6. Source Water Protection Tools

The long-term quality of drinking water depends on the combined actions of state and local government officials, water suppliers, and all others who live or work in source water areas. This chapter offers recommendations on some of the most important steps each group can take to protect valuable drinking water resources. Because municipal decision makers have primary authority over land use, and the responsibility to control associated impacts, recommendations focus on protection measures that can be implemented through local plans, ordinances and development standards. These measures consist of current, standard best management practices for managing land use impacts that are generally applicable to all source water areas. Water system security, distribution, or treatment issues that may affect drinking water quality are not part of the source water assessment but would be included in water supply management plans.

Because the focus of the Source Water Assessment Program is on identifying and ranking pollution risks, it was beyond the scope of this assessment to develop a detailed action plan for each study area. Major community water suppliers in Rhode Island are required to prepare a Water Supply System Management Plan that must describe specific measures needed to protect each reservoir or well field from sources of contamination. In addition, town comprehensive plans must include a water supply management component with a detailed implementation plan for drinking water protection.

Given this planning framework, the recommendations in this chapter are designed to complement existing efforts by providing a checklist of protection tools against which town officials can compare current practices, identify successful programs to be maintained and gaps to be filled. Because the effectiveness of any protection measure lies in the details, an audit of current plans, land use ordinances, and actions already taken to prevent pollution is need to determine their actual effectiveness. For example, the value of a groundwater zoning overlay district would depend on the area covered, the permitted uses and performance standards, the standards for review and approval of variances and special exceptions, and enforcement procedures. Municipal staff and boards who work with these programs on a regular basis are best qualified to conduct this review and make practical recommendations. Priority actions can then be incorporated into municipal plans, capitol improvement budgets, and ordinances to strengthen protection of valuable groundwater resources.

Water Supply System Management Plans

All large community water suppliers in the State are required by Rhode Island law to submit a water supply system management plan to the RI Water Resources Board.

The "water quality protection" component of the plan specifically requires large suppliers to identify "measures needed to protect each reservoir or well field from sources of contamination, including acquisition of buffer zones, diversion of storm water or spills, and desirable land use control regulations," and to prepare "a priority list of actions for implementing these protection measures."

www.wrb.state.ri.us/index.html

Unique Features of Source Water Assessments

SWAP assessments provide a screening level analysis and are not a substitute for a thorough Watershed Management or Groundwater Protection Plan. Yet assessments do have unique and useful features:

- Applied to all RI supplies, large and small,
- Consistent methods used for all supplies,
- All supplies rated for susceptibility to contamination.
- Future impacts evaluated through "build-out" analysis site specific to each wellhead and subwatershed of each major supplies.
- Cumulative effects of land evaluated using nutrient loading, percent impervious cover, other "indicators" and map analysis.
- Geographic information systems used for mapping and analysis provides basis for future planning.
- Results are made available to suppliers, local officials and others for use in developing priority protection actions.

6.1 Factors to Consider in Selecting Management Practices

The risk ratings used in this assessment are intended to help guide selection of management practices and direct efforts to the most serious threats. Given that all public water suppliers already have safeguards in place, it can be difficult to assess when existing efforts are sufficient and when more stringent controls are needed. RI HEALTH makes is clear that no source is free of contamination risk, and that without sufficient protection, any water supply can become contaminated. Even where there is general agreement on the need for stronger drinking water protection, there are no simple formulas for selecting the best mix of controls to achieve the desired degree of protection. This section outlines some of the factors to consider in making management decisions. However, making decisions about drinking water protection depends on town goals and policies that go beyond technical assessment results, as described below.

Municipal support for protecting drinking water and degree of protection desired

Comprehensive community plans establish goals for drinking water protection that identify critical resource areas and the degree of protection desired. These goals are implemented through zoning, land development regulations and budgeting for capital projects. The actual priority given to maintaining water quality is relative to competing goals such as minimizing local land use restrictions and promoting economic development. Some of the factors that influence the degree of protection needed and community willingness to adopt additional protection measures include, for example, the following:

- Co-occurrence of other sensitive resources within or downstream of the source water area. Sensitive aquatic habitat may actually require more pristine water quality than drinking water supplies. Two examples are cold-water trout streams, which are highly sensitive to sediment and increased temperature; and poorly flushed coastal waters, which are sensitive to nitrogen at levels far below 1 mg/l while the drinking water action level is 5 mg/l.
- Availability of multiple supplies, auxiliary supplies or alternative water sources within a system to provide emergency backup or replacement if one source is contaminated. Situations where no options are available call for a greater degree of protection. On the other hand where drinking water taste and odor is already impaired, local officials may feel that restoration is not cost effective and that funds are better spend seeking new sources.
- Willingness to rely on remediation and additional treatment in the case of contamination. Chlorination of groundwater supplies or use of more advanced treatment technologies may be viewed as a viable option to a high level of protection. However, the cost of treatment and changes in taste and odor should be evaluated. Formation of chlorination by-products known as total trihalomethanes may be

difficult to control with nutrient-enriched surface waters even with a high level of water treatment. Contamination by MTBE, fuel or solvents is much more costly and difficult to treat.

- Public perception of the potential for the supply to be compromised and willingness to accept this risk. For example, in developed watersheds where high-risk land uses have co-existed in within a watershed or wellhead without serious impact to water quality, local officials may reason that contamination is unlikely and that current protection practices are adequate.
- Confidence in existing protection measures. The municipality may already have adopted protection measures that may be viewed as sufficient for the time being, especially if additional protection measures are costly or unpopular.

Need for local action: State vs. municipal roles

A common misconception is that state agencies such as the RI Department of Environmental Management are responsible for protecting environmental quality and local controls are unwarranted or even beyond local authority. In reality, state agencies establish statewide, minimum standards for resource protection. Even where more stringent water quality criteria or development standards exist for drinking water supplies, these may not be sufficient to protect sensitive resources or to control cumulative impacts for the following reasons:

- State regulations are directed to avoiding impacts from individual projects on a case-by-case basis and do not specifically address the combined effects of multiple projects. As a result, state regulations may not be sufficient to protect sensitive water resources depending on the intensity of development and it's location in sensitive areas.
- At the State level, permit review is often compartmentalized based on resource type or pollution source. For example, applications for design of septic systems are reviewed based on the potential for a system to function properly on a particular site. Other impacts to wetlands or stormwater runoff must be evaluated separately.
- State agencies may grant variances from minimum standards on a case-by-case basis through established permit review procedures. For example, land that may have been considered unbuildable or uses considered too intense for a site may be approved by variance from individual sewage disposal system regulations or freshwater wetlands alteration permit.
- State agencies may lack site-specific data to identify sensitive resources requiring more stringent control to either prevent degradation of high quality waters or reduce impacts to water bodies showing signs of stress.
- State agencies have limited staff and are under pressure to review and approve permits in a timely fashion. Staff resources for follow-up field inspections and enforcement is often inadequate.

Given the need for resource protection at both the state and local level, the RI Zoning Enabling Legislation specifically authorizes RI cities and towns to designate critical resources and establish more stringent standards that take into account the sensitivity and vulnerability of local resources.

Selection of management practices based on sound planning

Although this chapter takes of broad view of "best management practices" to include planning and zoning strategies, discussion of pollution controls frequently centers on pollution control technologies, such as the type of stormwater treatment system used. Selecting performance standards and accompanying treatment systems is actually the last step in protecting water resources and not a substitute for sound planning and careful site design. Standard resource-based planning practice is based on a hierarchy of these three basic principles.

1) Wise land use planning and zoning. The type and intensity of land use should be appropriate for the resource. Low density, low impact uses, in combination with purchase of land or development rights for the most critical areas and unique resources, offers the surest protection for drinking water supply watersheds and recharge areas. These low-risk uses correspond to source areas with an average of less than 10 percent impervious, well-forested source areas, and undisturbed, forested shoreline zones.

2) Good site design. Careful site analysis based on natural resource mapping and field investigations, use of creative design to preserve the most sensitive and valuable site features, and use of building envelopes to limit clearing and grading within suitable areas are all low-cost, low-maintenance methods for minimizing project impacts.

3) Appropriate "best management practices" are used where impacts can't be avoided or minimized through planning or site design alone. These include, for example, techniques for hazardous materials storage, stormwater treatment systems and wastewater treatment technologies. To provide flexibility to address site-specific constraints performance standards can be set specifying the level of treatment to be provided by stormwater and wastewater systems, with the selection of the actual methods and technologies left to the designer.

When properly designed, operated and maintained, engineered management practices can effectively offset impacts of more intense development, but usually with much higher maintenance demands. High-maintenance technologies also require greater local oversight to ensure maintenance is carried out properly and that safety precautions are used over the long term. As a result, more complex pollution control systems require the greatest local investment of resources over the long run. In undeveloped areas where options are still available, relying on low density land uses is generally the least costly since

simple, nonstructural controls such as grassed swales, protected wetland buffers and conventional septic systems are the least costly to maintain over the long run. In communities with limited staff to oversee or assume responsibility for maintenance, prohibiting high risk uses and relying on simple, nonstructural controls may be more practical over the long run. As one town highway supervisor put it when referring to the type of stormwater controls allowed in his rural community – "if it can't be maintained with a backhoe, it doesn't get built".

Use of current management practices

Ongoing research on pollutant movement and effectiveness of various control strategies means that methods for controlling water quality impacts are constantly evolving. What may have been state-of-the-art even a few years ago may now be recognized as inadequate, especially for more sensitive resources. New, updated pollution control methods may also be simpler, with lower maintenance needs, as in the case of "low impact" stormwater controls. The current 5-year review cycle for updating municipal plans and supporting zoning ordinances and land development standards provides a good opportunity to bring performance standards for drinking water supply areas in line with current practices. Because the wheels of state government often move slowly, updating municipal land development standards may require use of new approaches that go beyond State minimum standards.

Level of management appropriate for the type of resource

In general, the more stringent practices are appropriate for more sensitive, high value, or high-risk areas where the goal is to protect very high water quality or restore impaired waters. In these situations, state minimum standards may not be adequate to address cumulative effects of land use activities within a watershed or recharge area using minimum standards. On the other hand, adoption of more stringent performance standards must be grounded in sound science, with required controls based on the pollutants of concern in a particular source area, existing water quality conditions and reasonable expectations for maintaining or restoring water quality.

Focus on pollution prevention

The management practices in this chapter emphasize pollution prevention techniques as the simplest and most cost effective approach to protecting water supplies, as opposed to pollution remediation or additional water treatment. A compelling justification for pollution prevention is that even low-level contaminants can affect taste and odor of drinking water standards at concentrations far below maximum health standards.

Threats to Coastal Waters

30% of RI coastal waters are closed to swimming, shell fishing or unsafe for aquatic life due to bacteria, nutrients or low oxygen.
The major sources are:

- *Runoff*
- *Septic systems*
- *Natural sources*
- *Combined sewers in urban areas.*

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Cost effectiveness and multiple benefits

Water quality benefits of pollution controls may be difficult to measure. For the most part we recommend management practices with documented pollution removal efficiency. Practices with uncertain water quality benefit may also be included where implementation costs are low and where multiple benefits can be achieved. For example, use of conservation development designs are recommended as a useful technique for reducing site disturbance and preserving undisturbed forest and wetland buffers. Water quality benefits are difficult to measure and may vary project by project. However, because cost is the same or lower than with standard development and wee designed projects usually offer multiple aesthetic and open space benefits, conservation development design is included as a primary protection strategy for developing watersheds.

6.2 Management Actions for Municipal Government

The following management practices are loosely organized according to the eight watershed protection tools outlined by the Center for Watershed Protection in the Rapid Watershed Planning Handbook and other publications (Center for Watershed Protection, 1998; 2000; and http://www.cwp.org/tools_protection.htm). These tools correspond to the stages of the development cycle, from initial land use planning, site design, construction, and land ownership. This is a logical progression and integrates a range of pollution controls. Additional information about these practices and guidance on selecting the appropriate level of control based on watershed vulnerability is also available through the Center for Watershed Protection and other sources.

1. Planning and zoning

Review assessment results and incorporate recommendations into town plans

Designate a committee to review assessment results with the following responsibilities: compare general assessment findings with watershed features and actual water quality conditions to validate results with review of technical assumptions as needed; evaluate effectiveness of current water supply protection measures to address identified risks, select priority actions, and report back to council with recommendations.

- Work with neighboring communities sharing water supply sources or service areas.
- Coordinate drinking water protection with stormwater planning under the RIDEM Phase II stormwater program.
- Provide continued support and resources to implement key recommendations, including updating town plans and ordinances.

Update water resource protection goals in comprehensive community plans

Are groundwater recharge areas and watersheds of drinking water supplies and other sensitive water resources clearly identified in town plans as protection priorities? Source water areas and other sensitive water resources should be clearly set apart as resources requiring the highest level of protection.

Establish specific water quality goals for critical areas, specifying the level of water quality and associated sensitive uses to be met. Typical goals include for example: maintaining existing high level of water quality to avoid the need for additional treatment, protection of co-occurring sensitive resources such as cold water fisheries or unique aquatic habitat, and ensuring maximum quantity of groundwater supply by maintaining pre-development infiltration rates.

Update town plans to incorporate source water protection goals and recommended actions at the 5-year Comprehensive Plan revision and associated visioning sessions.

Set aside an annual council work session with staff to review progress on meeting plan goals. Invite representatives of Planning and Zoning Boards, Conservation Commission, water suppliers, groundwater committee an others. Set annual action items.

Evaluate current and potential future impacts of zoning

In areas where current land use activities already present a high risk, are zoning standards and land development regulations adequate to minimize existing threats? A detailed review of current practices in comparison to recommendations of this assessment, water supply management plans, and other existing plans is needed to

Compare the change in risk from current to future land use for the study areas using bar charts for individual indicators in the "pollution risk results" chapter of this report. In a few cases where a build out analysis was not conducted, town future land use or zoning maps should be consulted to identify areas where commercial, industrial or high intensity development are planned.

Where future risks are noticeably higher than current conditions, are permitted uses consistent with town goals for the area? If not, is it possible to revise permitted uses in keeping with water quality goals?

Is there an opportunity to re-zone to lower intensity activities? If not, have standards for site design and best management practices been established to minimize risks?

Threats to rivers and streams
35% of RI rivers and streams do not meet fishable or swim quality due to bacteria, nutrients or metals. Major sources are:
- Runoff
- Septic systems
- Waterfowl and wildlife
- Direct discharges in urban areas

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Set goals for average watershed impervious cover

Use estimated impervious levels to set maximum levels based on current and future estimates. Wherever possible set average impervious goals below 10 percent for undeveloped watersheds (or less than eight percent in watersheds with sensitive aquatic habitat). Where watershed restoration is a priority, set average impervious goal at less than 25 percent. These are average levels for the watershed or recharge area as a whole; low-density residential areas may be 8-10 percent, while commercial areas may be set at 25 percent. In all cases target levels should be realistic based on estimated current levels and build out projections.

Incorporate impervious cover limits into zoning ordinances and land development regulations. Define maximum lot coverage to include all improvements such as buildings, driveways and parking areas, accessory structures with a foundation, impermeable patios, pools and similar surfaces.

Specialized plans

Groundwater / watershed protection plan. Has a municipal groundwater protection plan or watershed protection plan been adopted? If so, compare current practices with plan recommendations. Evaluate need to update plan or accelerate progress in implementing recommendations.

Water Supply Management Plan. Have town boards and commissions been involved in development of water supply management plans? Development and implementation of these plans should be closely coordinated with municipal planning and zoning activities.

Wastewater Management Plan. Municipalities are responsible for ensuring onsite wastewater treatment systems are properly maintained. Adopting a wastewater management plan is the first step in this process. This plan describes the existing status of onsite systems, including areas in need of remediation. It identifies future treatment needs and potential problem areas, evaluates septage handling capacity, sets town policies for promoting proper system maintenance, repair and upgrading, and describes proposed actions such as proposed inspection ordinances and educational strategies. An approved plan qualifies town residents to access low interest loans for septic system repair using the state revolving loan fund.

Update Water and Sewer facility plans with service boundaries

Have water and sewer utility districts been established, setting limits for future sewer and water extension into source water areas? How are applications handled for changes to established utility districts? Major changes to sewer districts require revision of sewer facility

plans, which must be approved by RIDEM. However, small changes that may be inconsistent with town plans and utility plans may be approved more easily. Urban growth boundaries may also be set, consistent with utility service districts, to clearly demarcate village and urban areas where infill is encouraged, sensitive source water areas where sewered development is contained, and outlying areas where low density is maintained without utilities.

Consistency with State Plans

Town plans must be reviewed by the Rhode Island Statewide Planning Program and other state agencies and approved for consistency with the State Guide Plan and programs administered by various state agencies. Situations remain, however, where drinking water source areas are zoned for high-risk activities such as industrial, commercial or high density uses after town plans are approved. State planners should consider establishing standards for review of town plans and ordinances to ensure that minimum protection measures are in place. Where more intensive land use is allowed through zoning, land development standards should be strengthened accordingly to minimize impact of high-risk activities.

Update zoning ordinances and land development standards consistent with adopted plans

Zoning standards and land development regulations are the mechanism used to implement land use goals. As noted above, the actual effectiveness of land use standards lies in the detailed provisions and their implementation. Specific strategies for controlling land development impacts are described in other section of this chapter.

Groundwater / watershed overlay zoning

Special protection measures are often adopted as part of an overlay zone where more stringent provisions apply to the source water area in general or to particularly sensitive areas such as shoreline zones and areas with high water table or other siting limitations. Factors to consider in evaluating effectiveness of the overlay zone include the following:

- Does the district cover all important recharge areas such as the aquifer recharge area, not only deeper reservoirs or wellhead protection areas?
- Are general protection measures in place for areas served by private wells outside of the key recharge areas?
- Are high-risk activities that use, generate or store hazardous materials prohibited? (Note: RIDEM regulates hazardous waste, not storage of hazardous products before waste is generated.)
- If commercial or industrial zones exist within the protection area are these activities consistent with town plans? If not, is a zoning change possible? If so, are site design, performance standards and

RIDEM's Wellhead Protection Program and Requirements

Since 1997, RIDEM has required under its "Rules and Regulations for Groundwater Quality," that municipal governments and all large water suppliers submit detailed wellhead protection plans.

The Wellhead Protection Program applies to all 671 public wells in the State.

Required plan elements include:

1) An evaluation of the groundwater quality within the wellhead protection area

2) A description of past and present efforts to protect groundwater quality

3) Identification of the protection strategies determined to be most appropriate for protecting groundwater quality

4) Recommend or draft a five-year implementation plan.

RIDEM. Wellhead Protection Plan Guidance, September 1996

town oversight and enforcement procedures strict enough to minimize impact?

- In areas that are already intensively developed, do land development standards include provisions to minimize impact with infill and redevelopment? For example, redevelopment of urbanized areas often provide an opportunity to retrofit drainage system for improved stormwater treatment, reduced impervious area through good design or use of permeable materials, restoration of wetland buffers, and improved wastewater treatment.
- Are new underground fuel storage tanks prohibited? Does this apply to all tanks, including new home heating fuel tanks? Are owners of existing home heating tanks required to remove tanks at the time of house sale or are incentives offered to encourage tank removal? For example, the town of New Shoreham offers a $300 rebate for each tank removed.

Other provisions for control of stormwater and wastewater discharges that may be included in overlay zoning are described in other parts of this chapter.

2. Land Conservation

Open Space Planning

Most water supply lands are designated for protection of the water supply and are not open for public recreation for security reasons. Municipalities should consider working with water suppliers and nonprofit organizations and neighboring communities to develop a regional open space plan for recreation and conservation, with linkages to existing open space. Low intensity recreation, preservation of unique habitat, and protection of unfragmented forest for habitat or woodland management, are all uses that are compatible with watershed and recharge area protection.

Use new subdivisions as opportunities to implement open space plans

Land protection priorities set out in town or regional open space plans can then be used to guide selection of common open space in new subdivisions. With each subdivision, protected open space can be pieced together into greenways, habitat corridors, expanded wetland buffers and protected unfragmented forest. The same might be accomplished with traditional cluster subdivisions but often inflexible design standards, with rigid lot frontage widths and building setbacks limit the designer's ability to adjust placement of roads and buildings to achieve the same level of protection. Conservation development design technique are effective in any area but large-lot residential zoning offer the greatest opportunity to preserve the largest acreages, especially if 50 percent or more of each parcel is preserved.

Continue to acquire land or development rights for water supply protection.

Priorities areas for water quality protection include:

- Reservoir intake and shoreline areas, stream shoreline areas throughout the watershed, and marginal lands that if development, present a higher risk of impact.
- Inner well protection areas and areas of deep, well-drained soil serving as deep groundwater recharge areas.
- Open space protection priorities identified through open space planning.

3. Shoreline buffers to Wetlands and Surface Waters

Maintain forested buffers to wetlands and surface waters.

Protecting or restoring forested shoreline buffers to wetlands, streams and other surface waters is one of the most effective methods for protecting surface drinking water supplies. In groundwater recharge areas, shoreline buffers have less direct benefit but help to maintain the overall health of water resources.

Establish or update setbacks from surface waters and wetlands in drinking water supply areas. Within the buffer zone, prohibit or regulate high-impact activities such as onsite wastewater treatment systems, new building construction, and land alterations such as clearing, filling and grading.

Where activities in buffers are allowed by special use permit or variance, evaluate whether standards for permit approval provide specific guidelines to minimize disturbance and reduce potential impacts to the maximum extent possible.

Include identification and protection of vernal pools in wetland protection provisions, to include a buffer surrounding the pool and travel corridors to surrounding upland or wetland habitat.

Consider establishing standards for wetland and surface water buffers to include:

- Maximum protection of forest and other natural vegetation with the shoreline zone, with the goal or maintaining or restoring a contiguous forested buffer.
- Revegetation of disturbed buffers following construction using native trees and shrubs.
- Restoration of developed buffers as existing uses in shoreline area are re-developed or expanded.
- Maximum protection of wetland buffers having high potential for nitrogen removal where source waters are located in coastal watersheds.

Small streams, big benefits

Small headwater streams (first and second order) are the workhorses in protecting good water quality despite their small size. These small tributaries, which typically comprise 60-80% of stream miles in less developed watersheds, are considered to have much greater ability to remove pollutants because of their extensive shoreline contact. (Alexander et al. 2000). In larger streams, the proportion of stream flow interacting with bottom sediments is considered too small to have notable effects on nitrogen dynamics.

Small streams are however, more susceptible to disturbance because they are abundant in the landscape and may be perceived to be less important. Because of their small size they are more likely to be impaired through direct disturbance during subdivision construction, secondary backyard "improvements", and by related changes in flow and sedimentation. To protect these valuable small streams, maximum buffer distances are often recommended for third order streams and smaller. (Center for Watershed Protection, 2000b; Alexander et.al. 2000)

- Avoid shoreline alterations such as bulk heading that circumvent nitrogen removal in riparian areas.

Consider implementing a shoreline buffer mitigation program where all onsite protection standards can't be met and after all possible efforts have been made to minimize onsite impacts to the extent possible. Applicants unable to meet all buffer requirements due to lot size, other site features or intense use for the parcel, would be required to provide compensation toward restoration of disturbed shorelines or permanent protection of shoreline areas on other properties.

In surface water supply watersheds, identify and prioritize shoreline areas in need of restoration. Target these for restoration with applications for redevelopment or expansion. Seek funding for restoration through RIDEM and the Natural Resources Conservation Service.

Educating residents about maintenance or restoration of shoreline zones is most critical in neighborhoods where wetlands and streams flow through backyards, and in waterfront developments. Topics include avoiding dumping yard wastes shoreline zones, maintaining or restoring naturally vegetated shorelines, discouraging waterfowl, avoiding shoreline alterations and bulkheads, and limiting disturbance for shoreline access.

Shoreline buffer widths

The optimum width for an effective buffer varies depending on the type of pollutant to be removed, the percent removal needed to protect sensitive waters, and site conditions. In their widely accepted buffer guidance document, the USDA Forest Service (Welsh 1991) recommends a minimum shoreline buffer distance of 95 feet, and up to 185 feet in areas of high water tables and steep slopes. These guidelines are specifically designed to maintain pollutant removal effectiveness of shoreline buffers in forested, farmland, and suburban /rural areas.

In their review of effectiveness of riparian buffers, Desbonnet and others (1994) concluded that a buffer between 200 and 250 feet wide is needed to reduce phosphorus and other pollutants by 80 percent. However, effectiveness of buffers for removal of nitrogen is less dependent on buffer width alone. Instead nitrogen removal by microbial denitrification requires shallow groundwater flow through wetland sediments, which varies, based on site conditions (Addy et.al.1999). Rosenblatt (REF) found that wetlands and associated buffers located on gently sloping outwash soils were more likely to provide proper conditions for denitrification.

The preceding recommendations focus on buffers in rural and agricultural area where, according to analysis by the Center for Watershed Protection, pollutant removal "appears to be due to relatively slow transport of pollutants across the buffer in sheet flow or under it in shallow groundwater. In both cases, this relatively slow movement promotes greater removal by soils, roots, and microbes." These findings stress the importance of infiltrating runoff for maximum water quality benefit. However, the Center for Watershed Protection qualifies this by noting, "Ideal buffer conditions are rarely encountered in urban watersheds. In urban watersheds, rainfall is rapidly converted into concentrated flow. Once flow concentrates, it forms a channel that effectively short-circuits a buffer" (Center for Watershed Protection 2000b). The management implications are that buffers need to be carefully designed to promote infiltration, avoid channelized flow, and in high-use areas, provide additional stormwater treatment and avoid over-reliance on natural buffer functions.

Summary guidelines for multiple use vegetated buffers

The approaches to establishing a buffer distance vary from standard, one-size fits all approach to more complex formulas based on site-specific conditions. For the sake of simplicity most RI municipalities adopt a standard buffer setback, then review and approve special use permits or variances on a case-by-case basis. Where buffer standards have been established, standards for approval of special use permits and variances should be evaluated to determine their adequacy in avoiding and mitigating impacts, while maintaining the water quality function of the buffer. Factors to consider include:

- Sensitivity of the nearby resource.
- Characteristics of the buffer itself, such as erodible soil types, steep slopes, high water table or floodplain, and poor vegetation. Many rating systems recommend greater buffer distances to compensate when any of these conditions are present within the buffer.
- Use of the parcel and potential for the buffer to be disturbance, with high-intensity activities requiring greater buffer distances.
- Management practices to maintain buffer function over the long term and prevent encroachment.

Table 5
Summary of standard buffer widths for water quality protection*

Buffer distance (ft)	Type of buffer	Pollutant removal / special conditions
150	Multiple use standard buffer	75% removal of sediment and nutrients
250	Protection of sensitive areas	80% removal of sediment and nutrients
100	Minimum buffer for water quality protection for low-intensity uses.	60- 70% removal for phosphorus, nitrogen and total suspended solids or less. Assumes good site conditions and runoff managed through sheet flow or infiltration through buffer.
360	Viral inactivation	Based on rapid ground-water flow rate of three feet/day; also temperature dependant.
35 – 50	Restoration of urban buffers	50 – 60% removal of sediment and nutrients possible; poor wildlife habitat.

* Increased buffer distance is generally recommended where buffers include steep slopes, high water tables and sensitive habitat. Wildlife habitat values not included above.

Sources: Addy et.al. 1999; CWP 2000b; Desbonnet et.al.1994; Herson-Jones et.al. 1995; Horsely & Witten, Inc. 1997; Welsh 1991.

Buffers for new land development projects

Shoreline buffers located on private property are most susceptible to gradual alteration by landowners – activities that are very difficult to monitor and enforce. Reduce potential for gradual wetland loss by delineating parcel boundaries within suitable building areas and including wetlands and associated buffers within designating open space

Review of variances or special exceptions from buffer standards on existing lots of record

- Consider buffer characteristics in establishing buffer widths and uses – are there limiting conditions such as high water table or erodible soils that would reduce effectiveness of the buffer?
- Minimize extent of disturbance to the maximum degree possible, moving construction and clearing out of the buffer wherever possible.

- Require the applicant to seek variances from side, front, and other setbacks before seeking reduction in buffer distance.
- Reduce size of project to minimize impact, with smaller building footprint and reduced wastewater flow from septic systems.
- Establish performance standards for control of stormwater and wastewater discharges. Limit impervious cover and require use of low impact stormwater controls to maintain pre-development runoff volume. Require advanced wastewater treatment systems in sensitive areas and problem soils.
- Establish limits of disturbance on plans and fence off in field to avoid unnecessary construction damage.

Protect the buffer from alteration after construction

- Mark the upland boundaries with permanent fencing and signs that describe allowable uses.
- Require revegetation after construction using native shrubs and trees.
- Educate buffer owners about the purpose, limits, benefits and allowable uses of the buffer. Also educate residents about the operation and maintenance of stormwater drainage systems located on individual lots, such as drainage swales and rain gardens that homeowners may need to maintain or avoid altering.
- Use pamphlets, neighborhood association meetings, demonstration sites and stream walks to educate homeowners.

4. Land Development standards: Site Design, Erosion and Sediment Control, and Stormwater Management

At the project level, managing development impacts begins with careful site design to direct development to suitable areas, limit site disturbance and impervious area, and incorporate nonstructural stormwater controls into project design from the earliest stages. Good land development practices are needed even where pollution risks are estimated to be low because this rating is an estimate for the study area as a whole. In practice, impacts are likely to occur in site-specific locations, affecting water quality of stream segments and surface waters locally. In addition, our estimates assume use of good management practices to avoid steep slopes and high water table, keep wetland buffers intact, implement effective erosion controls, and keep septic systems functioning properly with good maintenance. Actual impacts may be much greater depending on the site conditions, the location of development and intensity of use. Establishment of mini farms with horses or other animals would also result in much higher pollutant inputs than predicted, especially if animal wastes are not properly managed. Because of the potential for site-specific impacts, use of good land development practices remains important when watershed risks are low, and becomes critical where marginal sites are subject to development.

Changes in hydrology = water quality impacts

Urban runoff alters basic water flow and pollutant pathways in a way that robs watershed ecosystems of natural pollutant removal functions.

- *Water running off, rather than infiltrating the ground bypasses natural pollutant removal pathways in soil.*
- *Stormwater flowing to wetlands and surface waters is often channelized in pipes, swales, or other drainage ways, bypassing most of the riparian buffer area and escaping treatment in shoreline buffers.*
- *Reduced recharge as a result of high runoff is known to lower water tables. As a result, groundwater discharging to streams may flow below, rather than through shallow wetland sediments, bypassing potential groundwater nitrogen treatment zones of high microbial activity.*

Guidelines for land development

The following practices represent current management practices for new land development as well as re-development and expansion of existing uses. These are not intended to be comprehensive. Implementing these may require amendment to zoning ordinances and land development regulations. In each case, education, field inspection and enforcement would also be needed.

Project planning and review

Soil mapping provides critical information such as soil permeability and water table depths needed to locate sites for buildings, onsite wastewater treatment systems, and both structural and non-structural stormwater facilities. RI Soil Survey maps are useful for general planning purposes but are not accurate at the parcel level. Site-specific soils mapping by a professional soil scientist should be required for all land development projects to accurately identify soil conditions as early as possible in the site planning process, ideally, when wetland boundaries are first delineated. Accurate soil mapping results can then be used to identify sites for more costly site investigations such as installation of water table monitoring wells and soil evaluation pits excavated using heavy equipment.

Use conservation design principles to preserve forest cover and protect wetland buffers from backyard encroachment. Relatively undeveloped areas with large lot zoning stand to gain the greatest acreage of open space with this technique, especially if at least 50 percent of the parcel is reserved as open space. The principles are equally appropriate for more dense development, including commercial and village areas where effective use of even small open space areas can have substantial benefits.

Use site analysis to identify permeable soils suitable for stormwater infiltration. Integrate planning for nonstructural stormwater drainage systems with site layout, to include rooftop runoff diverted to vegetated areas, use of small landscaped stormwater storage and infiltration areas known as “rain gardens” and use of roadside swales rather than traditional curb and catch basin.

Limit impervious cover with narrower roads and modified cul-de-sacs. Consider use of permeable pavements in sensitive areas and where necessary to achieve impervious target levels.

Review parking requirements and set maximum parking requirements for commercial and industrial developments. Use permeable materials for overflow parking.

Establish limits of disturbance for new road construction, with individual building envelopes for buildings and driveways. Mark disturbance limits on plans and fence off in the field. Where septic systems are used, fence off the proposed leach field to protect against compaction by heavy equipment during construction. Earmark individual trees or groups of trees to be protected and fence off at the dripline or other root protection zones identified by qualified arborists. With new septic system construction, fence off the leach field during construction to protect against compaction by heavy equipment. This is essential to ensure long-term function of the leach field.

Clearly identify all material storage areas, stockpiles and stump dumps (if on-site disposal is allowed) on plans. Keep within specified limits of disturbance or store at another location.

Prohibit disposal of "clean fill" in source water areas, which, by definition, may contain construction debris such as asphalt.

Prohibit use of subdrains to lower high water tables for development sites. Prohibit use of subdrains to intercept high water table for individual building sites and septic systems unless the discharge can be accommodated on site without contributing to offsite runoff. In environmentally sensitive areas, or where lot sizes are small, prohibit construction of basements in high water tables, which require either extensive filling or use of subdrains.

Establish standards for control of runoff volume, keeping the amount of runoff at pre-development levels in sensitive areas.

Identify highly erodible areas during project review and take additional erosion and sediment control precautions in these areas. Where town staff is limited, establish permit review fees to cover cost of hiring outside consultant to review erosion control and stormwater management plans, and most importantly, conduct field inspections during construction.

Require plans for erosion and sediment control and for stormwater management for all land development projects, including minor subdivisions. Require approval of maintenance plans for stormwater systems, with responsible parties identified and enforceable provisions for ensuring routine maintenance.

Develop and distribute educational materials to homeowners on importance of nonstructural stormwater controls, maintenance requirements for facilities located on private lots, and penalties for altering drainage systems. Follow up with field inspections and enforcement.

Resources for site design and low impact development

Excellent resources for controlling environmental impacts through site design and innovative stormwater control are available for in-depth guidance. The following are particularly useful and all but one are designed for Rhode Island communities.

- The *Conservation Design Manual* describes the step-by-step process for evaluating a site, identifying open space for preservation, and selecting suitable areas for development. Produced by Dodson Associates for RIDEM. Available to view or download at the RIDEM website at www.state.ri.us/dem/programs/bpoladm/suswshed/ConDev.htm .

- The two-volume set: *Low –Impact Development Design Strategies: An Integrated Design Approach*, and *Low-Impact Hydrologic Analysis*, describes the current approach to stormwater management emphasizing control of runoff volume using nonstructural controls. The manual stresses site design and micro-management of runoff to keep stormwater on site and mimic pre-development hydrology. Produced by Prince George's County with EPA support and available to view or download at http://www.epa.gov/nps/lid/ . Hard copies may be ordered through the EPA National Service Center for Environmental Publications on line at www.epa.gov/ncepihom/ordering.htm , or by phone at 1-800-490-9198.

South County Technical Planning Assistance Project. Prepared by Dodson Associates for RIDEM. Includes several resources for land use planning and design to protect open space, all available to view or download at www.state.ri.us/dem/programs/bpoladm/suswshed/sctpap.htm , including:

- Model ordinances for conservation development and other land use strategies;
- South County Design Manual, which uses actual sites in southern Rhode Island to illustrate future development scenarios using conventional development vs. more compact designs with conservation development techniques.
- Rapid Site Assessment Guide – Produced by URI Cooperative Extension for RIDEM. Offers guidance on use of Geographic Information Systems to conduct a planning level site analysis using simple static maps available on the web and RIGIS coverages for those with access to ArcView GIS software.

Scituate Reservoir Watershed Zoning Project – Parts 1 and 2. 1998. Two-volume set prepared by Newport Collaborative Architects for RIDEM. Describes design strategies to preserve rural character while

protecting local water quality. Includes model development standards. Additional information at www.state.ri.us/dem/programs/bpoladm/suswshed/Scituate.htm . Available in paper copies through RIDEM. Contact Scott Millar at 401-222-3434.

5. Wastewater Management

When properly sited, operated and maintained, onsite systems provide a safe, cost-effective and environmental sound treatment option for low-density areas. The RIDEM Individual Sewage Disposal System (ISDS) program establishes minimum standards for siting, design and installation of onsite wastewater treatment systems. Once installed, however, Rhode Island municipalities are responsible for making sure septic systems are properly maintained. To keep these systems functioning over the long term, and to protect public health and local water quality, many Rhode Island communities are establishing onsite wastewater management programs with support and funding by the RIDEM. Use of advanced onsite wastewater treatment systems is becoming commonplace, however, these systems are bound to fail unless properly maintained. Town oversight is needed to ensure all advanced wastewater treatment systems, including existing systems, have maintenance contracts in place that are renewed annually.

Sewers

Make sewer leak detection and repair a priority in source water areas. Watertight lines and pump stations prevent wastewater leakage, loss of groundwater recharge, and overloading of wastewater treatment facilities with infiltrating groundwater.

Establish sewer and water district boundaries to avoid sewer expansion into source water areas unless necessary to accommodate existing high density and high risk land uses, and where all other onsite options have been evaluated, such as improved wastewater management and use of advanced onsite wastewater treatment systems. Where sewers already exist or are planned for source water areas, existing zoning and land development standards should be carefully evaluated to determine if current standards are adequate to control high risk land uses, limit development of marginal sites, and mitigate potential impacts of more intense development supported by sewers. Control of hazardous materials, stormwater treatment and recharge, and protection or restoration of wetland buffers are particularly critical in more intense development is permitted.

Local management of onsite wastewater treatment systems

Develop a local wastewater management program. Most communities begin with development of a wastewater management plan. A

RIDEM-approved plan qualifies town residents for low-interest loans for septic system repair under the RI State Revolving Loan Fund. Implementation of the plan includes public education and in many cases, development of a wastewater management ordinance that requires regular system inspection with pumping as needed, repair or replacement of failing systems. Some communities require gradual phase-out of cesspools over time. When hiring staff to manage the program, consider joining with neighboring communities to share personnel and equipment.

Consider establishing treatment standards specifying use of advanced treatment systems in critical areas. Examples of existing programs: Block Island has set treatment standards townwide, with advanced treatment required in the town's primary drinking water supply wellhead, and based on soil type in other wellhead protection areas. Little Compton requires alternative systems as a condition of approval for construction in wetland buffers. Jamestown requires advanced treatment in densely developed areas served by private wells with high water table.

Prohibit use of deep leaching chambers (4'x4' galleys) due to lack of treatment potential with deep discharge.

Require alternative treatment systems for large flow and high strength systems within source water areas; and also for smaller systems located in critical areas, including shoreline buffers and inner protected well radius, and in areas with poor soils where horizontal and vertical setbacks can't be met.

Where development is clustered on small lots and high water table, require use of advanced treatment systems rather than raised fill systems to avoid increased runoff and nuisance flooding to neighboring properties.

Where monitored nitrate levels are elevated (>2 mg/l) and where septic systems are estimated to be the dominant source and where projections show nitrogen sources from onsite systems increasing with future development, require use of advanced treatment systems for new or replacement systems for high intensity development. The need for advanced treatment is especially critical where monitored nitrate concentrations are near the 5 mg/l level, especially where projections indicate increased future inputs.

Prohibit new development on marginal sites (less than 2 ft. water table depth) in source water areas due to risk of treatment failure where water tables are likely to rise to the surface during wet periods.

Where advanced treatment systems are already being used, establish maintenance fees to cover cost of town oversight in tracking annual renewal of maintenance contracts and ensuring that maintenance is properly conducted.

Establishment of a mandatory inspection program will identify failing systems and illicit discharges, as required under the RIDEM Phase 2 stormwater program. Wastewater and
stormwater management planning should be closely coordinated.

Establish a computerized database for tracking septic system inspection results and maintenance schedules. Several programs are available, including low-cost, web-based reporting systems with minimal staff requirements. Begin by putting town-owned onsite wastewater treatment systems on inspection and maintenance schedules. Budget for upgrading of large institutional systems to advanced treatment in critical areas. Technical assistance in selecting appropriate technologies is available through the URI Onsite Wastewater Training Center. More information about conventional and alternative systems, go to www.uri.edu/ce/wq/owtc/html/owtc.html .

6. Use and Storage of Hazardous Materials

Background

Underground fuel storage tanks are the major source of new groundwater contamination incidents in Rhode Island (RIDEM 2002).
Prohibiting siting of new underground storage tanks in source water areas is the most effective way to prevent increased risk of contamination.

The technology does not exist to ensure underground storage tanks and components will be 100% leak proof and only small quantities can contaminate water supplies.
Even with a major overhaul of state regulations for UST in the last few decades, with new standards for tanks, a DEM review of its waste management program has found that leaks and spills from underground storage tanks are almost impossible to prevent entirely (RIDEM 2001). Improved double wall and fiberglass tanks are now much less prone to leaks but leaks from fuel lines and pumps are common and unpredictable, and no method exists to test. Leak detection methods are imprecise. Leaks may go unnoticed for a long period and even relatively small quantities can have disastrous effects. Tank pressure testing is not 100 percent accurate, and even small leaks can be a major source of contamination. There is no convenient way to test pumps and lines for leaks.

Not all underground tanks are regulated.
RIDEM regulates all commercial tanks but does not regulate underground tanks storing heating fuel consumed on-site at homes or businesses. RIDEM underground storage tank (UST) regulations prohibits new underground storage tanks in community wellhead protection areas only; new tanks are allowed in all other areas, including, non-community wellhead protection areas, aquifer recharge areas, and surface water supply watersheds.

RIDEM has limited staff to inspect these facilities and even more limited resources to effectively enforce violations.
In 2001, the RIDEM Office of Waste Management carried out 47 compliance monitoring inspections of UST facility operations. The purpose was to determine compliance with continuous monitoring systems or corrosion protection systems to ensure that tanks are not leaking and releasing gasoline or other hazardous materials such as MBTE into the environment. Results: DEM inspections found noncompliance at just about every facility inspected (RIDEM 2001)

Enforcement is difficult and time consuming. In 2001 RIDEM notified 59 UST facilities of non-compliance, but only 27 were brought into compliance. Municipal staff lack the training, time or jurisdiction to inspect these facilities on their own (RIDEM 2001).

Recommended local actions

New underground storage tanks
Prohibit installation of new underground storage tanks, in town-identified critical areas through groundwater protection overlay zone or site review standards. Include both commercial tanks and heating oil tanks for onsite use.

Existing underground storage tanks
Make formal inquiry to DEM to identify existing state-regulated underground storage tanks and other facilities generating or storing hazardous waste within town critical areas. Determine type of facility and compliance record. Identify additional improvements that can be made beyond minimum standards. Invite representatives of Planning Board, Conservation Commission, water suppliers, groundwater committee to participate in review. Set annual action items.

Establish standards for existing facilities triggered by renovation, expansion, or sale of existing uses. Required improvements should be based on RIDEM recommendations to include for example: replacement of underground storage tank with above ground unit;

improved monitoring and reporting requirements, including use of downgradient wells and sampling; and employee training.

Require removal of existing heating fuel tanks for homes and businesses at the time of property sale, building improvement or expansion. Establish sunset clause for removal of tanks in high risk areas; offer rebates for voluntary removal in less critical areas. For example, the New Shoreham offers a $300 rebate for each underground tank removed.

Promote private well water testing of all wells located within 1000 feet (or greater for larger wells) of underground storage tanks for fuel components and MTBA

Commercial and industrial facilities using or storing hazardous materials

RIDEM regulates storage and transport of hazardous waste but does not have jurisdiction over facilities that use hazardous materials, even though the hazardous product and the waste may be the same material.

Review and update groundwater /watershed zoning to prohibit siting of new facilities that use, store, or generate hazardous materials and wastes. Regulate storage of hazardous materials in the same way that hazardous waste is regulated. A useful guide to best management practices is the RIDEM Hazardous Waste Compliance Workbook for Rhode Island Generators, available through the Office of Waste Management at www.state.ri.us/dem/programs/benviron/waste/index.htm .

Identify areas where new lower-risk commercial /industrial facilities may be permitted by right or by special exception in less critical portions of the groundwater recharge area. Establish local performance standards for design, siting and monitoring.

Update standards for stormwater management, wastewater treatment and wetland buffer protection for businesses in aquifer recharge areas. For example, gas stations and convenience stores are known to generate more heavily contaminated runoff and require special stormwater runoff controls. Oil and water separators typically used may not be appropriate; other treatment units are now available that may have better pollutant treatment performance. All such units require routine care and maintenance contracts should be in place.

Update standards for review and approval of special use permits or variances to bring businesses in closer conformance with current performance standards. These requirements may include for example,

shoreline buffer restoration, stormwater system retrofitting, or site design and landscaping improvements.

Town owned facilities

Identify town-owned facilities using or storing hazardous materials. Evaluate management practices at these locations and in routine operations such as road maintenance and landscape care in town parks. Install model practices at town facilities. Coordinate these activities with required improvements under RIDEM Phase 2 stormwater planning.

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7. Monitoring, Education and Stewardship

Investigate results of hotspot mapping

Identify appropriate methods to investigate sites to determine if mapped site is actually a potential source of pollution, determine if action is necessary. Consider different strategies for residential, business and agricultural properties. For example, to investigate potential hotspots in agricultural areas: work with local farmers, the Natural Resource Conservation Service, and the RIDEM Division of Agriculture to determine if mapping represents actual field conditions, current conservation practices, and need for additional management to minimize impacts. Use RIDEM Division of Agriculture mapping to review current type of crop, location and number of large animals, and animal waste storage sites. Cooperate with these groups to conduct field investigations and contact landowners to discuss assessment results and management options.

Municipal Lawn and landscape Care

Provide training for municipal staff in lawn and landscape care. Low-impact landscape care, using current fertilizer and irrigation practices, and use of low-maintenance sustainable plants, can improve local parks and lawns while reducing landscaping costs over the long run. Contact the URI GreenShare program at www.healthylandscapes.org/ .

Hydrologic modifications

The RI Water Resources Board is currently working with governmental officials and water suppliers to identify water use needs and establish policies for allocating water among different users, including protection of downstream water flow for habitat. All interested parties are welcome to participate in this process. For more information go to www.wrb.state.ri.us/ .

Compliance and enforcement

In many cases plans and regulations are comprehensive but staff is lacking to monitor and enforce current activities. Municipalities and

water suppliers should discuss opportunities to coordinate in improving enforcement of local regulations, including hiring an environmental enforcement officer to work with town staff such as the building inspector, wastewater management coordinator and others conduct field inspections, educate landowners and developers, and pursue enforcement actions where needed.

Community pollution prevention education

As a joint effort between water suppliers and local officials, expand public education to promote awareness of local water resources and the need for protection. Use educational campaigns to encourage individual adoption of good management practices and also to build public support for local source water protection ordinances.

- Start by mailing the assessment summary fact sheet to watershed residents and water users.
- Join forces with existing organizations promoting conservation and education. Work with nonprofit organizations to implement watershed education programs in schools.
- Support private well water protection education and facilitate private well water sampling; actions taken to protect private wells will also protect public supplies.
- Aim to establish a continuous educational program targeting different audiences through a variety of methods. Occasional educational efforts are less effective. The most successful communities have appointed a committee with citizen volunteers to spearhead efforts, such as the North Kingstown Groundwater Committee, which works closely with the town water supply department, the planning department, and other town officials.
- Target residents and businesses in critical areas for education on issues of concern in their neighborhood such as shoreline development in waterfront areas, lawn care in areas with large lots and high-maintenance lawns, and areas in need of septic system repair and upgrading.
- Work with business groups to promote good "housekeeping" practices among commercial and industrial property owners.

Consumer Confidence Reports

The 1996 Amendments to the Safe Drinking Water Act (SDWA) require public water supply systems that serve residential customers to prepare and distribute annual consumer confidence reports. These reports are intend to help educate public water supply consumers and to promote a dialogue between water suppliers and their customers on the importance of source water protection.

6.3 Management Actions for Water Suppliers

Implementing municipal management actions listed above would require coordination with water suppliers and their active support. In many cases water suppliers already are leading non-regulatory efforts, such as educational outreach and monitoring. Additional actions water suppliers can take to protect drinking water supplies follow. In many cases, water suppliers already have active watershed management programs that incorporate many of these elements.

- Implement all recommendations of the latest water supply systems management plan.
- Continue to prioritize and acquire land for protection.

- Identify priorities for restoration, including potential sites for stormwater drainage system improvements and shoreline revegetation. In cooperation with government agencies and nonprofit organizations pursue funding to implement projects through capital budgets and competitive grants.
- Post signs alerting the public to location of Wellhead or Watershed Protection Area.
- Cooperate with local officials to update local plans and ordinances to implement land use protection measures.
- Inspect water supply and protection area regularly for potential pollution sources.
- Provide assistance to communities in review of development proposals to evaluate potential impacts and identify alternative designs and management practices to minimize impact.
- Expand monitoring where needed to evaluate stream water quality through simultaneous monitoring of stream quality and flow. In surface reservoirs track nutrient enrichment status through standard benchmarks such as Carlson's Trophic State Index.
- In groundwater aquifers promote private well water protection education and encourage private well water sampling. Actions taken to protect private wells will also protect public supplies.
- Cooperate with local officials and nonprofit organizations to develop and carry out watershed/groundwater education programs for those who live and work in source water areas.

6.4 What Residents, Landowners and Businesses Can Do

Drinking water protection eventually comes down to the individual actions of those who live and work in water supply areas. The following are basic actions each person can take to protect public supplies and the health of their own home and yard.

Residents

Vehicle and Engine Maintenance

- Recycle used motor oil. Never pour waste oil on the ground or down storm drains.
- Local sanitation departments or service stations can often accept used motor oil.
- Keep up with car maintenance and the maintenance of other motorized equipment such as lawn mowers and snowmobiles, to reduce leaking of oil, antifreeze, and other hazardous fluids.

Heating fuel

Replace underground home heating fuel tanks with properly-contained above ground tanks.

Household Hazardous Products

- Follow the product label directions for use and storage very carefully.
- Keep products in their original, labeled containers and out of the reach of children.
- Buy only as much as you will need. Give surplus products to friends, neighbors and groups who can use them.
- Consider using nontoxic, nonhazardous alternative products.
- Do not pour paints, used oil, cleaning solvents, polishes, pool chemicals, insecticides, and other hazardous household chemicals down the drain, in the yard, or on the street.
- Dispose of household hazardous waste properly and recycle wastes where possible.

Septic system care

- All septic systems need regular care to function properly and avoid costly repairs.
- Inspect septic systems annually and pump when needed, usually every 3 – 7 years.
- Comply with local wastewater management requirements.
- Repair or replace failing septic systems. If you have a cesspool plan to replace it.
- Avoid using septic system additives.
- Place only toilet paper in the toilet.
- Don't pour grease or hazardous household products down the drain.
- Compost kitchen wastes rather than using a garbage disposal.
- Conserve household water to reduce the amount of wastewater generated.

Yard and garden care

- Maintain wooded buffers or restore natural vegetation along wetlands or watercourses than run through your property.
- Avoid dumping leaves and brush in shoreline areas.
- Use native, low-maintenance plants that require less fertilizer and water.
- Reduce fertilizer and pesticide use. When using these, follow product labels carefully.
- Use organic fertilizers or compost instead of traditional chemical fertilizers.
- Limit outdoor water use. Summer water demand typically doubles or triples due to outdoor watering.
- Reduce stormwater runoff by limiting paved surfaces. Direct runoff to well-vegetated areas or gravel rather than pavement leading to storm drains.
- If you have a private well have it tested annually.

Pets and livestock

- If you have horses or other livestock, provide proper animal waste collection and storage. Keep animals out of streams and waterways.
- Pick up after your pets.

Contacts:

Healthy yard and garden care:

URI Cooperative Extension Master Gardener Hotline

URI GreenShare Program http://www.healthylandscapes.org/

Septic systems

URI Onsite Wastewater Training Center www.uri.edu/ce/wq and Master Gardener Hotline 1-800-448-1011, M-Th. 9am –2pm.

Private well protection:

URI Home*A*Syst, 401-874-5398,

Animal waste management:

USDA Natural Resources Conservation Service 401-828-1300, www.ri.nrcs.usda.gov .

Hazardous waste recycling and disposal:

RI Resource Recovery Corporation, Eco-Depot 401-942-1430.

Farmers and Landowners

Work with the USDA Natural Resource Conservation Service to develop a conservation plan that addresses proper nutrient, manure, pest, and irrigation water management.

Consider use of conservation tillage to minimize erosion.

Maintain and restore naturally vegetated buffers to surface waters. This is especially critical in watersheds of drinking water supply reservoirs.

Contact them at (401) 828-1300, www.ri.nrcs.usda.gov

Businesses

- Adhere to all laws, regulations, and recommended practices for hazardous waste management, above and underground storage tanks, floor drains and wastewater discharges.
- Clearly post signs to show proper hazardous material handling and storage practices
- Provide regular training for employees in management of fuel tanks, monitoring equipment, and safety practices.
- Contact RIDEM Pollution Prevention Program for assistance in reducing use of hazardous materials and in voluntary good "housekeeping" inspections.

Check local regulations with city/town hall and state regulations with the RI DEM Office of Water Resources (401) 222-4700, www.state.ri.us/DEM/program/benviron/water/index.htm