Aquifer Protection
Best Management Practices

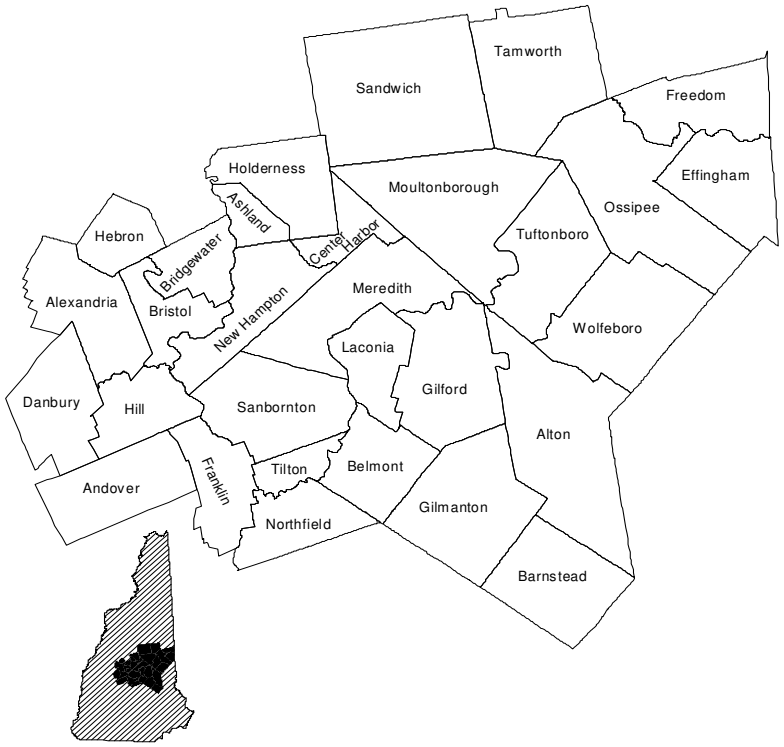
Tri-Town
Aquifer Project

Protecting Shared
Drinking Water Resources

Belmont
Northfield
Tilton

April 2007

THE LAKES REGION PLANNING COMMISSION



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Belmont • Northfield • Tilton

April 2007

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"The primary thrust of this proposal addresses the need for *collaborative* drinking water resource planning among three municipalities."

"Thoughtful planning which works to balance economic growth with ground water protection will assist in maintaining the viability of common drinking water resources into the future."

Quotes from cover letter to Source Water Protection Grant application, November 28, 2001

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Appendix B. Matrix of Site Design (Structural) BMPs **121**

The Best Management Practices (BMP) Matrix rates performance, cost effectiveness, and cold weather effectiveness of site design (or structural) BMPs outlined in the guidebook. These ratings evaluate whether the BMP has the ability to abate site contaminants, control storm events, be installed properly, and be maintained regularly to continue to achieve original design performance levels.

Appendix C. Schematics of Site Design (Structural) BMPs **129**

The schematics were chosen for each site design, or structural, BMP included in this guidebook. They provide an example of what the design could look like and can be used as a point of reference during the preliminary decision-making phase of a project.

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Acknowledgments

Members of the Water Resources Committee would like to thank the towns of Belmont, Northfield, and Tilton for supporting this project and for dedicating resources to this drinking water protection effort. Belmont, Northfield, Tilton, and the Lakes Region Planning Commission would like to express appreciation to the Drinking Water Source Protection Program of the New Hampshire Department of Environmental Services for providing funding for this project and extensive staff support along the way. Staff spent considerable time and effort to ensure content is accurate and represents current scientific data. Special thanks to Pierce Rigrod and Paul Susca for their editing and insight. We would also like to thank Garret Graaskamp with the American Ground Water Trust for providing editorial assistance.

Particular recognition should be given to those who participated in the Water Resources Committee from the towns of Belmont, Northfield, and Tilton. Committee members attended project meetings, assisted with fieldwork, and guided all elements of this project. Throughout the past year and a half committee members shared extensive local knowledge with dedication, respect for each others' ideas, and a collaborative spirit.

Common Vision

The towns of Belmont, Northfield, and Tilton are very fortunate that a large stratified drift aquifer serves our existing and potential future drinking water needs. Water is the most basic of resources, and the three towns have a great responsibility to assure that we preserve water quality and conserve water quantity for future generations. Each of our towns recognizes that we share this valuable resource and agree that there is the need for continued collaborative drinking water resource planning. In order for one town's efforts to be effective, they must be complemented by actions in each of the other towns. Thoughtful planning which works to balance economic growth with ground water protection will assist our towns in maintaining the viability of common drinking water resources into the future.

PROJECT SUMMARY

A stratified drift aquifer, totaling approximately 11,108 acres, lies beneath the towns of Belmont, Northfield, and Tilton.[1] The aquifer currently supplies drinking water to a portion of the towns' residents, and has the potential to provide additional sources of drinking water to meet future needs. In the fall of 2001, community interest in the preservation of the quality and quantity of existing and potential future drinking water supplies through aquifer protection measures was expressed to the Drinking Water Source Protection Program (DWSPP) of the New Hampshire Department of Environmental Services (NHDES). The Lakes Region Planning Commission (LRPC) worked with the three towns to develop a proposal for a Source Water Protection Grant to provide planning assistance that would guide the towns in protecting the quality and quantity of this important drinking water resource. The project received funding from NHDES in the spring of 2002, and the project report, *Protecting Shared Drinking Water Resources,* was completed by December 2003. In conjunction with this report, an *Implementation Strategies Workbook* was developed based on priority recommendations identified by the three communities.

> "We would welcome the opportunity to work with our neighboring towns by initiating plans and doctrine to protect the quality of our shared water resources..."
>
> *-Chairman of the Board of Selectmen, Tilton*

> "We appreciate the opportunity for assistance in planning for...present and future water quality in our region."
>
> *-Board of Selectmen, Northfield*

The three towns and LRPC continued their partnership by implementing one of these priority recommendations, and components of additional recommendations, through the development of the Best Management Practice (BMP) Guidebook. The BMP Guidebook is specifically designed to provide guidance to minimize and mitigate the impacts of certain land uses and practices in order to protect the aquifer.

Project Goals and Community Participation

The overarching goal of the project is to assist the towns of Belmont, Northfield, and Tilton in their long-term planning efforts by providing accurate and in-depth information regarding their drinking water resources. This project aims to:

[1] Protecting Shared Drinking Water Resources: A Collaborative initiative of Belmont, Northfield and Tilton. Lakes Region Planning Commission. December 2003.

- Provide Belmont, Northfield, and Tilton with a guidebook of best management practices targeted toward community officials, developers, business owners, other professionals, and homeowners to enable further protection of the stratified drift aquifer as a drinking water source for existing and potential future needs;
- Facilitate the exchange of information and ideas across town boundaries; and
- Explore opportunities for collaborative initiatives to protect shared water resources.

This planning project is innovative in its collaborative approach to drinking water supply protection. The three towns have been fully committed to the project from the start; they recognize that the stratified drift aquifer does not fit neatly within any one town's boundaries and that there is a need to work together to protect the viability of this shared drinking water resource. The framework, methods, and outcomes of this effort will serve as a model for drinking water protection efforts throughout the region. The quotes in the blue boxes are from the letters of support written by the three communities for the project grant application. These quotes illustrate the towns' strong support for the project and their level of commitment to working collaboratively to protect the shared aquifer resource.

Without the active participation of representatives from the three communities, a great deal of the town-specific concerns, issues, and information would be missing from this report and the project overall. The dedication of the community representatives who served on the Water Resources Committee was apparent from their level of participation in community meetings, fieldwork, and extensive follow-up between meetings via e-mail exchanges and phone calls. The Water Resources Committee included representatives from Boards of Selectmen, Planning Boards, Conservation Commissions, Water Supply Companies, Residents, Town Planners, Town Land Use Staff, and Town Administrators. These community representatives have expressed a commitment to continuing their efforts to protect the stratified drift aquifer by working to implement key project recommendations.

"The Town of Belmont is very fortunate, in regards to our drinking water needs, to be located on a large aquifer area. However, along with the benefits of this comes great responsibility to assure that we preserve quality and conserve quantity for future generations. We also recognize that we share this valuable resource with adjacent communities and that in order for our efforts to be effective, they must be complemented by actions of both Northfield and Tilton."

-Vice Chairman of the Board of Selectmen and Chairman of the Planning Board, Belmont

Implementation

This Guidebook is designed to be a tool to protect the stratified drift aquifer as a drinking water supply. Utilizing and implementing the Guidebook recommendations to decrease threats to the stratified drift aquifer will be a challenging process. Educating the target audience about the economic and environmental benefits of adopting BMPs will be a key component of long-term project success. Implementing the BMP Guidebook will assist the towns protect the quality and quantity of existing and potential water supplies provided by the stratified drift aquifer. It will take the continued dedication of community representatives already committed to the project, as well as extensive education and outreach efforts to the broader public, to continue implementing measures that protect drinking water resources for the benefit of today's residents and the next generations.

How Can I Get Involved?

For information about project implementation, please contact the Planning Department, Planning Board, and/or Conservation Commission of Belmont, Northfield, or Tilton for additional information.

For more information about this project or the contents of this Guidebook, please contact:

Lakes Region Planning Commission (LRPC)
103 Main Street, Suite No. 3
Meredith, NH 03253
(603) 279-8171

For information on statewide efforts to protect ground water and drinking water, please contact:

New Hampshire Department of Environmental Services
Drinking Water Source Protection Program (DWSPP)
Paul Susca, Source Water Protection Coordinator
P.O. Box 95, 29 Hazen Drive
Concord, NH 03302
(603) 271-7061

Efforts should be made to move beyond the reliance of using only conventional, structural BMPs, to more holistic planning. At their most efficient, performance of conventional structural BMPs can be only partially successful in the removal of pollutants or ground water recharge. Often, only about 50 percent of a particular pollutant is removed with a structural BMP as the result of our best efforts.[2] Utilizing macro-planning principles such as conservation design will optimize protection of water resources in the three communities.

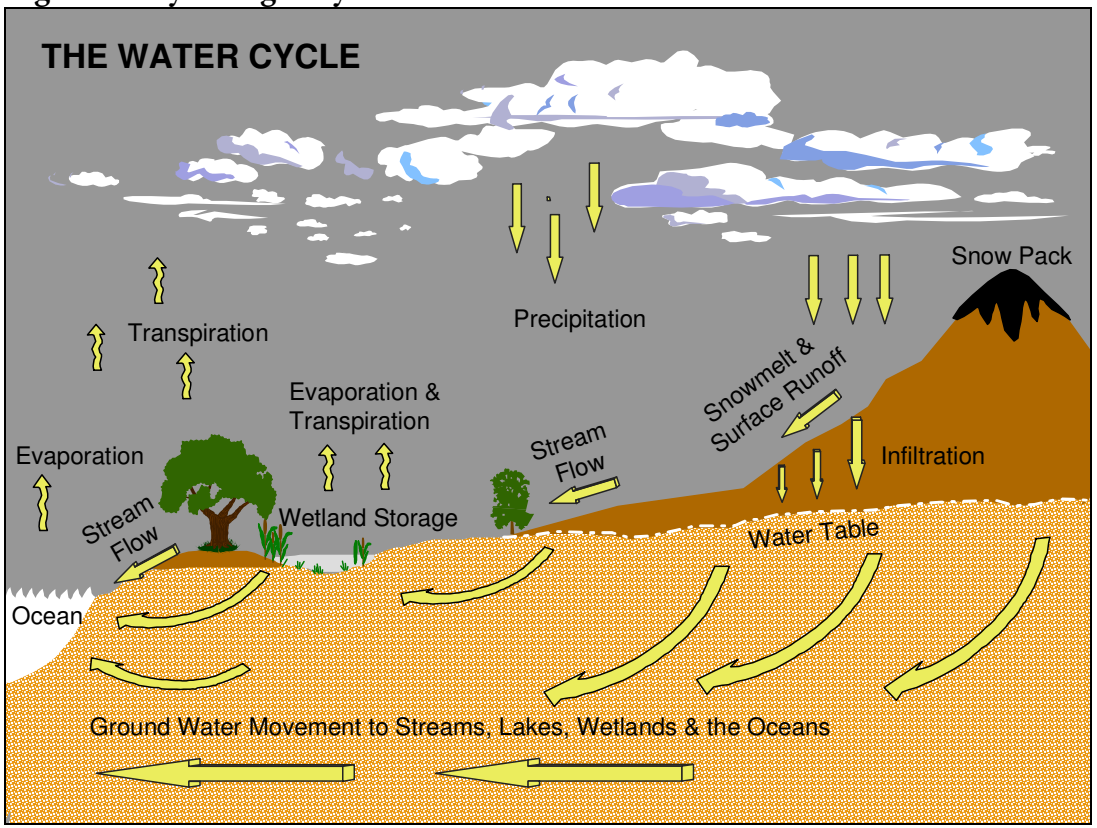
Although all three towns share the aquifer, Belmont, Northfield, and Tilton have different needs and concerns associated with land use. Each town should use this Guidebook to evaluate how to best utilize BMPs to strengthen and improve ordinances and regulations pertaining to aquifer protection.

[2] Conservation Design for Stormwater Management. A Design Approach to Reduce Stormwater Impacts from Land Development and Achieve Multiple Objectives Related to Land Use. Delaware DNREC and Brandywine Conservancy. September 1997.

Background Information on Ground Water Resources

This project focuses on the long-term protection of drinking water resources. Since the water is underground, you can not see where the water is, how much there is, or how it moves just by looking around in the same way you can with surface water such as a lake or river. In order to plan for the protection of the quality and quantity of ground water resources, an understanding of what is happening beneath the surface is necessary.

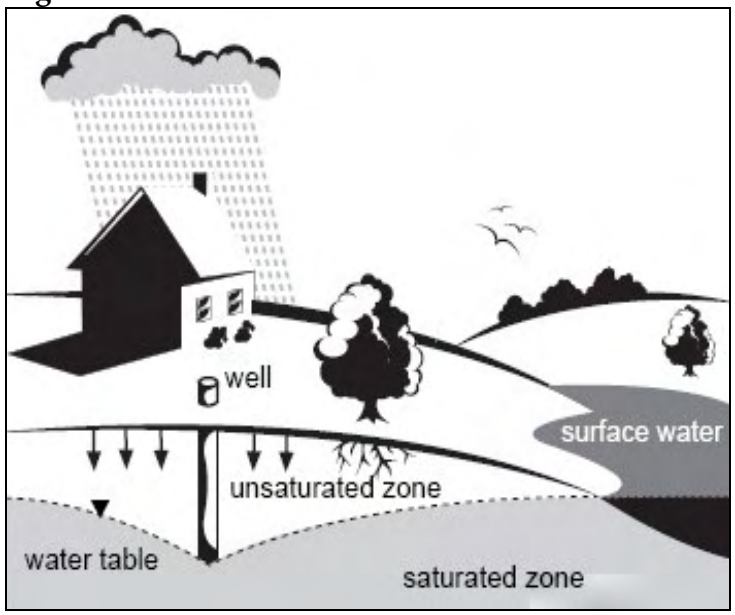
Figure 1. Hydrologic Cycle



Source: Modified from American Ground Water Trust

The movement of water between the atmosphere and the earth, through precipitation and evaporation, as well as overland and subsurface flow, is called the hydrologic cycle. When rain and snow fall, some of the water enters surface water bodies, some evaporates, and some is absorbed by the roots of plants and trees. The rest of the water soaks into the ground, moving down through rocks and soil until it reaches the water table. This phenomenon is called 'recharge.' Beneath the water table is the saturated zone, where all the spaces between rock and soil particles are filled with water. These large, water-filled layers of sand and gravel (called stratified drift) were left behind by the glaciers. These layers comprise a stratified drift aquifer (aquifer).[3]

Figure 2. Saturated Zone



Source: National Small Flows Clearinghouse

When addressing the prevention of contamination of the aquifer, there are a few issues to consider. The aquifer recharge rate, or how quickly water or snowmelt soaks into the ground, depends on the soil composition, as well as land cover and slope. Since this aquifer is composed predominantly of sand and gravel, water can flow relatively quickly into the aquifer.

Additionally, the total land area of the three towns is 46,550 acres, and approximately 24% of this total acreage is located within the direct recharge area of the aquifer, illustrated in Figure 3. The direct recharge area is the land area which lies directly over the stratified drift aquifer. Water has a more direct route to the aquifer in this area due to a higher concentration of porous soil types such as gravel and sand with minimal benefits of filtration or attenuation. This could allow pollutants to more rapidly and severely contaminate the aquifer than if the water was flowing through soils that slowed and trapped some of the contaminants. Land use activities which take place in this direct recharge area have the potential to directly impact ground water quality and quantity (Figure 4).

[3] Presentation Notes, "The Ground Water Protection Connection". Garret Graaskamp, Ground Water Specialist, American Ground Water Trust. Drinking Water Protection Workshop of the Belmont/Northfield/Tilton Initiative to Protect Shared Drinking Water Resources. November 20, 2002

Figure 3. Stratified Drift Aquifer – Direct Recharge Area – Belmont, Northfield, and Tilton

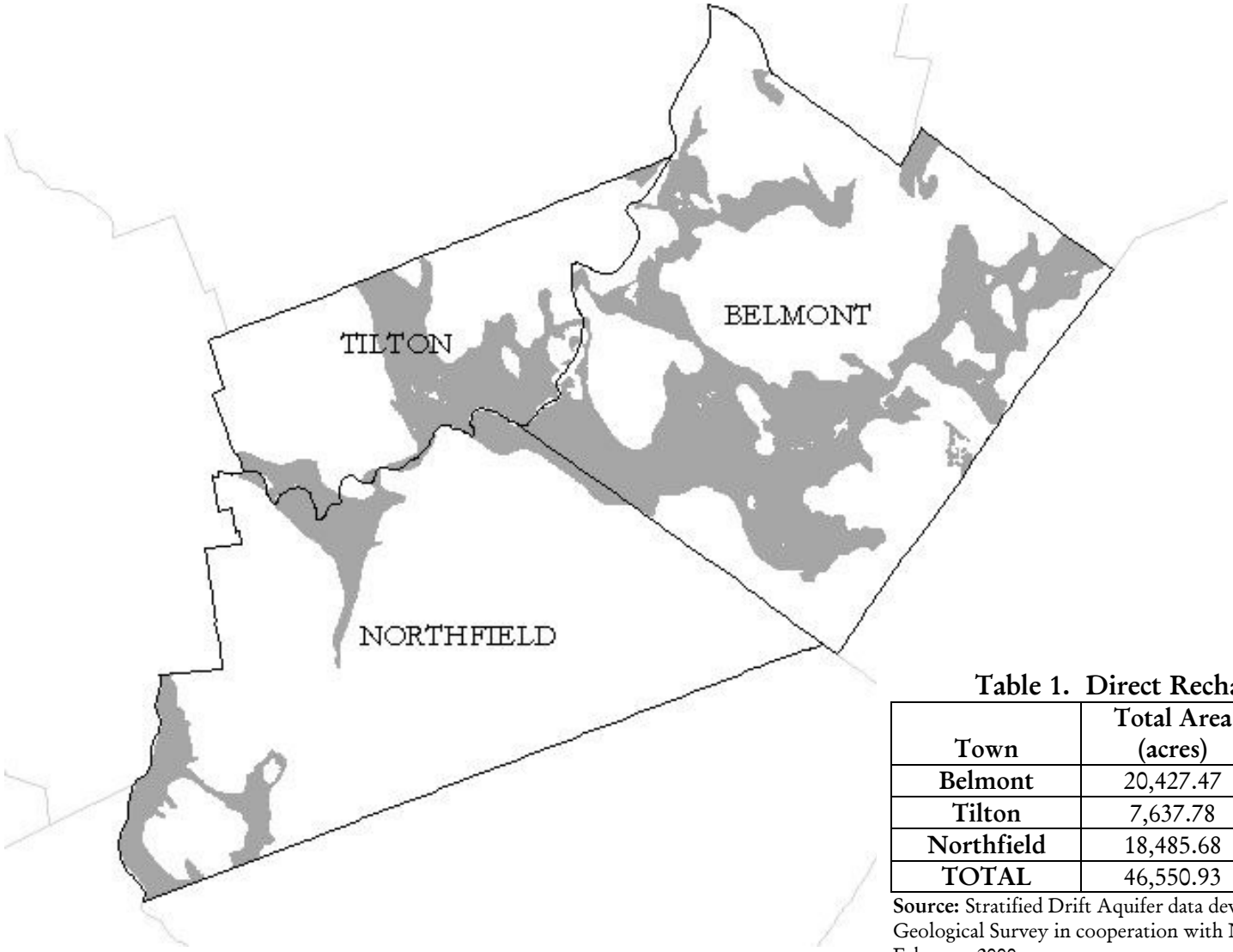


Table 1. Direct Recharge Area

Town	Total Area (acres)	Aquifer Area (acres)
Belmont	20,427.47	7,053.11
Tilton	7,637.78	2,078.35
Northfield	18,485.68	1,976.86
TOTAL	46,550.93	11,108.32

Source: Stratified Drift Aquifer data developed by the US Geological Survey in cooperation with NHDES Water Division, February 2000.

The water within the aquifer is not static; it is always moving from one place to another. Although the movement of ground water is usually much slower than surface water, the rate of flow varies. Other factors being equal, ground water moves faster through coarser materials such as sand and gravel. If pollutants reach the aquifer in the direct recharge area, a large area could become contaminated quickly due to the relatively high hydraulic conductivity of the aquifer materials. Since the aquifer is an important source of drinking water for the three communities, the municipalities are dedicated to protecting this valuable resource.

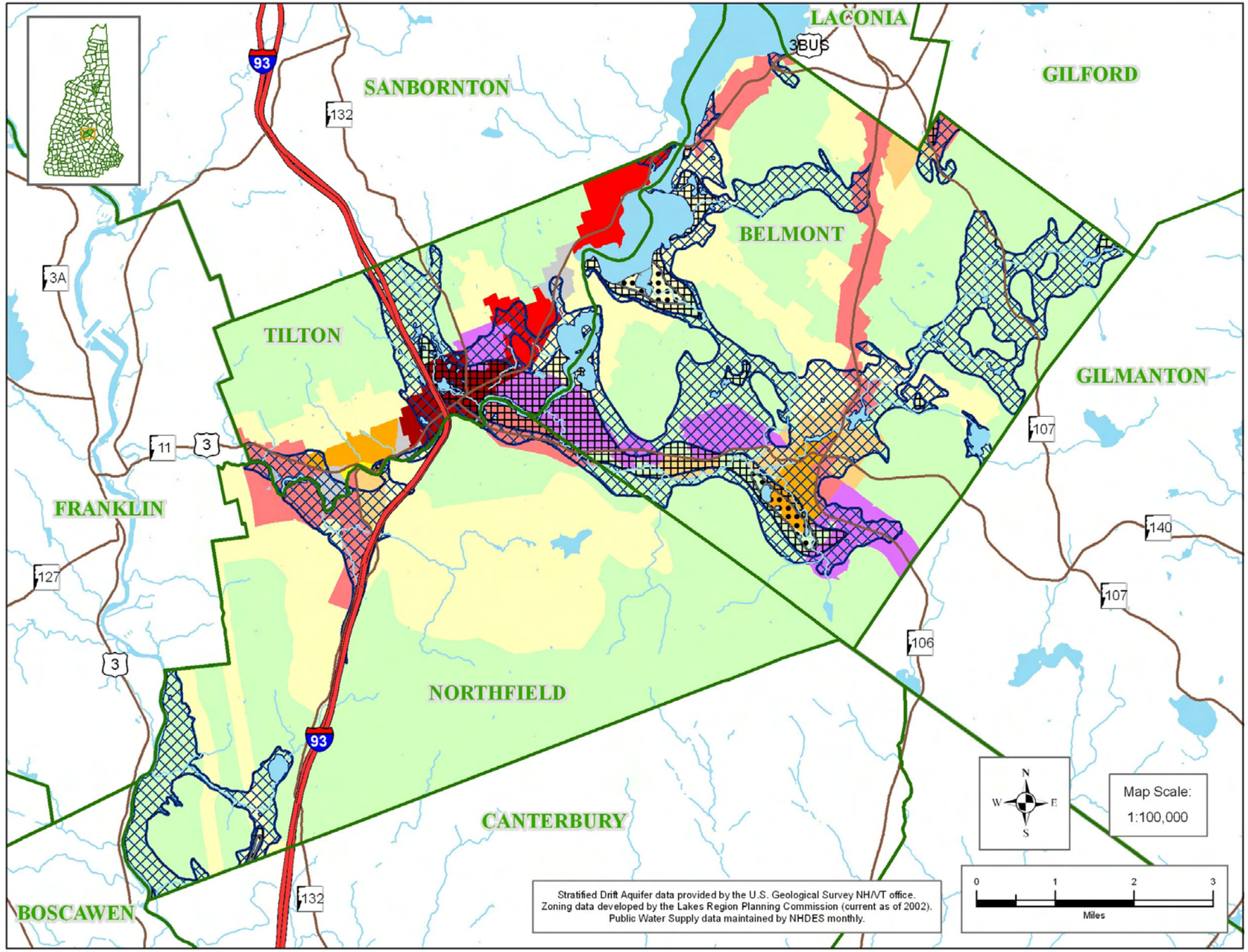
Currently, 33% of the total population of the three towns is served by water drawn from the aquifer. Two water suppliers, the Tilton & Northfield Water District and the Belmont Water Department, supply 3,950 customers (87% of the population served by the aquifer). In addition, there are two other smaller public water supply systems drawing from the aquifer: Lakeland Management Company and Lochmere Village District. The size of the population served by each of the four public water supply systems is depicted in Table 2.

Table 2. Public Water Systems and Population Served

PWS System (gravel wells)	Pop. served
Belmont Water Department	1,450
Lochmere Village District	293
Lakeland Management Co	308
Tilton Northfield Aqueduct Co	2,500
TOTAL	**4,551**

Source: Public Water Supply data developed and maintained by the NHDES-Water Division, Water Supply Engineering Bureau. December 1, 2006.

Figure 4: Stratified Drift Aquifer and Zoning



Aquifer Transmissivity (ft sq/day)

- 1-1000
- 1001-2000
- 2001-4000
- Aquifer Boundary

Belmont Zoning

- Commercial (C)
- Industrial (I)
- Rural (R)
- Residential Single-Family (RS)
- Residential Multi-Family (RM)
- Village (V)

Northfield Zoning

- Commercial/Industrial (CI)
- Conservation (CONS)
- Residential (R1)
- Multi-Family Residential (R2)

Tilton Zoning

- Downtown (DN)
- General Commercial (GC)
- Industrial Park (IN)
- Medium Density Residential (MR)
- Mixed Use (MU)
- Rural Agricultural (RA)
- Resort Commercial (RC)
- Regional Commercial (RG)
- Village Residential (VR)

Other Features

- Town Boundary
- Water Body
- Stream

L·R·P·C

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Meredith, NH 03253

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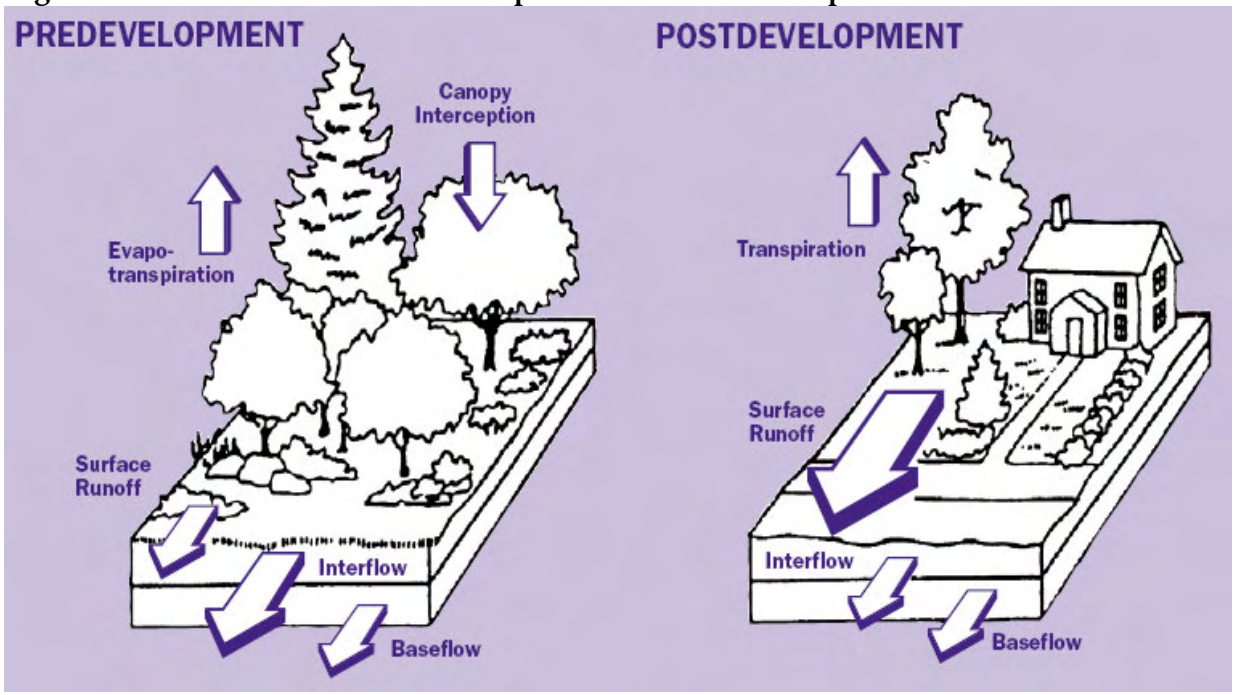
Tri-Town_Aquifer\Stratified Drift Aquifer and Zoning.mxd

Why Use Best Management Practices to Protect Your Drinking Water?

Naturally vegetated areas are best able to capture and treat rainfall or snowmelt during recharge. Vegetation slows and absorbs surface runoff, allowing water to more effectively infiltrate into the soil horizon (Figure 5). Root structures of vegetated areas hold topsoil that assists in filtering potential pollutants from the water as it recharges the aquifer. Land use pressures and increased development result in fewer naturally vegetated areas to allow percolation and filtration of the rainfall and surface runoff.[4] Topsoil, as well as vegetation, is usually stripped from a site prior to development, thereby compounding the lack of filtration.

Figure 5. Water Balance Pre-Development vs. Post-Development



Source: NHDES

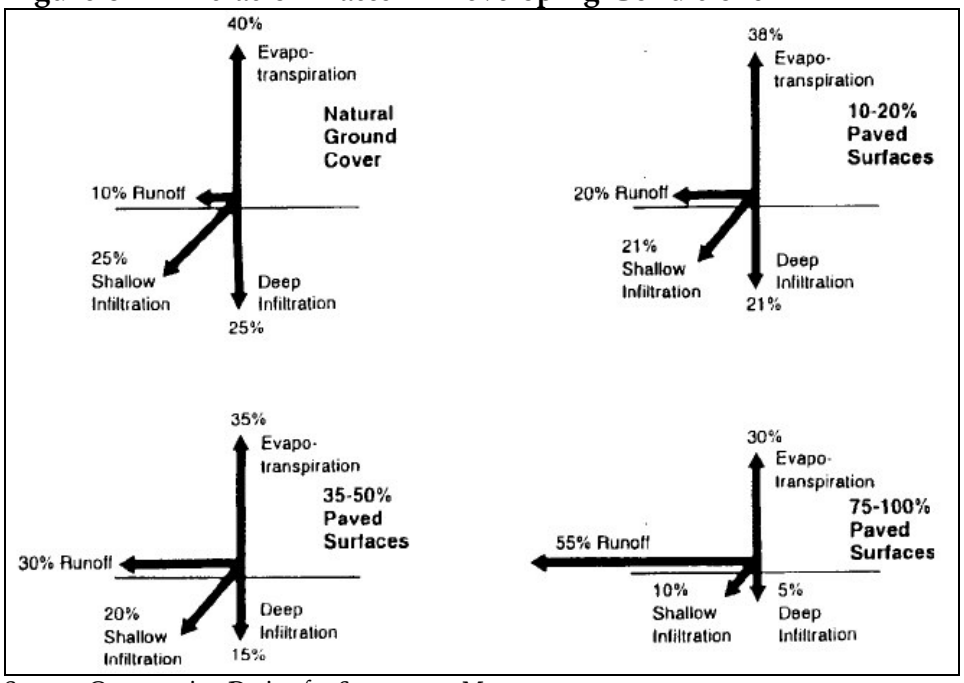
[4] Best Management Practices to Reduce Non-Point Source Pollution in the Town of Plainfield, Connecticut. American Ground Water Trust. In cooperation with the Town of Plainfield, CT. December 2000.

Water Quantity

Impacts to ground water quantity are not always easily seen or measured. A way to illustrate potential effects is by looking at a water budget. New or expanded development results in more roads, buildings, lawns, and parking lots. Along with this often comes road widening, commercial buildings, service centers, and infrastructure development. These activities increase the amount of impervious surfaces, resulting in water moving off site quickly and less water soaking into the ground. As Figure 6 shows, an increase in surface runoff translates into a decrease in infiltration. This results in a decrease in recharge to the water table and therefore, the aquifer. It may not seem like much impact to develop a 10 acre site, however, as reductions in infiltration continue acre-by-acre, development-by-development, the cumulative effect grows larger.

A sign of possible problems is when the water table declines or stream flow rates fall. The water table elevation fluctuates seasonally, however, when there is a decline over a period of time that is not attributable to differences in precipitation or ground water withdrawals, or a combination of the two, then changes in land cover may be responsible for the change. In a healthy system, ground water is constantly moving and discharging into wetlands, streams, or other surface waters. When precipitation is diverted (e.g. discharged to surface water body) and not replenishing the aquifer, there is less water to feed wetlands and streams. During dry periods this can be exacerbated during a drought or peak in water use.[5]

Figure 6. Infiltration Rates in Developing Conditions



Source: Conservation Design for Stormwater Management

[5] Conservation Design for Stormwater Management. A Design Approach to Reduce Stormwater Impacts from Land Development and Achieve Multiple Objectives Related to Land Use. DE DNREC and Brandywine Conservancy. 1997.

Impervious surface within the direct aquifer recharge area.

Since most of the aquifer area is zoned industrial or commercial in all three communities, the future impervious surface coverage could be very extensive. In order to estimate the amount of impervious surfaces overlying the aquifer, the impervious surface coefficients, developed by the University of Connecticut Cooperative Extension, were applied to the developed lands data. Different impervious surface coefficients were developed for commercial zones, industrial zones, and residential zones, which provide an estimate of impervious surface coverage by zone. Further information about the use of impervious surface coefficients can be found in *Protecting Shared Drinking Water Resources: A Collaborative initiative of Belmont, Northfield and Tilton*, located in each town office and the LRPC. The type of land use and corresponding impervious surface coefficient is given in Table 3, while the estimated acres of impervious cover are depicted in Table 4. Figures 7 and 8 illustrate the current and potential future impervious surface areas of Belmont, Northfield, and Tilton.[6]

Establishing protection of the aquifer through planning, zoning, and best management practices is crucial to long-term security of the ground water resources. Ultimately, the impacts to ground water quantity from reduced infiltration can have serious and far reaching consequences. Implementation of BMPs to improve infiltration assists in minimizing development impacts to the ground water.

[6] Protecting Shared Drinking Water Resources: A Collaborative initiative of Belmont, Northfield and Tilton. Lakes Region Planning Commission. December 2003.

Table 3: Land Use Types for Impervious Surface Coefficients

Impervious Surface Coefficient	Type of Land Use for Impervious Surface Coefficient
7.0	Residential (Minimum Lot Size = 2-5 acres)
8.0	Residential (Minimum Lot Size = >5 acres)
10.0	Residential (Minimum Lot Size = 1-11/2 acres)
16.0	Residential (Minimum Lot Size = 1/2-3/4 acres)
28.0	Residential (Minimum Lot Size = 1/8-1/4 acres)
53.0	Industrial
53.5	Commercial/Industrial
54.0	Commercial

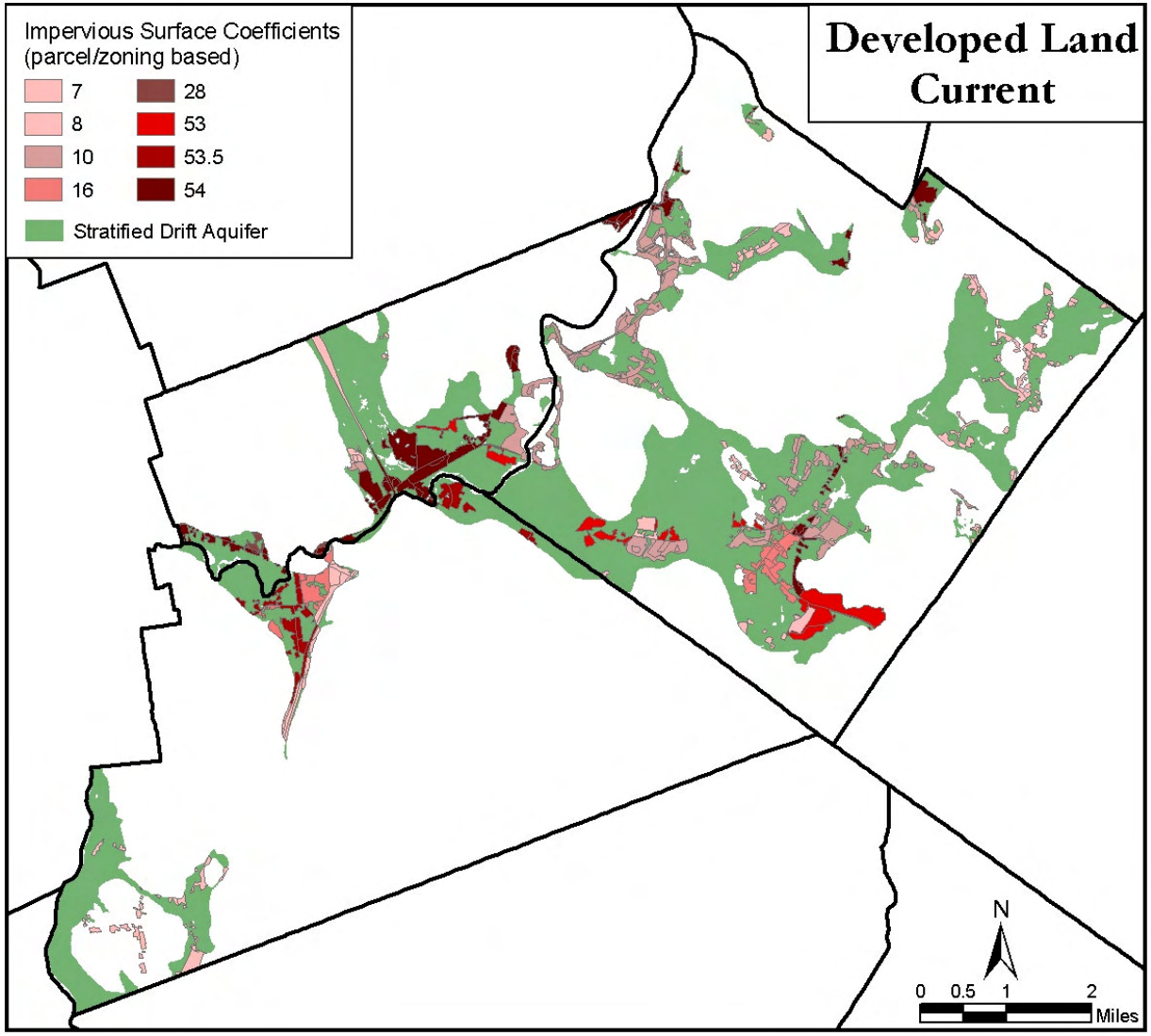
Source: Protecting Shared Drinking Water Resources: A Collaborative initiative of Belmont, Northfield and Tilton.

Table 4: Estimated Acres Impervious

Impervious Surface Coefficient	Belmont Acres of Zone Developed	Estimated Acres Impervious Belmont	Northfield Acres of Zone Developed	Estimated Acres Impervious Northfield	Tilton Acres of Zone Developed	Estimated Acres Impervious Tilton
7.0	393.5	27.6	172.5	12.1	63.4	4.4
8.0	-	-	44.6	3.6	-	-
10.0	753.9	75.4	-	-	97.6	9.8
16.0	136.8	21.9	91.4	14.6	-	-
28.0	-	-	-	-	18.3	5.1
53.0	257.1	136.6	-	-	44.6	23.6
53.8	-	-	180.5	96.6	-	-
54.0	142.2	76.8	-	-	458.7	247.7
TOTAL	**1683.5**	**338**	**489**	**126.9**	**682.6**	**290.6**

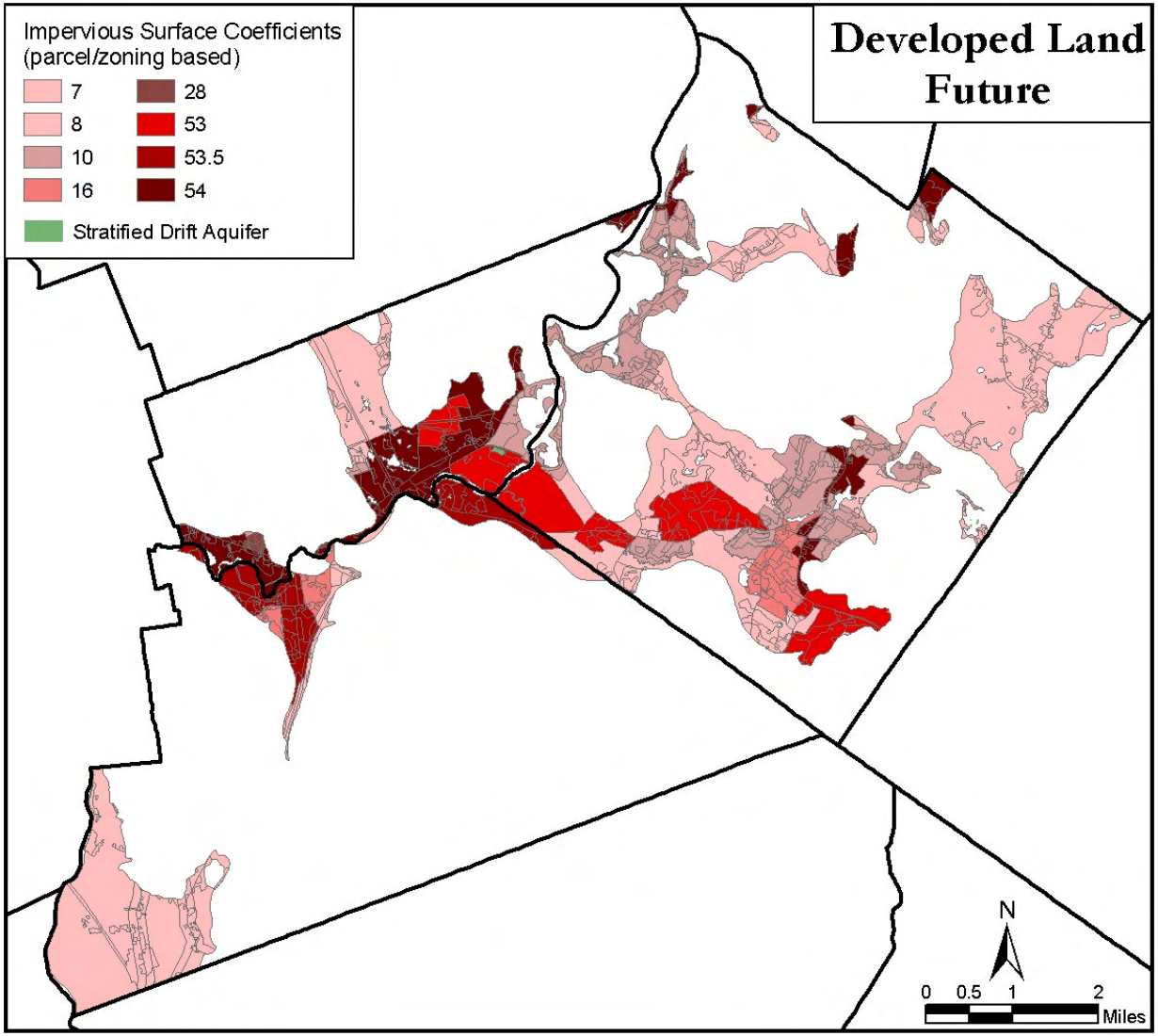
Source: Protecting Shared Drinking Water Resources: A Collaborative initiative of Belmont, Northfield and Tilton.

Figure 7. Impervious Surface Analysis – Current



Source: Protecting Shared Drinking Water Resources

Figure 8. Impervious Surface Analysis – Projected



Source: Protecting Shared Drinking Water Resources

Water Quality

During storms, rainwater flows across impervious surfaces and compacted soils, collecting contaminants, and carrying them to water bodies and into ground water. All of the activities that take place in developed areas have the potential to contribute to the pollutants in storm water runoff. While storm water runoff is often associated with surface water contamination, it can also contribute to ground water/aquifer contamination. Oil, gasoline, and automotive fluids drip from vehicles onto roads and parking lots. Landscaping by homeowners, around businesses, and on public grounds contributes pesticides, fertilizers, and nutrients to the environment. Construction activities disturb protective vegetation and soils thereby creating a more direct avenue for pollutants to infiltrate into the ground and aquifers. They can also contribute various chemicals, automotive fluids, and pollutant-laden sediment to waterways and potentially ground water if construction materials are mishandled. Improperly stored hazardous substances (e.g., household cleaners, pool chemicals, or lawn care products), illicit discharges to storm drains (e.g., used motor oil), and improperly maintained septic systems can also contaminate water supplies.

The US Environmental Protection Agency (EPA) considers nonpoint source (NPS) pollution, including storm water runoff, to be one of the most important sources of contamination of the nation's surface and ground waters. According to a nationwide study, 77 of 127 priority pollutants tested were detected in urban runoff.[7] Principal contaminants found in storm water runoff include heavy metals, toxic chemicals, organic compounds, pesticides and herbicides, pathogens, nutrients, sediments, and salts and other de-icing compounds. Some of these substances are carcinogenic; others lead to reproductive, developmental, or other health problems. Encouraging NPS pollution best management practices (BMPs) for new and existing development will reduce negative environmental impacts on both surface and ground water quality.

Potential Contamination Sources

Potential contamination sources (PCSs) are defined in Section 485-C-7 of the Ground Water Protection Act as "human activities or operations upon the land surface shall be considered potential contamination sources if the activity or operation poses a reasonable risk that regulated contaminants may be introduced into the environment in such quantities as to degrade the natural groundwater quality."[8] Regulated substances, which include regulated contaminants as well as oil or any hazardous substance listed under federal regulation 40 CFR 302, must be managed in accordance with state BMPs as specified under state rule Env-Wq 401, Best Management Practices for Groundwater Protection. The three communities

[7] Best Management Practices to Reduce Non-Point Source Pollution in the Town of Plainfield, Connecticut. American Ground Water Trust. In cooperation with the Town of Plainfield, CT. December 2000.

[8] http://www.gencourt.state.nh.us/rsa/html/L/485-C/485-C-7.htm

have identified existing potential ground water contamination sources within the aquifer direct recharge area. Figure 9 illustrates the locations of these sources.[9]

[9] Protecting Shared Drinking Water Resources: A Collaborative initiative of Belmont, Northfield and Tilton. Lakes Region Planning Commission. December 2003.

Figure 9: Water Resources and Potential Contamination Sources

- Potential Contamination Source
- 2002 Local PCS Inventory
- Reported Contamination area

Aquifer Transmissivity (ft sq/day)

- 1-1000
- 1001-2000
- 2001-4000

Wellhead Protection Area

- Gravel Well
- Bedrock Well

Other Features

- Town Boundary
- Water Body
- Stream

Potential contamination source data maintained by the NH Dept of Environmental Services continually locating sites/facilities, date of data unknown.

Additional local PCS Inventory sites identified by town volunteers, in cooperation with LRPC.

Stratified Drift Aquifer data provided by the U.S. Geological Survey NH/VT office.

N W E S

Map Scale:
1:100,000

L·R·P·C

Lakes Region Planning Commission
103 N. Main St. Suite #3
Meredith, NH 03253

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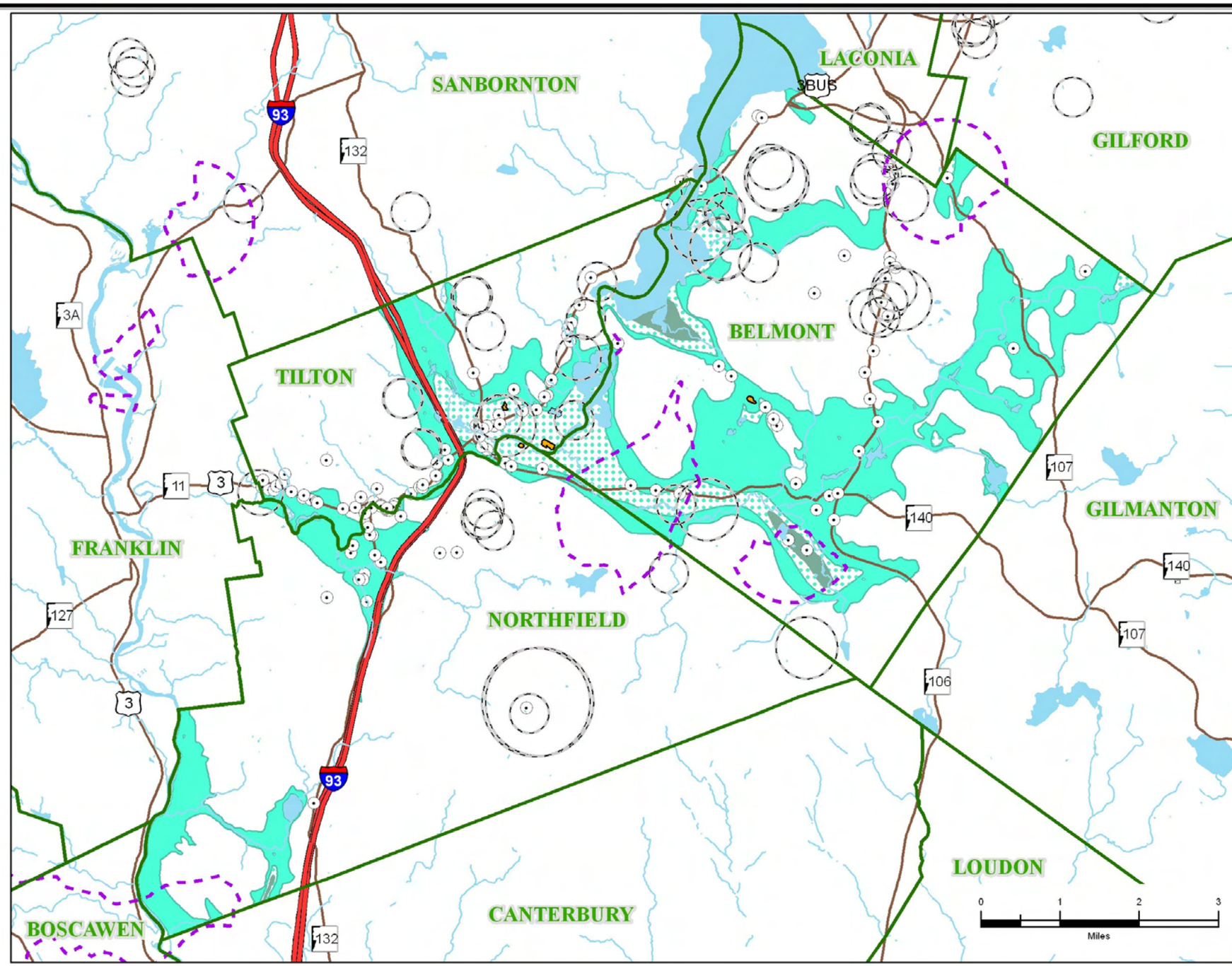

Table 5. Potential Contamination Sources

Potential Contamination Source/Type	Description of Potential Contamination Source	Total # Throughout The Three Towns	Total # Currently Active
Source Water Hazard Inventory Sites	Includes all ground water hazard inventory (sites regulated for ground water concerns), remediation, and initial response spill sites regulated by NHDES to ensure the protection of water resources. *(Updated monthly*)*	127	38
Underground Storage Tank Sites	Sites where there are (or were for inactive sites) underground storage tanks. Tanks with documented releases become classified as a Leaking Underground Storage Tank (LUST) and are listed in the previous row as a Source Water Hazard. *(Updated monthly)*	35	16
Aboveground Storage Tank Sites	Sites where there are (or were for inactive sites) aboveground storage tanks. Tanks with documented releases become classified as a Leaking Aboveground Storage Tank (LAST) and are listed above as a Source Water Hazard. *(Updated monthly)*	14	11
Resource Conservation and Recovery Act (RCRA) Sites	Facilities that generate hazardous waste. Documented releases are listed in the category of Source Water Hazard above. *(Updated monthly)*	101	59
Point/Nonpoint Potential Pollution Sources	Includes local land use inventories carried out by the regional planning commissions in 1995. (March 1995)	29	21
Salvage With 50+ Automobiles	Includes salvage yards registered with NHDES with 50 or more automobiles. (November 1991)	8	8
Local Potential Contamination Sources Inventory Sites (NHDES)	Includes potential contamination sources located within a source water protection area. Sites are located by public water systems applying for a sampling waiver or by windshield surveys by NHDES-WSEB staff. *(Updated monthly)*	40	40
Local Potential Contamination Sources Inventory Sites (LRPC & Town Representatives)	Includes local potential contamination sources identified by LRPC and town representatives during field sessions in each town with GPS equipment as part of this planning project. *(2002)*	91	---

* "Updated monthly" means that the coverage is updated monthly by NHDES to reflect new information that becomes available. The fieldwork upon which the coverage is based is not updated monthly. In the case of the NHDES Local Potential Contamination Sources Inventory, the fieldwork is scheduled to be redone every three years.

Source: Inventory of Public Water Supply Sources and Potential and Existing Sources of Ground water Contamination in the Towns of Belmont, Northfield, and Tilton. NHDES Water Supply Engineering Bureau. January 21, 2007.

RSA 485-C (Groundwater Protection Act) requires all potential contamination sources to follow BMPs, specifically BMPs that are within DES's BMP rule, Env-Wq 401. The BMP rules apply to any business using regulated substances in regulated containers (> 5 gal). The BMPs are basic operational practices and structural controls concerning the transfer, storage, and disposal of regulated substances. Many BMPs are non-structural and inexpensive to implement such as developing spill

response plans, instituting good housekeeping, and recordkeeping. Structural BMPs, such as impervious surfaces or berms, may be more expensive. However, structural BMPs that prevent regulated substances from infiltrating into ground water will reduce the potential liability of significant financial cost for ground water clean up and remediation. Local entities (towns, water suppliers) are indispensable partners with DES to ensure compliance with BMP requirements.

Site planning for new development provides an opportunity to utilize a greater range of BMPs at lower cost to address future potential problems. The goal of this guidebook is to familiarize you with various BMP types and to refer you to materials that will provide specific information needed to make selections for your sites. This guidebook contains examples of BMPs that are suitable for the region. By providing this guidebook to their communities as a resource, the three municipalities are taking a proactive approach to ensure their drinking water supply has the greatest protection available.

How to Use the BMP Guidebook

The guiding principle in selecting a BMP is, will the BMP perform treatment of expected contaminants from proposed uses prior to infiltration. This Guidebook is a resource to raise awareness regarding land use activities and their effect on the aquifer. It describes BMPs that can reduce or prevent pollutants from entering the regional aquifer and impacting ground water. Implementing the BMPs in this Guidebook will help protect the regional public drinking water supply. The Guidebook contains information on BMPs relevant to the land uses and management goals of Belmont, Northfield and Tilton. The Guidebook is designed to serve as a resource for engineers, developers, business owners, town officials, and community members. It is intended as a basic guide for identifying BMPs that may be appropriate for controlling ground water pollution and achieving aquifer protection. Each section includes the following:

- Overview of the BMP category
- Specific information for each BMP
- Laws and regulations in NH pertaining to each category

The BMPs were selected from a variety of published information resources prepared by federal, state, and non-government organization sources listed in the Resources section (pg. 89) of the Guidebook. This list should not be used as a sole source of information for selecting BMPs. As the three communities change and evolve, new approaches may be required to protect the aquifer resources. Furthermore, additional BMPs may become appropriate as new innovations to control pollution and protect ground water are pursued. The Guidebook is not a blueprint on how to design specific BMPs; it is a resource guide to identify BMP options that may be considered during site plan review and activity planning to prevent the pollution of ground water resources.

Choosing appropriate BMPs for a site is based on several factors. Site characteristics such as land use, hydrology, geology, topography, and soil types all effect the selection of BMPs. Further considerations should include development type, aesthetics, maintenance, cost, and ownership. Potential Contamination Sources must comply with Env-Wq 401. Municipalities can also require that specific BMPs be utilized in sensitive ground water recharge areas. Ultimately, where not specifically prescribed by rules, BMP suitability should be based on many factors and is the responsibility of the site engineers and developer to ensure the BMPs meet the site design specifications and protect the aquifer from pollutants.

Reducing pollution from regulated substances is paramount to protecting the aquifer resources. NH DES oversees numerous regulatory programs for substances of concern to aquifer protection. Regulations and information specific to these programs can be found at http://www.des.nh.gov/desadmin.htm.

Past practice has shown that a combination of several complementing BMPs are usually necessary to achieve best water resource protection and sustainable land uses for a particular parcel of land and surrounding area. New innovations to control pollution and runoff are being developed. These evolving approaches to control runoff and protect ground water resources should also be considered. The BMPs contained in the Guidebook were chosen to address the following topics:

- Underground & Aboveground Storage Tank BMPs
- Commercial & Industrial BMPs
- Conservation Design
- Site Design BMPs
- Erosion & Sediment Control BMPs
- Septic System BMPs
- Road Maintenance BMPs
- Gravel & Sand Pit BMPs
- Residential BMPs

Each BMP was chosen to specifically protect the stratified drift aquifer and drinking water supply. There are numerous BMPs appropriate for storm water runoff and surface water protection. However, in order to facilitate the creation of a guidebook to focus on water quantity and quality issues for the aquifer, only those BMPs that address ground water protection have been included. Furthermore, BMPs for high-density, ultra-urban areas are not suitable for the three communities and have not been included.

Appendix A contains checklists highlighting the regulations and suggested BMPs pertinent to each land use category in this Guidebook. The checklists will provide an overview of when a permit is required or when a BMP is recommended. The reader should contact town and state officials for updated and specific permitting and BMP requirements before submitting a site development plan for official consideration.

Appendix B is a comprehensive matrix of the BMPs outlined in the Site Design Section. The matrix rates performance, cost effectiveness, and cold weather effectiveness. Since New Hampshire is in a northern climate, special consideration must be paid to the effects of winter conditions (snow, ice, salt) on the effectiveness of the BMPs, as the next section will explain.

Appendix C contains schematics of each site design, or structural, BMP included in this Guidebook. The schematics provide an example of what the design could look like and should not be used as the only engineering reference.

Cold Climate Considerations

BMPs should always be chosen with site and environmental considerations in mind. Many innovative technologies have been designed and successfully installed in warmer regions of the country; however, many of these BMPs are not suitable for the New Hampshire climate. Prior to adopting BMPs at a site, you first must evaluate the suitability of the BMP to the region.

The UNH Stormwater Center is conducting research on porous pavement and other BMPs and can be contacted for specific information at http://www.unh.edu/erg/cstev/. Caraco and Claytor (1997) is another good source for insight into many of the situations and cold weather BMP modifications that should be addressed for central New Hampshire. Items to be considered when selecting a BMP to be installed in New Hampshire are:[10]

- Frost heaves – potential to damage structural features of BMP such as pipes or concrete infrastructure
- Pipe freezing – when freezing occurs there is a reduction in treatment as well as risk of flooding
- Reduced biological activity – for BMPs that rely on biological mechanisms to reduce nutrients and organic matter. Cold temperatures reduce microbial activity
- Reduced settling velocities – when water cools, its viscosity increases, which reduces particle velocity by up to 50% and makes it more difficult for particles to settle out
- Reduced infiltration – due to freezing of soils and filter media
- Increased runoff volumes during snowmelt – if the ground remains frozen, snowmelt cannot infiltrate the soil and instead will contribute to the amount of runoff present
- Access difficulties in ice and snow – access points frozen shut, difficulty locating BMPs under snow load

There is also a potential for additional maintenance requirements during late fall and winter months due to seasonal occurrences such as leaf fall, road salting and sanding, freezing, and vegetative die-off. The increased vegetation, snow removal aids on the roads, and accumulation of materials in snow piles increase the pollutant loading during these months. Cold climate pollutants include:[10a]

[10] Stormwater BMP Design Supplement for Cold Climates. Caraco, Deborah and Richard Claytor. Prepared by the Center for Watershed Protection, Ellicott, Maryland for the U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, EPA Grant #CP 985242-01-0. 1997.

- Sand
- Salt
- PAHs – Polycyclic Aromatic Hydrocarbons emitted from fireplaces and inefficient vehicles in winter
- Cyanide – salt additive to prevent clumping

Therefore, BMPs that use filtration, settling, or trapping to remove contaminants require frequent inspection and maintenance. Some highly successful BMPs found in warmer climates, such as porous pavement and surface sand filters are not normally suitable in the New Hampshire region but may be allowable under certain conditions. Regular maintenance of BMPs is recommended just prior to the first snowfall or road sanding, after the last snowfall, and during spring snowmelt to ensure proper treatment of runoff.

New Hampshire Laws and Regulations

The following regulations give communities the authority to implement various actions associated with this Guidebook to protect ground water, such as developing a Master Plan or enacting innovative land use controls. This list is not exhaustive. There are additional federal and state regulations pertinent to ground water protection that are not included here. The New Hampshire legislature enacts new RSAs and the RSA numbers also change. The reader should always check the current regulations to make sure they will be complying with the law. The current laws and regulations can be found at: http://www.gencourt.state.nh.us/rsa/html/indexes/.

Regulations:

- Subdivisions, Nonresidential and Multi-family Residential Site Development (RSA 674:35; 674:43) – Authorizes local planning boards to regulate developing or developed land.

- Innovative Land Use Controls (RSA 674:21) – Defines innovative land use controls and terms for including them in ordinances. Adoption of ground water or aquifer protection regulations as part of a zoning ordinance are also regulated within RSA 674: 21.

- Master Plans (RSA 674:1-4) – Describes requirements for developing a local master plan.

- Zoning Ordinances (RSA 674:17-20) – Authorizes and describes the process for implementing zoning ordinances in municipalities.

- Alteration of Terrain Program Site (RSA 485-A:17) – Regulates excavation and road construction activities greater than 100,000 square feet, or 50,000 square feet within a protected shoreland area. Protected shoreland is any land within 250 feet of the public boundary of public waters, which includes all waterbodies with a surface area of 10 acres or more, all fourth order or higher water courses, estuaries, and coastal waters www.des.nh.gov/rules/env415.pdf.

- NPDES Permit – Phase II Stormwater Regulations – Federal permit for construction sites (including road construction areas if soil is disturbed) that disturb one or more acres. The NHDES is the permitting authority for these regulations. They can be found at www.des.nh.gov/stormwater/construction.htm.

- Septic System Regulations (Env-Ws 1000) – Rules governing subdivision and individual sewage disposal systems. They can be found at www.des.nh.gov/rules/envws1000.pdf.

- Minimum Shoreland Protection Standards (RSA 483-B:9 and CSPA rules Env-Wt 1400) – Prohibits the establishment or expansion of salt storage yards within protected shoreland areas.

- Disposal of Waste to Surface Water (RSA 485-A:13) – prohibits disposal of waste to surface water without a permit. Plowed snow contains waste and needs a permit for such disposal.

- Gravel Excavation Regulations (RSA 155-E & Env-Wq 401) – Authorizes communities to regulate gravel excavations. Operational and reclamation standards are outlined, including setbacks, buffers, drainage, erosion and sediment control, chemical storage, and reclamation.

- Statutory Authority (RSA 125-C:4 & Env-A 600, 700, 800, 900, 2800) – Provide standards for particulate matter emissions.

- Underground Storage Tanks (RSA 146-C and Env-Wm 1401) – New Hampshire regulations specific to underground storage tanks.

- Aboveground Storage Tanks (RSA 146-A:11-c and Env-Wm 1402) – Governs aboveground storage tanks regulations in New Hampshire. Contact the DES Oil Remediation and Compliance Bureau at (603) 271-3644 with questions regarding above or underground tanks.

- Homeowner Grant Program (RSA 146-E) – Homeowners are required to use DES "Best Management Practices for the Installation or Upgrading of On-Premise-Use Heating Oil Tank Facilities." This program authorizes up to $1,000 for owners that demonstrate a financial need to meet these requirements http://www.des.state.nh.us/orcb_hwrb.htm.

- The Hazardous Waste Management Act (RSA 147-A) – Authorizes NH DES to regulate the management, transportation, and disposal of hazardous waste in New Hampshire. Specific regulations governing hazardous waste are found in Env-Wm 100-1000. Questions regarding proper hazardous waste management should be directed to the DES Hazardous Waste Compliance Section at (603) 271-2942. Further information can be found at www.des.state.nh.us/hwrb/hwrules.pdf.

- The Ground Water Protection Act (RSA 485-C) – Authorizes local entities (e.g. municipality, water supplier) to apply to DES to reclassify existing wellhead protection areas (WHPAs) or high value groundwater (aquifers) zones. Reclassification to "GAA" is designed for wellhead protection areas and limits a short list of high-risk land uses within the WHPA. GAA reclassification also provides the authority for a local entity to institute a BMP management program that includes conducting regular BMP surveys (inspections) and distributing education materials to ensure compliance with state rule Env-Wq 401, Best Management Practices for Groundwater Protection. GA1 reclassification applied to high-value groundwater, such as an aquifer, involves establishing a PCS management program and education.

- Collection and disposal fee (RSA 261:153(V) and RSA 149-M:18) – City treasurers and town clerks can assess a fee to pay for collection and disposal fees of motor oil, car batteries, and car tires. A Vehicle Registration Fees fact sheet is available at www.des.nh.gov/sw.htm or call DES at (603) 271-2975.

- The N.H. Pesticides Controls (RSA 430:28-48) – Requires pesticide applicators to obtain permits from or to be licensed by the Division of Pesticides Control prior to application. Pesticides must be registered with the state, and applicators must submit reports of pesticide usage annually. Commercial applicators are also required to pass an exam that covers label protocol, chemical safety, environmental consequences, pest types, and use of application equipment. More information on certification, storage of pesticides, application, and setbacks from water resources can be found in the rules Pes 100-1000 at www.state.nh.us/agric/pecorl.html.

- The Shoreland Protection Act stipulates that no fertilizer, except limestone, shall be used within 25 feet of the high water line of a waterbody www.des.nh.gov/cspa/483B.htm.