015	0	.015	.013	.013	.013
Millville	0	.007	0	.007	.143	.143	.143
Uxbridge	0	.243	0	.243	.104	.104	.104
Subtotal	0.006	2.421	0	2.427	5.045	2.666	5.049
Peters River subbasin							
Central Falls	0	0.906	0	0.906	0	0	0
Cumberland	1.177	.732	0	1.909	.015	.015	1.192
Lincoln	.166	1.08	0	1.246	.058	.058	.224
North Smithfield	.002	.005	0	.007	.106	.106	.108
Pawtucket	0	.672	0	.672	0	0	0
Smithfield	0	.087	0	.087	.011	.011	.011
Woonsocket	4.759	0	2.799	1.96	.007	.007	4.766
Attleboro	0	.277	0	.277	.003	.003	.003
Bellingham	.831	0	.25	.58	.066	.066	.897
Blackstone	0	.011	0	.011	.006	.006	.006
Franklin	0	.13	0	.13	.013	.013	.013
Wrentham	0	.051	0	.051	.006	.006	.006
Subtotal	6.935	3.951	3.049	7.837	0.285	0.285	7.226
Abbott Run subbasin							
Cumberland	13.173	0	11.704	1.469	0.105	0.105	13.278
Attleboro	0	.054	0	.054	.002	.002	.002
Franklin	0	.051	0	.051	.008	.008	.008
North Attleboro	1.861	0	1.537	.324	.036	.036	1.897
Plainville	0	.074	0	.074	.013	.013	.013
Wrentham	0	.222	0	.222	.023	.023	.023
Subtotal	15.034	0.401	13.24	2.195	0.187	0.187	15.221
Total of the lower Blackstone River basin	22.694	2.852	12.327	13.215	7.17	7.17	29.869

[1]Includes 2.379 million gallons per day withdrawn by Ocean State Power in the West River subbasin. The withdrawn water is then piped to Ocean State Power's thermoelectric facility in Burrillville, Rhode Island, which is located within the Clear River subbasin.

[2]Estimated self-supply withdrawal/use for Seville/Dorado, Company, Inc., a textile mill, 2.039 million gallons per day.

[3]Includes self-supply withdrawal from Ocean State Power.

The following illustration from the Blackstone report summarizes the transfers of water into and out of the study area during 1995-99, in addition to documenting withdrawals, use, and return flows within the area. This type of graphic presentation can be created for geographic water-accounting areas of any size. A similar illustration was used to provide a comprehensive representation of water use on Block Island (Veeger, and others, 2000).

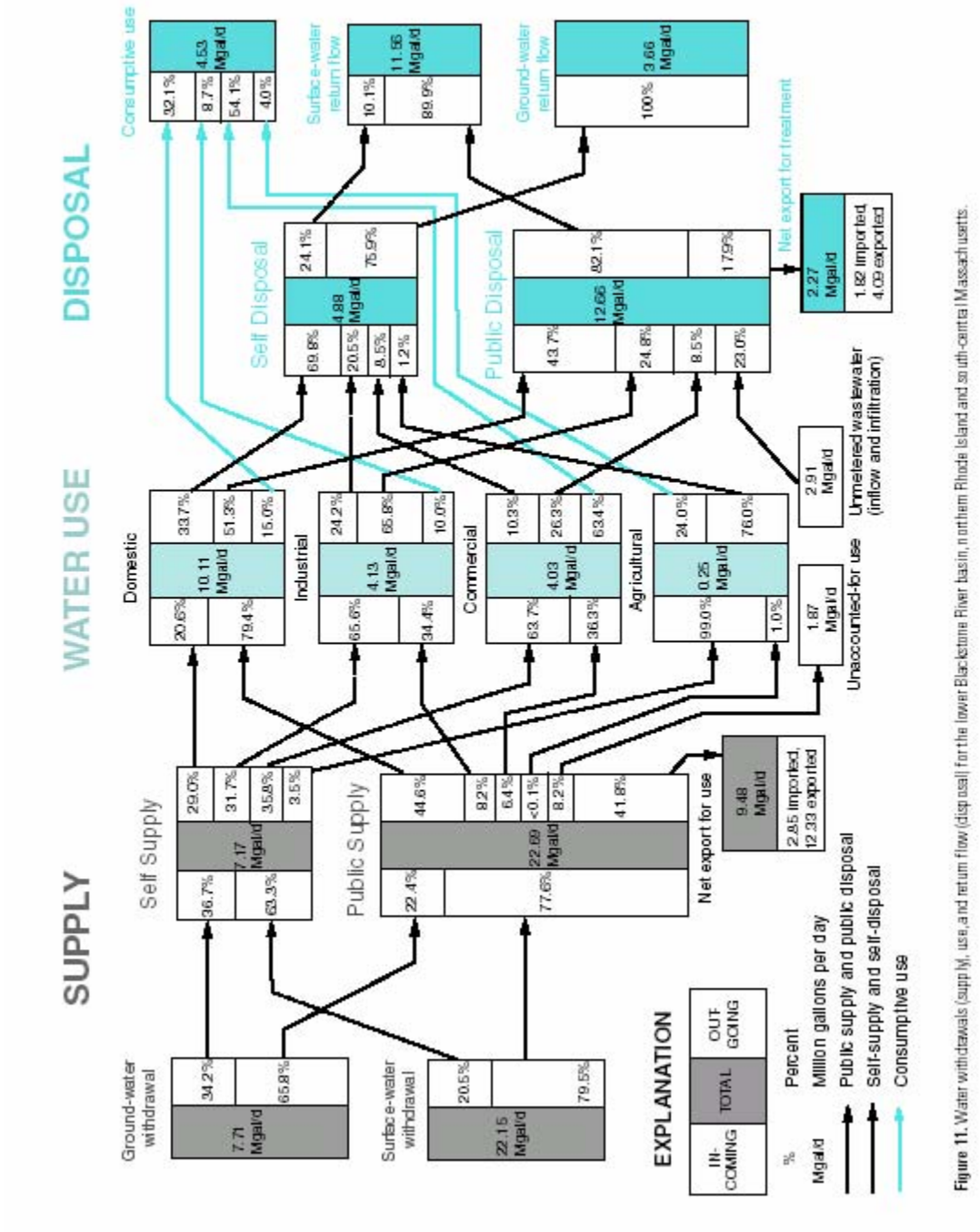


Figure 11. Water withdrawals (supply), use, and return flow (disposal) for the lower Blackstone River basin, northern Rhode Island and south-central Massachusetts.

SECTION VI – EXISTING EFFECTS OF OUT-OF-BASIN TRANSFER

During the course of a year, the OOBT Committee reviewed publications from various states (Massachusetts, Connecticut, Georgia and New York) and various regional and national water-related groups (American Water Works Association, American Water Resources Association, Colorado Trout Unlimited, etc.) addressing OOBTs and associated regulatory approaches, as applicable. The committee also reviewed the Regulated Riparian Model Water Code for reference to OOBTs. The purpose of this comprehensive evaluation was to assess the effects of OOBTs—both positive and negative—on water basin dynamics, within the basin of origin and the receiving basin, as well as the role of OOBTs in ongoing water management in Rhode Island.

Based on the committee's review of available documentation, it appears that more and more water management districts are discouraging new OOBTs. For example, Colorado Trout Unlimited wrote that future water supply management and development efforts in Colorado "need to recognize the fundamental political and economic inequities and the adverse environmental consequences of new transbasin transfers and emphasize the most efficient utilization of existing supplies to avoid new transbasin transfers." On a similar note, the Code states that diversions "have been extremely political and unpopular in areas from which water had been diverted. In practical effect, a transbasin diversion of water is a transbasin diversion of wealth."

It also appears that more states are discouraging OOBTs through rigorous permitting requirements (e.g., Massachusetts Interbasin Transfer Act) or trying to promote re-establishment of the natural hydrologic cycle within a water basin by discouraging OOBTs and encouraging reintroduction of wastewater into the basin of origin. New York State, for example, has mandated a prohibition on "interbasin diversions" in the Great Lakes basin unless the transfer is approved by all of the Great Lakes states.

The Code acknowledges that interbasin transfers will occur and states that "in determining whether to issue a permit for an interbasin transfer of water, the State Agency shall give particular weight to any foreseeable adverse impacts that would impair the sustainable development of the water basin of origin." The Code continues that in addition to various water rights factors, "the State Agency shall consider:

a) The supply of water available to users in the basin of origin and available to the applicant within the basin in which the water is proposed to be used;
b) The overall water demand in this basin of origin and in the basin in which the water is proposed to be used; and
c) The probable impact of the proposed transportation and use of water out of the basin of origin on existing or foreseeable shortages in the basin of origin and in the basin in which the water is proposed to be used."

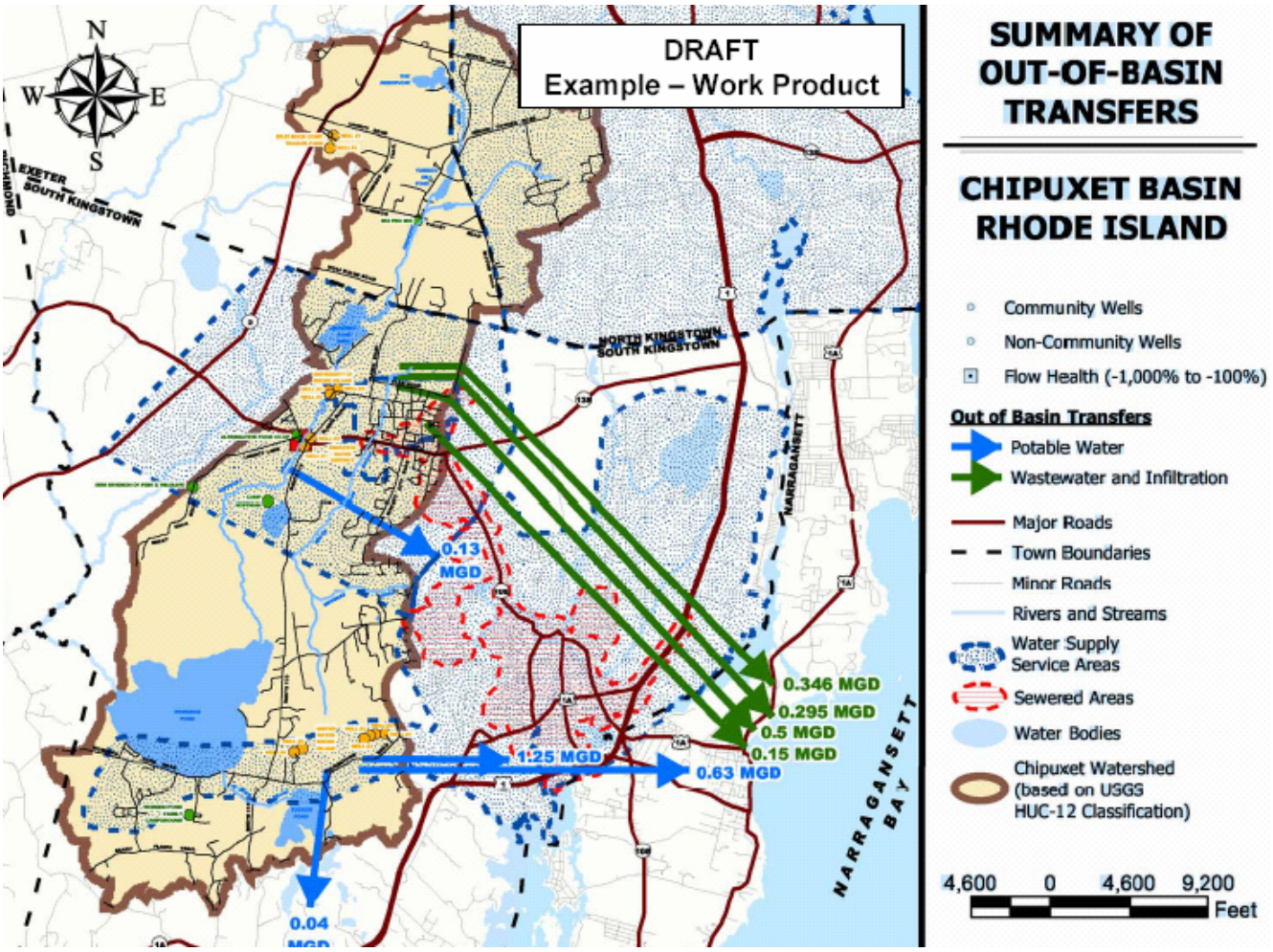
However, the Code does not expressly prohibit interbasin transfers of water. Rather, the Code provides for compensation to the basin of origin through an Interbasin Compensation Fund.

GIS Evaluation of OOBTS in the Pawcatuck River Basin

In order to better understand the nature of OOBTs and potential effects, the committee embarked on a geographic information system (GIS)-based evaluation in the Pawcatuck River basin. The committee also investigated methodologies for evaluating/quantifying OOBTs in consideration of the size and scale of a basin in the context of "geographic water accounting basins".

Information from RIGIS, Water Supply Systems Management Plans and other data was plotted on a large map to facilitate discussion of the nature of water use and wastewater management within the entire watershed of the Pawcatuck River. In addition, data from a draft US Geological Survey report titled, Water Use and Availability in the Pawcatuck River Basin, Rhode Island and Connecticut, 1995 – 1999 was assessed. Statistics from local water supply districts and other parties familiar with water use and wastewater management was

compiled to better refine the analysis. Based on this initial review, the committee decided that it was difficult to compile the necessary data and visualize OOBTs on the scale of an entire basin. The decision was made to focus the evaluation on the Chipuxet sub-basin where numerous OOBTs result in a significant deficit between water exported out of the basin and water imported.



Chipuxet River Basin

- The Chipuxet River basin represents the eastern headwaters of the Pawcatuck River watershed. The HUC-12 (Hydrologic Unit Code) basin delineation used by the committee was established by the Federal Geographic Data Committee (FGDC)

Two major groundwater reservoirs (i.e., aquifers) have been mapped in the basin and include the Chipuxet Aquifer and the Mink Aquifer. Three major community water suppliers (Kingston Water District, University of Rhode Island, and United Water Rhode Island) are located within the Chipuxet basin. One other community water supplier, the Split Rock Corporation trailer park is located in the northern portion of the basin. Based on the preliminary data compiled in the draft USGS report, the three major water suppliers in the basin withdrew an average of approximately 3.5 million gallons per day (MGD) during the period from 1995 to 1999. No Rhode Island Pollutant Discharge Elimination System (RIPDES) permitted facilities are located within the Chipuxet basin.

The OOBTs identified within the basin and the estimated average quantity of the OOBTwere depicted on a GIS map which shows that the Chipuxet basin is, in fact, exporting a significant volume of potable water--groundwater through infiltration and inflow (I/I) into sewer pipes, and wastewater. Total OOBT approximates 3.55 MGD, whereas, no imports of water into the basin could be identified. The task of compiling this map, which occurred over the course of approximately 6 to 7 months, provided the committee with the opportunity to visualize the actual movement of water within a Rhode Island watershed. This exercise also provided the committee with the opportunity to discuss the various types of OOBTs and the potential positive and negative effects of OOBTs.

Two OOBTs identified in the Chipuxet sub-basin included I/I of groundwater and surface water into existing sewer systems that discharge [wastewater] out of the basin of origin, and the evaporative losses from agricultural/residential water use, principally for agricultural irrigation purposes. These OOBTs were considered important by the committee due to their potential magnitude. Based on the content of the Regional Facilities Plan for the South Kingstown Regional Wastewater Treatment Facility, the magnitude of the OOBT associated with I/I can be significant and is often unquantified. As stated in the report,

> "Infiltration is groundwater entering a collection system primarily through defective sewer pipes, pipe joints, other connections and manhole walls. Inflow is the water discharge into a collection system from such sources as roof leaders, sump pumps, foundation drains, manhole covers and cross connections".

OOBTs can have positive and negative effects on water use and water management; however, positive effects appear limited to the receiving basin. One of the most prominent advantages is that OOBTs can provide supplemental water for supply and use via interconnections between water suppliers during normal times and for emergency purposes. This is particularly important given recent concerns regarding terrorism. The committee agrees that OOBTs providing for emergency interconnections are important, but these interconnections must be monitored to ensure that their use is temporary and strictly of an emergency nature. OOBTs can also provide water to support development in water-short areas. OOBTs can help alleviate "stressed conditions" in other water basins. In addition, OOBTs can enhance storage capacity during low flow periods or drought periods. Often, these scenarios incorporate the transfer of water from a "water-rich" basin to a "water-poor" basin.

Any OOBT can negatively affect the natural hydrologic cycle by decreasing the available water within the basin of origin. The majority of OOBTs do not include any provisions for return flow (either wastewater or unused water). By reducing the available water in the basin of origin, OOBTs may result in a significant decline in the availability of groundwater and surface water for the future, and limit the yield of existing groundwater supply sources or development of new groundwater supply sources. OOBTs can also affect the availability of water to fight fires or respond to emergencies in the basin of origin.

The committee's research indicated that OOBTs appear to impact groundwater reservoirs more quickly than surface water reservoirs. Direct observation of the "stage" of a groundwater reservoir is not possible; consequently, land use planners and the public are not as aware that this is a limited resource. A reduction in the amount of water in a basin also impacts stream flow, particularly during summer and early fall when water demand is high. Depletion in low flows of rivers and streams will affect water quality and water temperature, particularly in areas receiving wastewater discharges or inflow from areas serviced by Individual Sewage Disposal Systems (ISDS). In some cases, OOBT can actually augment flows. However, in most instances, these impacts negatively affect the usability of the surface water resource as aquatic habitat and for recreational purposes because the water body's capacity to dilute pollution is diminished.

OOBTs can also have negative effects on the receiving basin due to excess water. For example, some coastal areas in Rhode Island are served by municipal water and private septic systems. The combination of heavy rains and high water tables due to excess recharge from OOBTs can flood basements in low-lying areas with contaminated groundwater. This is also one of the factors that caused fish kills in Greenwich Bay. Surface

water quality may be negatively impacted by the OOBT of wastewater, thereby affecting the water quality within the receiving basin.

OOBTs may also impact the sustainable development potential of the basin of origin, since the full build-out potential of the basin of origin with respect to water availability may not be totally known or understood. Public water suppliers may not be able to meet existing and/or future water demands. Additionally, these impacts may have other social and economic ramifications for the basin of origin. This concept is consistent with the Code which states, “implicit in this policy is a recognition that interbasin transfers are not to be permitted if it would prevent the basin of origin from meeting any of the environmental or other social and economic objectives set forth in this Code or in related laws and regulations pertaining to water quality.”

SECTION VII – MANAGING OUT-OF-BASIN TRANSFER IN RHODE ISLAND

While most hydrologists would likely recognize the potential threat long before it happened, the need for managing OOBT commonly becomes apparent to the average person, only after the flows of perennial streams have become severely depleted. A classic example of this is the Ipswich River basin in Massachusetts, where gradual increases in OOBT of ground water by several public water supply systems caused severe depletion of stream flow, degradation of water quality and aquatic habitat, and diminished recreational use of the river. At times, during warm summer months, nearly half of the 45-mile long river goes dry (Zarriello and Ries, 2000, p.2).

View of the Ipswich River during the summer drought of 1999.
Photo courtesy of David Armstrong and Timothy Driskell, U.S. Geological Survey.

Similar adverse impacts can be expected to occur in water basins in Rhode Island—especially in basins underlain by major ground-water reservoirs—if comprehensive basin-wide management of the water resource is not undertaken. (Groundwater reservoirs are thick bodies of highly porous and permeable glacial deposits that underlie many of Rhode Island's major stream valleys). Substantial depletion of low stream flow is already taking place in the headwaters of the Pawcatuck River basin, where public supply systems, agricultural, commercial, and industrial users withdraw water from a common groundwater reservoir that underlies the Chipuxet River. Stream flow depletion is caused mainly by transport of wastewater out of the Chipuxet River sub- basin, but evaporation that results from irrigation and other consumptive uses is also a contributing factor. Evaporative loss resulting from water use is generally not considered an OOBT; however, loss of 1 MGD (million gallons per day) to evaporation has the same effect on stream flow depletion as piping 1 MGD out of a basin as

water supply or wastewater. In the Pawcatuck River basin, for example, potential demand for irrigation water during some months of drought may be as high as 7 MGD to irrigate some 2,000 acres of cropland reported to be under irrigation in Washington County in 1997.

The Rhode Island Farm Bureau reports that crops need one inch of water per week or 4.29 to 4.43 inches per month (one inch of water per week on one acre = 27,152 gallons, the equivalent of 3,879 gallons per day per acre, or 116,370 to 120,249 gallons per month per acre.) The Bureau also reports that precipitation during July 2002 was only 0.39 inches, leaving a demand for irrigation of 4.04 inches per acre (4.43 in. - 0.39 in. = 4.04 in.) or 109,694 gallons per acre for July (27,152 gal/in x 4.04 in = 109,694 gal). For 2,000 acres, this is equal to a potential irrigation demand of 219,388,000 gallons for July or an average of 7 million gallons per day. (219,388,000 gals/31 days = 7,077,032 gallons per day)]

Transfer of water from one water basin to another affects the water budgets of both basins. Transfer of water out of a basin—as either water supply or wastewater—depletes the average flow of streams downstream of withdrawal points by virtually the same amount transferred. Transfer of water into a basin increases the average flow of streams down gradient from septic systems and downstream of points where treated wastewater is returned to streams. The effects of such transfers are most apparent during dry summer months when flows are normally lowest.

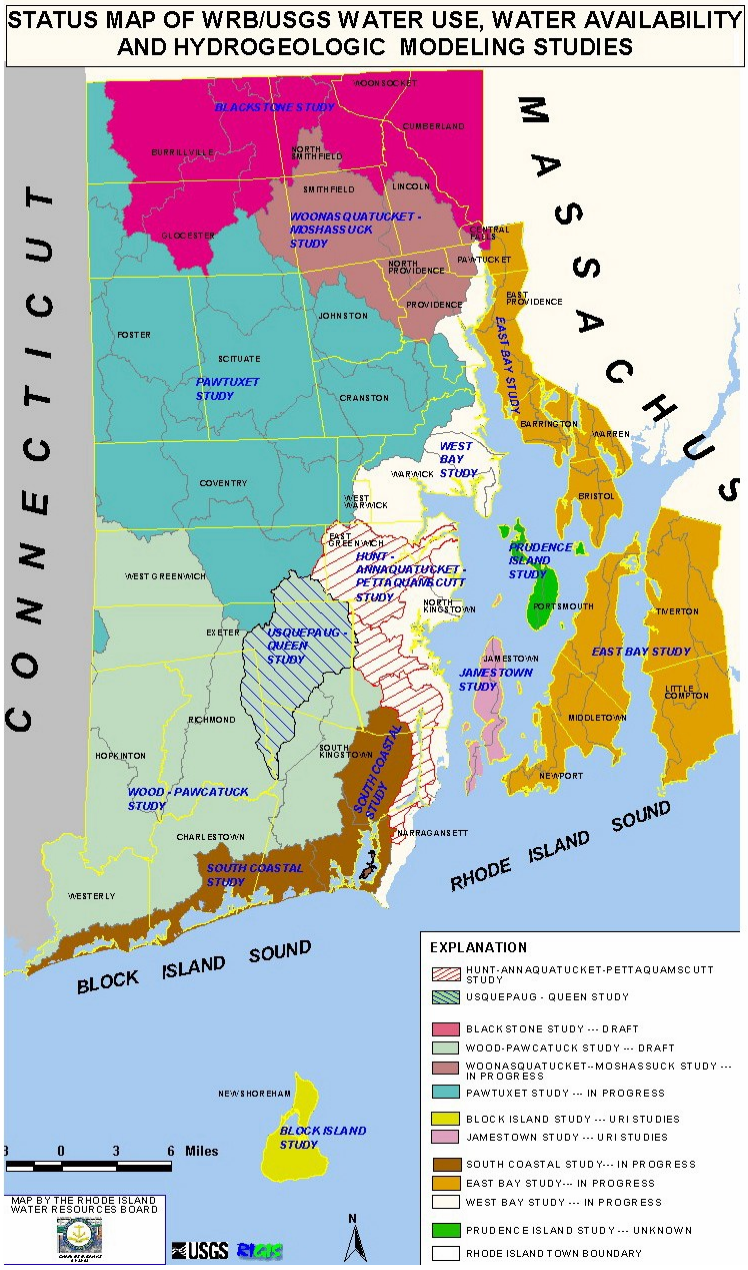
The primary objective in managing OOBTs should be to protect the reasonable needs of water basins of origin; that is, to assure actual and foreseeable water needs of the basin are met. This includes the need to preserve minimum flows of streams and minimum water levels in ponds and aquifers within a donor basin. Laws and regulations related to maintaining water quality and environmental standards require that OOBTs must not be allowed in excess of those amounts needed. The Regulated Riparian Water Model Code (§1R-1-14) "rejects any abstract standard that might prevent interbasin transfers beyond that amount necessary to serve actual or foreseeable needs of the basin of origin." The Code does allow OOBT of surplus, unneeded, water by means such as flood skimming. Management of OOBTs should, of course, provide for transfers to water-short communities during emergencies such as those resulting from protracted droughts, and accidental or intentional damage to their water supply sources or water distribution infrastructures.

POTENTIAL MANAGEMENT CRITERIA FOR OUT-OF-BASIN TRANSFERS

While the OOBT Committee's mission was to develop criteria for out-of-basin transfers that protect the reasonable needs of water basins, the Committee found that OOBT was just one of many important criteria. The Committee largely agreed that decision-makers would first need to know how much, and where, water was being withdrawn and where it was being used or discharged. Second, the Committee felt that a better method of estimating OOBT was needed—one that would be based on scalable geographic units.

Geographic Water Accounting Areas

As previously noted, the USGS has completed water-use and availability studies for two, major, Rhode Island river basins and has completed hydrologic modeling studies in several ground-water reservoir areas. A similar water use study was completed for Block Island by the University of Rhode Island. Other studies have been proposed or are underway in major river basins across the state, including the Island of Jamestown, the south coastal area, and the East Bay and West Bay areas that do not geographically conform to the definition of water basin. These study areas appear to be good candidates for designation as official, state "geographic water-accounting areas"; that is, areas or basins in which comprehensive water use information will be periodically accounted for using a data storage and retrieval system such as NEWUDS.



Analysis of data retrieved from a storage-retrieval system can be used to identify water-use trends and predict future water needs of water basins or other accounting areas. Because adverse effects may result from transfer of water between basins of any size, managing out-of-basin transfers should not be constrained to control transfers only between major river basins or geographic accounting areas. In the Pawcatuck River basin—a likely accounting basin—a presentation before the WAPAC committee documented that transferring water from supply wells in the Wood River basin to the proposed Richmond Commons development site would result in wastewater discharge by way of septic systems to the headwaters of Meadow Brook, possibly having an adverse impact on a downstream fish hatchery. Both Wood River and Meadow Brook are sub-basins in the Pawcatuck River basin.

Central Water Withdrawal Registry

An automated, statewide, water data storage and retrieval system is an essential tool for managing water use within water basins and for managing transfers among basins. In 1990, a consultant's report prepared for the Rhode Island Water Resources Coordinating Council, recommended the establishment of a statewide water and wastewater information system that would provide for a wide range of water use data for use in proactive and comprehensive planning for water resources management (A.D. Little, 1990, p. S-40). The Code (§4R-2-03) requires essentially the same type of system. Although NEWUDS does not incorporate all the features recommended in the consultant's report or the Code (water level and water quality data are available in other data bases) it appears to be more than adequate as a decision support tool.

Monitoring of Minimum Flows of Streams

One of the most important steps leading to effective control of OOBTs will be the development of criteria for establishing minimum flows of major perennial streams. Once quantitative measures of low flow have been established, the goal will then be to monitor withdrawals and OOBTs to assure that minimum flows are maintained. The latter goal can be achieved by maintaining a strategically located and well-distributed network of stream gages, in conjunction with development of methods for determining low flow statistics for stream reaches at locations other than at the gages.

- Surface Reservoirs

Management of OOBTs in order to maintain minimum stream flows downstream from withdrawal points is most readily and effectively accomplished in those basins in which the water is withdrawn and exported from surface reservoirs. Surface reservoirs are typically filled during periods of high runoff, thereby capturing and storing for later use, water that would otherwise have discharged to the ocean within a matter of days. Where a reservoir has a storage capacity in excess of that required to meet normal water demands, releases can be made during periods of low flow to mimic natural, low flows of streams. Rhode Island has several reservoirs (e.g., Flat River Reservoir, Pascoag Reservoir, Wilson Reservoir) that were once used to provide power and process water for downstream industries and now used primarily for recreation. Modification of the dams on these reservoirs may make it feasible to release water that would aid in maintaining minimum stream flows.

- Groundwater Reservoirs

Management of OOBTs in order to maintain minimum stream flows in water basins from which withdrawals are made from ground-water reservoirs is much more difficult. This is because of the intimate, hydraulic connection of these reservoirs with overlying streams, and because the impact of groundwater withdrawals on stream flow depletion varies with the number, location, and pumping regimen of wells. For example, large withdrawals and export of ground water in the lower reaches of a large water basin such as the Pawcatuck River basin could cause significant flow depletion of some stream reaches, but have no impact on stream flow in headwater areas. Conversely, withdrawal and export of moderate amounts of ground water from wells in headwater areas of a basin may cause severe depletion of stream flow there, but have relatively little impact on stream flows near the mouth of the basin. The impact that pumping wells in Rhode Island's sand and gravel aquifers can have on the flows of nearby streams is illustrated in the following figure. It shows that streamflow may be depleted by 40% to 85% of the pumping rate within a few days, the percentage increasing with time of pumping. The figure is from the USGS report on water-use and availability in the Blackstone River basin in northern Rhode Island and sound-central Massachusetts (USGS WRIR 03-4190).

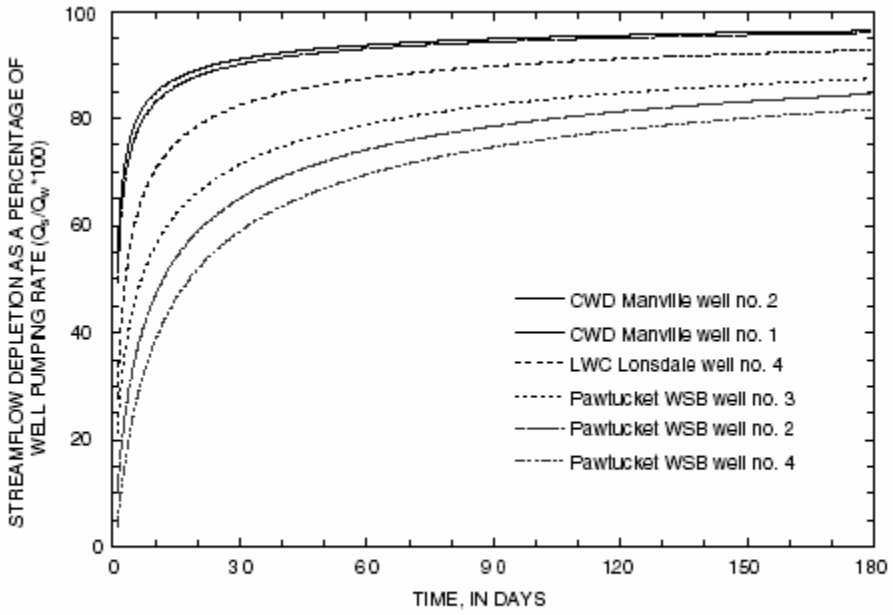


Figure 15. Streamflow depletion as a percentage of well pumping rate [Q_s/Q_w * 100] for six public-supply wells with different aquifer properties and distances to the stream in the lower Blackstone River basin, northern Rhode Island and south-central Massachusetts. Q_s is the rate of streamflow depletion (cubic feet per second) and Q_w is the pumping rate of the well (cubic feet per second).

A recent modeling analysis of the hydrology of the Hunt-Annaquatucket-Pettaquamscutt aquifer in southeastern Rhode Island by the USGS demonstrated that nearly all the water withdrawn from wells in that aquifer is derived from depletion of flow in the rivers, brooks, and ponds that overlie it. Computer simulation models are valuable tools for evaluating the impact of proposed groundwater development schemes on stream depletion, especially when proposals involve OOBTs. Additionally, Geographic Information Systems "GIS" software can be integrated with water modeling software to display relevant maps showing the location of water basins, surface and groundwater reservoirs, well locations, and transfer of water from one basin to another.

Once reasonable estimates have been made of the long-term water needs within a donor basin, and after minimum stream flow requirements have been established, several measures are available for managing out-of-basin conveyance of water. A combination of both regulatory and nonregulatory measures may be used to control export of water from one accounting basin to another or from one sub-basin to another within a single accounting basin. Some may be used to determine how much, and when, water can be safely exported from one basin to another.

REGULATION AND PERMITTING

Water Use Permits

One of the fundamental tenets of the Code is that "All withdrawals of waters of the State are unlawful unless made pursuant to a permit." Implementation of a water withdrawal permit system in Rhode Island would provide an important tool for fairly allocating limited supplies of water. A permit system could also be used to prevent over development of water resources, particularly in basins that contain major groundwater reservoirs, and where uncontrolled development may cause many perennial stream reaches to go dry or have unacceptable low flows.

Pre-application Review Process

If given legislative authority to manage OOBTs, the WRB should consider establishing criteria for justifying "significant" OOBTs. For example, the WRB could examine the feasibility/advisability of modifying water supply system management plans (required by RIGL 46-15.3-5.1) to include a requirement that an applicant proposing to withdraw water from a new source, or increase withdrawal from an existing source, which may result in a significant OOBT either as water supply or wastewater, assess the impact of the transfer. As part of the development plan review process conducted at the local level, applicants could be required to assess the hydrologic, biologic, sociologic, and economic impacts of an OOBT on either the donor or receiving basins.

Because the Committee did not have time to thoroughly study the various criteria, the following are suggested for further evaluation (abstracted and modified from the Interbasin Transfer Act of Massachusetts):

1. That all reasonable efforts have been made to identify and develop all viable sources in the receiving area of the proposed interbasin transfer.

2. That all practical measures to conserve water have been taken in the receiving area, including but not limited to the following:

   (a) The identification of distribution system sources of lost water from inflow and infiltration I/I and private users that discharge to a sewer system, and where cost effective, the implementation of a program of leak detection and repair.

   (b) Metering of all water users in the receiving area and a program of meter maintenance.

   (c) Implementation of rate structures that reflect the costs of operation, proper maintenance, proposed capital improvements, and water conservation, and which encourage the same.

   (d) Public information programs to promote water conservation, the use of water conserving devices, and industrial and commercial recycling and reuse.

   (e) Contingency plans for limiting the use of water during seasonal or drought shortages.

   (f) Implementation of land use controls to protect existing water supply sources of the receiving area that meet the requirements of state and local water plans.

3. That a comprehensive forestry management program which balances water yields, wildlife habitat and natural beauty on watershed lands presently serving the receiving area and under control of the proponent has been implemented.

4. In the case of groundwater withdrawals, the results of pump tests will be used to indicate the impact of the proposed withdrawal on static water levels, the cone of depression, the potential impacts on adjacent wells, lake and pond levels, and the potential to affect in-stream values.

5. The impacts of all past, authorized or proposed transfers on stream flows in the donor basin shall be considered.

Other Potential Regulatory Measures

- The WRB, with the recommendation and approval of DEM and the Division of Statewide Planning, could establish limits of OOBT based on estimates of long-term water needs in basins of origin.
- The WRB could develop state guidelines and regulations for approving OOBTs, and rules and procedures for follow-up data collection to assure compliance with approved conditions of water export.
- Cities and towns could develop ordinances to control expansion of sewer systems that transport water out of a basin.

NONREGULATORY MEASURES

Other management measures that may affect or aid in managing OOBTs include the following:

- Encourage development that focuses on returning treated wastewater to individual sewage disposal systems, rather than to collection systems that transport wastewater out of basins.
- Encourage reuse of water within basins to reduce amounts presently being exported as wastewater.
- Encourage reasonable and efficient use of water by irrigators.
- Because evaporation losses resulting from irrigation and power production contribute to stream flow depletion, measures should be sought to minimize them. (Note: Although losses to evaporation from such consumptive uses as irrigation and power production are not normally considered out-of-basin transfers, the effects of these losses on stream flow depletion and the stream ecosystem are the same.
- Establishment of basin-wide management committees like those recommended in the 1999 draft report by the RI Watershed Approach Writing Group sponsored by URI Coastal Resources Center and DEM.
- The WRB, DEM, and other interested state agencies, support funding to develop methods for determining low flow statistics for perennial streams at locations other than at gages.
- Study the feasibility of modifying dams on reservoirs that were formerly used to augment summer flows for downstream industries to determine if current recreational needs can be maintained, while at the same time, permitting releases to maintain minimum flows of streams.

SECTION VIII – FINDINGS, RECOMMENDATIONS AND OTHER AREAS TO EXPLORE

FINDINGS

Not enough data currently exists in Rhode Island to adequately assess the impact of existing water uses (or OOBTs), nor to evaluate the potential impacts of proposed uses. A water allocation plan, coupled with a new management framework is necessary to justify future water allocation decisions. Once reasonable estimates have been made of the long-term water needs within geographic water accounting areas, and after minimum stream flow requirements have been established, then a permit system can be implemented for water and wastewater. Indirectly, this regulatory measure can be used to control export of water from one accounting area to another, or from one sub-basin to another within a single accounting area.

Water use planning needs to occur in tandem with land use planning. Water use planning needs to occur at the basin level and consider the regional and local context. Any new process must acknowledge existing authorities, laws, regulations and plans while promoting regional solutions. Any new program must be efficient, have a reasonable period for phase-in, foster cooperation and information sharing and thus, enable reliable and consistent decisions.

The committee did not have the time or manpower resources to adequately assess the impact of out-of-basin transfers of water supply and wastewater on a statewide basis. However, it is apparent that significant depletion of low flows is presently occurring as a consequence of OOBTs in the Pawcatuck and Hunt River basins, and is likely to occur in the South Branch Pawtuxet River basin, which includes the Big River sub-basin. These problems are likely to get worse if out-of-basin transfers of water supply and wastewater are not properly managed. Once reasonable estimates have been made of the long-term water needs within geographic water accounting areas/basins, and after minimum stream flow requirements have been established within these areas/basins, a permit system can be implemented to manage future out-of-basin transfers of both water supply and wastewater.

RECOMMENDATIONS

Regulatory Management Measures

1. Develop a centralized water withdrawal registry to provide data on public and private groundwater and surface water use.

2. Develop a statewide water use permit system that recognizes maintenance of minimum stream flows with out-of-basin transfer as a key criterion. The permit system would be managed at the basin level to fairly allocate water and control over-development of available supplies, beginning with those river basins underlain by major ground-water reservoirs. A permitting system would address water withdrawals, water use and wastewater discharges, and incorporate both water quantity, as well as water quality, considerations. During phase-in of the permit system, estimated to be a multiyear period, new or expanded OOBTs for both groundwater and surface water should be discouraged, other than for emergency purposes.

   Suggested Combined Water/Wastewater Permit Criteria
   - Water and wastewater quantity thresholds for proposed uses
   - Safe yield within the geographic water accounting area
   - Strong evidence of conservation and optimum use of the water resource. Conservation measures can be improvements in water transmission and water use efficiency, reduction in water use, enhancement or reuse of return flows for storm water and wastewater.
   - Water quality considerations that maintain the chemical, physical and biological integrity of the water resource
   - Conformance to federal regulations, state plans, municipal comprehensive plans and local ordinances
   - Consideration of environmental, economic and social impacts on both source and recovery basins

- Stressed basins: where demand for water exceeds, or is projected to exceed, safe yield
    - Existing and proposed out-of-basin transfer of water
    - Stream flow standards
    - Areas of critical environmental concern (ex: fisheries, wetlands, wildlife habitat)
    - Development potential within each basin; designated growth areas
    - Special use areas - scenic sites, historically or archaeologically significant sites
    - Other socio-economic factors, including priority uses and equity considerations

3. Establish a statewide pre-application review process for all development projects that meet a certain, gallons per day of water threshold and satisfy certain environmental, economic and social criteria. The pre-application review process would be conducted by formal, multi-disciplinary teams. Pre-application review for "significant" projects would include a greater level of impact assessment than for "insignificant" projects. (See Other Areas to Explore, P. 3.)

    - Insignificant projects would be those that require less than some, established, water threshold, have no significant impact on the geographic water accounting area, and yet satisfy certain environmental, economic and social criteria.

    - Significant projects would be those that require greater than some, established, water threshold and deemed "significant" from a geographic water accounting area standpoint. The impact assessment process would be more comprehensive to satisfy environmental, economic and social criteria. (The process could be similar to RI CRMC's "Assent" process for development, which occurs in areas protected by Special Area Management Plans.)

    - Examples of significant uses:
        - New or expanded public water supply or wastewater treatment facilities
        - Highly consumptive uses, such as agriculture and power generation
        - Certain development projects

4. Coordinate with provisions in the state's Comprehensive Planning and Land Use Regulation Act and RI Zoning Enabling Act to provide for sustainable development of water resources on a basin level. Upon passage, local ordinances must be made consistent with state laws.

5. Review existing written sales agreements between public water suppliers, whether instate or interstate and provide for new agreements as necessary.

Nonregulatory Management Measures Including Decision Support Tools

- Based on findings from the water use and availability studies, identify geographical accounting water areas and prepare a statewide Water Allocation Plan. Rank areas according to the need for allocation.
- Maintain financial support of the existing USGS stream gage network in Rhode Island and review the need for additional gages to effectively monitor minimum flows of perennial streams.
- Encourage routine monitoring of stream levels by entities withdrawing water
- Support funding to develop methods for determining low flow statistics for perennial streams at locations other than at gages.
- Support development of computer models of river basins to simulate proposed water development and management strategies.
- Determine an accurate method to calculate OOBT for each basin considering future water demand. Calculate a mass balance of water inputs (precipitation, transfers into basin) and outputs (withdrawals, evaporation) for both water and wastewater.
- Identify wastewater distribution systems (public and private) where lost water from inflow and infiltration occurs; where cost effective, implement/enforce a program of leak detection and repair.

- Implement public information programs to promote water conservation, use of water conserving devices, and industrial and commercial recycling and reuse.
- Provide funding for water audits and technical assistance.
- Integrate and maintain financial support for various computerized, water databases such as NEWUDS.
- Implement rate structures that reflect the costs of operation, proper maintenance, proposed capital improvements, and water conservation.
- Revise DEM's Facilities Plan Review Checklist.

Other Areas to Explore

The Out-of-Basin Transfer Committee notes several areas where either more research is necessary, or more time for sufficient discussion by the full Water Allocation Program Advisory Committee. Some of these items were brought up in committee while others were listed on the RI Water Works Assn. paper, Flow Allocation Policy Position (2002).

- Need for a state environmental assessment mechanism such as NEPA (National Environmental Policy Act) – institute as part of statewide pre-application review process
- Cheaper methods of gauging streams and wells
- Aquifer storage and recovery
- Alternative storage reservoirs for water supply, such as quarries
- Dredging to increase reservoir storage capacity (streamline permit process)
- Increase offline storage (flood skimming)
- Increase capture of storm water
- Use raw water to augment low flows in certain streams
- Special Water Management Areas which may require more stringent management plans
- Require historic water use data prior to permitting significant increases in use of existing resources
- Restore water supply sources for emergency use if not drinking water standards

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SECTION X – APPENDIX

OOBT MODEL WATER CODE REFERENCES

SECTION #	TITLE	CONCEPT	TEXT EXCERPT
Chapter 1	**Declaration of Policy**	**Litigious/admin settings**	
§ 1R-1-01	Protecting the Public Interest in the Waters of the State	Public interest Sustainable development	Water cannot be fully subordinated to private rights; water is always a matter of public concern and subject to regulation in the public interest Need to balance economic growth against other important values.
§ 1R-1-02	Assuring Efficient and Productive Use of Water	"Reasonable use" standard	Basic policy of requiring a permit for all water uses
§ 1R-1-03	Conformity to the Policies of the Code and to Physical Laws	Interconnected surface and subsurface systems	Conform to the physical laws that govern the natural occurrence, movement, and storage of water.
§ 1R-1-04	Comprehensive Planning	Develop a comprehensive water allocation plan	Establishing and maintaining sustainable development of the waters of the State
§ 1R-1-05	Efficient and Equitable allocation During Shortfalls in Supply	Water rights are subject to the obligation of the State to provide for coping with water shortages and water emergencies.	Water rights are not some form of private property, which the State is debarred from interfering with without paying full compensation.
§ 1R-1-06	Legal Security for Water Rights	Creation of a water right	A system of permits that make a water right a matter of legal record entitled to legal protection.
§ 1R-1-09	Coordination of Water Allocation and Water Quality Regulation	Ambient water quality standards and effluent discharge standards for point sources affect water allocation:	Regardless of whether both functions are vested in a single agency or not, water allocation must be coordinated with water quality for effective management of a water source and to comply with federal laws and regulations.
§ 1R-1-10	Water Conservation	Encourage, through permits, private efforts to conserve water	Quantification of the water conserved will involve comparing the amounts of water used before introduction of the voluntary conservation measures with that use afterward.
§ 1R-1-11	Preservation of Minimum Flows and Levels	Protect the appropriate biological, chemical, and physical integrity of water sources	Federal standards have a large, and generally controlling, role in setting the protected levels for underground water.
§ 1R-1-12	Recognizing Local Interests in the Waters of the State	Special Management Water Areas	Many States will choose to administer the permit process…through Special Management Water Areas covering only particular portions of the States.

OOBT MODEL WATER CODE REFERENCES (Continued)

SECTION #	TITLE	CONCEPT	TEXT EXCERPT
§ 1R-1-13	Regulating Interstate Water Transfers	Out of state transfer and use	While the public interest that the State Agency exists to promote is the interest of the public of this State, membership in a federal union precludes anything less than an even-handed treatment of the interests of persons and communities in other States.
§ 1R-1-14	Regulating Interbasin Transfers	Protect the reasonable needs of water basins	Interbasin transfers are not to be permitted if it would prevent the basin of origin from meeting any of the environmental or other social and economic objectives.
Chapter 2	**General Provisions**	Repeals limitations on the use of water derived from the location of the use.	Code disregards artificial land boundaries in favor of allowing all whose lands contribute to the drainage to share reasonably in the natural benefits of the water.
§ 2R-1-01	The Obligation to Make Only Reasonable Use of Water	Reasonable use is the fundamental criterion for allocating water.	Eliminate or minimize wasteful uses of water, prevent unreasonable injury, and assure allocation to uses consistent with the public interest and sustainable development.
§ 2R-1-02	No Prohibition of Use Based on Location of Use	Uses of the waters of the State on nonriparian or nonoverlying land are lawful.	The rule announced in this section applies to interbasin uses of water as well as intrabasin transfers to nonriparian or nonoverlying land.
§ 2R-1-03	No Unreasonable Injury to Other Water Rights	Primary responsibility for determining when an unreasonable injury occurs is now vested in the State Agency rather than in the courts.	There is no injury, reasonable or otherwise, if the affected party is compensated.
§ 2R-1-04	Protection of Property Rights	State can regulate property rights in the public interest	The State can compel even holders of vested property interests to obtain a permit subject to loss of their property interest if they fail to comply with the permit requirement.
§ 2R-1-02	Biological Integrity	Definition	The preservation of sufficient water in a water source to assure the survival of the ecosystem as such, although human needs necessarily preclude any aim of preserving all ecosystems without change.
§ 2R-1-03	Chemical Integrity	Definition	The preservation of the chemical integrity of a water source is necessary so that neither human nor other life forms are endangered by excessive pollution or low flows.

OOBT MODEL WATER CODE REFERENCES (Continued)

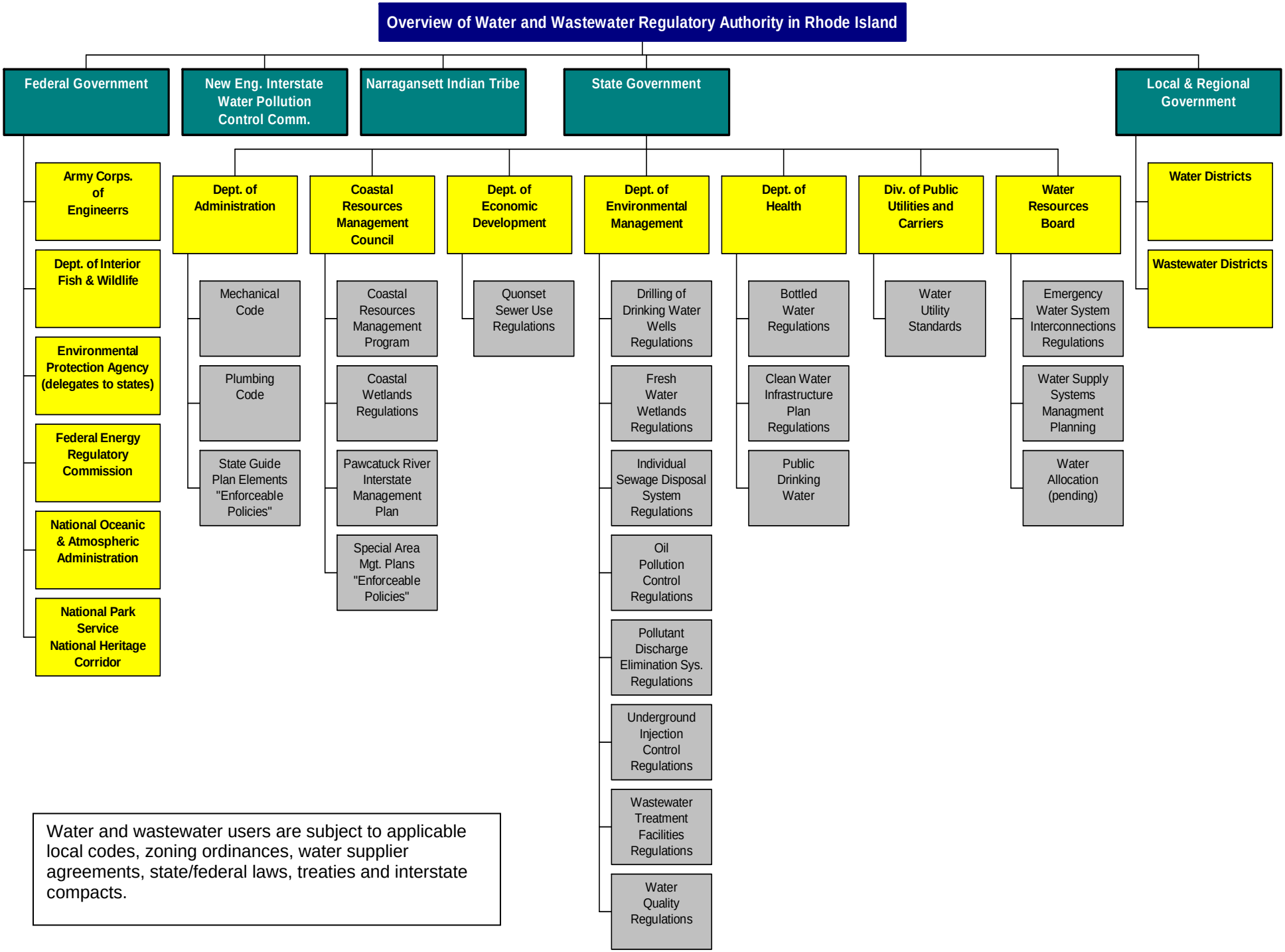
SECTION #	TITLE	CONCEPT	TEXT EXCERPT
§ 2R-2-04	Comprehensive Water Allocation Plan	Promote and secure the sustainable development and reasonable use of the waters of the State taking into account economic, environmental, and other social values.	Planning seeks to define the public interest in the waters of the State and to determine the data necessary for decision making to achieve the public interest and the sustainable development of the waters of the State.
§ 2R-2-05	Conservation Measures	Definition	Nothing in this Code attempts to spell out in detail what steps might actually qualify as appropriate conservation measures.
§ 2R-2-06	Consumptive Use	Code resolves all instances of water use where the obligation to obtain a permit from the State Agency might be in doubt in favor of the permit obligation.	Any use that is not a "nonconsumptive use".
§ 2R-2-10	Interbasin Transfer	Definition	An "interbasin transfer" is any transfer of water, for any purpose and regardless of the quantity involved, from one water basin to another.
§ 2R-2-18	The Public Interest	Definition	The "public interest" is any interest in the waters of the State capable of protection or regulation by law
§ 2R-2-20	Reasonable Use	The criterion of decision under the common law of riparian rights	The use of water in quantity and manner for economic and efficient utilization without waste, unreasonable injury to other water right holders, and consistent with the public interest and sustainable development.
§ 2R-2-22	Special Water Management Area	An optional form of an administration	The waters of the State within a hydrogeographically defined region are managed by an Area Water Board
§ 2R-2-24	Sustainable Development	Definition	Integrated management of resources considering the needs of future generations
§ 2R-2-27	Waste of Water	Regulate or otherwise deal with waste of water	Permitting the consumption of water for a purpose that is not reasonable
§ 2R-2-28	Water Basin	Hydrologic definition of a water basin	A basin is not a fixed hydrologic reality but in fact varies with the scale and purpose of the analysis

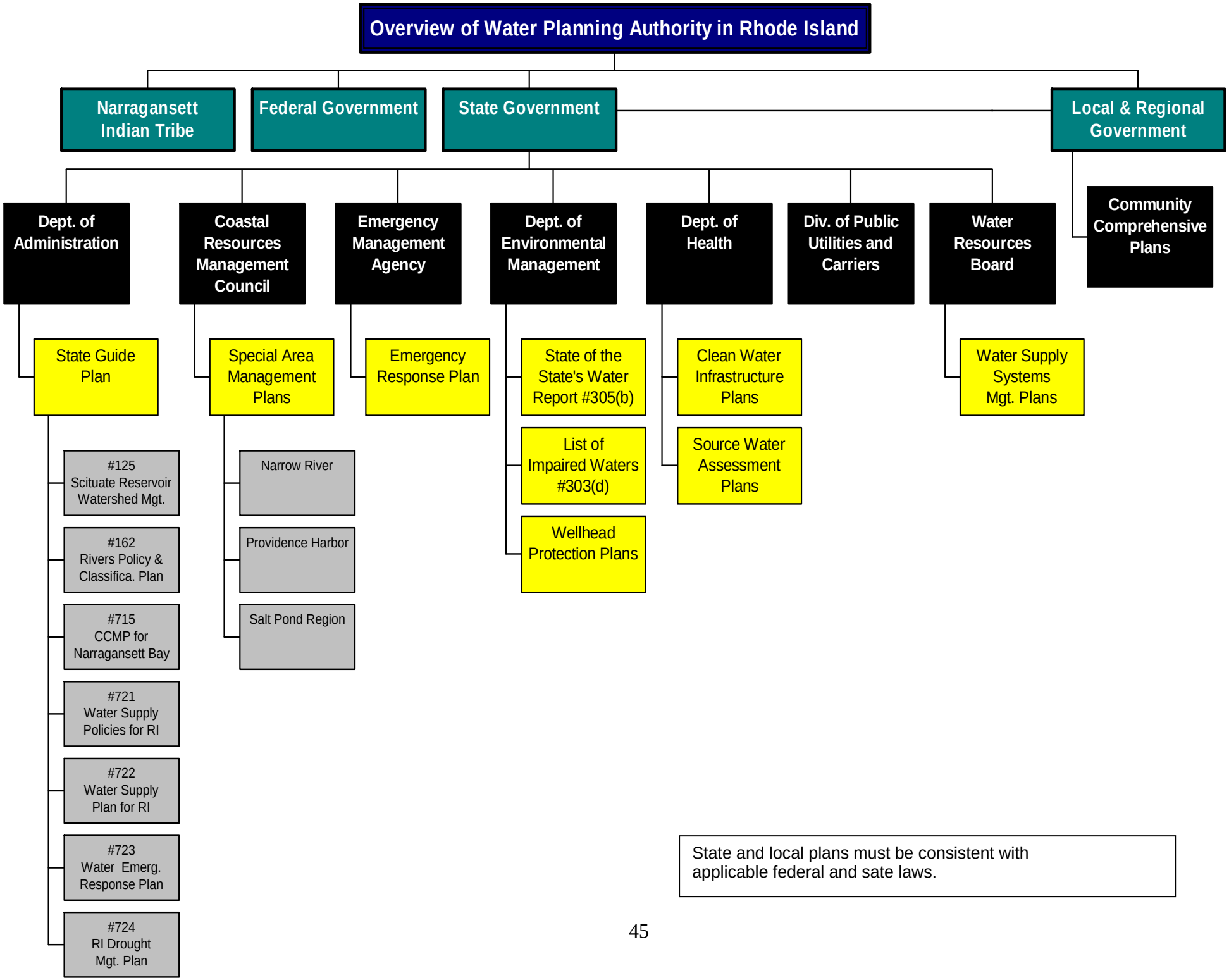
OOBT MODEL WATER CODE REFERENCES (Continued)

SECTION #	TITLE	CONCEPT	TEXT EXCERPT
§ 2R-2-30	Water Right	Usufructory property interest	Holders of water rights do not own the water to which their right pertains
Chapter 3	**Waters Subject to Allocation**		
§ 3R-2-01	Protected Minimum Flows or Levels Not to Be Allocated or Withdrawn	Regulate minimum flows	Protect the biological, chemical, and physical integrity of each water source
§ 3R-2-02	Standards for protected Minimum Flows or Levels	Manage withdrawals so as to mimic natural seasonal variations in flow	The State Agency shall establish a minimum flow or level as the larger of the amounts necessary for the biological, chemical, and physical integrity of the water source.
Chapter 4	**Administration**	**Coordination with Other Branches of Government**	
§ 4R-1-01	Basic Responsibility and Authority	The State Agency is responsible and vested with all powers necessary	The State Agency supervises and controls the development, conservation, and use of the waters of the State
§ 4R-3-04	Combined Permits	Combine the decision-making process relating to water allocation, water quality, and other water management issues	Combine a permit when it would improve the administration of both laws
Chapter 6	**Establishing a Water Right**	**Permit requirements**	
§ 6R-1-01	Withdrawals Unlawful without a Permit	The requirement of a permit to withdraw water exempting only certain small uses	All withdrawals from the waters of the State are unlawful unless made pursuant to a permit.
§ 6R-1-02	Small Withdrawals Exempted from the Permit Requirement	Several statutes exempt small users, variously defined, and uses particularly domestic and agricultural.	These users might still be required to register their use.
§ 6R-1-06	Registration of Withdrawals Not Subject to Permits	The Agency needs information about all uses of the waters	The Agency is given broad authority to define which exempted users must register and what information registrants need to provide.
§ 6R-2-01	Contents of an Application for a Permit	Minimum information that the Agency must include on the form.	The required information is essential to determining the impact of the proposed project on the sustainable development of the state's waters.
§ 6R-3-01	Standards for a Permit	Standards to be used in evaluating a permit application	The basic standard is that the use must be reasonable; the second standard is that the withdrawal not exceed the safe yield of the source.

OOBT MODEL WATER CODE REFERENCES (Continued)

SECTION #	TITLE	CONCEPT	TEXT EXCERPT
§ 6R-3-02	Determining Whether a Use is Reasonable	Consider impacts on users dependent on hydrologically interconnected water sources	The Agency shall consider the effects of the withdrawal on the public interest in the waters of the State, including impacts on interstate or interbasin water uses.
§ 6R-3-06	Special Standard for Interbasin Transfers	Special attention to the concerns of the basin of origin	The Agency shall consider water demand as well as the supply of water available in the basin of origin and the receiving basin.
§ 6R-4-03	Evaluating Allocations for Their Potential Effect on Water Quality	Coordination with the State's water quality agency	The State Agency shall determine the effect of allocation on the capacity of the water source to assimilate effluent.
§ 6R-4-04	Combining Permits for Water Allocation and Water Quality	Terms and conditions governing both water allocation and water quality	Combine the allocation permit with a National Pollutant Discharge Elimination System permit.
Chapter 7	**Scope of the Water Right**	Defines the extent of the water right through the terms and conditions of the permits	The terms will define how much water can be withdrawn at any given time and place, as well as the purpose of the withdrawal.
§ 7R-1-01	Permit Terms and Conditions	Authority of the State to impose restrictions during water shortages and water emergencies	The Agency must require that each user install and maintain adequate metering to report information and adopt conservation measures.
§ 7R-1-02	Duration of Permits	The Agency can revise the terms and conditions of the permits in light of changing circumstances	Actual regulated riparian statutes have used periods ranging from 1 to 20 years, with 10 being the most common.
Chapter 8	**Multijurisdictional Transfers**	Relates permits for the transport of water outside the State in so far as the withdrawal or use is not already covered by a federal decree, statute, compact, or treaty.	
§ 8R-1-01	Transportation and Use of Water Out of the State	Under proper conditions the transport of water is consistent with the public interest	A complete ban on interstate transportation and use of water is lawful only if authorized or approved by Congress.
§ 8R-1-02	Requirement of a Permit to Transport and Use Water Out of the State	Transport of water out of the State is subject to the ordinary permit process for withdrawals within the State.	No permit is necessary for the transport of water in closed containers or for domestic use of the persons transporting the water.


Overview of Water and Wastewater Regulatory Authority in Rhode Island
Federal Government
New Eng. Interstate Water Pollution Control Comm.
Narragansett Indian Tribe
State Government
Local & Regional Government
Army Corps. of Engineerrs
Dept. of Interior Fish & Wildlife
Environmental Protection Agency (delegates to states)
Federal Energy Regulatory Commission
National Oceanic & Atmospheric Administration
National Park Service National Heritage Corridor
Dept. of Administration
Coastal Resources Management Council
Dept. of Economic Development
Dept. of Environmental Management
Dept. of Health
Div. of Public Utilities and Carriers
Water Resources Board
Water Districts
Wastewater Districts
Mechanical Code
Plumbing Code
State Guide Plan Elements "Enforceable Policies"
Coastal Resources Management Program
Coastal Wetlands Regulations
Pawcatuck River Interstate Management Plan
Special Area Mgt. Plans "Enforceable Policies"
Quonset Sewer Use Regulations
Drilling of Drinking Water Wells Regulations
Fresh Water Wetlands Regulations
Individual Sewage Disposal System Regulations
Oil Pollution Control Regulations
Pollutant Discharge Elimination Sys. Regulations
Underground Injection Control Regulations
Wastewater Treatment Facilities Regulations
Water Quality Regulations
Bottled Water Regulations
Clean Water Infrastructure Plan Regulations
Public Drinking Water
Water Utility Standards
Emergency Water System Interconnections Regulations
Water Supply Systems Managment Planning
Water Allocation (pending)
Water and wastewater users are subject to applicable local codes, zoning ordinances, water supplier agreements, state/federal laws, treaties and interstate compacts.


Overview of Water Planning Authority in Rhode Island
Narragansett Indian Tribe
Federal Government
State Government
Local & Regional Government
Dept. of Administration
Coastal Resources Management Council
Emergency Management Agency
Dept. of Environmental Management
Dept. of Health
Div. of Public Utilities and Carriers
Water Resources Board
Community Comprehensive Plans
State Guide Plan
Special Area Management Plans
Emergency Response Plan
State of the State's Water Report #305(b)
List of Impaired Waters #303(d)
Wellhead Protection Plans
Clean Water Infrastructure Plans
Source Water Assessment Plans
Water Supply Systems Mgt. Plans
#125 Scituate Reservoir Watershed Mgt.
#162 Rivers Policy & Classifica. Plan
#715 CCMP for Narragansett Bay
#721 Water Supply Policies for RI
#722 Water Supply Plan for RI
#723 Water Emerg. Response Plan
#724 RI Drought Mgt. Plan
Narrow River
Providence Harbor
Salt Pond Region
State and local plans must be consistent with applicable federal and sate laws.

Water Registration Programs

	New Jersey	Maine	Connecticut
1. Is there a threshold for registration? What is it?	> 100,000 gpd for more than 30 consecutive days	Within 500 feet of a river, stream, or brook: >20,000 gpd More than 500 feet, > 50,000 gpd Withdrawals from Class GPA lake, pond or groundwater – threshold based on acreage of waterbody	> 50,000 gals in any 24-hour period
2. Are private wells included?	Yes if they meet threshold. Private homes would not meet this threshold.	Household uses are explicitly exempted.	Yes, if they meet the threshold
3. How many private wells (approx.) does the state have?			
4. Are there exemptions from the registration requirement? Grandfathering?	Water allocation permit exemptions for agriculture, aquaculture, and horticulture. They need to obtain an agricultural water usage certification or agriculture Water Use Registration	Non-consumptive uses (dams), household use, public water systems regulated by the Dept. of Human services, public emergencies, commercial and industrial storage ponds, in-stream storage ponds, water withdrawals subject to existing reporting requirements.	There are exemptions from the permits but not from the registration
5. Does registration include groundwater?	Yes	Yes	Yes
6. Surface water?	Yes	Yes	Yes
7. Are rules different for the two sources?	No	Yes	No
1. What are the application requirements?		Must file a Water Withdrawal Report	Pertain only to a permit application; there is no

State	Permitted for	Registration Program	De minimis	Formal Permitting Program	Minimum Flow Protection	Shut-off
VT	*Not specified* .005 cfsm	*None*	5% 7Q10 conservation flow standard	*Case by case* Alternatives must be considered. Report must be filed 1X/yr	ABF Feb median flow used Seasonal volumetric caps IFIM	✓
Online guidelines, laws, applications, contact info and other public information – very useful. Certification by a registered P.E. required to make sure the system complies with the maximum withdrawal rate.						
NH	≥20,000 gpd	✓	5% 7Q10	✓	Successive turndown Q60 Q80 Q90	✓
MA	≥100,000 gpd	✓	5% 7Q10	✓	ABF	✓
CT	≥50,000 gpd grandfathered July 1982	✓	Nothing defines the minimum impact 5% of 99% duration flow (roughly equal to 7 Q10)	✓	ABF Used for new projects. Site specific projects could have lower flow	✓
Daily USGS readings on Internet. Want to modify registration renewal process and establish a seasonally varying instream flow standard						

APPENDIX A

			registration of water diversions occurring
2. Does the state have water supply management plans? How do they relate to the registration program?			Yes – all public water utilities with more than 250 customers are required to prepare Water Supply Plans
3. Is registration voluntary?	No. It is required by regulation.	No	No
4. If not, how is the registration program enforced? By whom? How successful?		ME State DEP	CT State DEP Inland Water Resources Division Enforcement
5. How many permits/registrations are there? What is the break down by sector?			About 1900 registrations in 1983 (1300 consumptive); 650 permit applications and 450 permits issued (not all consumptive)
6. What studies were in place prior to establishing a registration system?			Water Resource Plans done in the 1970s by the state
7. Why was registration established?		To protect natural resources	Lobbying effort of the water industry

Water Allocation Matrix

An Overview of Water Allocation and Permitting in New England & New York

Final – January 16, 2003

APPEND

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Michael Holt – NYS DEC
Elizabeth Scott – RI DEM
Jeffrey Cueto – VT DEC
Denise Springborg - NEIWPCC

Statutes & Regulations

	CT	MA	ME	NH	NY	RI	VT
Do state statutes authorize environmental agencies to manage, allocate and/or regulate water use?	Yes - CT Water Diversion Policy Act	Yes - Water Management Act (WMA)	In 2002, ME law established the Water Withdrawal Reporting Program which requires larger water withdrawals to be reported to the DEP. The law also directs the DEP to undertake rule making to establish water use standards for surface waters.	Yes - Rivers Management & Protection Act - protection of instream flow; New groundwater development; Dam impoundments.	Yes - drinking water supply withdrawals; GW withdrawals on Long Island; withdrawals from the Great Lakes Basin.	General Law authorizes the RI Water Resources Board to manage the withdrawal & use of all waters. WRB is explicitly directed to inventory water sources & determine if existing uses are threatened, or reached/exceeded safe yield.	No statutes exist. Withdrawals are regulated under three existing permit programs: land use, regulation of streamflow, & dams.
Have regulations been passed under the statute?	Yes - 3/90; Rev - 8/91	Yes - 3/86; Rev - 7/92		Yes. Minor & Major GW withdrawals - 2001. Proposed instream regs only by 2002 - expected in 2003.	Water Supply Permits - 4/72 & 7/95; Long Island Wells (non PWS) - 4/72 & 7/95; Great Lakes Basin Withdrawals - 9/91 & 7/95	No regulations adopted yet; registration & allocation process in development.	The Procedure for Determining Acceptable Minimum Streamflows was adopted on 7/93 (not a rule); Water Withdrawals for Snow Making Rule 2/96
Do state statutes/regulations apply to surface & groundwater withdrawals?	Yes	Yes	The Water Withdrawal Reporting Program applies to GW & SW.	Yes. Permits required for ground water withdrawals. No permit specifically required for SW withdrawals.	Yes	Yes	Yes, if the GW withdrawal affects surface water.

	CT	MA	ME	NH	NY	RI	VT
Do the regulations establish streamflow requirements - minimum or otherwise?	No. Minimum Streamflow Regulations apply only to DEP stocked streams	Safe yields are considered.	No rules relating to streamflow have been adopted.	Streamflow requirements will be established for designated river reaches; pilot program under development. Surface WQ Regulations narrative requires maintaining water quantity.	No - case by case basis.	DEM is developing instream flow standards under authority of federal Clean Water Act.	Yes
If not in regulations, are streamflow requirements defined in WQ standards?	WQ regulations reference maintaining healthy aquatic environment; however no quantified limits are defined.	No	No	Standards reference maintaining flow but have no quantified limits.	Being considered.	WQ standards require maintenance of flow to protect designated uses. No explicit instream flow standard exists, but is under development.	Yes
Do regulations specify methodologies that must be used to determine streamflow requirements?	No - Criteria in the Minimum Streamflow Regulations for calculating release volumes are criticized as unclear.	Yes - but methodologies for basin safe yields are problematic.	No	-	Not currently. Being considered.	Not currently.	No
Do statutes or regulations include a grandfathering clause to govern existing withdrawals?	Yes	Yes. Existing users from 1981-1985 could register by 1/88; registrations are valid for 10 yrs; can reapply if water use is unchanged.	The Water Withdrawal Reporting Program allows exemptions for some existing withdrawals.	No statutes guarantee "grandfathered" water allocations to existing withdrawals.	Yes	No	No
If yes, what are the conditions for grandfathering?	Diversions registered by 7/1/83 are exempt & insulated from regulations and review.	Meter & report volumes annually.	Withdrawal reporting is subject to various exemptions.	No permits required for large GW withdrawals prior to 8/98.	Drinking water supplies developed before 1906 do not require a permit.	-	-

	CT	MA	ME	NH	NY	RI	VT
If no statute exists, does the state require registration of withdrawals?	-	-	Under the 2002 law, large water withdrawals must be reported.	Water Use & Water Registration statute requires registration of withdrawals >140,000 gp week	By law, all withdrawals from the Great Lakes Basin that are > 100,000 gpd must be registered.	Registration program under development.	No
Are water withdrawals regulated by other programs?	DEP is decision making agency.	DEP is decision making agency.	ME's Site Law requires adequate provision for water supplies. In unorganized territories, the ME Land Use Regulatory Commission reviews water use impacts.	DHHS regulates bottled water suppliers.	Delaware & Susquehanna River Basin Commissions	RI Freshwater Wetlands Program, WQ Certification process & Coastal Resources Management Council Program	Varies - see above.

Permits

Which state agency is responsible for issuing permits?	DEP issues. DPH reviews.	DEP	Withdrawals are not permitted; however, many are incidentally subject to state review under ME's land use statutes & permit requirements.	DES - Permits only issued for ground water withdrawals.	DEC	DEM issues permits for withdrawals affecting freshwater wetlands (lakes, rivers, etc.) & issues WQ Certificates. CRMC issues permits for withdrawals affecting coastal resources.	Land Use Permit - District Env. Commissions; other permits issued by DEC.
Which other agencies review the application prior to granting a permit?	Water supply permits are reviewed by the DPH.	Several agencies & organizations provide input during permitting process.	Various agencies review land use permit applications.	DES with local review & public hearings.	DOH & PSC review. Basin Com review if applicable.	-	Varies depending on permit.

	CT	MA	ME	NH	NY	RI	VT
Are permit criteria defined by regulations?	No	Yes	Land use permits establish conditions.	Yes	Yes	Yes	Yes
What are the standard permit conditions?	Monitoring & reporting, conservation, leak detection, calibrating meters.	Individual metering, conservation and others for new water supplies (source protection, etc).	Land use permit conditions can include monitoring & reporting, & limits on water withdrawals.	Conservation, monitoring & reporting.	For new supplies: source protection, service area constraints & conservation.	None relative to water withdrawals.	Flow & level management plan, monitoring & reporting, conservation flows.
Do permit conditions allow for flow offsets & other water saving measures?	-	Considered by DEP during permit deliberations.	The new Water Withdrawal Reporting Program does allow for consideration of return flows.	If return flow mitigates impact, it is recognized.	Typically only standard conservation measures.	Considered during permit deliberations.	System efficiency/ conservation promoted.
Do the regulations set threshold volumes or flows for permitting?	Permits are not required for withdrawals < 50,000 gpd; General permit maximum is 250,000 gpd with some exceptions.	Permits are required for GW & SW withdrawals >100,000 gpd.	The Water Withdrawal Reporting Program sets thresholds based on type & size of water source.	GW withdrawals >56,000 gpd require permits. Minor withdrawals apply to >57,600 gpd but <144,000 gpd.	None for water supplies. Long Island wells > 45 gpm require a permit.	No	No
Are permits granted for a limited time period?	General permits - 5 years; Individual permits - generally 10-15 yrs but up to 25 yrs.	WMA permits issued for max of 20 yrs but reviewed every 5 yrs.	-	GW > 57,600 gpd issued for 10 yrs; must reapply thereafter.	Water supply permits do not expire; Long Island water supply & well permits are reviewed every 10 yrs.	-	No. Snow making permits are subject to review.

	CT	MA	ME	NH	NY	RI	VT
Environmental Impact Studies							
Is a study required as part of the permit application process?	Yes, if permit involves an inter-basin transfer.	WMA regs prescribe a methodology based on flow duration curves & safe yield; methodology problematic & thus DEP evaluates impacts on a site by site basis with public comment & stakeholder input.	May be required for land-use permitting & engineering reviews.	Yes - where potential impacts are identified & for all withdrawals with low flow assessments.	Most require an Env. Assessment Form; some require a complete Env. Impact Study	An analysis of the impact of proposed withdrawals to freshwater wetlands is required.	Required by various permit programs; not in regulations.
Are minimum study requirements defined?	No		No	Yes - various.	Yes - various.	Yes - as related to the above analysis.	No
Do regulations specify methodologies that must be used to evaluate flow impacts (ABF, IFIM)?	No		No	No. The process is defined but not the methodology.	Not currently. Being considered.	ABF is defined in wetlands regulations though no set flow requirements are established.	No with the exception of snow making.
Allocation							
Does a state council or board exist to address water allocation?	Yes - Water Planning Council.	Yes - Water Resources Commission.	No - Common law of riparian rights.	No	No	Yes - Water Resources Board.	No

State Survey Contacts:

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Michael Holt - NYS DEC
Elizabeth Scott - RI DEM
Jeffrey Cueto - VT DEC

Key:

GW - groundwater
SW - surface water
WQ - water quality

Appendix A

Narrative Description of State Water Use Data Collection Programs

At the request of the committee, USGS water use specialists, led by the four regional water use coordinators (Deborah Lumia, Joan Kenny, Molly Maupin, and Susan Hutson) undertook a survey of the current condition of water use data collection in all 50 states, the District of Columbia, and Puerto Rico. Its purpose was to answer the question, "What kinds of data are collected and stored by each state, and how often?" A series of questions were addressed to the water use specialist in each state (see Chapter 2 for a list of the survey questions), and the responses were tabulated. This appendix is a narrative describing the results of the survey in each state. The overall results of the survey are summarized in Chapter 2.

Alabama has a permitting program for all categories of water use. Data are reported to the state annually for all public water supplies and for other all other water users whose withdrawal exceeds 100,000 gallon per day. Laws are applicable statewide with no difference between surface and groundwater. The state maintains a water use database, which is updated annually. Latitude and longitude are not recorded for wells or surface water intakes.

Alaska has a water use permitting program for all categories of water use. Monthly withdrawal amounts are requested until the facility is issued a certificate to use the water, then the facility reports only if the certificate requires reporting. Most users continue to report on a voluntary basis. Permits are required for usage in excess of 1,500 gallon per day for public water supply and domestic water use and for usage in excess of 10 acre-feet per month for all other users. Laws are

applicable statewide with no difference between surface and groundwater. The state maintains a water use database, which is updated annually. Latitude and longitude are not recorded for wells or surface water intakes. Sometimes the reported water use data are checked against the permitted amounts.

Arizona requires water permits, collects water use data, and maintains a database of annual water use for all users whose groundwater withdrawal rate exceeds 35 gallon per minute in five "active management areas" (Phoenix, Tucson, Pinal, Prescott, Santa Cruz). Groundwater withdrawals are governed by a 1980 state law. Surface water has been adjudicated statewide according to the provisions of a 1919 law using the "first in time is first in right" principle. Surface water data are available from a variety of sources such as Central Arizona Project, Gila Water Commissioner, and irrigation districts. Latitude and longitude of wells and surface water intakes are not reported, but the township, range, and quarter section of these points are recorded. Data checking is done using electric power consumption data and information from satellite photos for monitoring irrigated area.

Arkansas requires water permits and maintains a database of monthly water use reported annually for all surface water uses of more than 1 acre-foot per year and all groundwater wells having a potential flow of 50,000 gallon per day or more. Latitude and longitude are required for all wells and surface water intake points, as well as township, range, section, quarter section, and quarter-quarter section for all of these points. The database is maintained by the USGS, and water use data are sometimes checked against power consumption data. Trends through time are checked for the period of the data, from 1985 to present (see Chapter 3 for more information on the Arkansas water use database).

California has the authority through the California State Water Resources Control Board to permit water use. The state requires annual reporting of surface water withdrawals for permitted water rights for the first 10 years of the permit to substantiate water use. Once the permitted withdrawal is well documented, the permit holder is issued a "license" to withdraw from surface water sources and is required to submit a "report of licensee" once every three years that documents monthly withdrawals over the last three-year period. Water rights acquired prior to 1914 and riparian water right holders are requested to report but are not required to do so. Total groundwater extractions in Los Angeles, Riverside, San Bernardino, and Ventura Counties that are in excess of 25 acre-feet per calendar year (or greater than 10 acre-feet per year from any single withdrawal point) are required to be filed with the State Water Resources Control Board within the first six months of the succeeding year. Surface water withdrawal of any amount must be reported except for the exempted water rights mentioned above. These regulations apply statewide for surface water but only to the four counties mentioned

in state water code for groundwater. Many other agencies in California besides the State Water Resources Control Board collect water use information for their own purposes. Other groundwater basins have been adjudicated throughout California, and regional "water masters" have been designated by the courts to maintain groundwater extraction data. California's multiagency water management organizational structure, the number of its water users, and its complex water-transfer infrastructure combine to create a complex water use information environment.

Colorado has the legal authority to permit withdrawals, and it may require reporting of diversions of any magnitude at any location where a surface water or groundwater withdrawal occurs. Records are maintained for all major surface water deliveries. Groundwater withdrawal data are generally not required, except in the Arkansas River basin where monthly withdrawals are required for all wells pumping greater than 50 gallons per minute. Water permits are obtained statewide in the same manner for surface water as for groundwater. The location of any point of diversion may be requested by the state engineer; however, latitude and longitude generally are not required. Township, range, section, and quarter-quarter-quarter section are requested for wells. The state maintains a water use database that consists of withdrawal information originally collected at specific points of diversion, then aggregated by water district and forwarded to the state by the seven division offices. The state makes periodic site measurements and checks on site data recorders. Power companies provide electric consumption data for well pumpage calculations.

Connecticut has the legal authority to permit or register withdrawals. Public water use is reported to the state for users using greater than 50,000 gallons per day, with data being recorded monthly, quarterly, or annually depending on the user. Laws are applicable statewide and are the same for surface and groundwater. The state maintains a water use database for public water supply but not for other water use categories.

Delaware has a water use permitting program, requires the collection of data, and maintains a water use database. Monthly water use data are reported annually for any facility drawing 50,000 gallons per day or more, for all water use categories except for domestic and livestock. Both surface and groundwater use data are compiled on a similar basis. Locations of wells and water use intakes are plotted on maps. Data consistency is checked by comparison with the previous year's data at the same withdrawal site.

The **District of Columbia** has a permitting program for well construction; however, it has no authority for collecting withdrawal (or any other) data once the well is permitted. Little groundwater is pumped in the District except for dewater-

ing or for cleanup of contaminated sites. Public water supply is managed by the U.S. Army Corps of Engineers Washington Aqueduct operations. This water comes entirely from two surface water intakes on the Potomac River located in Maryland at Little Falls and Great Falls. Monthly withdrawal information from these intakes is reported to the Maryland Department of the Environment in accordance with Maryland laws (see below).

Florida has a water use permitting program managed by five water management districts that collectively cover the state. Rules regarding trigger levels for requiring permits and the degree of reporting of water use data vary from one district to another, with the rules being more stringent in critical water use areas. In general, permits are required for all users having the capacity to use 1 million gallons per day and for all wells greater than six inches in diameter. Water use data are reported monthly, quarterly, or annually, depending on the water management district, with the exception of agricultural water use, which is collected only in some areas of the state. A database of latitude and longitude of public water supply users has been compiled, but similar location data are not generally available for other water use categories. Some data checking is done by comparison with the past year's water withdrawals.

Georgia has a water use permitting program, requires the collection of data, and maintains separate databases for surface water and groundwater use. Data are compiled annually for all users withdrawing at least 100,000 gallons per day for public, industrial, commercial, and power water use, but not for irrigation, livestock, and domestic use. Laws apply statewide in the same manner for surface and groundwater.

Hawaii has a water use permitting program and requires the collection of monthly water use data in all water use categories for uses exceeding 1,000 gallons per day. Laws apply statewide in the same manner for surface and groundwater. The database is updated monthly to quarterly, depending on the receipt of water withdrawal data. The latitude and longitude of wells are recorded; this information will be required for surface water intakes in the future.

Idaho has the legal authority to permit or register withdrawals, data are reported to the state, and a water use database is being constructed. Data reporting is required of any single- or multiple-user water system having an instantaneous diversion rate of at least 0.24 cubic feet per second (108 gallons per minute), or which is irrigating more than five acres in area. Water use regulation is mandatory for all diversions within the Eastern Snake Plain aquifer boundaries and for some diversions outside this area. The law applies similarly to surface and groundwater. The database will be updated annually. Latitude and longitude locations of wells are required and are verified using global positioning system

technology. Location coordinates for surface water intakes will be required in the future. Withdrawal data are checked against water right permit limits.

Illinois does not have legal authority to permit or register withdrawals, but it does have an Illinois Water Inventory program administered by the Illinois State Water Survey. This inventory covers public water supply wells and surface water intakes, high-capacity (more than 70 gallon per minute) private wells, and surface water intakes for industry, commercial establishments, and fish and wildlife management areas. Annual water use data have been surveyed since 1978 and are stored in a Public Industrial-Commercial Survey database using township-range-section location coordinates. Agricultural water use is not systematically surveyed, except in some project areas. A separate private well database for wells with a capacity of less than 70 gallons per minute has recently been established.

Indiana has the legal authority to register water withdrawals and collects monthly data on all water use categories for any facility capable of withdrawing 100,000 gallons per day. Laws are applicable statewide and are the same for surface and groundwater. The water use database is updated annually. Locations of wells and surface intakes reported in Universal Transverse Mercator coordinates are required. The state tracks changes in withdrawals by comparing the current year's withdrawal to the previous year's withdrawal at the same site.

Iowa has a water use permit program, except for agricultural or irrigation water withdrawals from the Mississippi and Missouri Rivers, which do not require a permit. The state requires annual reporting of water use for all water uses exceeding 25,000 gallons per day. There are special threshold provisions for withdrawals from the Dakota and Jordan sandstone aquifers. Locations of wells and surface water intakes are specified by township, range, and section, but the latitude and longitude of these points are not reported. Some data checking is done against permitted usage rate and usage reports from water suppliers. The state maintains a database, which is updated annually.

Kansas has a water use permit program and collects water use data annually from all permitted water users. Annual reports for public water supply and industrial uses include monthly data. There is no lower trigger level for requiring water use reporting; all permitted users except those with domestic water rights must file an annual water use report or be fined. Permits are required for livestock water use at operations having 1,000 head or more of cattle or using at least 15 acre-feet per year for other kinds of livestock. Permits are not required for domestic use, or for public water suppliers with fewer than 10 connections. Laws are applicable statewide and are the same for surface and groundwater. Some areas of the state are closed to new appropriations. Latitude and longitude of wells and surface water intakes are assigned by the state and are verified using

global positioning system technology. The water use database is updated on a continuing basis as reports are received. Annual publications of irrigation and public water use data contain five-year averages for irrigation application rates, per capita use, and unaccounted-for water (Kansas Water Office and Kansas State Department of Agriculture, 2001; Kansas Water Office and USGS, 2001).

Kentucky has a water-withdrawal permitting program and collects water withdrawal data for public water supply, industrial, commercial, and mining water use, but not for thermoelectric, livestock, domestic, or aquaculture water use. The average daily water withdrawal is reported twice a year for uses exceeding 10,000 gallons per day. Laws are applicable statewide and are the same for surface and groundwater. Latitude and longitude coordinates of wells and surface water intakes are requested but are not often supplied. Public water supply data are sometimes checked against drinking water monthly operating reports.

Louisiana has the legal authority to register and collect water use information from wells. The state collects water use data for both surface and groundwater withdrawals, although no statute exists to cover surface water information. Facilities using more than 1 million gallons per day report withdrawal information quarterly; all other facilities receive a questionnaire every five years. Aggregate information also is collected at five-year intervals. The reporting program is statewide in coverage for both surface and groundwater. Monthly water use data are collected in the Baton Rouge area by the Capital Area Ground Water Commission. The latitude and longitude location of the measuring point are provided when wells are registered. The state has an ongoing program to collect latitude/longitude information for other facilities. The state and USGS maintain a database that is updated completely every five years. Data from the major facilities (greater than 1 million gallons per day) are updated quarterly. Data are checked by comparison with previous years' values, with typical use by similar facilities, and with data from other agencies or programs such as the Louisiana Department of Health and Hospitals, National Pollutant Discharge Elimination System permits, Louisiana Department of Agriculture Extension Service, and the USDA National Agricultural Statistics Service.

Maine does not have the legal authority to permit or register water withdrawals. Public water use data are reported to the state. Public water supply data are recorded monthly and are reported annually for surface water and groundwater withdrawals for most public water utilities.

Maryland has a water use permit program for public water supply, industrial, commercial, irrigation, and power water uses, but not for domestic and livestock water use. The state maintains a water use database for which twice a year, the six-month total of water use is reported to the state. Permit holders

using more than 10,000 gallons per day are required to submit reports. Laws are applicable statewide and are the same for surface and groundwater. Latitude and longitude coordinates of wells and surface water intakes are required, but the location for groundwater withdrawal may be the centroid of a well field, rather than the location of each individual well. Data are checked against the previous year's water use amount and against the permitted amount.

Massachusetts has the legal authority to permit or register water withdrawals. The state requires water use reporting for public, industrial, commercial, irrigation, and livestock water use, but not for domestic and power water use. Monthly water use is reported annually for all users exceeding 100,000 gallons per day, except for public use, where use is reported if at least 25 people or 15 connections are served. Laws are applicable statewide and are the same for surface and groundwater. Latitude and longitude data are recorded for wells and surface-water intakes for public supply, commercial, industrial, irrigation, and livestock water users. Water withdrawal data are checked by the state against the previous year's withdrawal amount, and background data, such as the presence of new wells, new owners, and corrections to the latitude and longitude, are also checked.

Michigan has the legal authority to register water withdrawals. Water use data are reported to the state for public water supply, industrial, and power use, but not for commercial, domestic, irrigation, and livestock with use. Irrigation is currently a split category; golf course irrigators are required to report annual water use, while agricultural irrigators are not. Monthly data are reported for any facility capable of withdrawing 100,000 gallons per day in any 30-day period. Laws are applicable statewide and are the same for surface and groundwater. Latitude and longitude coordinates of wells and surface water intakes are not recorded.

Minnesota has a water use permit program and collects monthly water use data through an annual reporting process for all water uses exceeding 10,000 gallons per day or 1 million gallons per year. Laws are applicable statewide and are the same for surface and groundwater. Location data for wells and surface water intakes are stored in the form of township, range, section, and quarter section down to the nearest 10 acres. A state database of reported water withdrawals is updated annually if staff are available. Some data are field checked and a web page (http://www.dnr.state.mn.us/waters/programs/ water_mgt_section/ appropriations/wateruse.html) shows trends in use over time for several water use categories.

Mississippi has a water use permit program for all users of surface water and groundwater. Permits are not required for groundwater wells less than six inches

in diameter. Laws are applicable statewide. Annual water use is reported yearly on a voluntary basis. Public water supply withdrawal points are recorded by latitude and longitude, using global positioning system technology, and also are recorded by township, range, and section. All other permitted withdrawal points are indexed by township, range, and section. Withdrawal data are checked by comparison with the corresponding data for the previous year.

Missouri has the legal authority to require users of 100,000 gallons per day or more to register with the state and report usage annually. However, this is largely a voluntary program. The state maintains a database of annual water use by these users. Laws are applicable statewide and are the same for surface and groundwater. Location coordinates are not required, but many users file latitude and longitude coordinates or township, range, and section location. Withdrawal data are checked by comparison with the corresponding data for the previous year and by looking for outlier data values.

Montana has a water permit program for new water uses. This is a one-time permit for all future years and is not annually renewed. The state does not maintain a water use database. Some new water users are required to submit usage data "at the request of the department." There is no requirement to report latitude and longitude of the water withdrawal. Laws are applicable statewide and are the same for surface and groundwater. Reported data, where available, are checked against permit limits.

Nebraska has the legal authority to permit or register withdrawals for surface water use, without the use of a trigger level. Records of locations of surface water points of diversion and groundwater wells are required. Surface water withdrawals in some basins, such as the Republican River basin, are reported to the state. Some information on public water suppliers is collected by the Nebraska Health Department. The state maintains an annual water use database. Laws are different for surface water (prior appropriation) and groundwater (correlative rights). Locations of points of diversion and groundwater wells are required, but they are not stored as latitude-longitude coordinates. An effort is being mounted to obtain the latitude and longitude of public water supply points. The state tracks changes in water withdrawals through time.

Nevada has a water use permit system for all water use categories except domestic water use. The state engineer determines who must report water use, based on the withdrawal amount. Monthly, quarterly, or annual data may be required, depending on the permit. Laws are applicable statewide and are the same for surface and groundwater. The state does not maintain a water use database. Latitude and longitude coordinates of the water withdrawal locations are not recorded.

New Hampshire has the legal authority to register water withdrawal for all water users exceeding 20,000 gallons per day averaged over a seven-day period. Permits are required only for groundwater withdrawals exceeding 57,600 gallons per day. The state collects monthly water use data on an annual basis for all registered and permitted users. The latitude and longitude of water use sites are stored in a specially designed New England Water Use Database System, which besides water use includes points of water discharge, locations of treatment plants and major distribution system facilities, and their linkage with one another so that the movement of water can be traced from point of withdrawal from the natural water system, through the infrastructure water system, to the point of discharge to the natural water system again (see Chapter 7 of this report for more information on this data system).

New Jersey has a water permit system for all water uses and collects monthly water use data for users exceeding 100,000 gallons per day (or capable of pumping 70 gallons per minute). The USGS maintains a water use database for the state that is being updated continually as new data come in. Latitude and longitude coordinates of all withdrawal points are recorded. Water use data are checked for users renewing or modifying a permit and for users in the proximity of a new water allocation permit.

New Mexico has a water permit system for all water uses. All permit holders regardless of level of use are required to report water use to the state on a quarterly or annual basis, except for domestic wells using less than 3 acre-feet per year and most irrigation water rights. All irrigation wells in the Roswell Artesian Basin are metered by court decree, and the owners are required to report usage. The state engineer may assume jurisdiction over water appropriation and use in other areas by "declaring" any groundwater basin with reasonably defined boundaries. Wells in declared basins may only be drilled with a permit, and they can only be drilled by well drillers licensed by the state engineer. Approximately 40 percent of water right holders are noncompliant about reporting their usage. Some reported withdrawals are monitored to ensure they do not exceed water right allocations. The state is entering available site-specific water use data into its database. This database includes the legal description (township, range, section) of the diversion points. The state also maintains separate databases for compiling five-year summaries of water use by category, county, and river basin. Data for the five-year inventories are compared to previously reported values in order to detect reporting errors or significant changes related to economic and population trends. Water use data are analyzed to support regional water demand projections.

New York has three different water use data collection systems depending on location within the state. Public water supply data are collected statewide for

all EPA-regulated systems (more than 25 people served or 15 connections). In Long Island, a set of four counties (Kings, Queens, Nassau, Suffolk) have a special data collection program in which all users of groundwater at pumping rates of greater than 45 gallons per minute are inventoried by the state. In the Great Lakes Basin (42 percent of the state), all water users withdrawing more than 100,000 gallons per day, or having a consumptive use of 2 million gallons over a 30-day period are inventoried by the state. The public water supply database stores annual water use data, is updated every three years, and includes latitude and longitude of the water withdrawal points, although some data are missing. The Long Island database contains annual water use data, is updated annually, and is checked by comparison with the previous year's water use. Latitude and longitude are stored for groundwater wells, although the value reported may be the centroid for a well field. The Great Lakes region database stores annual water use data, is updated every two years, and does not contain latitude and longitude of the water withdrawal points.

North Carolina has the legal authority to register water use, and water use reporting is mandatory within a critical capacity area for all users exceeding 100,000 gallons per day. Outside this area, water use reporting is voluntary and is requested of users exceeding 1 million gallons per day. Data on public water supply are collected every five years, and data are collected for other categories of water use through the registration program. Laws are applied the same to surface water and groundwater.

North Dakota has a water use permit program for all uses except those for which the amount used is less than 12.5 acre-feet per year and the use is for domestic, livestock, fish, wildlife, or recreation. For all permitted users, annual withdrawals are reported on individual response forms. The same laws apply to both surface and groundwater and are applicable statewide. The state maintains a water use database, which is updated every year when the response forms are returned to the state. Latitude and longitude coordinates of the withdrawal points are not recorded, but the township, range, and section values are required. Spot checks of the data are carried out by field-checking pumpage rates or electric consumption of the user. Reports showing unreasonable amounts of use for a given category or amounts exceeding the permitted amount are checked.

Ohio has the legal authority to permit or register water withdrawals and collects water use data annually for any facility capable of withdrawing 100,000 gallons per day. The same laws apply to both surface and groundwater and are applicable statewide. Latitude and longitude coordinates of water withdrawal points are recorded. Withdrawal data are checked by comparison with the previous year's values.

Oklahoma has a water use permit program for all categories except domestic water use. Permit requirements apply statewide for both surface water and groundwater, although ground water is considered a property right and surface water is considered to be publicly owned. The Oklahoma Water Resources Board (OWRB) maintains latitude and longitude locations of withdrawal points, which are determined from legal descriptions using conversion programs. Water use data are requested annually for any magnitude of use by all permitted water users; about 60 percent of the annual surveys are returned to the state. The OWRB maintains a water use database that is updated annually. Reported data are not checked against other information; however, surface water withdrawals are subject to annual review. The exception to the OWRB permitting and reporting requirement is for surface water withdrawals in the Grand River basin, which are under the jurisdiction of the Grand River Dam Authority. The GRDA maintains some records of surface water sales in the Grand River basin.

Oregon has a water use permit program and requires water use data of all permit holders. Various trigger levels for reporting are used, such as 15,000 gallons per day for domestic water use of less than 15,000 gallons per day, and 5,000 gallons per day for commercial and industrial water use. Some categories of water use are exempted, such as livestock watering and fisheries management. The reporting requirements are consistent statewide and require monthly water use data to be reported annually. The state locates diversions using township, range, section, quarter section, and quarter-quarter section values, and it is locating significant water withdrawal points using global positioning system (GPS) technology. The USGS and the state are using GPS to record well locations for specific groundwater projects. The water use database is updated continually as new reports are received.

Pennsylvania regulates public water supply only at the state level, with other categories of water use being regulated by the Delaware and Susquehanna River Basin Commissions, within the boundaries of those river basins. The two river basin commissions have the authority to register all water users exceeding 10,000 gallons per day and to permit water uses for all water users exceeding 100,000 gallons per day. The Susquehanna Commission has the authority to regulate all consumptive users of greater than 20,000 gallons per day. The Delaware River Basin Commission has authority to regulate water use for groundwater users exceeding 10,000 gallons per day in a special groundwater use area. The frequency of reporting water use data varies, with the Delaware Commission requiring annual reports and the Susquehanna Commission requiring monthly, quarterly, or annual reports, depending on the user. Some data checking is performed against permit levels and the past year's data as new water use data are stored.

Puerto Rico has the legal authority to permit or register water withdrawals; it maintains a water use database for all water uses regardless of the amount of use. The frequency of reporting water use data varies, depending on the amount of water withdrawn, the use, and the source of water. There is a fee assigned to the user depending on the water use, but the fee does not apply to water used in agricultural activities. Laws are applicable statewide and are the same for surface water and groundwater. Latitude and longitude coordinates of the withdrawal points are not recorded. Data reports are completely revised every three to five years at the time of permit renewal.

Rhode Island has the legal authority to permit or register water withdrawals for public water use only; it does not have this authority for any other usage category. The state requires collection of public water use data for users exceeding 100,000 gallons per day, regardless of whether the source is surface water or groundwater. The state does not maintain a water use database on an ongoing basis.

South Carolina has the legal authority to permit or register water withdrawals for all categories of water use. Data are recorded quarterly, or monthly during times of extremely low stream flow, for users that exceed 3 million gallons in any month (or approximately 100,000 gallons per day). Laws are applicable statewide and are the same for surface water and groundwater. The state maintains a water database on an ongoing basis. Latitude and longitude coordinates of withdrawal points are not required. Data are checked against the previous year's use and are summarized in a data report every one to three years.

South Dakota has a water use permit program for all categories of water use except domestic use. The state collects annual water use data from the largest public water supply systems and from all irrigation users, and every five years the state requests data voluntarily from other water users using questionnaires. Laws are applicable statewide and are the same for surface water and groundwater. Well and surface water intake locations have township-range-section values as part of the permit application, and these locations are converted to latitude and longitude by the state or USGS. Irrigation water use data are used collectively to determine whether water is available from a particular source for further appropriations, and individual irrigation water use data are used to determine whether an existing right is still active or subject to cancellation due to nonuse. No metering is required. The state maintains a database, updated annually, of irrigation withdrawals. The USGS maintains a site-specific database of public water supply, industrial, thermoelectric, and irrigation data. Sometimes, during enforcement actions, water use data are checked against power consumption data.

Tennessee does not have the legal authority to permit or register water withdrawals. Public water use data are reported to the state, and the USGS maintains a public water supply database. Public water supply data are recorded monthly and are reported annually for all surface water withdrawals and for groundwater withdrawals for systems serving more than 50 people. Latitude and longitude coordinates of the withdrawal points are recorded both for wells and surface water intakes.

Texas has legal authority to permit surface water use throughout the state, but groundwater use permits are required only in particular groundwater conservation districts. Water use data for municipal and industrial uses have been voluntarily submitted to the state for many years, but beginning in November 2001, water use data collection is mandatory for both surface water and groundwater users. Monthly water withdrawals are requested, but often only annual data are supplied. There has been no specified trigger level for water use data collection since data collection has been voluntary. The state maintains a water use database, which is updated annually. The locations of groundwater wells and surface water intakes are shown on maps. As part of a statewide water availability study, latitude and longitude coordinates of all permitted surface water diversion points are being determined. Changes in water use from year to year are tracked in a quality assurance process, and revisions to the data are made when necessary.

Utah has the legal authority to permit or register water withdrawals for all categories of water use. Annual water use data are collected for all water users exceeding 20 acre-feet per year, except for domestic, livestock, and irrigation use. Irrigation water use is estimated by the USGS using pumpage inventories and electric consumption records. These data are provided to the state and are published annually. A special emphasis in data collection is made for areas where groundwater management plans have been developed. Surface water withdrawals are monitored by river basin commissioners or local water entities. Well locations and surface water intakes are located by township-range-section but not by latitude and longitude. Water use data are checked and updated as water rights change and as large changes in withdrawals are noted from the previous year. The data are also checked and updated using field reviews.

Vermont does not have the legal authority to permit or register water withdrawals. Water use data are not reported to the state. Water use data for Vermont have been compiled by the USGS and incorporated within the New England Water-Use Data System in the same format as that for New Hampshire (see Chapter 7 of this report for more information on this data system).

Virginia maintains a water use register for all categories of water use except domestic. Monthly data are reported annually to the state for users whose average withdrawal rate exceeds 10,000 gallons per day for any single month and for irrigators whose use exceeds 1 million gallons per month. The procedure is

applicable statewide and it is the same for surface water and groundwater, with the exception of two coastal Ground Water Management Areas, where withdrawals of greater than 300,000 gallons per month must be reported. The locations of wells and surface water intakes must be shown on a map, and the latitude and longitude are requested if known by the user.

Washington has the legal authority to register the construction of wells, and permits are required for any use other than single-family domestic withdrawals. Water use data are not reported to the state.

West Virginia does not have the legal authority to permit or register water withdrawals. Public water use data are not reported to the state.

Wisconsin has the legal authority to permit or register water withdrawals for public water supply, industrial, and power use only; it does not have this authority for commercial, domestic, irrigation, or livestock use. Water use data are reported to the state annually for all public supplies, for industrial water users exceeding 100,000 gallons per day, and for all thermoelectric power facilities. The laws are applicable statewide and are the same for surface water and groundwater. A water use database is maintained on an ongoing basis, but whether latitude and longitude of water withdrawal points are stored in the database is unknown. Water use data for public water supplies are checked against the previous year's water use.

Wyoming has a prior appropriations doctrine that requires permits for beneficial use of water. The Wyoming State Engineer's Office maintains a database of permit information, which is useful for developing USGS water use estimates. Permits are required both for surface and groundwater use, although a usage rate of less than 25 gallons per minute is considered domestic water use and has a simpler permit process. The Wyoming Water Development Commission conducts a biannual survey of public water systems (see http://wwdc.state.wy.us/watsys/2000/raterept.html for the 2000 report), and in alternate years it conducts a similar survey of agricultural water use. These surveys contain annual water use data and a significant amount of ancillary information about each water user. Latitude and longitude data have been collected for public water supplies but generally not for other water users.

Appendix B

Biographical Sketches of Committee Members

DAVID R. MAIDMENT, *Chair*, is the Ashley H. Priddy Centennial Professor of Engineering and director of the Center for Research in Water Resources at the University of Texas at Austin. He is an acknowledged leader in the application of geographic information systems (GIS) to hydrologic modeling. His current research involves the application of GIS to floodplain mapping, water-quality modeling, water resources assessment, hydrologic simulation, surface water–groundwater interaction, and global hydrology. He is the coauthor of *Applied Hydrology* (McGraw-Hill, 1988) and the editor-in-chief of *Handbook of Hydrology* (McGraw-Hill, 1993). From 1992 to 1995 he was Editor of the *Journal of Hydrology*, and he is currently an associate editor of that journal and of the *Journal of Hydrologic Engineering*. He received his B.S. degree in Agricultural Engineering from the University of Canterbury, Christchurch, New Zealand, and his M.S. and Ph.D. degrees in civil engineering from the University of Illinois at Urbana-Champaign.

A. ALLEN BRADLEY is an associate professor of civil and environmental engineering at The University of Iowa and a research engineer at IIHR Hydroscience & Engineering. His research interests are in the areas of hydrology and hydrometeorology, including flood and drought hydrology, hydroclimate forecasting, and water resource applications of remote sensing. He received his B.S. in civil engineering from Virginia Tech, an M.S. in civil engineering from Stanford University, and a Ph.D. in civil and environmental engineering from the University of Wisconsin.

U.S. Geological Survey
Data Collection for Water Use Projects and Compilations

I. Water Use Projects (Study period 1995-99) in cooperation with the Rhode Island Water Resources Board (RIWRB): Metered and Estimated Withdrawals, Use, and Return Flow collected for the NEWUDS database

Note: The U.S. Geological Survey reports water-use monthly mean and annual mean data, in Million gallons per day (Mgal/d).

A. Water Withdrawals

Withdrawal Category	Sources of Data	Method of Data Collection: Metered and/or Estimated Data	Time Interval Available or Method of Estimate	Limitations of Data	Current Rhode Island Water Use Reporting
Major Public Water Withdrawals	Public Water Suppliers	Metered	Daily, Monthly, Quarterly, and Annual	- Rate unit dependent on collection frequency	Rhode Island Water Resources Board collects information through WSSMP's (all suppliers submit a plan, with the exception of North Smithfield and Richmond)
Minor Public Water Withdrawals	RIDOH, USEPA	Estimated	Based on USGS water-use coefficient for RI: 67 gal/d/person	- Data estimated, but can be compared to metered data from major users of similar categories (SIC codes)	RHDOH collects water quality data only, no quantity data Regulation for establishments in the Freshwater Wetland Protection areas
Self-Supplied Domestic	U.S. Census Bureau	Estimated	Based on USGS water-use coefficient for RI: 71 gal/d/person	- To date, the 1990 Census is the most current data for the populations on wells, extrapolated to 1995-99 - coefficient is an average (month/year), more data could be collected to reflect the seasonal usage	Regulation for establishments in the Freshwater Wetland Protection areas - RIDEM
Self-Supplied Commercial	RIEDC	Estimated	Based on IWR-MAIN water-use coefficients by SIC by gal/d/employee	- coefficient is an average (month/year), more data could be collected to reflect daily, monthly, seasonal usage	Regulation for establishments in the Freshwater Wetland Protection areas - RIDEM

Self-Supplied Industrial	RIEDC	Estimated	Based on IWR-MAIN water-use coefficients by SIC by gal/d/employee	- coefficient is an average, more data could be collected to reflect daily, monthly, and/or seasonal usage	Regulation for establishments in the Freshwater Wetland Protection areas - RIDEM
Self-Supplied Agricultural	USDA, RIDEM, and USGS	Estimated	Based on USGS water-use coefficients for irrigation and livestock	- Crop irrigation estimated by county, disaggregated by town based on land use - Golf course irrigation coefficient based on yardage or acres of golf course - Livestock use estimated by county, disaggregated by town, based on land use	Regulation for establishments in the Freshwater Wetland Protection areas - RIDEM

B. Water Use

Water Use Category	Sources of Data	Method of Data Collection: Metered and/or Estimated Data	Time Interval Available	Limitations of Data	Current Rhode Island Water Use Reporting
Public Supply - Domestic	Public Water Suppliers and U.S. Census Bureau	Metered and Estimated Distributions	Daily, Monthly, Quarterly, and Annual	- Data collection varies by Water Supplier throughout the State (Ex. Total use for retail area vs. by towns)	Distributions to domestic is available for some water districts - RIWRB
Public Supply - Commercial	Public Water Suppliers, RIWRB, and RIEDC	Metered and Estimated Distributions	Daily, Monthly, Quarterly, and Annual	- Data collection varies by Water Supplier throughout the State - Commercial and Industrial combined for some systems - Annual use for major users	Major user data collected by the RIWRB for establishments using more than 3 Million gallons per year (0.0082 Mgal/d) - RIWRB
Public Supply - Industrial	Public Water Suppliers, RIWRB, and RIEDC	Metered and Estimated Distributions	Daily, Monthly, Quarterly, and Annual	- Data collection varies by Water Supplier throughout the State - Commercial and Industrial combined for some systems - Annual use for major users	Major user data collected by the RIWRB for establishments using more than 3 Million gallons per year (0.0082 Mgal/d) - RIWRB
Public Supply - Agricultural	Public Water Suppliers, RIWRB, and RIEDC	Metered and Estimated Distributions	Daily, Monthly, Quarterly, and Annual	- Data collection varies by Water Supplier throughout the State - Annual use for major users	Major user data collected by the RIWRB for establishments using more than 3 Million gallons per year (0.0082 Mgal/d) - RIWRB

Self-Supplied Domestic	U.S. Census Bureau	Estimated	Based on USGS water-use coefficient for RI: 71 gal/d/person	- To date, the 1990 Census is the most current data for the populations on wells, extrapolated to 1995-99 - coefficient is an average (month/year), more data could be collected to reflect the seasonal usage	Regulation for establishments in the Freshwater Wetland Protection areas - RIDEM
Self-Supplied Commercial	RIEDC	Estimated	Based on IWR-MAIN water-use coefficients by SIC by gal/d/employee	- coefficient is an average (month/year), more data could be collected to reflect daily, monthly, seasonal usage	Regulation for establishments in the Freshwater Wetland Protection areas- RIDEM
Self-Supplied Industrial	RIEDC	Estimated	Based on IWR-MAIN water-use coefficients by SIC by gal/d/employee	- coefficient is an average, more data could be collected to reflect daily, monthly, and/or seasonal usage	Regulation for establishments in the Freshwater Wetland Protection areas- RIDEM
Self-Supplied Agricultural	USDA, RIDEM, and USGS	Estimated	Based on USGS water-use coefficients for irrigation and livestock	- Crop irrigation estimated by county, disaggregated by town based on land use - Golf course irrigation coefficient based on yardage or acres of golf course - Livestock use estimated by county, disaggregated by town, based on land use	Regulation for establishments in the Freshwater Wetland Protection areas- RIDEM

C. Consumptive Water Use

Consumptive Water Use Category	Sources of Data	Method of Data Collection: Metered and/or Estimated Data	Percent Consumptive Use	Limitations of Data	Current Rhode Island Water Use Reporting
Domestic	USGS Water Use Compilations	Estimated	15% of Water Use	Variations of seasonal use	None
Commercial	USGS Water Use Compilations	Estimated	10% of Water Use	Variations of seasonal use	None
Industrial	USGS Water Use Compilations	Estimated	10% of Water Use	Variations of seasonal use	None
Agricultural	USGS Water Use Compilations	Estimated	100% of Water Use	Coefficients available based on crop type, water withdrawals/use estimated	None

D. Water Return Flow

Return Flow Category	Sources of Data	Method of Data Collection: Metered and/or Estimated Data	Time Interval Available	Limitations of Data	Current Rhode Island Water Use Reporting
Wastewater Treatment Facilities (WWTF's)	Wastewater Treatment Facilities and RIDEM	Metered	Daily, Monthly, Quarterly, and Annual	- Limited data of wastewater by town and use categories	Regulated by RIDEM
Rhode Island Pollutant Discharge Elimination System (RIPDES)	RIDOH, USEPA	Metered	Daily, Monthly, Quarterly, and Annual	- Data reported in multiple units for sites	Regulated by RIDEM
Self-Disposed Domestic	U.S. Census Bureau	Estimated	Based on population on septic (71 gal/d/person minus 15% consumptive use)	- Assumes consumptive use is constant throughout the time period	ISDS program RIDEM
Self-Disposed Commercial	RIEDC	Estimated	Based on SIC coefficients minus consumptive use	- coefficient is an average for time period	ISDS program RIDEM
Self-Disposed Industrial	RIEDC	Estimated	Based on SIC coefficients minus consumptive use	- coefficient is an average for time period	ISDS program RIDEM

September 17, 2003

Data compiled by the U.S. Geological Survey

Summary of pilot threshold versus metered and estimated water use

Example Threshold:
20,000 gallons per day (gal/d),
[or 0.02 Million gallons per day (Mgal/d)]

I. Comparison of Threshold to Major Water Users in Public Water Supply Systems:

Defined as users consuming 3 Million gallons per year (Mgal/yr),
(0.0082 Mgal/d, or 8,200 gal/d)

Selected Major Users of Public Supply in Blackstone

Lincoln
Major Users

Metered Use (MG)	Metered Use (Mgal/d)	Metered Use (gal/d)	company
3.7602	0.010302	10,302	Acrivis Ltd.
10.64	0.029151	29,151	BICC General
6.7753	0.018562	18,562	Lincoln Park (Burrillville Racing Association)
43.322	0.11869	118,690	BW Materials
9.29	0.025452	25,452	CHEM Art Inc.
4.1644	0.011409	11,409	Community College of RI
11.3238	0.031024	31,024	AT Cross Company
8.601	0.023564	23,564	Gorham
5.69	0.015589	15,589	Holiday Retirement Home, Inc.
7.146	0.019578	19,578	LMA LLC
14.4647	0.039629	39,629	NAFTA
3.75	0.010274	10,274	RI Economic Development
3.57	0.009781	9,781	Risko Trust
18.808	0.051529	51,529	Tanury Industries
4.7	0.012877	12,877	Vennerbeck Stern Leach
7.1424	0.019568	19,568	Albion Mills Apartments
6.46	0.017699	17,699	Eagle Apartments
4.45	0.012192	12,192	Kirkbrae Glen
7.36	0.020164	20,164	Lincoln Housing Authority
7.08	0.019397	19,397	Planned Environments
4.98	0.013644	13,644	Wake Robin
3.52	0.009644	9,644	Washington Hill Group

APPENDIX

Cumberland Major Users

Metered Use (MG)	Metered Use (Mgal/d)	Metered Use (gal/d)	company
10.46	0.028658	28,658	Air Products
4.5	0.012329	12,329	Bear Hill Limited Partnership
39.8	0.109041	109,041	CCL Custom Manufacturing
4.505	0.012342	12,342	Chimney Hill Apts.
30.934	0.084751	84,751	Okonite Co.
4.481	0.012277	12,277	Sisters of Mercy
3.6095	0.009889	9,889	Slater Dye

Woonsocket Major Users

Metered Use (MG)	Metered Use (Mgal/d)	Metered Use (gal/d)	company
21.05	0.057671	57,671	ACS Industries
7.78	0.021315	21,315	CNC International Limited Partnership
6.64	0.018192	18,192	Callahan, James
39.68	0.108712	108,712	Consolidated Real Estate
3.81	0.010438	10,438	Fairmont Realty Assoc.
8.51	0.023315	23,315	Glenmark Associates
15.37	0.04211	42,110	Landmark Medical Center, Woonsocket Unit
11	0.030137	30,137	L'Hospice St. Antoine
9.56	0.026192	26,192	Mount Saint Francis Health Center
6.15	0.016849	16,849	National Chromium
7.23	0.019808	19,808	Oakland Grove Associates
n/a	#VALUE!	#VALUE!	Ocean State Finishing Co.
3.15	0.00863	8,630	Ortiz Real Estate Development
9.46	0.025918	25,918	Plaza Village Group
10.76	0.029479	29,479	RI Industries Fac. Corp.
32.43	0.088849	88,849	Seville/Dorado Co. Inc.
5.25	0.014384	14,384	Woonsocket Call
9.27	0.025397	25,397	Veterans Memorial Project
8.23	0.022548	22,548	Waterview Associates
2.93	0.008027	8,027	Woonsocket Health & Rehabilitation Center
12.33	0.033781	33,781	Woonsocket Housing Authority
15.12	0.041425	41,425	Woonsocket Reg. Wastewater
11.9	0.032603	32,603	Woonsocket Village

Metered Use (MG)	Metered Use (Mgal/d)	Metered Use (gal/d)	Smithfield Major Users company
54.89	0.150384	150,384	Bryant College
4.996	0.013688	13,688	Down Parmaceutical
8.817	0.024156	24,156	Fidelity Investments Institutional Services
14.178	0.038844	38,844	East Smithfield Water District
4.749	0.013011	13,011	Heritage Hills Nursing Ctr.
7.383	0.020227	20,227	Hopkins Manor Ltd
4.212	0.01154	11,540	New England Container
4.283	0.011734	11,734	No. Providence Housing Authority
10.304	0.02823	28,230	New England Stone Industries
4.182	0.011458	11,458	St. James Townhouses
3.246	0.008893	8,893	Susse Chalet
12.336	0.033797	33,797	Brentwood Apts.
4.412	0.012088	12,088	Douglas Commons
6.339	0.017367	17,367	Stony Brook Apartments
4.864	0.013326	13,326	Uvex Manufacturing

II. Comparison of Threshold with estimated water use: Minor Suppliers

- Using the coefficient of 67 gal/d per person, only minor water supply sites (ex. nursing homes, condominium complexes) serving approximately 299 people would be captured using the 20,000 gal/d threshold

- From the most current information received in 2003 from the RIWRB, 6 minor suppliers of approximately 47 minor suppliers in the State fall within the threshold and are listed below.

PWS TYPE	PWSID#	POP	PWS NAME	PWS ADDRESS
C	1647512	470	CENTRAL BEACH FIRE DISTRICT	SEA BREEZE AVENUE
C	1592023	600	PRUDENCE ISLAND UTILITY CORP	NARRAGANSETT AVENUE
C	2973130	750	MAPLEHILL MOBILE HOME PARK	61 HILLSIDE DRIVE
C	1647516	750	ELEANOR SLATER HOSPITAL/ZAMBARANO UNIT	2090 WALLUM LAKE ROAD
C	1900042	1008	TIVERTON WATER AUTHORITY, TOWN HALL	343 HIGHLAND ROAD
C	1615614	1200	SLATERSVILLE PUBLIC SUPPLY	1 MAIN ST. MEMORIAL TOWN BUILDING

Water Withdrawals from the Pawcatuck Watershed

Water Withdrawals	Percent of Total	Type of Data
Public Supply Withdrawals	55%	metered
Domestic Self-supplied withdrawals	18%	estimated based on public supply (71 gal/d/person
Commercial Self-supplied withdrawals	2%	estimated (based on SIC code)
Industrial Self-supplied withdrawals	4%	estimated (based on SIC code)
Agricultural Self-supplied withdrawals	21%	estimated based on agricultural water use coefficients

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APPENDIX F

Water Use Distributions from the Pawcatuck Watershed

Water Use	Percent of Total	Type of Data
Public Supply Domestic Use	26%	estimated based on public supply (67 gal/d/person)
Self Supply Domestic Use	25%	estimated based on public supply (71 gal/d/person
Public Supply Commercial Use	5%	metered data provided by water suppliers
Self Supply Commercial Use	3%	estimated (based on SIC code)
Pubic Supply Industrial Use	7%	water suppliers
Self Supply Industrial Use	6%	estimated (based on SIC code)
Pubic Supply Agricultural Use	1%	water suppliers
Self Supply Agricultural Use	28%	estimated based on agricultural water use coefficients

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Water Withdrawals from the Blackstone Watershed

Water Withdrawals	Percent of Total	Type of Data
Public Supply Withdrawals	82%	metered
Domestic Self-supplied withdrawals	7%	estimated based on public supply (71 gal/d/person
Commercial Self-supplied withdrawals	9%	estimated (based on SIC code)
Industrial Self-supplied withdrawals	1%	estimated (based on SIC code)
Agricultural Self-supplied withdrawals	1%	estimated based on agricultural water use coefficients

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Water Use Distributions in the Blackstone Watershed

Water Withdrawals	Percent of Total	Type of Data
Public Supply Domestic Use	47%	estimated based on public supply (67 gal/d/person)
Self Supply Domestic Use	13%	estimated based on public supply (71 gal/d/person
Public Supply Commercial Use	9%	metered data provided by water suppliers
Self Supply Commercial Use	16%	estimated (based on SIC code)
Pubic Supply Industrial Use	13%	water suppliers
Self Supply Industrial Use	1%	estimated (based on SIC code)
Pubic Supply Agricultural Use	0%	water suppliers
Self Supply Agricultural Use	2%	estimated based on agricultural water use coefficients

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ESTIMATES OF WATER USE FROM RI FARM BUREAU

1 inch of rain is equal to 27,154 gallons per acre.

If crops need 1 inch of rain per week they need 3,879 gallons of water per acre per day.

Rainfall in June July and August of 2000, 2001 and 2002.

Rainfall	2000	2001	2002	Average
June	4.79	6.73	3.37	4.96
July	3.64	1.92	0.39	1.98
August	2.42	4.49	2.01	2.97

Using the average for the three years

In June the crops needed 116,374 gallons of water per acre and received 134,684 so no withdrawals were needed.

In July the crops needed 120,253 gallons of water per acre and received 53,765 gallons per acre so farmers had to withdraw 66,488 gallons or 2,144 gallons per acre per day.

APPENDIX C

In August the crops needed 120,253 gallons of water per acre and received 80,647 gallons per acre so farmers had to withdraw 39,606 gallons or 1,277 gallons per acre per day.

So on average for the three months and three years in question, farmers withdrew 1,140 gallons of water per acre per day.

Metered data indicates 1,800 gallons per acre per day, which is not that far off from estimated data.

However in the drought year (2002), farmers needed 120,253 gallons of water per acre in July and received only 10,590. So they had to withdraw 109,663 or 1,566 gallons per acre per day.

Vicki Drew (NRCS) estimates that turf needs about 4,616 gallons of water per acre per day.

Rainfall	2000	2001	2002	Average
June	4.79	6.73	3.37	4.96
July	3.64	1.92	0.39	1.98
August	2.42	4.49	2.01	2.97

Thus using the average rainfall again in June crops needed 4,616 gallons per acre per day. The rainfall generated 4,489 gallons per acre per day so farmers had to withdraw 127 gallons per day on average.

In July, 4,616 gallons per day were needed and the rain yielded 1,734 so they needed to withdraw 2,882 gallons per day.

In August, 4,616 gallons per acre per day were needed and the rain yielded 2,602 so farmers withdrew 2,014 gallons per acre per day.

For the three month average, farmers withdrew 1,674 gallons per acre per day which is very close to the actual data collected on the three turf farms (1,800 gallons per acre per day.)

SRBC #56C
1/2/96

SUSQUEHANNA RIVER BASIN COMMISSION

1721 North Front Street • Harrisburg, Pennsylvania 17102-2391
Phone (717) 238-0426 • Fax (717) 238-2436

Agricultural Water Use Registration

Why Register?

In many portions of the basin, agricultural operations are being subjected to increased pressures resulting from industrial, residential, and other water users. Although the Commission and others already have some information regarding the amounts of water used by industries and municipalities, relatively little is known about the water use needs of individual farming operations. This information is needed so the Commission can consider agricultural needs in its planning activities and when reviewing withdrawal applications for new projects that may affect agricultural operations. The information provided on the form will be used by the Susquehanna River Basin Commission to better protect the basin's water resources to have them available for all basin residents to share. **This registration form is not a survey; water users who use in excess of 10,000 gallons per day over a consecutive 30-day period are legally required to complete a variation of the attached form that relates to their specific water use.**

Guidelines

APF

All water withdrawn or diverted from both ground water (well) or surface water (spring, river, stream, pond, or lake) should be included on the form.

The following farm operation guidelines are offered to help you decide if you are required to register. You will probably be required to register if your operations consist of:

1. Commercially irrigating all or portions of your cropland;

2. Commercially raising more than the following numbers of animals:

a. Dairy—	Cows with replacements	200 cows	d. Poultry—	Broilers	250,000 birds
	Intensive milking only	200 cows		Layers	125,000 birds
b. Beef—	Cow/Calf	500 cows		Pullets	250,000 birds
	Fattening	1,000 head		Turkeys	100,000 birds
c. Swine—	Feeder Production	900 sows			
	Farrow to Finish	250 sows			
	Finishing	2,000 hogs			

The above animal numbers are presented as guidelines only and for farms having only one type of animal. General farmers having several varieties of animals, or if using water for both irrigation and animals, will have to determine their water use by using fractions of the above numbers or by using other methods. The animal numbers do not include allowances for cooling system water requirements.

SUSQUEHANNA RIVER BASIN COMMISSION

1721 North Front Street • Harrisburg, Pennsylvania 17102-2391
Phone (717) 238-0426 • Fax (717) 238-2436

Agricultural Water Use Registration

1. **Registration information**

Farm or Tract Name: _____ Telephone No.: (___) _____

Operator: _____

Street: _____

City: _____ State: _____ Zip Code: _____

2. **Ownership**

Has ownership of the farm or tract changed over the last 5 years? _____ (yes) _____ (no)

3. **Irrigation Water Use (1 day = 24 hours)**

a. Total number of acres irrigated during any 30-day period: _____

b. Source of irrigation water: _____ pond _____ well _____ stream _____ spring

_____ public supply _____ other (specify) _____

c. Number of acres irrigated by type of irrigation: _____ sprinkler _____ drip

_____ other (specify) _____

d. Please list the crops and acreages of those crops that you currently irrigate or have irrigated during a 30-day period of maximum irrigation use.

Crop	Acres Irrigated

Crop	Acres Irrigated

e. If known, provide your maximum 30-day average daily irrigation water use.

_____ (gallons or acre-inches—select one)/day

Time span maximum use occurred: _____ to _____
(Month/Day) (Month/Day/Year)

4. Animal Water Use (1 day = 24 hours)

a. Please show the number of animals you currently raise or have raised in the past. The list should show the combination of animals raised on your farm at any one time that would result in the maximum animal water use.

Year of Maximum Water Use _____

Type		Number
Dairy cattle (number of lactating cows)		_____
Total herd size		_____
Beef cattle:	Cow/Calf Operation (number of cows)	_____
	Fattening (head)	_____
Swine:	Farrow (# sows)	_____
	Farrow-Finish (# sows)	_____
	Finishing (total # head)	_____
Poultry:	Broilers (house capacity)	_____
	Layers (house capacity)	_____
	Turkeys (house capacity)	_____
Other (list)	_____	

b. Does your barn have an evaporation cooling system? _____ (yes) _____ (no)

If yes, estimated maximum water use: _____ gallons/day

Estimated maximum number of days used per year: _____

c. Source of animal use water: _____ pond _____ well _____ stream _____ spring

_____ public supply _____ other (specify) _____

d. If known, provide your maximum 30-day average daily animal water use. _____ gallons/day

5. General

a. Provide a copy of the USDA Consolidated Farm Service Agency tract map of your farm or a sketch map showing location of farm, readily identifiable landmarks, fields irrigated, and point of water withdrawal.

b. Farm size (acres): _____ TOTAL _____ tillable _____ pasture _____ woodland

_____ fruit _____ turf _____ other (specify) _____

6. I certify that the information presented on this registration form is true and correct to the best of my knowledge, information, and belief.

Signature of registrant _____ Title _____

Date _____

WELL COMPLETION REPORT

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
Groundwater Section
235 Promenade St., Providence, RI 02903

D·E·M

DO NOT FILL IN
STATE WELL NUMBER
OTHER NUMBER

OWNER — Name | Address

LOCATION OF WELL — (No. & Street) (Town) (Plot #) (Lot #) (Pole #)

DRILLING EQUIPMENT — ROTARY ____ COMPRESSED AIR PERCUSSION ____ CABLE PERCUSSION ____ OTHER ____

CASING DETAILS — DIAMETER ____ | LENGTH ____ | TYPE ____ | NEW ____ USED ____ | DEPTH OF COMPLETED WELL IN FT. BELOW LAND SURFACE: ____

THREADED ____ WELDED ____ | DRIVE SHOE ____ YES ____ NO | GROUTING MATERIAL ____

PUMP TEST DATA (5 HR. MIN.) — STATIC WATER LEVEL (FT.) ____ | PUMPING LEVEL (FT.) ____ | DRAWDOWN (FT.) ____

DURATION (HOURS) ____ | YIELD (GPM) ____ | DEPTH TO BEDROCK ____

SCREEN DETAILS — MAKE ____ MATERIAL ____ LENGTH ____ DIAMETER ____ SLOT SIZE ____

HAS WATER BEEN TESTED? ____ WHEN? ____

WHERE? (LAB) ____ LAB # ____

ISDS APPROVAL NUMBER ____ | LOT SIZE ____

USE OF WELL ____ BUSINESS ESTABLISHMENT ____ TEST WELL

____ DOMESTIC ____ INDUSTRIAL ____ OTHER (SPECIFY)
____ PUBLIC SUPPLY ____ FARM

DEPTH FROM LAND SURFACE FEET	TO FEET	FORMATION DESCRIPTION

SKETCH EXACT LOCATION OF WELL WITH DISTANCES, TO AT LEAST TWO PERMANENT LANDMARKS, INCLUDING HOUSE (IF PRESENT).

INDICATE NORTH

LOCATION OF LOT TO AT LEAST TWO ROADS
(INCLUDE DISTANCES AND A POLE #)

INDICATE NORTH

DATE WELL COMPLETED	DATE OF REPORT	WELL DRILLER (SIGNATURE)	WELL DRILLER (PRINT)

REGISTRATION #	REGISTERED WELL DRILLER (SIGNATURE)	REGISTERED WELL DRILLER (PRINT)

APPI