# Protecting Shared Drinking Water Resources


*A Collaborative Initiative of Belmont, Northfield, and Tilton*

# Protecting Shared Drinking Water Resources

*A Collaborative Initiative of Belmont, Northfield, and Tilton*

## Final Project Report

**December 2003**

**Prepared by**
**Lakes Region Planning Commission**
**103 Main Street, Suite #3**
**Meredith, NH 03253**

Funding for this project was provided in part by a Source Water Protection Grant from the NH Department of Environmental Services and by the Lakes Region Planning Commission. The Lakes Region Planning Commission assumes sole responsibility for the accuracy and presentation of information contained in this report.

**"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 groundwater 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

# Table of Contents

# List of Maps, Figures, Tables, and Charts

# Common Vision

## Common Vision

The towns of Belmont, Northfield, and Tilton are very fortunate, in regards to our existing and potential future needs for drinking water, to be located on a large stratified drift aquifer. 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 groundwater protection will assist our towns in maintaining the viability of common drinking water resources into the future.

# Project Summary

## Project Summary

Beneath the towns of Belmont, Northfield, and Tilton lies a sizable stratified drift aquifer which currently supplies drinking water to a portion of the towns' residents, and which 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 which 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 was completed by December 2003. A project timeline is found near the end of this section.

### 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:

- Provide Belmont, Northfield, and Tilton with a detailed assessment of the stratified drift aquifer as a drinking water source to meet existing and potential future needs;
- Assist the towns in developing recommendations and implementation strategies for projects based on this assessment;
- 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.

Without the active participation of representatives from the three communities in many of the components of this project, 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.

**Project Report and Additional Resources**

This report is designed to provide the three towns with a comprehensive assessment of their stratified drift aquifer resources, including exploring potential threats to the quality and quantity of existing and potential drinking water sources and providing recommendations for addressing the most significant threats. This information should assist the three communities in their planning efforts to protect drinking water resources.

A four-page summary has been developed to provide an overview of this project and the contents of this report. This summary is available in each Town Hall.

Large format copies of the Potential Contamination Sources map contained in this report can be found in each Town Hall. Due to their larger size, a higher level of detail can be found on these maps, and those interested in this report are encouraged to view these larger maps for additional information.

In addition to this report, a compendium Implementation Strategies binder has been developed to assist the communities in implementing the recommendations determined to be of the highest priority to the protection of the aquifer. This second document is designed as a workbook to facilitate the efforts of the three towns. A copy of this binder can also be found in each Town Hall.

The following quotes are from the letters of support written by the three communities and included in 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.

"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*

"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*

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

## Implementation

This report, and the associated Implementation Strategies binder, are designed to assist the three towns in taking active steps to protect the stratified drift aquifer as a drinking water supply. Implementing key recommendations to address threats to the stratified drift aquifer will be a challenging process. The three towns will need to balance the benefits of growth and economic development with the long-term protection of the quality and quantity of existing and potential water supplies provided by the stratified drift aquifer, taking into account many of the issues and factors described in this report. 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 communities to draw in additional stakeholders, to implement measures to protect drinking water resources for the benefit of today's residents and the next generations.

## How Can I Get Involved?

**If you're interested in learning more about this project or the contents of this report, please contact:**

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

**If you would like information on statewide efforts to protect groundwater and drinking water, please contact:**

New Hampshire Department of Environmental Services (NHDES)
Drinking Water Source Protection Program (DWSPP)
Sarah Pillsbury, DWSPP Supervisor
P.O. Box 95, 6 Hazen Drive
Concord, NH 03302
(603) 271-1168
spillsbury@des.state.nh.us

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

**Project Timeline**

***Fall 2001***

- LRPC and NHDES meet with representatives from the towns of Belmont, Northfield, and Tilton to discuss the possibility of submitting a grant application to NHDES's Source Water Protection Grant program for a collaborative project to plan for the protection of existing and potential future drinking water sources.
- LRPC drafts and submits a grant application on behalf of the 3 towns.

***Spring 2002***

- The project receives a Source Water Protection Grant from NHDES.

***Summer 2002***

- A Kick-Off Meeting is held to involve representatives from the three communities in the project from the very beginning, and gather their perspectives, concerns, and ideas. This group of town representatives is given the name "Water Resources Committee".

***Fall 2002-Spring 2003***

- Four community meetings are held in community spaces in the three towns. Representatives from the three communities participate actively in the meetings, and are asked to contribute their local knowledge to the project. This information guided the project and is incorporated throughout this report.
- Community volunteers assist LRPC staff in carrying out the fieldwork for the Local Potential Contamination Source Inventory. The map and additional information on this inventory are found in a subsequent section, "Potential Contamination Sources".
- Key stakeholders, including the two largest public water suppliers drawing from the aquifer, are interviewed for this report.

***Summer - Winter 2003***

- Two additional community meetings are held to discuss project status, report content, public education and outreach, and the initiation of project implementation.
- This project report is drafted. Representatives from each community read a complete draft of the report and provide comments which are incorporated into a final draft. The report is also reviewed by NHDES and LRPC, and revised based on recommendations.
- Once the draft document is edited and in final draft form, Planning Boards of the three towns are provided with a copy for their review. This final report is then edited, formatted, and printed.
- A four-page summary of the project is developed for distribution.
- An Implementation Strategies workbook is developed and distributed to the Water Resources Committee which contains guidance and resources for implementing the priority recommendations.

# Background Information on Groundwater Resources

## Background Information on Groundwater Resources

Because this project focuses on the long-term protection of drinking water resources underground, you can't see where the water is, how much there is, and 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 shared drinking water resources, the three towns need an understanding of what is happening beneath the surface. It is critical to have a firm scientific basis when implementing projects and developing regulations specific to the needs of the three towns. This section of the report provides detailed information on the shared aquifer, drawing from a number of sources. In addition, information on the basics of groundwater dynamics is incorporated throughout this section, which should help readers with different levels of expertise begin reading this report from a similar level of understanding.

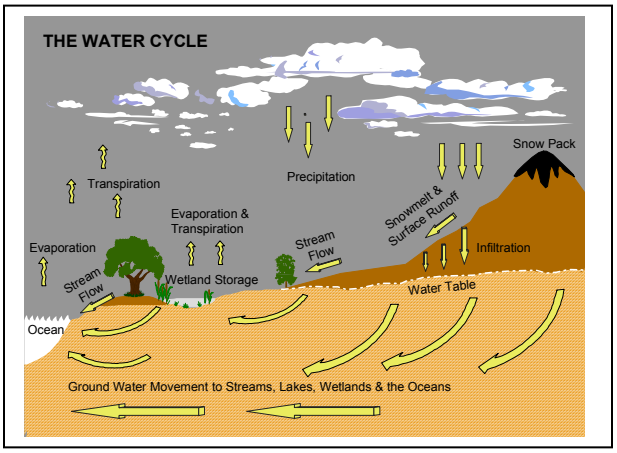



***Figure 1. Hydrologic Cycle***

**Source:** NHDES

The movement of water between the atmosphere and the earth, through precipitation and evaporation, 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. Beneath the water table is the saturated zone, where all the spaces between rock and soil particles are filled with water. Groundwater is the water in the saturated zone.

This report and project explores the long-term viability of drinking water supplied by the stratified drift aquifer situated beneath parts of the three towns. A stratified drift aquifer is made of deposits of sand and gravel (called stratified drift) left behind by the glaciers, which have the ability to store water in the empty spaces between their particles in a quantity large enough to yield a sufficient water supply to a well. Map 1 should help you get a sense of where the stratified drift aquifer is located beneath the three towns.

Although the primary focus of this report is on the portion of the aquifer which is contiguous and shared by the three communities, and which serves as a public water supply in the present, the total aquifer area for the three towns is provided throughout this report to assist the communities in their comprehensive planning efforts.

A stratified-drift aquifer is made of sand and gravel particles which can store a lot of water between them. The porosity, or the volume of empty space in a unit volume of material, is 20 to 40 percent in a sand and gravel aquifer.[1] The water within the aquifer is always moving from one place to another. The movement of groundwater is usually much slower than water flowing on the surface of the earth although the rate of flow varies, with faster movement through coarser materials. The direction of the movement of groundwater does not always correspond to the movement of water on the surface. Most groundwater eventually naturally discharges (exits the ground) into a river, lake, or wetland.[1]

Map 1 depicts three different shades of color within the outline of the aquifer. A darker shade of color indicates a zone of higher transmissivity, or an area of the aquifer that has a higher potential to yield a good supply of water. Wells located in the zones of highest transmissivity would likely yield enough water for municipal and industrial needs. Wells located in the zones of medium transmissivity would likely yield enough water for a small water system such as a condominium complex, while wells located in the lowest transmissivity areas of the aquifer would likely provide enough water for individual homes and light commercial uses.

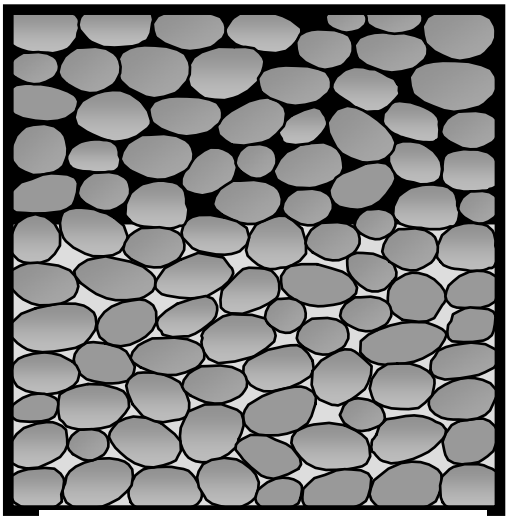


**Figure 2. Stratified Drift Aquifer**
Source: NHDES

Both the thickness of the stratified drift deposits from the water table down to the bedrock or till surface (called saturated thickness) and the ability of the porous material to transmit a fluid (called hydraulic conductivity) contribute to the transmissivity of the aquifer. Aquifer transmissivity is a number which indicates the ability of the entire thickness of the aquifer to produce water. The units of transmissivity, $ft^2$/day, come from multiplying hydraulic conductivity by saturated thickness.[2]

The table below shows the number of acres of the total stratified drift aquifer in each of the three transmissivity ranges, as well as the percent of the total aquifer in each range. The total size of the stratified drift aquifer area in the three towns is approximately 11,108 acres. Of this total, 2.18% (approximately 242 acres) is in the highest of the three transmissivity ranges, from 2000-4000 $ft^2$/day. Approximately 1955 acres, or 17.6% of the total aquifer area, are in the middle transmissivity range of 1000-2000 $ft^2$/day.

**Table 1: Stratified Drift Aquifer Acreages and Percentages**

| Transmissivity Range ($ft^2$/day) | Total Acres in Subregion | Percent of Total Aquifer |
|---|---|---|
| 0-1000 | 8910.79 | 80.22 |
| 1000-2000 | 1955.32 | 17.60 |
| 2000-4000 | 242.21 | 2.18 |
| *TOTAL AQUIFER* | 11,108.32 | 100.00 |

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

The following table breaks the acres of aquifer area down by town, as well as the acres in each transmissivity range. Belmont has approximately 7053 acres of land underlain by stratified drift aquifer, Tilton has approximately 2078 acres, and Northfield has approximately 1977 acres. Of the total acres of aquifer in each town, Belmont has 231.65 acres in the 2000-4000 $ft^2$/day transmissivity range, Northfield has 10.56 acres in this higher range, and Tilton has no acres in this range. In the middle category of transmissivities (1000-2000 $ft^2$/day), Belmont has approximately 1226 acres of land underlain by stratified drift aquifer, Tilton has approximately 577 acres, and Northfield has approximately 152 acres.

**Table 2: Aquifer Acres Per Town**

| Transmissivity Range | Subregion (acres) | Belmont (acres) | Tilton (acres) | Northfield (acres) |
|---|---|---|---|---|
| 0-1000 ft2/day | 8910.79 | 5595.42 | 1500.94 | 1814.43 |
| 1000-2000 ft2/day | 1955.32 | 1226.04 | 577.41 | 151.87 |
| 2000-4000 ft2/day | 242.21 | 231.65 | 0.00 | 10.56 |
| *TOTAL AQUIFER* | 11,108.32 | 7053.11 | 2078.35 | 1976.86 |

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

Currently, 29% of the total population of the three towns is served by water drawn from the stratified drift aquifer. Two water suppliers, the Tilton & Northfield Aqueduct Company and the Belmont Water Department, supply 3800 total customers (90% of the population served by the stratified drift aquifer). In addition to these two water suppliers, there are two other smaller public water supply systems drawing from the stratified drift 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 the following table.

**Table 3: Public Water Systems and Population Served**

| PWS System (gravel wells) | Pop. served |
|---|---|
| Belmont Water Dept | 1300 |
| Lochmere Village District | 113 |
| Lakeland Mgt Co | 308 |
| Tilton Northfield Aqueduct Co | 2500 |
| TOTAL | 4221 |

**Source:** Public Water Supply data developed and maintained by the NHDES-Water Division, Water Supply Engineering Bureau. December 30, 2003. Public water supply information revised periodically based on information provided by public water systems.

The four active public water supply systems have a total of seven active sources drawing from the stratified drift aquifer. The Belmont Water Department has two active sources (0201010-001,2), the Tilton & Northfield Aqueduct Company has two active sources (2351010-003,4), the Lochmere Village District has two active sources (2351020-001,2), and the Lakeland Management Company has one active source (0202010-004).

## Interviews with Water Departments

The two largest public water suppliers drawing from the aquifer, the Belmont Water Department and the Tilton & Northfield Aqueduct Company, provided information specific to their wells for this report. The interviews are summarized briefly below. Additional information drawn from the interviews, including concerns identified by the public water supply companies, is found in the "Potential Threats to Groundwater Resources" section of this report.

### *Tilton & Northfield Aqueduct Company*

Barbara and Ken Money, owners of the Tilton & Northfield Aqueduct Company, spoke with the Lakes Region Planning Commission in November 2002.

The company currently has two wells and has a third well sited. The company has only been drawing its water supply from the aquifer since 1998. Prior to that time the supply came from Knowles Pond. The company has approximately 900-1000 services. The number of services is not directly correlated with the number of people served or the amount of water used. For example, a service could be one house but it could also be a 35 unit apartment building or a business. The company is permitted for 1.2 million gallons per day, and currently averages 450,000 gallons per day. Water quality is very good. The company uses sodium hydroxide to adjust the pH, zinc orthophosphate for corrosion control, and chlorine for disinfection.

More than a third of the system is brand-new, with the oldest portions being 50 years old. There was a need to replace 100 year-old pipes in 1998, and at that time the rates went up 180 percent. A reduction in water usage was noted for about the first six months as people conserved due to the cost increases, but subsequently water usage went back up. Currently there are no large commercial users. Most large commercial operations are interested in fire protection as well as lawn irrigation.

The general water use pattern shows an increase over time. The company's long-term plans are to react to the needs of communities. The owners of the Tilton & Northfield Aqueduct Company expressed that their largest concern was growth and development that might impact water quality.

***Belmont Water Department***

Frank Clairmont, Water and Sewer Director of the Belmont Water Department, shared his thoughts on issues related to water supply in an interview with LRPC in March 2003. Mr. Clairmont has worked for the Belmont Water Department for 20 years.

The Belmont Water Department maintains two wells situated in close proximity to each other. The wells draw 110,000 gallons/day, and the town has a one million gallon storage tank. This means that eight or nine days worth of water can be stored in the tank. The tank has recently been completely refurbished. The water is adjusted for pH by adding caustic soda, and Aqua Mag is added to suspend iron and manganese so that the high iron content of the water is lowered to satisfy customers, but otherwise the water is untreated and water quality is very good.

Due to ice damage in 1994, a hole in the water tank caused the loss of 700,000 gallons of water. Replacing the tank would be a costly effort, as it costs approximately $1/gallon to build a new tank. Currently there is a site for a new well near the two existing wells. One of the existing wells is located near a road, and so is at a higher risk of becoming polluted from road salt and spillage. If a new well is built, the well closer to the road would likely be shut down.

Mr. Clairmont indicated that the potential for extending the current waterlines from existing wells to reach additional customers from a larger land area is limited. The current area supplied by the water company has been fairly constant for some time, and there are limiting factors for expansion such as: converting smaller diameter pipes to larger diameter pipes along the southern boundary, the town line and dog track as a barrier to the east, an uphill run with no houses to the northeast, and very few potential customers to the northwest. Growth within the area currently served was not discussed in the interview; without extending the waterlines, population growth in the area served could increase the amount of water distributed to households from the stratified drift aquifer.

## Future Water Needs

It is important to keep in mind that the aquifer could also serve as a water supply to meet the needs of future growth. Currently over a quarter of the population of the three towns is served by water drawn from the aquifer, and the use of the aquifer as a public water supply has the potential to increase. The next section of this report will provide information on demographic trends and population projections which need to be taken into consideration when thinking about future drinking water supply needs.

## Groundwater Recharge

The water found stored in the aquifer is replenished (called "recharged") when rain and snowmelt soaks into the ground and moves down through the soil to the saturated area below the water table, rather than evaporating or running off into surface waters. Groundwater in stratified drift aquifers is recharged in two ways: direct recharge and indirect recharge. The land area which lies directly over the stratified drift deposit is the direct recharge area; in most cases, this area directly contributes water that enters the ground to the underlying aquifer. The water contributed by areas outside the direct recharge area is called indirect recharge. This report will focus primarily on the direct recharge area of the aquifer.

**Figure 3: Direct Recharge Area-Stratified Drift Aquifer**

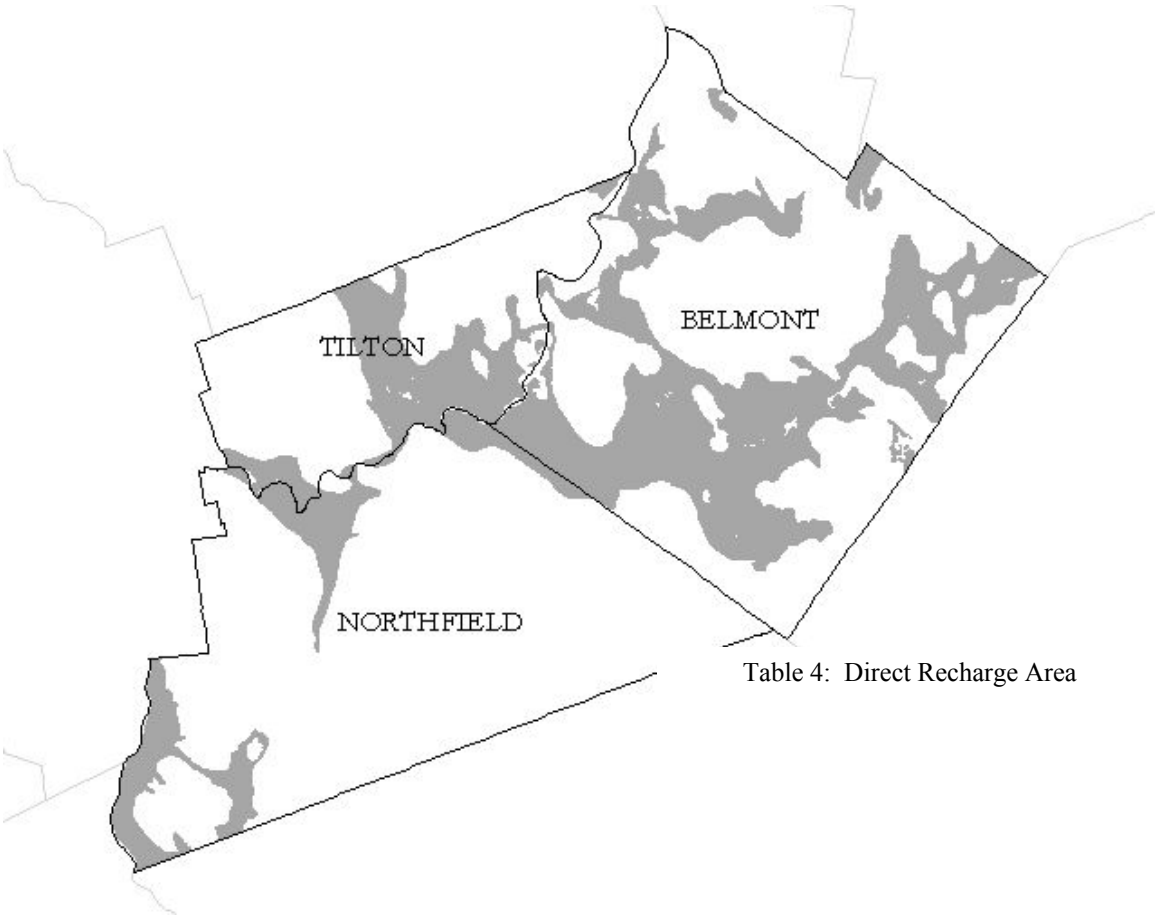



Table 4: Direct Recharge Area

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

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 above. Land use activities which take place in this direct recharge area have the potential to impact groundwater quality and quantity.

~

**An in-depth look at potential threats to the quality and quantity of drinking water supplies due to land uses and growth trends in this direct recharge area, as well as the potential for additional/expanded land uses in the future, forms the basis for the next section of this report.**

1. Presentation Notes, "The Ground Water Protection Connection". Garrett 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.

2. Ground-Water Resources in New Hampshire: Stratified-Drift Aquifers. US Geological Survey, Water Resources Investigations Report 95-4100. In cooperation with NHDES. 1995.

3. Citizen's Guide to Ground-Water Protection. US Environmental Protection Agency. EPA 440/6-90-004. April 1990.

# Potential Threats to Groundwater Resources

## Potential Threats to Groundwater Resources

By coming together to work collaboratively on this project, the towns of Belmont, Northfield, and Tilton are taking a proactive approach to the protection of existing and potential future drinking water supplies. Planning is critical for the long-term protection of the quality and quantity of water supplied by the aquifer, as once groundwater becomes contaminated it is very difficult and extremely costly to clean, and if recharge is not adequate quantity can diminish over time.

Adequate and clean drinking water supplies are extremely important for overall community health, economic well-being, growth potential, and quality of life. Since 29% of the current three-town population is served by systems drawing from the stratified drift aquifer, and since future public water supplies will likely draw from this resource to meet increases in demand, the protection of this resource is of utmost importance to the three towns' long-term viability.

Threats to water quality and quantity within the aquifer are divided into four broad topic areas in this section of the report:

- Growth and Development
- Present and Future Land Uses
- Potential Contamination Sources
- Reductions in Recharge

Although dividing this section of the report into the four topic areas outlined above makes the report more organized and easier to read, there are many links between each topic area, as will be discussed throughout this section. For example, population growth and the types of land uses which result may lead to reductions in recharge. This section will describe each topic area individually as well as demonstrate the interconnections between each that influence the quality and quantity of water in the aquifer.

It is important to stress once again the need for balance when exploring options for protecting the shared aquifer resource. While excluding all new growth, development, potential contamination sources, and impervious surfaces through the purchase and protection of all the land which contributes water to the aquifer might be the way to eliminate new threats, this approach is infeasible, prohibitively expensive, and impractical. This approach would also not eliminate or address existing threats.

This project seeks to provide information and resources which will assist the three towns in implementing strategies that will minimize to the greatest extent possible negative impacts to existing and potential future drinking water supplies drawn from the aquifer while taking into account current and future growth trends, economic needs, and associated land uses. By identifying threats to groundwater resources comprehensively, the three towns will have the information they need to plan effectively to ensure the viability of this important drinking water source.

As you read through the following information on growth, development, and land uses, and their potential impacts in the sub-region, keep in mind the key question that forms the basis for this project: **How can the three towns balance growth and development with the long-term protection of the quality and quantity of existing and potential future water supplies provided by the aquifer?**

## Potential Threats Identified By Community Members

During project meetings, members of the Water Resources Committee were asked to share their concerns regarding water quality in the subregion. The following list is a representative sampling of responses:

- Current and future development of the watershed
- Quantity as well as quality regarding the water available
- Housing in locations where it has never been before
- Industrial expansion
- Transportation routes versus protection of aquifers
- Upgrading of major roads has the potential to increase traffic, create different types of traffic, and increase development
- Road salt contamination
- One hazardous material spill can have a huge impact
- Clear-cutting, land clearing, and runoff
- Septic systems
- General development and subdivisions
- Current and future land uses in recharge areas

## Additional Potential Threats Identified

Frank Clairmont, the Water and Sewer Director of the Belmont Water Department, described a number of incidents which had and have the potential to impact groundwater quality. For example, he described an incident which occurred a number of years ago when a truck ran off the edge of Route 140 and tipped. The truck was carrying chemicals in barrels, and luckily none of the barrels spilled. Mr. Clairmont wondered aloud: "Was that a warning to us?" Another example of an incident which had the potential to contaminate groundwater took place in the early 1990s, when trichloroethane was sampled, possibly originating from an old junkyard 500 feet from one of the wells. This was cleaned up and did not contaminate the water supply. Yet another threat to the water supply took place when a beaver dam was torn down above the dog track, which washed dog manure down toward the wells. Monitoring indicated that the wells had not been contaminated. Mr. Clairmont also mentioned gravel pits as a potential contaminant source, if equipment is washed and maintained on-site of an open pit. Illegal trash dumping, depending on the nature of the trash, as well as old dumpsites where people dumped materials long ago could potentially be harmful to water quality. These incidents highlight the need to be aware of potential threats, minimize the threats when possible, and be prepared in the event of the actual unavoidable incident.[1]

1. Personal communication. March 2003.

# Growth and Development

## Growth and Development

The towns of Belmont, Northfield, and Tilton have been experiencing growth in many areas: total population, housing supply, and commercial and industrial activity. This section will look broadly at town-wide growth and demographic trends, and the next section on "Present and Future Land Uses" will examine carefully the patterns of distribution of these activities in the direct aquifer recharge area specifically.

### Population Trends and Projections

The total populations of Belmont, Northfield, and Tilton have been growing over time, as you can see in Table 5. Tilton had the smallest total population increase of the three towns in the decade between 1990 and 2000, an increase of 237 residents, bringing its total to 3477 people at the time of the 2000 Census. Northfield's total population increase was fairly close to Tilton's, 285 people, bringing the total town population to 4548 in 2000. Belmont showed the largest total population increase of the three towns, 920 people, which meant its population was 6716 people in 2000.[1] Belmont's large population increase placed it sixth in terms of population increase of the 30 towns in the Lakes Region during the decade between 1990 and 2000.[2] As a sub-region, the total growth in population of the three towns between 1990 and 2000 was 1442 people, an increase of 10.8% during that decade.

Looking back to the decade between 1980 and 1990, Tilton actually declined in population by 4.3 percent. During that same decade, Belmont and Northfield experienced a tremendous amount of population growth, 1770 and 1212 new people respectively. This population growth ranked Belmont as the fastest-growing municipality in the Lakes Region from 1980-1990 and Northfield as the second fastest growing municipality. [2]

**Table 5: Population and Percent Change**

| | ***Population*** | | | ***% Change*** | |
|---|---|---|---|---|---|
| **TOWN** | **1980** | **1990** | **2000** | **1980-1990** | **1990-2000** |
| **Belmont** | 4026 | 5796 | 6716 | 44 % | 15.9% |
| **Northfield** | 3051 | 4263 | 4548 | 39.7% | 6.7% |
| **Tilton** | 3387 | 3240 | 3477 | -4.3% | 7.3% |

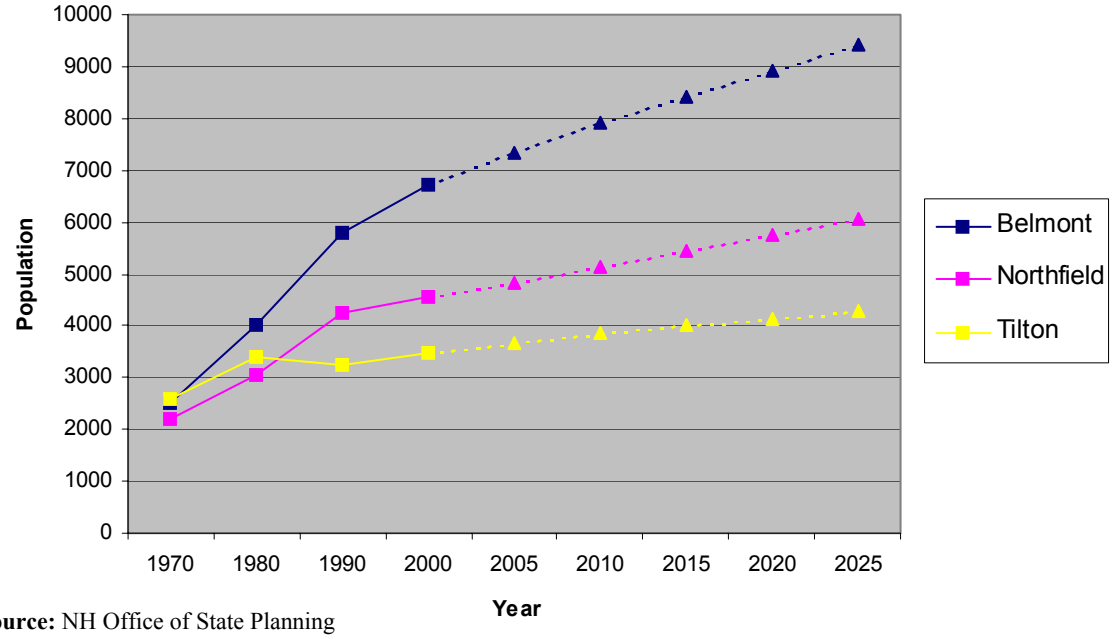
**Source:** US Census, 1980, 1990, and 2000

In the spring of 2003 the NH Office of State Planning (NHOSP) released an updated set of population projections based on the 2000 Census data. Actual population trends based on Census data from 1970-2000, as well as the NHOSP population projections for 2000-2025, are depicted in Chart 1. The NHOSP utilizes a model which relies on a number of data parameters and assumptions, and the resulting projections can provide guidance as to in which direction and at what rate communities might grow as a reflection of past and emerging trends. Although it is unlikely that actual population growth will match the population projections exactly and there can be substantial variations in some cases, the projections are still quite helpful for general planning purposes.

Chart 1 indicates that all three towns are projected to experience population increases in the 25 year span between 2000 and 2025. Of the three towns, Belmont is projected to show the highest rate of growth, with projections adding 2694 people by 2025. Northfield's projections place

1512 additional people in the community by 2025, and Tilton's projections would add 823 people in the same timeframe. Again, it is important to keep in mind that these projections are based on a set of assumptions and should be viewed as a starting point for thinking about future growth potential.[3]

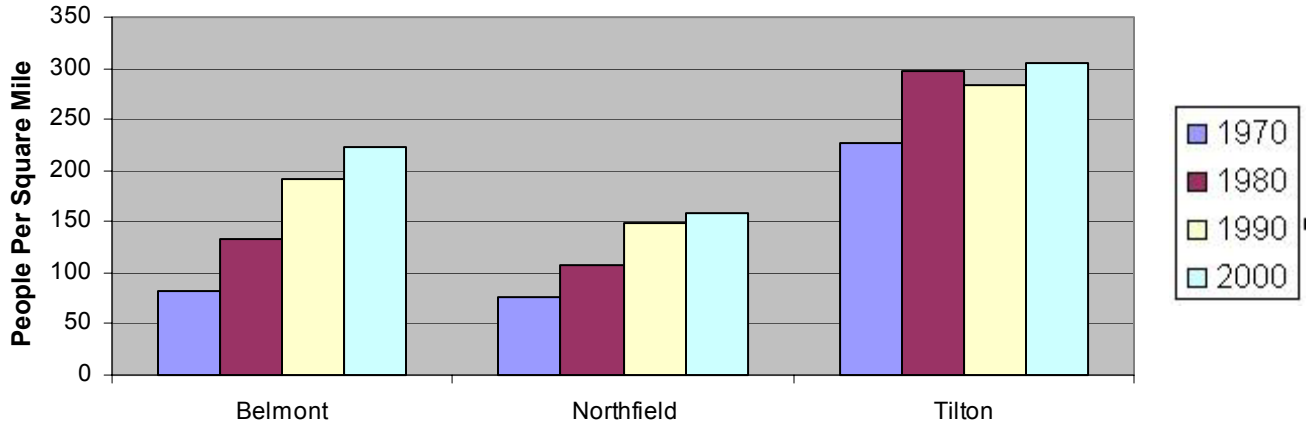
**Chart 1: Population Trends and Projections**




**Source:** NH Office of State Planning

Increases in population density, or the number of people per square mile, illustrate the increasing pressure growth places on a finite town area. Population density increases proportionally with increases in population. Chart 2 depicts population density in each town from 1970 to 2000.

**Chart 2: Population Density 1970 - 2000**

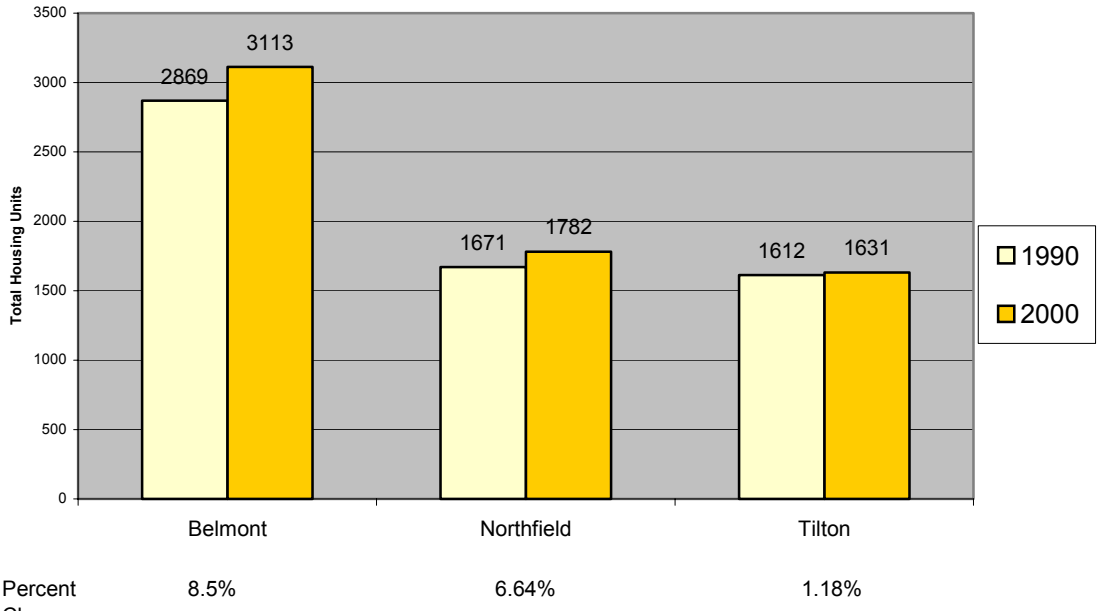



**Source:** US Census 2000 and the NH Association of Regional Planning Commissions

## Housing Supply

Housing stock has increased in the sub-region over time, with 374 additional units located in the three towns in 2000 than there were in 1990. A small number of these units, 19, were located in Tilton, while Northfield and Belmont had an additional 111 and 244 units respectively, as shown in Chart 3. The Lakes Region increased its total residential housing stock by 3650 units between 1990-2000, and Belmont's increase accounted for 6.68% of the Lakes Region total, the sixth largest percentage of the 30 towns located within the region.[4]

**Chart 3: Total Housing Units-1990 and 2000**




**Source:** US Census, 1990 and 2000

Table 6 contains information on the total housing stock in the three towns from 1980 to 2000. Seasonal housing units are also included in Table 6. Due to the location of the subregion in an area with a strong tourism economy, seasonal units comprise a portion of the total housing units in the towns. The decline in the number of seasonal units in Belmont and Northfield between 1990 and 2000 could mean the elimination of that housing stock, but it could also indicate a conversion from seasonal to year-round use.

**Table 6: Housing Stock**

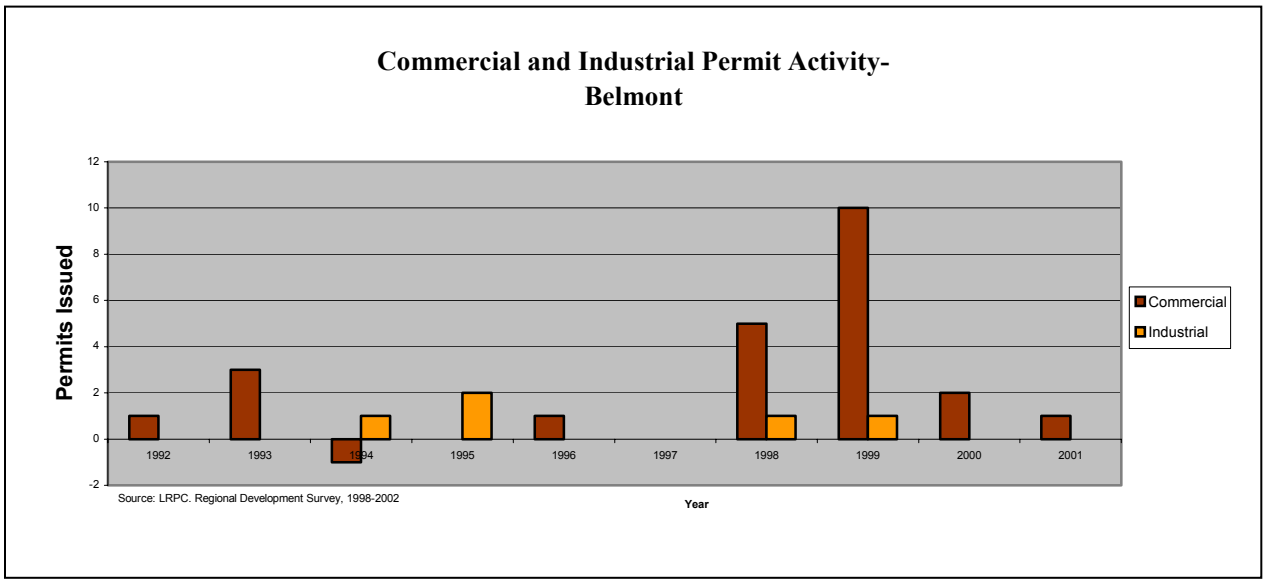
| | All Units | | | Seasonal Units | | |
|---|---|---|---|---|---|---|
| **Town** | **1980** | **1990** | **2000** | **1980** | **1990** | **2000** |
| **Belmont** | 1988 | 2869 | 3113 | 492 | 525 | 351 |
| **Northfield** | 1135 | 1671 | 1782 | 37 | 65 | 41 |
| **Tilton** | 1476 | 1612 | 1631 | 129 | 145 | 186 |

**Source:** Lakes Region Planning Commission, December 2001; Lakes Region Planning Commission, March 2003

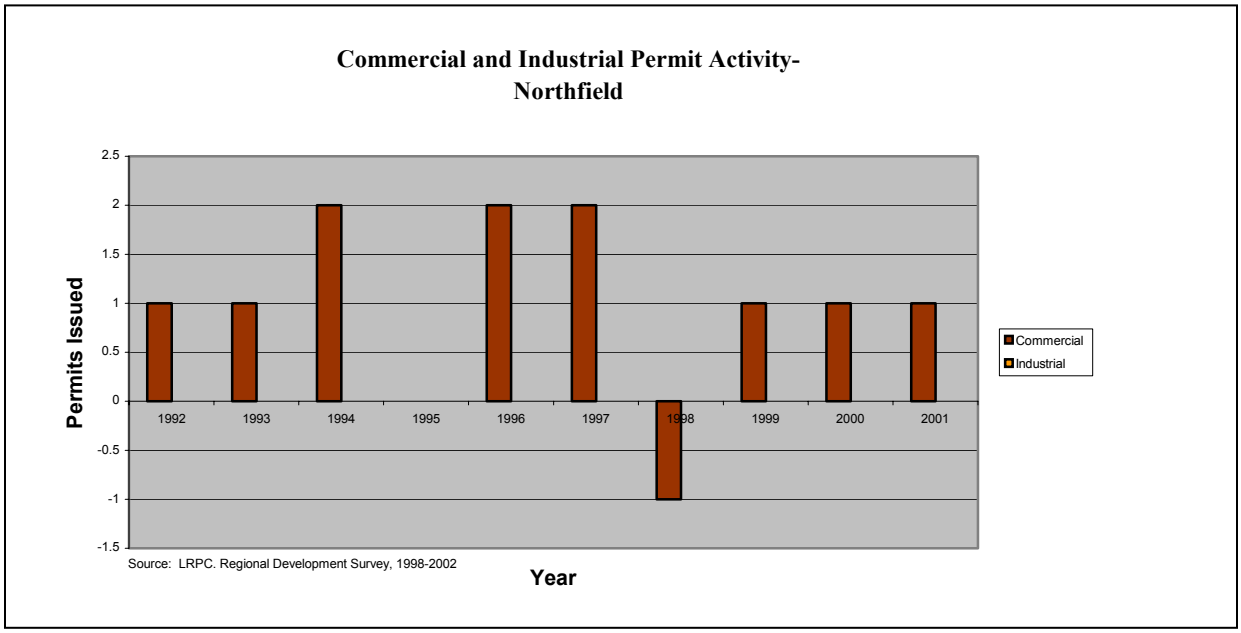
## Commercial and Industrial Growth

The following charts depict commercial and industrial permit activity in the three towns from 1992-2001. The numbers are derived from community responses to the 2002 Regional Development Survey distributed by LRPC annually. It is to be noted that the numbers indicate only the net number of permits issued, with demolitions and conversions taken into account, but do not indicate the actual number of commercial and industrial units constructed. 4.

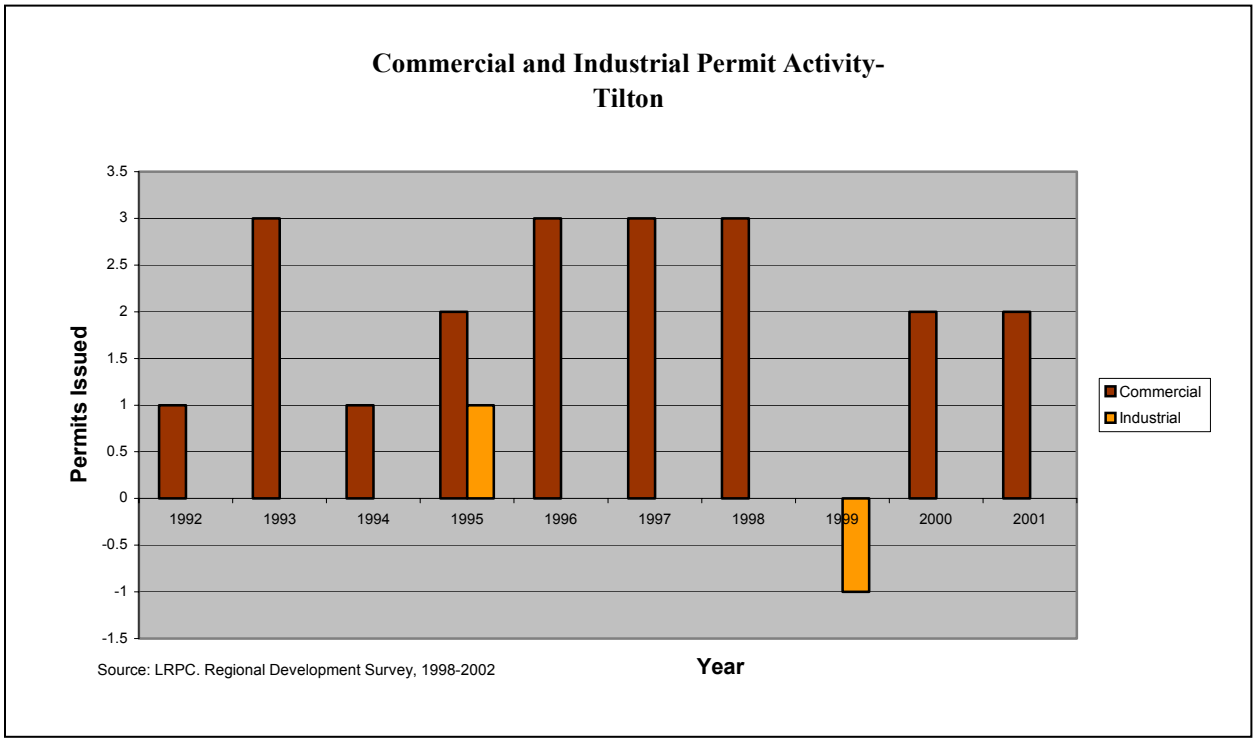
### Chart 4




### Chart 5



## Chart 6




From 1992-2001, Belmont issued 22 net commercial permits and 5 net industrial permits, Northfield issued 10 net commercial permits and 0 net industrial permits, and Tilton issued 20 net commercial permits and 0 net industrial permits. Tilton did issue one industrial permit in 1995, but had a negative one permit in 1999, so the net industrial permits were 0. Tilton did not issue more than 3 commercial permits in a single year, and Northfield did not issue more than 2 commercial permits in a single year. In 1999, Belmont issued 10 net commercial permits, and in 1998 the town issued 5 net commercial permits, but otherwise it did not issue more than 3 net commercial permits in a single year. In total, 52 net commercial permits and 5 net industrial permits were issued in the sub-region during the 10-year period. [4]

~

**The demographic and development trends described in this section provide information on the amount and rate of growth in the three towns. The next section of this report will examine the characteristics and patterns of distribution of this growth, and the potential impacts to the stratified drift aquifer which may result.**

1. US Census, 2000
2. Lakes Region Planning Commission. Lakes Region 2000 Census Interim Report: Population, Age, and Housing. December 2001
3. NH Office of State Planning. Municipal Population Projections: 2005 To 2025. March 2003
4. Lakes Region Planning Commission. Development Activity in the Lakes Region: 2003 Annual Report. March 2003

# Present and Future Land Uses

## Present and Future Land Uses

This section of the report will focus on present and future land uses in the direct aquifer recharge area. The next two sections, Potential Contamination Sources and Reductions in Recharge, will focus on the impact these land uses are having and could potentially have on the quality and quantity of the stratified drift aquifers' water.

### Road Network

Map 2 depicts the aquifer and the road network of the three towns, along with zoning information which will be discussed later on in this section. As you can see, the three towns' major roads lie over the aquifer and almost seem to follow its shape. One reason for this is that in addition to holding water between its particles and providing drinking water to the three towns, the sand and gravel of the stratified drift aquifer provides road-building materials and makes for excellent roadbed. In addition, stratified drift aquifers are often found in flat glacial valleys and associated with river corridors, locations conducive to road construction. There are a total of 194.8 miles of roads (Class I-VI) located within the three towns.[1] A large portion of the major roads, including I-93, Route 140,and Route 3/11, are located in the direct recharge area.

There have been increases in the numbers of people utilizing the road network in the subregion. The Average Annual Daily Traffic (AADT) counts for five locations in the towns are shown in the table below, for 1995 and 2001. It is important to note that the AADT counts, which are compiled by the NH Department of Transportation, represent the total 2-way volume of traffic at the location indicated for a 24-hour period of time adjusted to represent an 'average' day of the year.

**Table 7: Average Annual Daily Traffic Counts - 1995 and 2001**

| Map Point | Location | 1995 | 2001 | % Change |
|---|---|---|---|---|
| A. | I-93 South of US 3 and NH 11 (SB-NB) Exit in 19-20 | 21, 606 | 26, 745 | 23.8% |
| B. | NH 106 North of Brown Hill Road (SB-NB) | 10, 762 | 12, 099 | 12.4% |
| C. | US 3 and NH 11 East of Mosquito Bridge (SB-NB) | 16, 278 | 17, 373 | 6.7% |
| D. | NH 140 at Northfield Town Line | 4700 | 6400 | 36.2% |
| E. | NH 132 North of Bean Hill | 2200 | 2700 | 22.7% |

**Source:** Average Annual Daily Traffic for Belmont, Northfield, and Tilton. State of New Hampshire, Department of Transportation, Bureau of Transportation Planning. August 2002

The improvement of NH Route 140 from the Northfield town line through a portion of Belmont is currently in the preliminary engineering stages. A number of possible new road corridor alternatives were discussed during the planning phase, and one issue of concern expressed by residents was the potential impact to the stratified drift aquifer. All of the alternatives explored were within the aquifer zone and one of the considerations was the impact of creating an entirely new corridor versus upgrading the existing corridor. The current strategy is to keep NH Route 140 in its present alignment with an in-corridor upgrade. The current road corridor is located in the direct recharge area of the aquifer. Two-way average daily traffic volume in the Village of Belmont is projected to increase an estimated 87 percent above 1998 volumes by 2020.[2]

The "Environmental Scoping/Rationale Report" component of the "NH 140 Bypass Study" prepared by Rizzo Associates, Inc. states that "it is estimated that considerable growth of the Belmont employment base can be expected because of development or redevelopment of large parcels of industrially zoned land".[2] As you can see on Map 2, there are large areas zoned industrial which follow the NH Route 140 corridor; specific details about zoning in the three towns is found later on in this section. As has been discussed previously in this report, the towns will need to develop techniques which allow the benefits of economic development to take place in a manner that minimizes potential detrimental impacts to existing and potential drinking water supplies. The NH Route 140 corridor upgrade is an example of where this balancing will be important.

Potential impacts of roads to groundwater quality and quantity include: the reduction of recharge and increase in potentially polluted runoff of stormwater, road salt application, and the potential for hazardous spill accidents by vehicles transporting hazardous materials. These issues will be addressed more completely in the subsequent sections of this report. The layout of the roads also influences access to parcels of land and how zoning is laid out in the three communities. This will be discussed in detail below.

**Zoning Ordinances and Regulations**

The zoning ordinances of the three towns describe what types of potential uses might take place in delineated zones. Map 2 displays the current zoning maps of the three towns overlain by the aquifer area. Purple, red, and orange colors were used for industrial and commercial zones, green was used for residential single-family, multi-family, and village zones, and yellow was used for rural, conservation, and agricultural residential zones. As shown above, there is a large area zoned commercial and/or industrial in the area directly above the aquifer, which follows along the major roadways.

Tables 8-10 show the area of each zone of each town situated in the direct recharge area of the aquifer, the percent of the town's portion of the direct recharge area covered by each zone type, and the percent of the total direct recharge area covered by each zone type. In total, 29.2% of the total direct recharge area is located within a commercial and/or industrial zone. In addition, all of Belmont's Village District, including all associated educational and municipal facilities, and part of Tilton's Village Residential and Mixed Use Districts, are located in the direct recharge area of the aquifer.

**Table 8: Zoning and Direct Recharge Area - Belmont**

| Belmont Zoning 2002 | ACRES | Percent of Belmont Aquifer | Percent of Subregion Aquifer |
|---|---|---|---|
| C | 388.0070 | 5.50 | 3.49 |
| I | 1088.5770 | 15.43 | 9.80 |
| R | 3536.1960 | 50.14 | 31.83 |
| RM | 537.9480 | 7.63 | 4.84 |
| RS | 1143.3190 | 16.21 | 10.29 |
| V | 320.8170 | 4.55 | 2.89 |
| (No zone intersect) | 38.2470 | 0.54 | 0.34 |

**Source:** Derived from zoning coverage developed by the Lakes Region Planning Commission (2002) and stratified drift aquifer data provided by the US Geological Survey and NHDES.

**Table 9: Zoning and Direct Recharge Area - Northfield**

| Northfield Zoning 2002 | ACRES | Percent of Northfield Aquifer | Percent of Subregion Aquifer |
|---|---|---|---|
| CI | 634.1570 | 32.08 | 5.71 |
| CONS | 908.3010 | 45.95 | 8.18 |
| R1 | 295.8740 | 14.97 | 2.66 |
| R2 | 136.6160 | 6.91 | 1.23 |
| X | 0.1710 | 0.01 | 0.00 |
| (No zone intersect) | 2.3270 | 0.12 | 0.02 |

**Source:** Derived from zoning coverage developed by the Lakes Region Planning Commission (2002) and stratified drift aquifer data provided by the US Geological Survey and NHDES.

**Table 10: Zoning and Direct Recharge Area - Tilton**

| Tilton Zoning 2002 | ACRES | Percent of Tilton Aquifer | Percent of Subregion Aquifer |
|---|---|---|---|
| DN | 8.8420 | 0.43 | 0.08 |
| GC | 143.0610 | 6.88 | 1.29 |
| IN | 310.8550 | 14.96 | 2.80 |
| MR | 168.7840 | 8.12 | 1.52 |
| MU | 107.8780 | 5.19 | 0.97 |
| RA | 627.7290 | 30.20 | 5.65 |
| RC | 187.6710 | 9.03 | 1.69 |
| RG | 492.7770 | 23.71 | 4.44 |
| VR | 30.6740 | 1.48 | 0.28 |
| WATER | 0.0740 | 0.00 | 0.00 |
| (No zone intersect) | 0.0000 | | |

**Source:** Derived from zoning coverage developed by the Lakes Region Planning Commission (2002) and stratified drift aquifer data provided by the US Geological Survey and NHDES.

Tables 11-13 look more closely at the percent of the total aquifer with a transmissivity > 3000 $ft^2$/day in each zone in each town. This gives an indication of the type of zoning found in areas with higher transmissivities which are more likely to yield water for a public drinking water supply. These tables show that although only 29.2% of the total direct recharge area is zoned some form of commercial and/or industrial, 48.3% of the aquifer area with a transmissivity > 3000 $ft^2$/day is zoned for some form of commercial and/or industrial use. This has implications for the availability of future new public water supply sources, an issue which will be discussed in more detail in the "Potential Contamination Sources" section of this report.

**Table 11: Transmissivity by Zone - Belmont**

| Zone | Acres with a transmissivity > 3000$ft^2$/day | Percent of Belmont acres > 3000$ft^2$/day in zone | Percent of total aquifer acres > 3000$ft^2$/day |
|---|---|---|---|
| C | 21.5900 | 1.48 | 0.98 |
| I | 421.9060 | 28.94 | 19.20 |
| R | 405.5670 | 27.82 | 18.46 |
| RM | 92.7780 | 6.36 | 4.22 |
| RS | 381.2980 | 26.16 | 17.35 |
| V | 108.5760 | 7.45 | 4.94 |
| (No zone intersect) | 25.9650 | 1.78 | 1.18 |

**Source:** Derived from zoning coverage developed by the Lakes Region Planning Commission (2002) and stratified drift aquifer data provided by the US Geological Survey and NHDES.

**Table 12: Transmissivity by Zone - Northfield**

| Zone | Acres with a transmissivity > 3000ft$^2$/day | Percent of Northfield acres > 3000ft$^2$/day in zone | Percent of total aquifer acres > 3000ft$^2$/day |
|---|---|---|---|
| CI | 130.6070 | 80.41 | 5.94 |
| CONS | 3.6330 | 2.24 | 0.17 |
| R1 | 26.8640 | 16.54 | 1.22 |
| X | 0.0390 | 0.02 | 0.00 |
| (No zone intersect) | 1.2940 | 0.80 | 0.06 |

**Source:** Derived from zoning coverage developed by the Lakes Region Planning Commission (2002) and stratified drift aquifer data provided by the US Geological Survey and NHDES.

**Table 13: Transmissivity by Zone - Tilton**

| Zone | Acres with a transmissivity > 3000ft$^2$/day | Percent of Tilton acres > 3000ft$^2$/day in zone | Percent of total aquifer acres > 3000ft$^2$/day |
|---|---|---|---|
| DN | 2.6710 | 0.46 | 0.12 |
| IN | 193.5310 | 33.52 | 8.81 |
| MR | 51.1090 | 8.85 | 2.33 |
| MU | 0.1400 | 0.02 | 0.01 |
| RA | 35.5800 | 6.16 | 1.62 |
| RC | 1.8160 | 0.31 | 0.08 |
| RG | 291.5470 | 50.49 | 13.27 |
| VR | 0.9770 | 0.17 | 0.04 |
| WATER | 0.0340 | 0.01 | 0.00 |
| (No zone intersect) | 0.0000 | | |

**Source:** Derived from zoning coverage developed by the Lakes Region Planning Commission (2002) and stratified drift aquifer data provided by the US Geological Survey and NHDES.

Although Map 2 color-codes the various zoning categories of the three towns in a consistent manner, for example red to denote commercial, what is actually allowed to take place within those zoning categories can vary widely among the three towns. In order to gain a clearer picture of what could potentially take place and be built in the direct recharge area, a review of the zoning ordinances and regulations of each town is needed. Appendix I contains a complete review of potential land uses and their distribution based on the current zoning ordinances and regulations of each town, focusing on those uses which have the potential to impact the quality of the groundwater supply. The following is a brief overview of this information.

### *Tilton*

Every zone designated in Tilton's Zoning Ordinance (2003) has at least a portion which falls within the direct aquifer recharge area. The nine zones range from rural agricultural to industrial. The Rural Agricultural zone has the highest percentage of Tilton's aquifer area in a single zone, at 30.2%.

The location of the highway interchange (I-93) contributed to the designation of zones along the arterial highway: the Regional Commercial District, Resort Commercial District, General Commercial District, and Industrial Park District all refer to their location as a reason for the uses these areas are allowed to accommodate. As was discussed in the description of roads at the

beginning of this section, much of the road network is within the direct recharge area of the aquifer. Of the total aquifer area situated within the borders of Tilton, 54.6% falls within one of the following zoning categories: Regional Commercial, Industrial, Resort Commercial, or General Commercial.

The following is a brief summary of information contained in the Tilton Zoning Ordinance relevant to aquifer protection:

- The town of Tilton has not established an aquifer protection district or overlay zone with specific provisions to safeguard the aquifer. The aquifer map is not referred to in Tilton's regulations. Although no specific aquifer protection district is established, there are other provisions found within Tilton's Zoning Ordinance which acknowledge the importance of the protection of the aquifer and/or contain provisions which reduce the potential for the aquifer to become contaminated. A few examples of these provisions follow. More extensive and detailed information can be found in Appendix I.
- The Wetlands Conservation District, which was adopted in March 1986, refers to the protection of the aquifer, potential water supplies, groundwater, and aquifer recharge areas in its Purpose section. Within the district, uses are permitted which will not negatively impact the resource; all other uses require a Special Exception. In locations with Very Poorly Drained Soils, a public hearing is required, and one of the determinations necessary is that the "proposed use shall not cause pollution of surface or groundwater". The town acknowledges the importance of keeping surface and groundwater free from pollution, although no specifics are provided for making this determination.
- In the Industrial Park District, Special Exceptions are required for a number of uses which have the potential to impact groundwater without proper management practices. These uses, outlined in detail in Appendix I, are not allowed in any other zone.
- The town of Tilton does not allow the stockpiling and land spreading of Class B sewage sludge and the land spreading of industrial paper mill sludge containing hazardous materials and toxic substances, excluding septage/sewage/sludge generated in the town itself.
- *For a complete review of Tilton's Zoning Ordinance and Regulations, see Appendix I.*

***Belmont***

In Belmont, just as in Tilton, each zone designated in Belmont's Zoning Ordinance (2003) has a portion which falls within the direct aquifer recharge area. The 6 zones in Belmont range from rural to industrial. The Rural zone is the zone with the largest area situated over the aquifer, at 50.1%.

Similar to what was noted in Tilton, a large percentage of the major road network in Belmont is located within the direct recharge area of the aquifer. Zones were designated with this road network as the basis, placing a large portion of the total land area zoned commercial or industrial within the direct recharge area. Of the total aquifer area situated within Belmont, 20.9% is zoned either Commercial or Industrial.

The following is a brief summary of information contained in the Belmont Zoning Ordinance relevant to aquifer protection:

- The Belmont Zoning Ordinance contains an Article on Performance Standards and one section focuses on specific performance standards for aquifer protection. This section then identifies stratified drift aquifers as valuable sources of community and individual drinking water, and points out their susceptibility to pollution. For this reason, the prohibited uses outlined in NH RSA 485-C: 12 "shall not be allowed within the gravel stratified drift wellhead protection areas identified on the above

mentioned plan." The prohibited new uses outlined in NH RSA 485-C: 12 are: the siting or operation of a hazardous waste disposal facility as defined under RSA 147-A; the siting or operation of a solid waste landfill; the outdoor storage of road salt or other deicing chemicals in bulk; the siting or operation of a junk or salvage yard; the siting or operation of a snow dump; and the siting or operation of a wastewater or septage lagoon. Currently the additional level of protection afforded by the performance standards described above only apply to the wellhead protection areas; although regulating uses in wellhead protection areas to protect current drinking water supplies is critical, currently there is no language for mitigating impacts in the entire direct recharge area of the stratified drift aquifer to increase protection of existing drinking water supplies as well as potential future supplies.

- Restrictions on the placement and use of treated soils include not allowing its placement or use within a recharge area of any sole source drinking water supply, within 100 feet of any surface water, and within 25 feet of a wetland. In addition, pre and post soils and/or water testing could be required.
- Within the Agricultural Animals section of the Belmont Zoning Ordinance animal buildings, waste materials and grazing and keeping areas are required to be a minimum of 50 feet from wells, water bodies and wetland areas. In addition, "no...groundwater runoff nuisance shall occur."
- *For a complete review of Belmont's Zoning Ordinance and Regulations, see Appendix I.*

### *Northfield*

Northfield has the smallest percentage of its landbase within the direct aquifer recharge area of the three towns. In the southwest corner of Northfield there is a portion of aquifer with fairly low transmissivity overall, which appears on the map and in the area calculations for zone types. Although the primary focus of this report is on the portion of the aquifer which is contiguous and shared by the three communities, and which serves as a current public water supply, the total aquifer area for the three towns is provided to assist the communities in their comprehensive planning efforts.

In Northfield, just as in Tilton, a portion of each of the four zones designated in Northfield's Zoning Ordinance (2003) falls within the direct recharge area of the aquifer. Keep in mind that the entire stratified drift aquifer area, including the southwest area, is included in the calculations.

The Commercial/Industrial zone in Northfield was designated based on accessibility to the major road network. As was discussed earlier in this report, this means that a substantial portion of the Commercial/Industrial zone is situated in the direct aquifer recharge area. Of the total aquifer area situated within the borders of Northfield, 32.1% is zoned Commercial/Industrial.

The following is a brief summary of information contained in the Northfield Zoning Ordinance relevant to aquifer protection:

- While Northfield has the smallest percentage of aquifer area located within its town boundaries, it has the most extensive regulations to protect the aquifer. The Northfield Zoning Ordinance contains an extensive Groundwater Protection Overlay District (Article 6, Section 2). Northfield's Groundwater Protection Overlay District follows almost exactly the language of the Model Groundwater Protection Ordinance developed by the NH Office of State Planning and the NH Department of Environmental Services, 2001, with a few exceptions. The prohibited use of the siting or application of biosolids/sludge as well as the associated biosolids/sludge definition found in the definitions section are the only departure from the Model Groundwater Protection Ordinance. The Groundwater Protection Overlay District Article defines performance standards for all uses in the district, unless the use is exempt. It also outlines prohibited uses and conditional uses within the overlay district.

- The performance standards for the Groundwater Protection Overlay District cover the following topics: impervious surfaces and stormwater management; storage of animal manure, fertilizers, and compost; and storage of regulated substances.
- The following uses are prohibited in the Groundwater Protection Overlay District: the siting or operation of a hazardous waste disposal facility, a solid waste landfill, a junkyard, a snow dump, and a wastewater or septage lagoon; the outdoor storage of road salt or other deicing chemicals in bulk; and the siting or application of biosolids/sludge.
- *For a complete review of Northfield's Zoning Ordinance and Regulations, please see Appendix I.*

### *Site Plan Review and Subdivision Regulations in the Subregion*

The following is a brief review of components of the Site Plan Review Regulations and Subdivision Regulations of Belmont, Northfield, and Tilton which pertain to aquifer protection. Please note that this list is not all-inclusive. A more extensive review is found in Appendix I.

- One of the purposes of the Site Plan Review Regulations of Tilton (March 1992) is "To provide for the safe and attractive development or change or expansion of use of the site and to guard against such conditions as would involve danger or injury to health, safety, or prosperity by reason of: (2) Inadequate protection for the quality of groundwater."
- The Application Submission Requirements of Belmont's Site Plan Review Regulations (April 2003) include: the requirement that the Site Plan include the location of wells showing required well radius and the requirement for an Aquifer Plan which maps all known aquifers if the property is over or adjacent to a known aquifer (or a statement on the plan if not).
- In the narrative impact statement requirement of the Application Requirements of Northfield's Site Plan Review Regulations (October 2002) for both minor and major applications, applicants need to address a number of aspects including: increased consumption of groundwater; pollution of water and/or air; and disturbance to other aspects of the natural ecology.
- In the Plan and Report Requirements section of the Application Submission Requirements of Belmont's Subdivision Regulations (June 2003) there is a requirement for an Aquifer Plan which maps all known aquifers including those identified on the USGS maps or other applicable documents.
- In the Design Standards for Subdivisions section of Northfield's Subdivision Regulations there are provisions for Road Design and Construction which include Drainage provisions. "The design of drainage structures and ditches will include an analysis of any adverse affects they may have on upstream and downstream public and private lands or facilities including but not limited to...contamination of public and private water supplies, ponds or pools, and wells."
- Tilton's Subdivision Regulations (June 2003) outline extensive Design Standards for All Roadway Improvements, including provisions for the storm drain system. The requirements of a drainage study/stormwater management report to be submitted and reviewed by the Town or its Agent include: indicating the project location and watershed area; providing a watershed area plan showing the boundaries of each drainage area and sub-area; riprap design calculations meeting the requirements of a guidance document for stormwater management; and runoff calculations.

~

**Please note that allowable impervious surface coverages found in each town's zoning ordinance are summarized in a subsequent section of this report, "Reductions in Recharge". General recommendations regarding the zoning ordinances and regulations of the three towns are found in the "Recommendations" section at the end of this report. Specific recommendations on how to strengthen ordinances and regulations in the three towns to further protect the aquifer can be found in the separate "Implementation Strategies" document.**

1. Classified Road Mileage. State of New Hampshire, Department of Transportation. January 1, 2002.

2. NH 140 Bypass Study: Environmental Scoping/Rationale Report. Prepared for NHDOT by Rizzo Associates, Inc. NHDOT Project No. 12792.

# Potential Contamination Sources

## Potential Contamination Sources

This section focuses on potential sources of contamination of the stratified drift aquifer. "Potential contamination sources are facilities that typically use, produce, handle, or store contaminants of concern, which, if improperly managed, could find their way to a source of public drinking water."[1]. In addition, certain activities and land uses, if not conducted and designed following Best Management Practices, can result in the release of potential groundwater contaminants. If proper management practices are followed, a potential contamination source may never become an actual contamination source. An understanding of the location, types, and number of potential contamination sources can assist the three towns in planning for the protection of the quality of existing and potential future drinking water supplies.

These potential contamination sources will be reviewed at two scales: those found within the Wellhead Protection Areas (WHPA) of existing public water supplies which draw from the stratified drift aquifer and those found within the entire direct recharge area of the stratified drift aquifer. By looking closely at the vulnerability of existing wells to potential contamination threats, the towns and water suppliers will understand the level of threat to water quality and can take steps to reduce these threats and plan for long-term water supply protection. By stepping back to determine potential threats to the entire direct recharge area, the towns will have a broad understanding of potential contamination sources which will assist in planning for future drinking water supplies and taking steps to minimize those threats which have the potential to degrade the quality and reduce the quantity of water stored and moving through the aquifer.

### Direct Aquifer Recharge Area: Potential Contamination Sources

Map 3 shows the potential contamination sources found within the direct recharge area of the aquifer. Efforts were made to ensure that this map is comprehensive and accurate. Once again, keep in mind that the challenge for the three towns will be to balance the economic benefits which come from development in the commercial and industrial zones situated above the aquifer with the need to protect the quality and quantity of drinking water supplies. It is important for communities to know the location of all potential contamination sources and take steps to ensure their proper management in order to prevent them from becoming actual contamination sources.

NHDES has developed extensive coverages of public water supply sources and fairly comprehensive coverages of potential and existing sources of groundwater contamination throughout the state of NH, and the coverages for the towns of Belmont, Northfield, and Tilton are included on Map 3. Although NHDES had mapped a lot of the potential contamination source information, the category of "Local Potential Contamination Sources" was incomplete for the direct recharge area of the aquifer at the start of this project. NHDES had developed a fairly complete, although not necessarily up-to-date, Local Potential Contamination Source Inventory within Wellhead Protection Areas, but otherwise this information had not been collected for the database.

Volunteers from each town teamed up with LRPC staff members to locate additional potential local contamination sources with Global Positioning System (GPS) equipment in the field. The new data layer was incorporated into the existing NHDES map layer with GIS, forming a complete picture of potential contamination sources in the subregion. Potential local contamination sources include automobile repair facilities, cleaning services, salt storage

facilities, and waste processing and storage facilities. The local knowledge of those who volunteered was critical to ensuring that the coverage was complete.

The types of potential contamination sources fall into two categories: point and nonpoint. Point sources of pollution are those which originate from a single, distinguishable source, such as a leaking underground storage tank. Nonpoint sources of pollution are those which are not able to be traced to a single origin, such as fertilizer applied across many fields. Map 3 breaks the potential contamination sources into five broad categories: Known Contamination Sources, Potential Contamination Sources, Local Potential Contamination Source Inventory points, Known Contamination Areas, and Potential Contamination Areas. The first three categories include point sources of pollution, while the last two categories include nonpoint sources of pollution. As you can see, there are many more potential contamination sources than there are known contamination sources, which underlines the need for proper management to reduce the possibility of actual contamination. It is important to note that although two categories are labeled "known contamination", this does not necessarily mean the sources/areas are currently actively contaminating groundwater; this label indicates that these are sites where there is or has been in the past a known release of contaminant(s) to the ground.

A larger format version of this map is available in the Town Halls of each of the three towns, and due to its larger size it includes more specific information on the potential contamination sources than the information on Map 3. A comprehensive key which provides detailed information on the specific potential contamination sources is also available for review at each Town Hall. Those who are interested in viewing the map with a higher level of detail, as well as the associated key, are encouraged to do so; the information which follows utilized the higher level of detail of the larger format map and key.

**Overview of Potential Contamination Sources**

Map 3 shows that a large percentage of the known and potential contamination sources is located along the major transportation corridors of the three towns. As was discussed in the previous section, the road network lies to a large extent in the direct aquifer recharge area, and much of the commercial and industrial zoning of the three towns is located along this road network and in the direct aquifer recharge area as well. A comprehensive understanding of the distribution of known and potential contamination sources will assist the towns in developing and implementing strategies to minimize threats to groundwater quality and quantity. Map 3, and its more detailed version located in each Town Hall, is an important tool for drinking water protection planning efforts.

Table 14 summarizes information on the types of potential contamination sources identified on Map 3. The table provides a description of each potential contamination source type, and includes the total number of each potential contamination source type located in the subregion as well as the total number currently active. More specific information is contained in the comprehensive key located in each Town Hall.

**Table 14: 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 groundwater hazard inventory (sites regulated for groundwater 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 |
| Junkyards 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)* | 31 | 31 |
| 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 coverages are based is not updated monthly. In the case of the NHDES Local Potential Contamination Sources Inventory, the fieldwork is supposed to be redone every three years.

**Source:** Inventory of Public Water Supply Sources and Potential and Existing Sources of Groundwater Contamination in the Towns of Belmont, Northfield, and Tilton. NHDES Water Supply Engineering Bureau. September 17, 2003.

## Additional Potential Contamination Sources

### *Road Salt*

Winter weather conditions in New England make it necessary to remove snow and take steps to reduce icy conditions on roadways to ensure the safety of travelers and allow for the movement of goods throughout the region. The three towns will need to provide for the safety of their residents on the roadways in winter conditions while also taking into account the fact that runoff from highway deicing chemicals has the potential to cause detriment to groundwater resources.

Salt, or sodium chloride, is used as a deicer, and although it is effective and economical in lowering the freezing point of water so that plows can easily remove snow from the pavement, it can concentrate in runoff and move through the soil to groundwater resources. Dietary intake of sodium should be restricted as it is associated with general human health concerns. Although there is no health advisory level for sodium, "there is a Drinking Water Equivalent Level of 20 mg/L, a non-enforceable guidance level considered protective against non-carcinogenic adverse health effects".[5] Proper management practices can reduce the potential impacts of salt to groundwater resources.

The Maintenance Supervisor of the NH Department of Transportation spoke with the Lakes Region Planning Commission about road salting practices on state-maintained roads in June 2003. A brief summary follows.

There are two NHDOT patrol sheds in Belmont, and one of these serves the towns of Northfield, Tilton, Sanbornton, and most of Belmont with the exception of a portion of Route 106. Although the figures for state-maintained roads can't be broken down for each town individually, the totals for this patrol shed provide useful information as the patrol shed covers the three towns studied in this project plus one additional town.

In total, 26.64 tons per lane mile of salt were spread on the majority of state-maintained roads in the four towns served by the patrol shed in the winter season of 2002-2003. The amount of salt utilized depends on the weather and the associated road conditions. More salt is spread in more severe weather conditions such as in freezing rain. Most of the salt is probably dissolved before the annual sweeping of sand takes place. At this time, the same salting practices are carried out on state-maintained roads throughout the towns without variation based on the aquifer resource.[2] Salting practices on town-maintained roads should also be reviewed to determine if salt usage can be reduced in the direct recharge area without compromising road safety.

It is also important to ensure that salt is stored in a manner that will not compromise groundwater resources. There are five salt storage facilities situated in the direct recharge area of the aquifer. To minimize potential contamination, the salt should be covered from the elements and practices should be followed to keep the salt contained on-site. As an example of a positive step taken to protect the aquifer, Belmont raised funds in the current year's budget to construct an approved building to cover their municipal salt/salted sand storage, located in the direct recharge area of the aquifer, in accordance with EPA regulations.

### *Stormwater Runoff*

During storms, precipitation flows across impervious surfaces such as roads, parking lots, and rooftops and picks up contaminants and sediments. Impervious surfaces allow pollutants to accumulate, cause surface runoff to move rapidly, and reduce the amount of vegetated land which could mitigate the impacts of pollutants by filtering and slowing runoff. In addition, impervious surfaces reduce the recharge of groundwater, which will be discussed in detail in the next section of this report, "Reductions in Recharge". The types of pollutants which can accumulate on impervious surfaces such as roads and parking lots and be transported to surface water and groundwater resources include oil, gasoline, automotive fluids, heavy metals, and hydrocarbons.[6]

The construction of new roads creates additional impervious surfaces which increase the amount of stormwater runoff, reduce groundwater recharge, and increase necessary winter road maintenance.

***Potential Hazardous Materials Spills***

Vehicles transporting hazardous materials on the road network situated in the direct aquifer recharge area pose a potential threat to groundwater resources should an accidental spill occur.

***MTBE***

Communities have typically been concerned with the use of large quantities of hazardous substances and the associated potential threats to groundwater resources. Contamination of well water is not only caused by these large-scale uses. In the last five years, the widespread detection of the gasoline additive known as MTBE in groundwater throughout the country has increased awareness of the fact that even residential uses of gasoline can pose a potential threat to groundwater resources.

***Landscaping***

Certain types of landscaping such as extensive manicured lawns can contribute fertilizers, pesticides, and nutrients which have the potential to impact the quality of the groundwater supply.[6]

***Household Hazardous Wastes***

Hazardous waste produced by industry or transported for industrial uses are not the only sources of hazardous waste in the three towns. Common household chemicals, if disposed of improperly, have the potential to contaminate groundwater. Community members may not realize that pouring these common household chemicals, such as paint thinner and cleaning products, down the drain, or used motor oil onto the ground, could potentially pollute groundwater.

***Septic Systems***

Septic systems which are properly sited, constructed, and maintained are a minor potential threat to groundwater resources. However, when septic systems fail, there is the potential that groundwater will be contaminated. Contamination by improperly used or operated septic systems can lead to waterborne disease outbreaks as well as other adverse health effects.[7]

**Wellhead Protection Areas of Existing Drinking Water Supplies: Potential Contamination Sources**

NHDES, under the 1996 Amendments to the federal Safe Drinking Water Act, is required by the U.S. EPA to assess each public drinking water source in NH for susceptibility to contaminants which the Safe Drinking Water Act regulates. NHDES has done an assessment for each source, and these assessments provide information which can be used to improve protection of the public drinking water sources which draw water from the stratified drift aquifer.

NHDES developed maps and assessments which depict and describe each public water supply source, its Wellhead Protection Area (WHPA), and the known and potential contamination sources identified within that area. A WHPA is the estimated area around a well from which groundwater and surface water will flow to the well "under severe pumping conditions". The WHPA is delineated based on available site-specific information, or if there is not enough information available, the amount of water withdrawn from each well determines the diameter of the circle assessed.[2] The source assessments are based on a land use inventory within each source's WHPA and the results of the most recent sanitary survey.

The assessments rate the susceptibility of each source in terms of various susceptibility factors. Table 15 summarizes the susceptibility ratings for the public water supply sources which draw from the stratified drift aquifer in the subregion. Those factors which are rated medium or high for a particular source generally represent an increased risk of contamination for that source.[2] The table indicates which susceptibility factors were rated medium or high for each of the sources listed.

As you can see, a number of the public water supply wells drawing from the stratified drift aquifer received high or medium ratings for the same susceptibility factors. In total, 16 "High" susceptibility ratings were given to the 7 public water supply wells.

Seven of the wells received high ratings for having 10% or more agricultural land cover in the Wellhead Protection Area (WHPA). Please note that the ratings for this factor were based on satellite imagery, which were not ground-truthed. The concern is that in large agricultural areas nitrates are a common problem. Pesticides can also be a concern from agricultural land uses. The susceptibility rating of "High" or "Medium" does not necessarily mean that there is a problem, but rather indicates an increase in the risk for drinking water contamination due to certain land uses and activities. For example, having a large percentage of agricultural land cover does not necessarily mean that nitrates are present in quantities of concern.[3]

- Three of the wells received "High" ratings for having one or more numbered state highways or active railroads within the WHPA and within 1000' of the well. The concern is that roadways and railways in close proximity to the well increase the risk of accidental releases of potentially contaminating substances reaching the source. Also, as was described earlier in this report, roadways are a nonpoint source of pollution.
- Two wells received "High" ratings for having sewer line(s), septic system(s), or regulated substances (other than that which would be associated with the well) stored within the sanitary radius. The concerns associated with this Susceptibility Factor are that development in close proximity to the well can contaminate the source and that if potential contamination sources are located close to a well it would be difficult to respond to a release in time to prevent actual contamination.[3]
- Two wells received "High" ratings for having confirmed current detections of contaminants of concern from anthropogenic sources in source water. The two wells with these high ratings are located approximately 10 feet from each other in a parking lot.[3]
- One well received a "High" rating for having more than 10 potential sources of anthropogenic contamination within the portion of the WHPA that is within 1000' of the well. As explained earlier, potential contamination sources located close to a water supply source are an undesirable attribute in case of an accidental release.[3]
- One well received a "High" rating for having 10 or more septic systems or any sewer line located within 500 feet of the well and/or a high density of septic systems (more than 30) in

the remainder of the WHPA. Septic systems located close to a well increase the risk of contamination from pathogens and other contaminants.[3]

**Table 15: Susceptibility Ratings for the 7 Public Water Supply Wells Drawing from the Stratified Drift Aquifer**

| System Name | Source Name/ Description [Source ID] | Summary of Susceptibility Ratings | Comments |
|---|---|---|---|
| **Tilton Northfield Aqueduct Company** | GPW 1/ EASTERLY [2351010-003] | High = 2<br>Medium = 1 | **High:** There are one or more numbered state highways or active railroads in WHPA and within 1000' of the well; there is 10% or more agricultural land cover in WHPA.<br>**Medium:** There are routine pesticide application sites in WHPA but not within 500' of the well. |
| **Tilton Northfield Aqueduct Company** | GPW 2/ WESTERLY [2351010-004] | High = 3<br>Medium = 1 | **High:** There are one or more numbered state highways or active railroads in WHPA and within 1000' of the well; there is 10% or more agricultural land cover in WHPA; there are 10 or more septic systems or any sewer line located within 500' of the well and/or a high density of septic systems (more than 30) in the rest of the WHPA.<br>**Medium:** There are routine pesticide application sites in WHPA but not within 500' of the well. |
| **Belmont Water Department** | GPW 1, EAST, next to Shaker Rd. [0201010-001] | High = 1<br>Medium = 3 | **High:** There is 10% or more agricultural land cover in WHPA.<br>**Medium:** There are fewer than 10 septic systems and no sewer line within 500 feet of the well and there are fewer than 30 septic systems in the remainder of the WHPA; less than 10% of the WHPA has urban land cover but 10% or more of the WHPA located within 1000' of the well has urban land cover; there are one or more farms with 10 or more outdoor animal units within the WHPA but none within 1000' of the well. |
| **Belmont Water Department** | GPW 2, WEST, closer to pond [0201010-002] | High = 1<br>Medium = 2 | **High:** There is 10% or more agricultural land cover in WHPA.<br>**Medium:** There are fewer than 10 septic systems and no sewer line within 500 feet of the well and there are fewer than 30 septic systems in the remainder of the WHPA;<br>there are one or more farms with 10 or more outdoor animal units within the WHPA but none within 1000' of the well. |
| **Lochmere Village District** | GPW 1/ 116'W of PH-Well situated within a parking lot [2351020-001] | High = 3<br>Medium = 2 | **High:** There are current detections of contaminants of concern from anthropogenic sources; there are sewer line(s), septic system(s), or the storage of regulated substances other than that associated with the well within the sanitary radius; there is 10% or more agricultural land cover in WHPA.<br>**Medium:** There are 10 or fewer potential sources of anthropogenic contamination within the portion of the WHPA that is within 1000' of the well; there are fewer than 10 septic systems and no sewer line within 500 feet of the well and there are fewer than 30 septic systems in the remainder of the WHPA. |
| **Lochmere Village District** | GPW 2/ 111'NW of PH-Well situated within a parking lot [2351020-002] | High = 3<br>Medium = 2 | **High:** There are current detections of contaminants of concern from anthropogenic sources; there are sewer line(s), septic system(s), or the storage of regulated substances other than that associated with the well within the sanitary radius; and there is 10% or more agricultural land cover in WHPA.<br>**Medium:** There are 10 or fewer potential sources of anthropogenic contamination within the portion of the |

| | | | |
|---|---|---|---|
| | | | WHPA that is within 1000' of the well; and there are fewer than 10 septic systems and no sewer line within 500 feet of the well and there are fewer than 30 septic systems in the remainder of the WHPA. |
| **Lakeland Management Company** | GPW 1, 3000' NE of PH [0202010-004] | High = 3<br>Medium = 2 | **High:** There is 10% or more agricultural land cover in WHPA; there are more than 10 potential sources of anthropogenic contamination within the portion of the WHPA that is within 1000' of the well; there are one or more numbered state highways or active railroads within the WHPA and within 1000' of the well.<br>**Medium:** There are one or more known sources of anthropogenic contamination within the WHPA but not within 1000' of the well; there are fewer than 10 septic systems and no sewer line within 500 feet of the well and there are fewer than 30 septic systems in the remainder of the WHPA. |

**Source:** Drinking Water Source Assessment Reports for individual public water suppliers drawing from the stratified drift aquifer. NHDES. 2000-2003.

## Protection of Drinking Water in State Regulations

The three communities can begin and/or extend their local efforts from a common basis of existing State regulations and authorities. Appendix II contains a summary of setbacks for the protection of drinking water found in State regulations developed by NHDES. This list of setbacks is currently under review by the Drinking Water Source Protection Program. The summary does not constitute a model or any form of recommendations; it is simply a list of setbacks that are currently included in State regulations. Recommendations to change the setbacks may be forthcoming in the future.

This summary table can serve as a reference to the three communities as they work to protect existing and potential future sources of drinking water. Some examples of setbacks in State regulations are: 400 ft. setbacks for new underground storage tanks from large community wells, 400 ft. setbacks for biosolids application (sludge and septic) from large community wells, and 400 ft. setbacks for the outdoor storage of regulated substances in regulated containers from public wells. This information was utilized in the Favorable Gravel Well Analysis described below.

## Future Drinking Water Supplies: Favorable Gravel Well Analysis

A Favorable Gravel Well Analysis was conducted for the entire aquifer area of the three towns. Although there is a large extent of stratified drift aquifer among the three communities, a number of constraints place limitations on how much of the aquifer could potentially yield a suitable water supply to a community well. Map 4 is the product of this analysis, described in detail below. This analysis is an important planning tool for the protection of potential future drinking water supplies.

### *How the Analysis Was Conducted*

The NH Department of Environmental Services developed the technique of Favorable Gravel Well Analysis to assist water suppliers and community planners in using the stratified drift aquifer maps for future drinking water supply source planning. The first step in the analysis is to take a map of the entire stratified drift aquifer and eliminate the areas with a transmissivity lower than a certain threshold. As was described in a previous section, "Background Information on

Groundwater Resources", although the stratified drift aquifer maps don't show potential well yield, transmissivity is a rough estimate of the aquifer's ability to yield water in a sufficient quantity to supply a well. The assumption made was that the area of the stratified drift aquifer that is potentially suitable for siting a 75 gallons per minute or greater well would be included in the analysis, and so aquifer areas with transmissivities of less than 1000 $ft^2$/day were eliminated.[4]

**Figure 4.** Favorable Gravel Well Analysis-Before

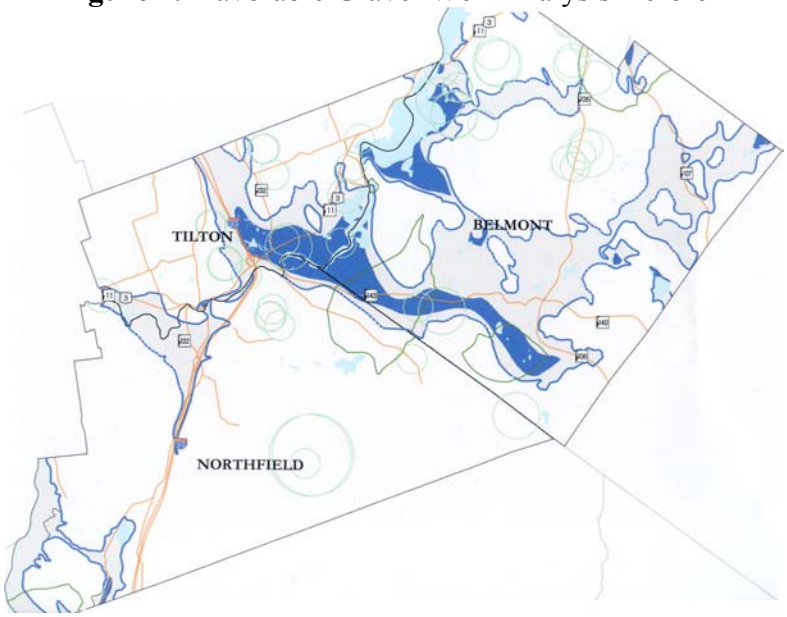
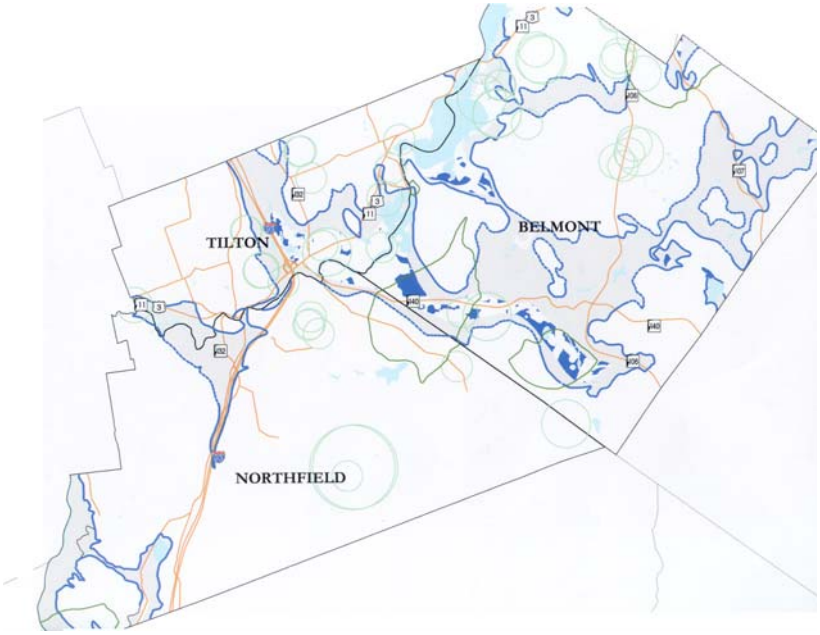



**Figure 5.** Favorable Gravel Well Analysis-After



The next step in the analysis is to eliminate areas that do not have a sufficient Sanitary Protective Area to become a new community well according to NHDES rules. The Sanitary Protective Area for community wells ranges from a radius of 150 to 400 feet around the well depending on the well's maximum permitted daily withdrawal. For the 75gpm well analysis, a 300 ft. radius is used. This area is required to be maintained in its natural state, and controlled by the water supplier through ownership or easements, to minimize the potential for contaminated water (both groundwater and surface water) to reach the well. In order to determine which areas would likely be suitable for large community well development, 300-foot buffers were created around human-made features such as buildings and roads, as well as all other potential contamination sources, and these areas were eliminated from being identified as a potential community well site. Actual known contamination sources were buffered by 1000 feet.[4] The resulting Map 4 illustrates the areas of the stratified drift aquifer potentially suitable for the location of a new community well based on the assumptions described above. Figures 4 and 5 illustrate the aquifer area with a transmissivity>1000 $ft^2$/day before and after the Favorable Gravel Well Analysis. As you can see, once all the constraints are eliminated, there is much less aquifer area potentially suitable as a community well for future drinking water supplies.

It is important to note that the NH Department of Environmental Services developed the Favorable Gravel Well Analysis as a planning tool and not as a well siting tool. The map provides an indication of where to start looking for potential new community well sites and areas that might be more important to protect for future drinking water supplies. Site-specific investigations would be the next step for a community to take to determine whether or not a specific site has the potential for a community well with adequate yield and which meets the well-siting requirements.[4]

~

**The following section examines reductions in recharge due to impervious surfaces. "Reductions in Recharge" is the fourth and final section on potential threats to drinking water resources, which collectively provide a solid foundation to assist the towns in planning efforts.**

1. "Viewing an Explanation of the Assessment Reports" and "Explanation of Assessment Reports for Non-Transient Systems". NHDES web-site, Water Division, Drinking Water Source Protection Program (www.des.state.nh.us/dwspp).

2. Doug Dowey, Maintenance Supervisor. NH Department of Transportation. Personal communication 6/23/03. Figures drawn from the summary salt reports for October 2002 to May 2003, dated 5/1/2003.

3. Drinking Water Source Assessment Reports for individual public water suppliers drawing from the stratified drift aquifer. NHDES. 2000-2003.

4. Using Stratified-Drift Aquifer Maps to Plan for Potential Future Community Wells. NHDES Environmental Fact Sheet WD-WSEB-22-12. 1999.

5. Managing Highway Deicing to Prevent Contamination of Drinking Water. EPA Source Water Protection Practices Bulletin. EPA 816-F-02-019. August 2002.

6. Managing Storm Water Runoff to Prevent Contamination of Drinking Water. EPA Source Water Protection Practices Bulletin. EPA 816-F-02-019. July 2001.

7. Managing Septic Systems to Prevent Contamination of Drinking Water. EPA Source Water Protection Practices Bulletin. EPA 816-F-02-019. July 2001.

# Reductions in Recharge

## Reductions in Recharge

As noted in the earlier section "Background Information on Groundwater Resources", the word recharge describes the movement of water from the surface down through the soil to the aquifer, contributing to the quantity of water in the aquifer. The natural ability of precipitation to enter the ground, move through the soil to the water table, and contribute to the aquifer can be interrupted when land is paved or other surfaces which don't allow water to enter the ground are placed over the direct aquifer recharge area. Cement, asphalt, roofing, and other materials that prevent precipitation and runoff from entering the ground are known collectively as impervious surfaces. Impervious surfaces can lead to reductions in the recharge of groundwater by allowing precipitation to evaporate off their surface or to be diverted away from the area where water entering the ground would recharge the aquifer. Not only do impervious surfaces inhibit the recharge of groundwater, but they also provide a surface for the accumulation of pollutants, prevent the natural processing of pollutants by plants and soil, and create a direct route for pollutants to enter surface water in some cases. The infiltration and groundwater recharge parts of the hydrologic cycle can get disrupted by the presence of large expanses of impervious surfaces.[1.]

### Other Factors Which Can Reduce the Quantity of Groundwater

Other factors which can reduce groundwater quantity besides reductions in recharge caused by impervious surfaces include contamination of available groundwater supplies, the transfer of groundwater outside of the direct recharge area, and groundwater withdrawals. Potential contamination sources were addressed in a previous section of this report, in terms of their impact on groundwater quality. It naturally follows that if groundwater is contaminated, that quantity of groundwater is no longer available as a drinking water supply unless costly efforts are undertaken to clean the contaminated groundwater. The transfer of groundwater outside of the direct recharge area can occur if wastewater collection systems such as sanitary and storm sewers collect water and ultimately discharge it outside of the area which would contribute to the recharge of the aquifer. Runoff from impervious surfaces should be treated and recharged to groundwater where feasible to minimize impacts. Large groundwater withdrawals are regulated at the state level, and so will not be addressed in this document which focuses on local planning efforts.

### Locations Where Impervious Surfaces May Be Warranted

While impervious surfaces can impact the resource negatively as described above, there are instances where impervious surfaces can prove beneficial in preventing contaminants from entering the ground and potentially contaminating the aquifer resource. Examples of types of land uses which might warrant the use of impervious surfaces to prevent groundwater contamination include the storage of regulated substances and the storage of road salt. In commercial and industrial zones, impervious surfaces can prove beneficial in containing hazardous substances and preventing contamination in the case of an accidental spill, and might be used to redirect polluted stormwater runoff through stormwater management systems designed following Best Management Practices to ensure that clean water is recharged to the aquifer.

The concept of balance has woven itself throughout this project and throughout this report; once again, in the case of impervious surfaces, community needs will have to be balanced when determining to what extent and in which situations impervious surfaces should be allowed in the direct recharge area of the aquifer.

**Review of Town Ordinances and Regulations**

In order to gain an understanding of the potential amount of impervious surfaces which may be created over the direct recharge area, a review of each of the three town's zoning ordinances was conducted. The zoning ordinances provide useful information on the maximum impervious surface coverage per lot allowed in each town. These percentages are presented below. Keep in mind that each lot may not ultimately be covered with impervious surfaces to the maximum percentages; still, this information can be helpful in understanding the possibilities left open by the existing zoning ordinances, which might reduce aquifer recharge.

***Tilton***

The following table shows the maximum lot coverage allowed by Tilton's Zoning Ordinance (2003) by zone, drawn from the Table of Dimensional Values (Article 7). Lot coverage is defined by the zoning ordinance to include the building footprint, pavements, and parking areas.

**Table 16: Maximum Lot Coverage: Tilton**

| Zoning District | Maximum Lot Coverage |
|---|---|
| MU | 50% |
| VR | 60% |
| MR | 50% |
| RA | 40% |
| DN | 100% |
| RG | 75% |
| RC | 60% |
| GC | 75% |
| IN | 75% |

**Source:** Tilton Zoning Ordinance (2003)

The lowest percentage of maximum impervious surfaces allowed in any zone is 40% in the Rural Agricultural zone, which has a minimum lot size of three acres unless it is a back land, in which case the minimum lot size is 6 acres. In a Rural Agricultural zone it is perhaps less likely that the maximum percentage will be made impervious, but it is important to note that this high percentage is permissible. The rest of the percentages range from 50 to 100 percent, depending on the zone. For the Resort Commercial zone, 60% of the lot can be made impervious, and for the General Commercial, Regional Commercial, and Industrial zones 75% impervious surface coverage is allowed.

***Belmont***

The following table shows the maximum lot coverage allowed by Belmont's Zoning Ordinance (2003) by zone, drawn from the Dimensional Regulations (Article 5, Table 2). Lot coverage is defined as the non-green area within the zoning ordinance.

**Table 17: Percent of Lot Coverage: Belmont**

| Zone | Percent of Lot Coverage |
|---|---|
| Commercial | 75% |
| Industrial | 75% |
| Residential Multi-Family | 60% |
| Residential Single Family | 60% |
| Rural | 30% |
| Village | 60% |

**Source:** Belmont Zoning Ordinance (2003)

The lowest percentage of maximum lot coverage in any zone is 30% in the Rural zone. The rest of the percentages range from 60 to 75 percent, with 75% for both the Commercial and Industrial zones.

***Northfield***

In Northfield, the Groundwater Protection Overlay District addresses impervious surfaces for the area over the stratified drifted aquifer. Impervious surface coverage of less than 15% is allowed in the Overlay District.

For any use that will create impervious surfaces on a greater than 15% of any lot or 2500 square feet of any lot (whichever is greater), the Planning Board may grant a Conditional Use Permit as long as the percentage impervious surface is permitted within the underlying district. The Landscaping section of Northfield's Site Plan Review Regulations includes provisions for impervious surfaces. For residential projects a minimum of 70% of the land area being developed is required to remain in its natural state or be maintained as a landscaped area, not covered by an impermeable material. In a non-residential development a minimum of 30% of the land area being developed cannot be covered by an impermeable material. The preference is for this remaining 30% of the land to be left in its natural state in cases where there are existing trees and forest cover. This section also specifies that there will not be more than 150 feet of continuous improved parking surface in parking lots; the lots need to be interrupted by shade trees and landscaping to meet this requirement.

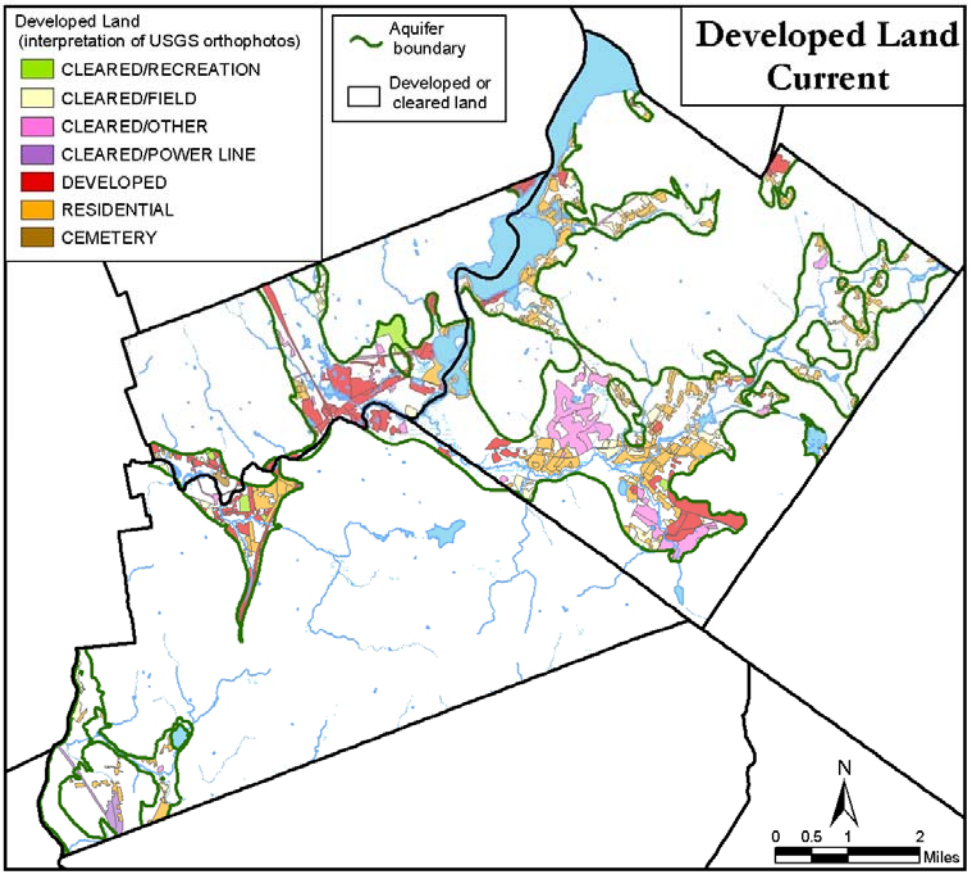
The proposed use needs to comply with the Performance Standards of the Groundwater Protection Overlay District, which indicate that a stormwater management plan is required for any use that renders greater than 15% or 2500 square feet of any lot impervious. The Planning Board needs to ensure that this stormwater management plan is consistent with two guidance documents on Best Management Practices identified in the ordinance. In addition, the stormwater management plan "shall demonstrate that stormwater recharged to groundwater will not result in violation of Ambient Groundwater Quality Standards...at the property boundary".

**Present Extent of Impervious Surfaces**

In order to determine the amount of impervious surface that covers the direct recharge area of the aquifer, an Impervious Surface Analysis was conducted. The technical aspects of this analysis are outlined in Appendix III. The following is an overview of the analysis process and a summary of the results.

The first step in the analysis process was to digitize developed lands from USGS digital orthophoto quadrangles using the "Developed Land Mapping Standards" established by NH GRANIT. Developed lands were only digitized in the direct recharge area of the aquifer. Map 5 depicts this step in the analysis process.

**Map 5.** Current Developed Land-Interpretation of USGS Orthophotos

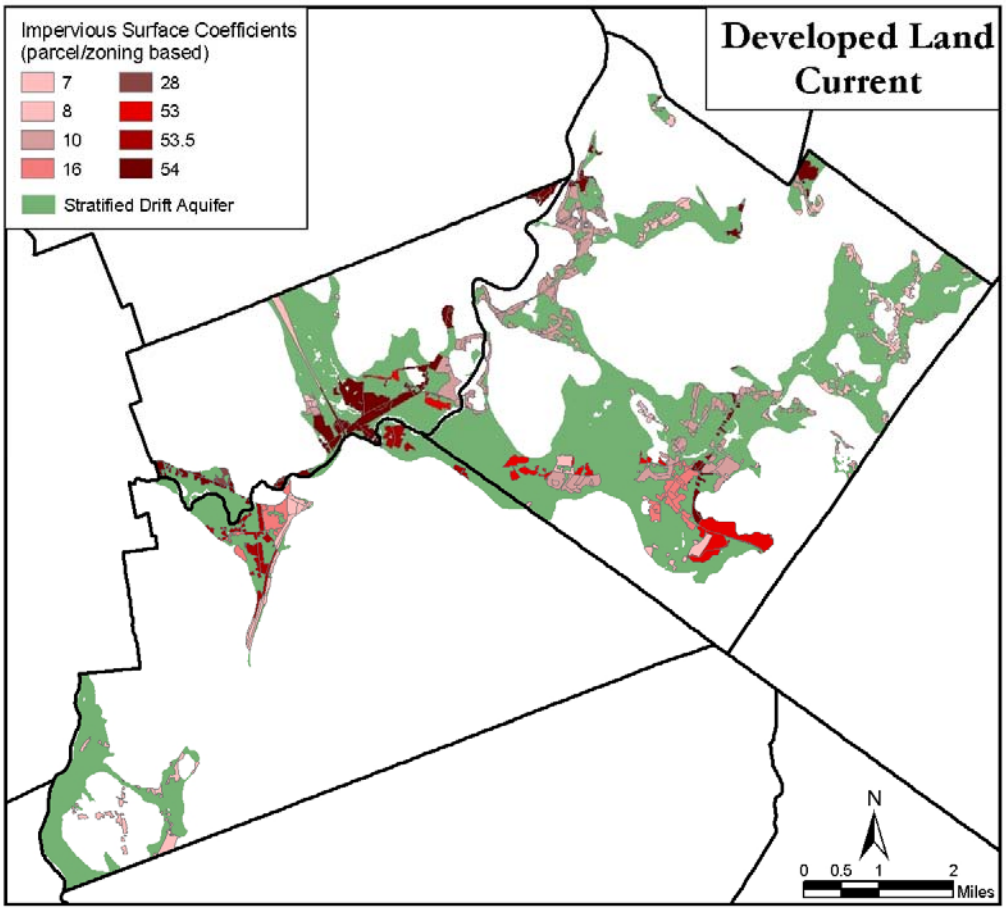



Impervious surface calculations were then made using Map 5. In order to estimate the amount of impervious surfaces overlying the aquifer, impervious surface coefficients, developed by the University of Connecticut Cooperative Extension, were applied to the developed lands data. These impervious surface coefficients provide an estimate of impervious surface coverage by zoning category. For an explanation of the land use types associated with each impervious surface coefficient, please see Appendix III.

To simplify the analysis, it was assumed that any developed land in each zoning category matched the zone where it was located. For example, any development in a commercial zone was assumed to be a commercial land use.

These calculations are illustrated in Map 6. The results of the calculations are depicted in Table 18. As an example of how to read the table, Belmont has 753.9 acres of land in the direct recharge area of the aquifer that is estimated to currently be 10% impervious.

**Map 6.** Impervious Surface Analysis-Current




This information assists in determining the current status of impervious surfaces in the direct recharge area. Based on this impervious surface analysis, developed land is estimated to cover 2855.1 acres of the direct recharge area of the aquifer. Since 466 acres of the direct recharge area are surface water acres, these acres are not included in the following calculations. An estimated 27% of the direct recharge area of the aquifer (land area only) is currently developed as defined by the "Developed Land Mapping Standards" described at the beginning of this section. "Developed" does not equate to "impervious". By applying the impervious surface coefficients to these developed lands by zone, 755.4 acres of this developed land, or 7% of the direct recharge area of the aquifer (land area only), is estimated to be currently impervious.

**Table 18.** 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 | 136.3 | - | - | 44.6 | 23.6 |
| 53.5 | - | - | 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** |

It is important to keep in mind that this estimate only illustrates the amount of impervious surfaces based on model coefficients for zoning types, not on actual zoning in the towns. In some cases this analysis may underestimate the amount of impervious surfaces on a developed parcel if the zoning ordinance of the town the parcel is located in allows for a greater percentage of impervious surfaces than the coefficients approximate. For example, the coefficients estimate an impervious surface coverage of 53% for developed parcels in an industrial zone, but the zoning ordinances of both Belmont and Tilton currently allow 75% lot coverage in the industrial zone. By comparing the maximum lot coverage tables and information at the beginning of this section with the coefficients of the impervious surfaces analysis, you will have a clearer sense of these potential variations if lots are developed to maximum allowed imperviousness. This has implications both for the present estimate of impervious surfaces and for possible future increases in the impervious surface coverage in the direct recharge area of the aquifer.

The next step in this impervious surface analysis would be to project the impervious surface coefficients onto the current zoning which overlies the aquifer, in order to calculate the potential amount of impervious surfaces which might cover the direct recharge area of the aquifer if the three towns were to be fully built-out. The map and numbers derived from this type of analysis could be viewed as a starting point from which to examine potential future conditions, not as a factual representation of what lies ahead for the towns. The first components of these projections were carried out and are found in Appendix III. There are a number of assumptions which underlie this analysis which should be carefully reviewed before viewing the results. Should the concepts underlying this approach be deemed a significant source of information for planning to the towns, a more comprehensive analysis could be conducted which addresses each of the assumptions outlined in Appendix III.

~

**It will be a true challenge for the three communities to determine to what extent and in which situations impervious surfaces should be allowed in the direct recharge area of the aquifer. Since more than a quarter of the direct recharge area is zoned commercial and/or industrial and may experience growth in the future, and since impervious surfaces currently cover a portion of the direct recharge area of the aquifer and may cover a larger area in the future, minimizing impacts from impervious surfaces is another important element of drinking water planning efforts.**

1. Ground-Water Resources in New Hampshire: Stratified-Drift Aquifers. US Geological Survey, Water Resources Investigations Report 95-4100. In cooperation with NHDES. 1995.

# Project Recommendations

## Project Recommendations

### Section Overview

The following broad recommendations were developed based on the findings of this report and information gathered from the three communities through the Water Resources Committee. The recommendations explore potential options for the long-term protection of the quality and quantity of drinking water supplied by the stratified drift aquifer. Each recommendation is followed by an overview of the potential benefits of implementing the recommendation as well as the challenges the communities might face, either individually or collaboratively, in working to implement the recommendation. This information is designed to assist the three communities in selecting approaches to aquifer protection appropriate for their town and the subregion.

Please note that the following project recommendations are not in order of priority. The next section of this report will discuss those recommendations which were determined to be priorities by the Water Resources Committee. Implementation Strategies have been developed for the priority recommendations and are found in a separate workbook. A copy of the workbook is available in the Town Hall of each of the three communities.

**Recommendation: Ensure that the Master Plans of the three communities contain language which support any potential ordinances/regulations to protect the aquifer.**

**Benefits of Implementing the Recommendation:**

- The Master Plan should contain supporting information to give legal standing to the implementation of ordinances and other regulations of the Planning Board. This is very important should ordinances/regulations be challenged in court. Including this information in the Master Plan is critical to the implementation of a number of project recommendations.
- Community education about the importance of existing and potential future clean drinking water supplies is critical in gaining community support for the implementation of project recommendations, and the Master Plan can assist in the public education process.
- The three communities should also consider including a segment within their Master Plans which indicates the shared nature of the aquifer resource, and the need for a collaborative approach towards its protection. Reference to this project, which included participation from the three communities, would support future collaborative efforts.

*Note: Both Northfield and Tilton are in the process of updating their Master Plans, and they should work to ensure that the Master Plan supports any potential aquifer protection efforts. Belmont has just completed its Master Plan update, and included a comprehensive section on aquifer protection.*

**Recommendation: Develop an aquifer protection ordinance which will meet the needs of the three communities. There are two approaches that could be taken: one set of standards, consistent between all three communities, or three different ordinances which increase the level of protection in all three communities.**

**Benefits of Implementing the Recommendation:**

***Approach One: One aquifer protection ordinance consistent between all three communities.***

- If all three communities could come to a consensus on all aspects of an aquifer protection ordinance, then the same requirements would be consistent across the entire aquifer. Benefits of this approach include consistent levels of protection of water quality for existing and potential future water supplies and opportunities for collaborating on public education and outreach regarding the specific content of the ordinance.

***Approach Two: Individually designed aquifer protection ordinances for each community.***

- Since the aquifer is presently protected at varying levels in the three communities, this approach would allow each community to tailor the ordinance to meet individual community needs, drawing from a set of concepts and standards developed for the whole aquifer. For example, Northfield may want to refine its existing ordinance to make it more effective, while Belmont may want to expand on its existing language to incorporate additional levels of protection, while Tilton may want to develop its initial aquifer protection ordinance-all three towns would be provided with the same information and resources from which to develop their approaches.

**Challenges to Implementing the Recommendation:**

In crafting ordinances for either approach, many factors must be considered to achieve a balance between zoning restrictions, existing and future land uses, economic development, transportation corridors, and the protection of the quality and quantity of drinking water for the three communities in the present and into the future. It will be extremely important to take into account the many diverse needs of each community when developing the aquifer protection ordinances. Information contained in this report, as well as the knowledge of those who participate in the Water Resources Committee, town boards, town officials, and key stakeholders, will be very helpful in the development of draft ordinances. In either approach, public outreach and education are critical. Zoning ordinances need to be brought before Town Meeting for approval by the local legislative body, a vote by the townspeople.

**Recommendation: Strengthen site plan review and subdivision regulations in each community to minimize any potential negative impacts to the shared aquifer.**

**Benefits of Implementing the Recommendation:**

- Strengthening components of the site plan review and subdivision regulations, in a manner which supports and complements the protection of the aquifer through provisions in the zoning ordinance as described in the previous recommendation, will increase the overall long-term protection of the resource.
- In site plan review and subdivision regulations, the towns can require certain pieces of information as part of the application process. By including the location of the stratified drift aquifer as one of those requirements, as well as requirements which ensure that impacts are mitigated to the greatest extent possible, the quality and quantity of water supplied by the aquifer can be further protected.
- Since such a large percentage of the direct recharge area is zoned commercial and/or industrial, site plan review regulations are an important planning tool for the three towns.

**Challenges to Implementing the Recommendation:**

As in the case of the development of an aquifer protection overlay zone within the zoning ordinance, a balanced approach is critical when strengthening site plan review and subdivision regulations. The requirements should be comprehensive and support the protection of the aquifer without being so restrictive or costly that economic development and/or other important community needs are hindered.

***Note:*** *Although revisions to site plan review and subdivision regulations do not necessarily need to follow revisions to the zoning ordinance, this order of revision will make it easier for the communities to ensure that the regulations are consistent with the zoning ordinance without any conflicts.*

**Recommendation: Develop a general education and outreach program to educate members of the three communities about their shared aquifer resources and ways they can contribute to groundwater protection.**

**Benefits of Implementing the Recommendation:**

- To raise community awareness about aquifer protection, education and outreach are essential. The members of each community need to be provided with the opportunity to learn about the importance of this shared resource. By building a foundation of knowledge throughout the three communities, citizens will be better informed when the time comes to make important community decisions regarding the aquifer. The education and outreach program should stress the importance of the aquifer and a clean drinking water supply to every aspect of these communities: economics, quality of life, health, ecological processes, etc.

**Recommendation: Explore opportunities for land protection in the direct aquifer recharge area to protect both existing and potential future drinking water sources.**

**Benefits of Implementing the Recommendation:**

- Permanent land protection, either through land purchases or conservation easements, will ensure that in the protected area aquifer recharge will occur and no detrimental impacts from potential contamination sources will take place.
- An additional benefit of land protection is the creation of public open space, which is currently very limited in the three communities. Land protected over the aquifer could potentially provide recreational opportunities, increase wildlife habitat, and contribute to the rural character of the three communities.
- If it were possible to protect a parcel that is situated in more than one of the towns, and ideally at the nexus of all three, a shared park on the parcel would create an opportunity for public education about the importance of the shared drinking water resources.
- Successful grant applications to programs such as the Water Supply Land Grant Program and the Land and Community Heritage Investment Program for protection of land in Wellhead Protection Areas and the direct aquifer recharge area would bring additional resources to the three communities which would benefit present and potential drinking water supplies.
- The towns may want to begin by looking closely at the land identified in the Favorable Gravel Well Analysis as having a higher potential for serving as a public water supply. On the ground site visits to these areas as well as additional hydrogeologic research would assist in

determining which sites might be suitable for land protection efforts to protect potential future water supplies.

- Water suppliers could coordinate efforts to develop a permanent source of drinking water in the stratified drift aquifer with greater protections to meet existing and future needs. This partnership would assist in ensuring that adequate clean drinking water supplies would be available in the future. Innovative techniques should be explored for increasing the levels of protection around existing and potential future drinking water sources, such as shifting the focus for development potential to areas outside of this zone, thereby allowing higher density development in less sensitive areas and reducing development pressure around drinking water sources.

*Note: Combined Water Supply Land Grant and LCHIP applications has resulted in 75% funding of projects elsewhere in the state. By leveraging funds, the towns could permanently protect drinking water sources and obtain public open space at a low cost to each town.*

**Recommendation: Work with the Tilton & Northfield Aqueduct Company and the Belmont Water Department to ensure that a emergency plan exists for the protection of groundwater in the event of a hazardous material spill on the road network in the direct aquifer recharge area in close proximity to the water supply wells.**

**Benefits of Implementing the Recommendation:**

- In the event of a hazardous material spill over the direct aquifer recharge area, an emergency plan could facilitate a rapid response in assembling a cleanup by trained professionals. This would minimize the chances that a well, and the stratified aquifer, could be contaminated.

**Challenges to Implementing the Recommendation:**

All existing emergency response mechanisms would need to be researched to determine whether or not responses would be quick enough and of an appropriate nature to ensure protection of the water stored in the aquifer were an accidental spill to occur in the direct recharge area. Additional response mechanisms specific to the protection of groundwater would need to be coordinated with existing systems. Personnel and equipment costs would need to be researched.

**Recommendation: Follow Best Management Practices for road salting and salt storage in the direct aquifer recharge area, including working with NHDOT to identify methods for reducing salt use on state roads in the direct aquifer recharge area.**

**Benefits of Implementing the Recommendation:**

- Proper siting of salt storage facilities, on flat sites away from surface water, with an impervious surface underlying the facility, and a cover over the salt to protect the salt from runoff, should minimize potential groundwater impacts from runoff coming into contact with salt.
- In addition, the aquifer can receive additional protection from road salt impacts if the communities and NHDOT follow Best Management Practices during road salt application in the vicinity of public water supplies as well as in the direct aquifer recharge area. In applying road salt, location, quantity, and frequency are important factors in minimizing potential impacts.

**Challenges to Implementing the Recommendation:**

Although some practices, such as applying the proper amount of salt for given road conditions, are not costly, other methods, such as utilizing alternatives to NaCl, could add a substantial cost. Each community needs to ensure that roads are safe for travel, while also minimizing groundwater impacts, which is a difficult task during extreme weather events and long winters.

If it were determined that NHDOT and the towns were willing to explore reductions in road salt use and the implementation of BMPs to protect groundwater quality in critical areas, a coordinated approach would need to be taken to assure that those applying the road salt would have adequate information to implement this Recommendation while at the same time keeping the roads clear enough for safe passage of vehicles. Signage along the roadways indicating reductions in the use of salt might also be an important component of implementation.

**Recommendation: Develop targeted education and outreach programs for residents to increase awareness of potential threats to groundwater resources and methods for reducing these threats. Three potential topic areas are household hazardous materials, the use of chemical fertilizers, and septic system maintenance.**

**Benefits of Implementing the Recommendation:**

***Topic Area One: Household Hazardous Materials***

- Community members need to know that pouring common household chemicals such as paint thinner, cleaning products, and used motor oil on the ground or down the drain has the potential to contaminate groundwater. By educating community members about these threats to groundwater, smaller amounts of household hazardous materials will be disposed of improperly.
- Continued participation in Household Hazardous Waste Collection efforts will help ensure that these household hazardous materials are disposed of properly and no longer pose a threat to groundwater supplies.

***Topic Area Two: The Use of Chemical Fertilizers***

- If excessive amounts of chemical fertilizers are used on residential lawns, chemicals and nutrients can be carried by stormwater runoff and have the potential to impact groundwater.
- Proper use of fertilizers in adequate but not excessive quantities, as well as the encouragement of the use of organic fertilizers rather than chemical fertilizers, can lessen the likelihood of impacts to groundwater.

***Topic Area Three: Septic System Maintenance***

- While septic systems which are designed, installed, and maintained properly do not pose a threat to groundwater, poorly functioning and/or failing septic systems have the potential to contaminate groundwater.
- By educating community members about the importance of septic system maintenance, potential groundwater contamination can be averted.

**Recommendation: Develop an education and outreach program for gravel pit owners/operators to explain the communities' concern for safe drinking water supplies and the aquifer resource and remind them of the importance of following Best Management Practices, and develop/improve earth removal regulations for gravel pits not providing material for state roads.**

**Benefits of Implementing the Recommendation:**

- Removal of sand and gravel in the direct aquifer recharge area increases the potential for groundwater contamination if Best Management Practices are not followed.
- By reducing the potential for pollution from equipment operation, maintenance and washing, maintaining unexcavated material above the seasonal high water table, and ensuring proper site reclamation, the potential for groundwater contamination will be minimized.

**Recommendation: Develop voluntary Best Management Practices for commercial and industrial uses, suited to the needs of the three communities, to minimize pollution from stormwater runoff while encouraging recharge to the aquifer.**

**Benefits of Implementing the Recommendation:**

- Since a large portion of the direct recharge area is zoned commercial and/or industrial, it is important that Best Management Practices be followed to minimize pollution from stormwater runoff and encourage recharge to the aquifer. These Best Management Practices may be incorporated as requirements into the aquifer protection overlay zone and site plan review and subdivision regulations for new developments by reference, and used as an educational tool for uses which are already grandfathered in.
- Business owners and operators should be involved in the process of the development of Best Management Practices. This type of cooperative effort would ensure that many perspectives were incorporated during the development process, which will contribute to the success of the implementation of this Recommendation.
- Best Management Practices manuals have already been developed for issues such as stormwater management. A review of these existing materials will determine if they are appropriate tools, or whether more specific educational materials should be developed for the protection of the aquifer in the three towns, which incorporate the most desirable aspects of existing techniques along with design guidelines which outline the specific elements most important to the three towns and the protection of their drinking water supply in the present and into the future.

**Challenges to Implementing the Recommendation:**

If specific materials are desired, the towns will need to explore additional funding sources to design and produce these materials in sufficient quantities and of such quality that they can be distributed throughout the three communities.

**Recommendation: Develop health regulations/ordinances which protect groundwater resources.**

**Benefits of Implementing the Recommendation:**

- The threat of contamination of groundwater could be minimized by requiring that businesses which handle large quantities of hazardous substances implement Best Management Practices.
- A local official such as the Building Inspector could be given the authority to inspect certain types of businesses to be sure they are following proper hazardous material handling practices and to educate these business owners.
- If education and multiple requests don't lead to cooperation, enforcement action can be taken by the municipal official.

**Challenges to Implementing the Recommendation:**
Funding for the implementation and enforcement of health regulations may pose a potential challenge. Health ordinances would need to be passed by the local legislative body, but do allow permit fees.

**Additional Recommendations:**

**Recommendation: Update the Potential Contamination Source Inventory once every three years. A copy of the updated map should be inserted into this resource document and updated information should be submitted to NHDES. By maintaining an accurate and up-to-date Potential Contamination Source Inventory for the direct aquifer recharge area, the three communities will have a thorough understanding of potential contamination threats to the aquifer, which can serve as an important tool in the planning process.**

**Recommendation: Towns should obtain copies of the updated surficial geology maps from USGS as they become available, and any other revised maps and studies, and incorporate updates into this report as additional planning tools. The towns may also consider carrying out additional hydrogeologic studies to gain a more complete understanding of groundwater movement and characteristics.**

**Recommendation: The Water Resources Committee, which includes representatives from each of the three communities which share the common aquifer, should continue to meet regularly to share town initiatives and information and to discuss opportunities for collaboration. Additional stakeholders should be drawn into the implementation of specific relevant projects.**

**Recommendation: The Water Resources Committee should meet annually to review progress in implementing priority recommendations and to monitor project results. The table found at the end of this document should assist the Water Resources Committee in this monitoring process. Once recommendations identified as priorities have been implemented, the Water Resources Committee should reprioritize the remaining recommendations and explore opportunities for implementation.**

## Identification of Priority Recommendations for Implementation

At the Water Resources Committee meeting in April 2003, the draft project recommendations were presented to the group for discussion. Eleven broad recommendations were outlined, covering the following topics: aquifer protection ordinances, subdivision regulations, site plan review regulations, land protection, emergency planning, best management practices for road salting and salt storage, targeted education and outreach programs, earth removal, groundwater reclassification, health regulations/ordinances, and best management practices for commercial and industrial uses. Town representatives were then asked the following questions:

- Are the recommendations comprehensive? Should any others be considered for addition? Should any be eliminated?
- What are the challenges to the implementation of recommendations?
- Which projects provide opportunities for collaboration among the three communities?
- Which recommendation or set of recommendations are most appropriate at the present for addressing drinking water protection issues?

During the discussion which followed, committee members pointed out how implementation will require strong leadership and discussed the importance of buy-in of communities and landowners. The possibility of this project becoming a model for aquifer protection was also mentioned. Project recommendations were refined to incorporate the local knowledge of members of the Water Resources Committee. The final complete recommendations are found in the previous section of this report.

After the recommendations were reviewed and discussed, each participant was given a "Project Recommendations Prioritization Worksheet" which listed the eleven recommendations and asked each participant to "Please select the top three recommendations you feel are priorities for implementation." They were asked to number these from 1-3, with 1 being the number one priority.

The outcome of this prioritization was a unanimous vote in favor of developing aquifer protection ordinances as the number one priority. The full recommendation was written as follows:

"Develop an aquifer protection ordinance which will meet the needs of the three overlying communities. There are two approaches that could be taken: one set of standards, consistent between all three towns, or three different ordinances which increase the level of protection it all three communities."

The recommendation was designed to leave room for flexibility in the development of an aquifer protection ordinance or ordinances. The Implementation Strategies document contains specific recommendations, guidance, and resources to assist the three towns in implementing this priority recommendation.

Participants were also asked to share their perspectives on the greatest challenge to implementing the recommendation they selected as the number one priority. Responses to this question included:

- "Having the leadership to make the decision to change the zoning for the benefit of the townspeople."
- "None."
- "Adopt case law from other known regulations being enforced across the region."
- "Existing industrial and commercially zoned properties."
- "Balance."

Additional points raised during the meeting included: any ordinances adopted need to have legal standing, be enforceable, and have teeth so that the Planning Boards can act; pre-existing landowners' rights need to be considered; and mechanisms need to be in place for mitigating impacts. It is important to identify challenges to implementing recommendations at the outset, so that the challenges can be properly addressed in the implementation stage. The challenges identified by participants are addressed in the Implementation Strategies document.

Town participants were also asked the question: "For the recommendation you selected as the number one priority, do you agree that the three communities should work collaboratively in its implementation?" All but one person responded "Yes" to this question; the single other response was "Possibly". This question was not asking whether or not the towns wanted to work on a single ordinance or three separate ordinances, but was instead asking whether or not there was interest in working together during the process of implementation. The responses are a positive

indication that representatives from the three towns are willing to work together to address issues related to the shared aquifer resource.

The second priority recommendation selected by the majority of town participants was to strengthen subdivision and site plan review regulations in each community to minimize any potential negative impacts to the shared aquifer. The majority vote for this recommendation as the second priority included representation from each of the three towns. The Prioritization Worksheet originally had subdivision regulations and site plan review regulations as two separate recommendations, but the general consensus of the group, as expressed during the discussion as well as in the actual prioritization, was to put the two together into one recommendation. Information on implementing this recommendation will be incorporated into the Implementation Strategies document.

The third priority recommendation selected by the largest number of town participants was to "Develop Best Management Practices for commercial and industrial uses, suited to the needs of the three communities, to minimize pollution from stormwater runoff while encouraging recharge to the aquifer." This is a recommendation which will require additional resources for its implementation. As part of the Implementation Strategies component of this project, LRPC worked with the towns to draft and submit a grant application to the 2004 Source Water Protection Grant Program of the New Hampshire Department of Environmental Services to attempt to garner funding to implement this recommendation.

Other recommendations which were identified as one of the top three priorities by one or more participants were: to develop targeted education and outreach programs; to follow BMPs for road salting and salt storage; to explore opportunities for land protection in the direct aquifer recharge area; and to work with water suppliers to develop an emergency plan for hazardous spills. The complete wording of these recommendations can be found in the Recommendations section. Implementation Strategies have not been developed for these recommendations, in an effort to focus on the top priorities and provide substantial information and resources to the three towns. Still, it is helpful to know which other recommendations were selected as priorities (top three) by one or more participants for future planning and implementation.

# Organizational Table for Project Recommendations

This table is a tool the three towns can use to keep track of progress and to monitor results. It is recommended that this table be reviewed and updated annually by the Water Resources Committee. Once recommendations identified as priorities have been implemented, the Water Resources Committee should identify new priorities from the remaining recommendations and explore opportunities for implementation. Over time, new ideas may emerge and additional recommendations may evolve from changing circumstances. These new ideas and recommendations can be added to this table and incorporated into the implementation process.

| Recommendation | Top Priority Recommendations | Resources Needed To Implement Recommendation | Key Stakeholders and Possible Partners | Timeframe for Implementation | Date Successfully Implemented |
|---|---|---|---|---|---|
| **Aquifer Addressed in Master Plan** | | | | | |
| **Aquifer Protection Ordinance** | | | | | |
| **Site Plan Review and Subdivision Regulations** | | | | | |
| **General Education and Outreach to Towns** | | | | | |
| **Land Protection to Protect Sources** | | | | | |
| **Emergency Plan for Haz. Material Spills** | | | | | |
| **BMPs for Road Salting and Salt Storage** | | | | | |
| **Targeted Education and Outreach to Residents** | | | | | |
| **Education and Outreach for Gravel Pit Operations** | | | | | |
| **BMPs for Commercial and Industrial Uses** | | | | | |
| **Health Regulations/Ordinances** | | | | | |
| **Other:** | | | | | |

It is suggested that this table be photocopied and filled in annually. A blank copy is found on the back side of this page. The file is available at the Lakes Region Planning Commission should you prefer to fill the update in electronically.

| Recommendation | Top Priority Recommendations | Resources Needed To Implement Recommendation | Key Stakeholders and Possible Partners | Timeframe for Implementation | Date Successfully Implemented |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

# Acknowledgments

## 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. Thanks are extended to the three speakers who shared information and resources with the Water Resources Committee at the November 2002 meeting: Sarah Pillsbury of the Drinking Water Source Protection Program of NHDES, Garrett Graaskamp of the American Groundwater Trust, and Dr. David Wunsch, NH State Geologist and Director of the NH Geological Survey. The Tilton & Northfield Aqueduct Company and the Belmont Water Department are thanked for participating in the project by attending Water Resources Committee meetings as well as by contributing information through formal interviews. The extensive mapping assistance provided by Katie Callahan is greatly appreciated, both through her work efforts at NHDES and by voluntarily providing technical assistance to develop project maps including the detailed analyses. The efforts of those who reviewed sections of this document are greatly appreciated, including members of the Water Resources Committee, Paul Susca and Sarah Pillsbury of NHDES, water supply company representatives, and LRPC staff.

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.

# Appendix I

Review of the current zoning ordinances and regulations of each town, focusing on those aspects which relate to the protection of groundwater.

The following is a review of the current zoning ordinances and regulations of each town, focusing on those aspects which relate to the protection of groundwater. For additional information on town ordinances and regulations please refer to the complete documents, available in the Town Halls of each town.

***Tilton***

*Zoning Ordinance*

The Tilton Zoning Ordinance (2003) defines the word aquifer in its definitions section (Article II.) as "a soil deposit with capacity to transmit and store a large amount of groundwater, having the potential to meet public or private water needs." The town of Tilton has not established an aquifer protection district or overlay zone with specific provisions to safeguard the aquifer. The aquifer map is not referred to in Tilton's regulations. Although no specific aquifer protection district is established, there are other provisions found within Tilton's Zoning Ordinance which acknowledge the importance of the protection of the aquifer and/or contain provisions which reduce the potential for the aquifer to become polluted, as outlined below.

The Wetlands Conservation District (Article XIV), which was adopted in March 1986, refers to the protection of the aquifer in its Purpose section: "It is intended that this chapter shall: Prevent the development of structures and land uses on naturally occurring wetlands which will contribute to the pollution of surface and groundwater by sewage and/or toxic substances. ... [and] Protect potential water supplies and existing aquifers and aquifer recharge areas." The Wetlands Conservation District is defined as areas with poorly drained or very poorly drained soils based on the 1968 SCS Soil Survey for Belknap County. Within the district, uses are permitted which will not negatively impact the resource; all other uses require a Special Exception. In locations with Very Poorly Drained Soils, a public hearing is required, and one of the determinations necessary is that the "proposed use shall not cause pollution of surface or groundwater". The town acknowledges the importance of keeping surface and groundwater free from pollution, although no specifics are provided for making this determination.

In the Industrial Park District, Special Exceptions are required for the following uses which have the potential to impact groundwater without proper management practices: the bulk storage of fuel, chemicals, or flammable materials and salvage yards and junkyards. These uses are not allowed in any other zone. Motor vehicle repair/maintenance shops and gasoline sales are permitted in the General Commercial and Regional Commercial zones, and require Special Exceptions in the Regional Commercial zone. In the Downtown zone, gasoline sales are permitted but motor vehicle repair/maintenance shops require a Special Exception.

Tilton also has Excavation Regulations within its zoning regulations (Section 3.2). The Chart of Permitted Uses (Article 6) of the Zoning Ordinance indicates that the removal, excavation, and processing of earth materials is only permitted by Special Exception in the Industrial zone. The ZBA is instructed to make its determination to issue a special

permit after obtaining technical advice from the Soil Conservation Service through the Belknap County Soil Conservation District (currently the Natural Resources Conservation Service and the Belknap County Conservation District), "and may set such restrictions as are just and in the best interest of the Town of Tilton." Provisions are included for restoring the excavated area "to an acceptable condition within ninety days after depletion of the deposit or completion of the work."

The town of Tilton does not allow the stockpiling and land spreading of Class B sewage sludge and the land spreading of industrial paper mill sludge containing hazardous materials and toxic substances, excluding septage/sewage/sludge generated in the town itself. (Section 3.2.5)

*Site Plan Review Regulations*

The Site Plan Review Regulations of Tilton (March 1992) have some components which relate to the protection of aquifer resources. One of the purposes of the regulations are "To provide for the safe and attractive development or change or expansion of use of the site and to guard against such conditions as would involve danger or injury to health, safety, or prosperity by reason of: (2) Inadequate protection for the quality of groundwater." As part of the information required on site plans, natural features should be shown (although aquifer boundaries are not referenced specifically). The Planning Board can require the developer to provide an environmental and economic impact statement, which may require documentation on ground and surface water quality, amongst other items. In the "Design and Construction Requirements" section it states that the design of the development should fit the existing natural (as well as man-made) environments with the least stress, including the fact that provisions should be made for the protection of natural features, although specifics are not detailed.

*Subdivision Regulations*

The Subdivision Regulations for the Town of Tilton (June 2003) contain information which relates to the long-term viability of the town's drinking water supply. For example, in the section which describes preliminary layout requirements, one requirement is to provide information on existing private/public wells as well as the results of each percolation test hole and soil conditions information to show that the lots can support on-site water and waste disposal if they are necessary "without danger of contamination of water supply on such lots or on other property". (Section 4.4.D)

In the General Requirements for the Subdivision of Land (Section VI), two provisions relate to water supply protection. First, the applicant needs to take into account the preservation and protection of existing features so that the natural environment is preserved; the aquifer is not listed specifically but the list is not all-inclusive. Second, the Planning Board needs to consider the impact of a proposed subdivision on services including water supply and storm drainage. Section 6.6 of the General Requirements focuses on the storm drainage system, stating that the removal of surface waters should not adversely affects neighboring properties or the public stormwater system and will

reduce flooding, erosion, and sedimentation. Specific details on designing stormwater management systems to minimize impacts to water quality are not included, but runoff is addressed. The water system General Requirements are outlined in section 6.8, including a requirement to include the well location of any individual wells as well as the protective radius on the plan.

Section VII of Tilton's Subdivision Regulations outlines extensive Design Standards for All Roadway Improvements, including provisions for the storm drain system. The requirements of a drainage study/stormwater management report to be submitted and reviewed by the Town or its Agent include: indicating the project location and watershed area; providing a watershed area plan showing the boundaries of each drainage area and sub-area; riprap design calculations meeting the requirements of a guidance document for stormwater management; and runoff calculations.

***Belmont***

*Zoning Ordinance*

The Belmont Zoning Ordinance (2003) contains an Article on Performance Standards (Article 7), and Section A focuses on specific performance standards for aquifer protection. This section begins with a definition of a stratified drift aquifer. It then indicates that gravel/stratified drift wells are those shown on NHDES's map entitled "Drinking Water Resources and Potential Contamination Sources for the Town of Belmont", with the date of March 15, 1999 and as amended by NHDES.

This section then identifies stratified drift aquifers as valuable sources of community and individual drinking water, and points out their susceptibility to pollution. For this reason, the prohibited uses outlined in NH RSA 485-C: 12 "shall not be allowed within the gravel stratified drift wellhead protection areas identified on the above mentioned plan." The prohibited new uses outlined in NH RSA 485-C: 12 are: the siting or operation of a hazardous waste disposal facility as defined under RSA 147-A; the siting or operation of a solid waste landfill; the outdoor storage of road salt or other deicing chemicals in bulk; the siting or operation of a junk or salvage yard; the siting or operation of a snow dump; and the siting or operation of a wastewater or septage lagoon. Currently the additional level of protection afforded by the performance standards described above only apply to the wellhead protection areas; although regulating uses in wellhead protection areas to protect current drinking water supplies is critical, currently there is no language for mitigating impacts in the entire direct recharge area of the stratified drift aquifer to increase protection of current drinking water supplies as well as potential future supplies.

Treated soils are regulated in Article 12, Section F, Part 3. Restrictions on the placement and use of this material include not allowing its placement or use within a recharge area of any sole source drinking water supply, within 100 feet of any surface water, and within 25 feet of a wetland. In addition, pre and post soils and/or water testing could be required.

In the Definitions Article (Article 14), the definition for Industrial Use includes uses which are not permitted in town, including tanneries, fertilizer plants, and processing of ammonia, chlorine, petroleum or explosives. Uses not permitted include those above, but are not limited to those.

Within the Performance Standards for Manufactured Housing Park and Manufactured Housing Subdivision Section (Article 7, C.), the total lot area is reduced by the amount of non-buildable area before determining the number of units allowed on the lot. Non-buildable area includes wetlands, wellhead protection areas, and wells.

Within the Agricultural Animals section of the Belmont Zoning Ordinance (Article 4, Section J), animal buildings, waste materials and grazing and keeping areas are required to be a minimum of 50 feet from wells, water bodies and wetland areas. In addition, "no...groundwater runoff nuisance shall occur."

*Earth Excavation Regulations*

Belmont has Earth Excavation Regulations, November 1982, which include information relevant to the protection of the stratified drift aquifer. Within the regulations, a definition for aquifer references a USGS map entitled "Availability of Ground Water", which is inconsistent with the more recent map referred to in the Zoning Ordinance. Applicants who want to excavate land and who aren't excluded by the provisions of section 3.1 need to apply to the Planning Board for an excavation permit. This permit needs to include, amongst other requirements, "the elevation of the highest annual average groundwater table within or next to the proposed excavation", as well as a plan for the restoration of the area affected by the excavation. The Planning Board will not grant a permit "where the excavation would substantially damage a known aquifer". Exceptions to needing to obtain a permit are: the excavation of less than 500 cubic yards of earth incidental to agricultural or silvicultural activities, normal landscaping, or minor topographical adjustment; excavation incidental to the lawful construction or alteration of a building or structure or parking lot or way including a driveway; excavation from an area contiguous to or from land in common ownership with stationery manufacturing and producing plants in operation as of the effective date of RSA 155-E using earth obtained from this area; excavation from a granite quarry; or excavation performed exclusively for the lawful construction or maintenance of a Class I-V Highway following certain provisions of the Earth Excavation Regulations.

*Site Plan Review Regulations*

Belmont has extensive Site Plan Review Regulations (April 2003) which contain sections relevant to the protection of the aquifer. One purpose of the Site Plan Review Regulations is stated as "to protect environmental quality by means such as protecting groundwater...". Elements of the Applications Submission Requirements (Section 5) which pertain to aquifer protection include: the requirements of the Site Plan include the location of wells showing required well radius; the requirement for an Aquifer Plan which maps all known aquifers if the property is over or adjacent to a known aquifer (or a

statement on the plan if not); and the requirement for a Stormwater Management and Erosion Control Plan and Report for projects with a cumulative disturbed area > 20,000 square feet, construction/reconstruction of a street or road, disturbed critical areas, or construction of three or more dwelling units or a primary non-residential structure which includes a proposed schedule for the inspection and maintenance of all Best Management Practices. The Narrative Overview needs to contain the projected increase in the number of auto trips per day as well as a list of significant environmental features (although aquifers are not referred to specifically here) amongst many other requirements.

Where required by the Planning Board, a narrative description of ongoing maintenance requirements for water quality measures required by the stormwater management and erosion and sediment control plans shall be recorded on the deed (5.E.5.i.). In addition, as required by law or as determined by the Planning Board, an environmental and/or economic impact statement prepared by a qualified consultant may be required, which may require documentation on a number of items including ground and surface water quality. (5.E.7.c.)

Projects designated as "Minor" are exempt from submitting an Aquifer Plan and Stormwater Management and Erosion Control Plan and Report except in cases where the Planning Board determines otherwise. Minor Projects are those projects where: all structure construction/reconstruction does not exceed 600 square feet; all disturbed area does not exceed 20,000 square feet; and no significant off-site impacts are generated.

In cases where the Planning Board determines that environmental concerns may be faced during the construction process, the applicant will post a security to defray the cost of construction and of environmental protection, stabilization, and reclamation.

*Subdivision Regulations*

Belmont's Subdivision Regulations (June 2003) contain a number of provisions related to the protection of aquifer resources. In the Plan and Report Requirements section of the Application Submission Requirements (5.D) there is a requirement for an Aquifer Plan which maps all known aquifers including those identified on the USGS maps or other applicable documents. If there is a cumulative disturbed area > 20,000 square feet, construction or reconstruction of a street or road, a subdivision of more than three building lots, or disturbed critical areas then there is a requirement that a stormwater management and erosion control plan and report be submitted to the Planning Board. The Stormwater Management Plan needs to include, in addition to a number of other items, identification of watershed boundaries and information on temporary and permanent stormwater management and erosion and sediment control BMPs. The Stormwater Management Report needs to contain a number of items, including a proposed schedule for the inspection and maintenance of all BMPs and runoff calculations.

In the Narrative Overview section of Belmont's Subdivision Regulations (Section 5.E.1) significant features need to be addressed including a list of significant environmental

features. Although aquifers are not referred to directly, the example list is not all-inclusive. Under the Legal Documents and Permits section (5.E.5) there is a requirement that a narrative description of on-going maintenance requirements for water quality measures in the stormwater management and erosion and sediment control plans be recorded on the deed to the property where the measures are located. Additional items which may be required by the Planning Board (5.E.7) include an environmental impact statement prepared by a qualified consultant which may require information on ground and surface water quality.

In the case of Minor Subdivisions of three or fewer lots, applicants are exempt from the requirements of an Aquifer Plan and a Stormwater Management and Erosion Control Plan and Report except in cases where the Planning Board determines they are required when reviewing the application.

The Design Standards section of the Subdivision Regulations (Section 9) 9.D provides design standards for Stormwater Management and Erosion Control including requirements for meeting BMP standards outlined in a guidance document and for controlling runoff. In Section 10, Construction Standards for Streets and Roads are outlined, including requirements for adequate disposal of surface water runoff (10.E).

***Northfield***

While Northfield has the smallest percentage of aquifer area located within its town boundaries, it has the most extensive regulations to protect the aquifer. The Northfield Zoning Ordinance (2003) contains an extensive Groundwater Protection Overlay District (Article 6, Section 2). "The purpose of this ordinance is...to preserve, maintain, and protect from contamination existing and potential groundwater supply areas and to protect surface waters that are fed by groundwater. The purpose is to be accomplished by regulating land uses which could contribute pollutants to designated wells and/or aquifers identified as being needed for present and/or future public water supply."

Northfield's Groundwater Protection Overlay District follows almost exactly the language of the Model Groundwater Protection Ordinance developed by the NH Office of State Planning and the NH Department of Environmental Services, 2001, with a few exceptions. The prohibited use of the siting or application of biosolids/sludge as well as the associated biosolids/sludge definition found in the definitions section are the only departure from the Model Groundwater Protection Ordinance. An analysis of the model ordinance is contained within the Implementation Strategies document.

In Northfield, the Groundwater Protection District is an overlay of the stratified drift aquifers shown on the NHDES map entitled "Drinking Water Resources and Potential Contamination Sources for the Town of Northfield, NH", 10/29/99. The Groundwater Protection Overlay District Article defines performance standards for all uses in the district, unless the use is exempt under Article XI, described below. It also outlines prohibited uses and conditional uses within the overlay district.

The performance standards for the Groundwater Protection Overlay District cover the following topics: impervious surfaces and stormwater management; storage of animal manure, fertilizers, and compost; and storage of regulated substances. If greater than 15 percent or more than 2500 square feet of any lot are made impervious, a storm water management plan is required which is consistent with two guidance documents on Best Management Practices. The stormwater recharged to groundwater must not result in the violation of Ambient Groundwater Quality Standards at the property boundary. Best Management Practices outlined in a specified guidance document must be followed for the storage of animal manure, fertilizers, and compost. Specific requirements are outlined for the storage of regulated substances with the capacity of five gallons or more including: storage in product-tight containers on an impervious surfaces; prevention of unauthorized entry; protection from precipitation for outdoor storage areas; distance restrictions from surface water, storm drains, and wells for locating outdoor storage areas; secondary containment for outdoor storage of regulated substances if in total there are greater than or equal to 275 gallons on one property; and clear labeling of storage containers.

The following uses are prohibited in the Groundwater Protection Overlay District: the siting or operation of a hazardous waste disposal facility, a solid waste landfill, a junkyard, a snow dump, and a wastewater or septage lagoon; the outdoor storage of road salt or other deicing chemicals in bulk; and the siting or application of biosolids/sludge.

Conditional Use Permits can be granted by the Planning Board for uses permitted within the underlying district if the use is or is involved in one or more of the following: the storage, handling, and use of regulated substances in quantities greater than 100 gallons or 800 pounds dry weight as long as a suitable plan is in place "to prevent, contain, and minimize releases from catastrophic events such as spills or fires which may cause large releases of regulated substances"; and any use that will render more than 15 percent or 2500 square feet of any lot impervious, so long as "the proposed use is not a prohibited use and will be in compliance with the Performance Standards as well as all applicable local, state and federal requirements." A more extensive look at each town's regulation of impervious surfaces can be found in the "Reductions in Recharge" section.

Article XI of the Groundwater Protection Overlay District Ordinance lists a series of exceptions to the provisions of the ordinance as long as all applicable local, state, and federal requirements are complied with. Exceptions include: all private residences; the sale, transportation, and use of pesticides as defined in RSA 430:29 XXVI; and underground storage tank systems and above-ground storage tank systems, which are exempt from inspections outlined in the ordinance. Exceptions from following the Performance Standards which regulate stored substances (E-H) include: businesses or facilities where regulated substances are not stored in containers with a capacity greater than five gallons; storage of heating fuels for on-site use or fuels for emergency electric generation if certain provisions are followed; storage of motor fuel in tanks attached to vehicles for use by the vehicle; storage and use of office supplies; and household hazardous waste collection projects regulated under NH Code of Administrative Rules Env-Wm 401.03 (b)(1) and 501.01 (b).

*Site Plan Review Regulations*

Northfield's Site Plan Review Regulations (October 2002) contain regulations relevant to the protection of groundwater. Within the Purpose section (Section 2) the protection of the quality of groundwater is listed as one intention of the regulations. In the narrative impact statement requirement of the Application Requirements for both minor and major applications (Section 5.3.B.), applicants need to address a number of aspects including: changes in surface drainage; increased consumption of groundwater; pollution of water and/or air; and disturbance to other aspects of the natural ecology.

Within the Major Site Plan Requirements (6.B) the plan for the site needs to include, along with many other items, zoning and special district boundaries, which presumably would include the Groundwater Protection Overlay Zone. In addition, the plan needs to include the location of all physical/natural features; although aquifers are not specified they would be delineated by the Groundwater Protection Overlay Zone outline. The location of all wells within 150 feet of the parcel also need to be indicated. Documentation which also needs to be submitted, where applicable, includes sufficient information to determine whether the development complies with the Zoning Ordinance.

Within Section 7, Design Standards and Requirements for Site Plan Review, there is a section on stormwater drainage systems (7.8). When describing instances where municipal stormwater drainage systems are not available, it states that "the goal of all such systems shall be to promote the natural absorption of stormwater back into the groundwater system"and that no increase in runoff from the property will be permitted.

The Landscaping section (7.13) includes provisions for impervious surfaces. For residential projects a minimum of 70% of the land area being developed is required to remain in its natural state or be maintained as a landscaped area, not covered by an impermeable material. In a non-residential development a minimum of 30% of the land area being developed cannot be covered by an impermeable material. The preference is for this remaining 30% of the land to be left in its natural state in cases where there are existing trees and forest cover. This section also specifies that there will not be more than 150 feet of continuous improved parking surface in parking lots; the lots need to be interrupted by shade trees and landscaping to meet this requirement.

There are a few other provisions of Section 7 relevant to the protection of groundwater resources. Section 7.15 includes provisions for Underground Petroleum Storage Tanks, stating that all non-residential underground tanks for petroleum or petroleum by-products need to comply with the NH Water Supply and Pollution Control Commission rules, including all new non-residential tanks of any capacity whether or not the Water Supply and Pollution Control Commission invokes jurisdiction. Section 7.16 deals with Hazardous and Toxic Materials, stating that the applicant needs to provide an impact and risk assessment on each material which will be received, handled, stored, processed, sold, or discharged "regarding public and worker health and safety, and other potential threats to the community and its natural resources."

*Subdivision Regulations*

Northfield's Subdivision Regulations and Road Design Standards (March 1998) also contain provisions related to groundwater resources. Within the General Requirements for the Subdivision of Land (Section VII) there is a section on the Documentation of Impacts which says that if the Planning Board finds it necessary, the developer will need to provide a documented environmental and economic impact statement which may include documentation on ground and surface water quality (7.4). Within Section VIII, Design Standards for Subdivisions, there are provisions for Road Design and Construction (8.1) which include Drainage provisions. "The design of drainage structures and ditches will include an analysis of any adverse affects they may have on upstream and downstream public and private lands or facilities including but not limited to...contamination of public and private water supplies, ponds or pools, and wells." Finally, in Section 9.2, Conversions to Condominiums or Time-Sharing Units, part F, it states that drinking water supplies from groundwater will be "protected by restriction [on] land use and prohibiting all activity detrimental to water quality and quantity within the protective radius based upon the average daily demand on the system." A table then follows outlining the protective radius based on system demand, stating that no sewer, sewage, or waste disposal system will be permitted within the protective radius.

*Excavation Regulations*

In Northfield's Excavation Regulations (April 1990) it states that the Excavation Plan within the Application for Permit (V) needs to include, along with many other requirements, all measures to control water pollution as well as the location of wells within 150 feet of the property boundary. Within the Operation Standards section (Section VII) it states that appropriate water quality measures need to be integrated into the excavation process. Most specifically, in the Prohibited Projects section (Section IX) it states that the Regulator "shall not grant a permit...where the excavation would substantially damaged a [known] aquifer, so [designated] by the United States Geological Survey." This is reinforced in the Excavation Checklist found at the back of the regulations, which includes an item stating that the excavation will not substantially damage a known aquifer.

# Appendix II

Summary of State Regulations Pertaining to Groundwater Protection

# Summary of Setbacks for Protection of Drinking Water in State Regulations

| Land Use Type | Drinking Water Well | Surface Water Source of Public Drinking Water |
|---|---|---|
| Septic System | 75' from property line (more for large systems unless there is monitoring) | 75' from any surface water<br>100' – 125' if special soils under Shoreland Protection Act |
| Underground Storage Tank<br>**for new tanks only. Old tanks are grand fathered | 400' from large community well<br>200' from small community well<br>75 ' from private well | 75' from any surface water |
| Above Ground Storage Tank | None | None |
| Pesticide Application | 400' from gravel pack public well<br>250" from all other public wells<br>special permits can be granted | 25' from any surface water<br>Usually 250' from public water source as condition of permit |
| Pesticide Storage | 400' from public wells (bulk storage is 400' from any well)<br>75 feet from private wells | 75' from any surface water |
| Pesticide Mixing | 400' from gravel pack public wells<br>250' from all other public wells<br>75' from private wells | 75' from any surface water |
| Hazardous Waste Storage, Disposal or Treatment Facility | 1000 – 3000 feet from zone of contribution of a public well<br>Disposal facilities prohibited in GAA | 1000 – 3000 feet from intake<br>Prohibited in watershed of Class A Rivers |
| Landfill | Prohibited within WHPA of a community or non-community, non-transient well | 1000' upgradient from any community drinking water supply reservoir or intake (up to ¼ mile on certain portions of designated rivers) |
| Pet Cemeteries | 200' from private or community water supply<br>400' from municipal water supply | 200' from private or community water supply<br>400' from municipal water supply |
| Solid Waste Facilities: Transfer/ Recycling/Processing Facilities, Incinerators, etc. | Prohibited only in wellhead protection areas reclassified GAA | Shoreland Protection Rules prohibit within 250 feet. |
| Treated Contaminated Soils | Prohibited in recharge area of any sole source drinking water supply | 100' from any surface water |
| Buried Stump and Asphalt | 75' from any well | 75' from any drinking water supply |
| Groundwater Discharge Permit Wastewater Facilities: lagoons, spray irrigation etc. | Siting modeled and monitored to assure compliance at property line | Siting modeled and monitored to assure compliance with surface water quality standards |
| Biosolids Application – Sludge and Septage | 400' from large community well<br>300' from all other wells | 500'from any drinking water supply |
| On-site Stockpiling | 500' from nearest well – for septic<br>300' if sealed and covered | 500' from surface water drinking water supply |
| Biosolids Facility | 500' from any well | 500'from any drinking water supply |

| | | |
|---|---|---|
| Outdoor Storage of Regulated Substances in Regulated Containers | 75' from private wells<br>400' from public wells | 50' from surface waters |
| Junkyards | Prohibited only in WHPAs classified as GAA | Shoreland Protection Rules prohibits within 250 feet. |
| Salt Storage | Prohibited only in wellhead protection areas reclassified GAA | Shoreland Protection Rules prohibits within 250 feet. |
| Snow Dump | Prohibited only in GAA | None |

Source: Drinking Water Source Protection Program, NH DES, May 23, 2002

Notes:

- This is simply a list of setbacks that are currently included in state regulations. It is under review by the Drinking Water Source Protection Program of NH DES. The list does not constitute a model or any kind of recommendations. Recommendations to change these setbacks may be forthcoming in the future.
- Most land uses are prohibited within 200-400 feet of new community water supply wells because the water supplier must own or control this area. There are many existing wells, however, that are not protected by this "sanitary protective radius."
- The Shoreland Protection Act setback only applies to certain rivers (fourth order) and great ponds (greater than 10 acres).

# Appendix III

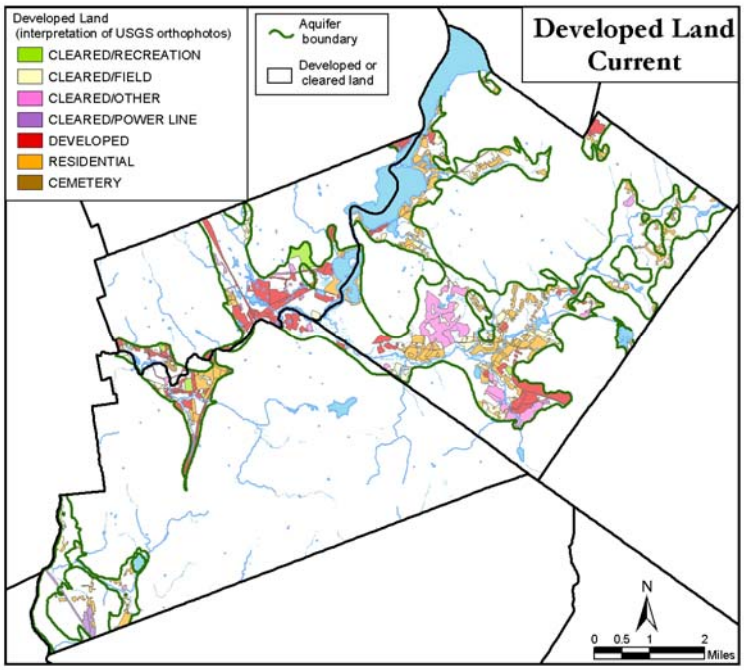
Summary of Technical Aspects of Impervious Surface Analysis

**Summary of Technical Aspects of Impervious Surface Analysis**

In order to determine the amount of impervious surface that covers the direct recharge area of the aquifer, an Impervious Surface Analysis was conducted. This appendix summarizes the technical aspects of this analysis. The Reductions in Recharge section of this report contains a less technical overview of the analysis and includes two larger full-color maps (Map 5 and
Map 6). This analysis provides information to the three communities on the current extent of impervious surfaces overlying the aquifer.

The first step in the analysis process was to digitize developed lands from USGS digital orthophoto quadrangles using the "Developed Land Mapping Standards" established by NH GRANIT. These guidelines specify digitizing to the obvious use boundary whenever possible; using the NHDOT road centerline where appropriate; and where the use boundary is indistinct, using either a 0.5 or 1 acre fixed size delineation based on availability of municipal water/sewer services. Developed lands were only digitized in the direct recharge area of the aquifer. Map 5 depicts this step in the analysis process.

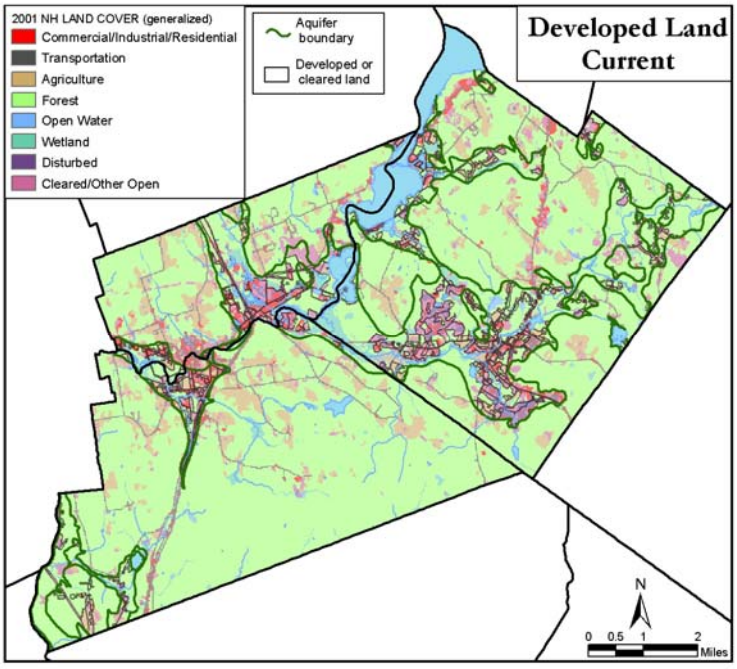
**Map 5.** Current Developed Land-Interpretation of USGS Orthophotos




Map 5 was then compared to Map 5.5, which depicts current developed land based on generalized New Hampshire land cover interpreted from Landsat photos. This comparison was made to determine how consistent the generalized land cover maps from Landsat photos are to digitized developed lands maps using the "Developed Land Mapping Standards". The developed lands appear to be delineated with a great deal of consistency utilizing the two different approaches. This consistency indicates that it might be possible in the future to skip the digitizing step in the impervious surface analysis and utilize the existing generalized land cover maps from Landsat photos to

apply the impervious surface coefficients. This potential approach should be researched further.

**Map 5.5.** Current Developed Land-Generalized New Hampshire Land Cover




Impervious surface calculations were then made using Map 5. In order to estimate the amount of impervious surfaces overlying the aquifer, 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. Residential zones were further broken down into minimum lot size categories with different impervious surface coefficients for each. These residential impervious surface coefficients were applied to Belmont, Northfield, and Tilton based on the zoning ordinances of each of the three towns for all developed parcels.

To simplify the analysis, it was assumed that developed land in each zoning category matched the zone where it was located. For example, any development in a commercial zone was assumed to be a commercial land use; other uses in the zone such as residential were not differentiated.

These calculations are illustrated in Map 6. The results of the calculations are depicted in Table 18. As an example of how to read the table, Belmont has 753.9 acres of land in the direct recharge area of the aquifer that is currently estimated based on the development digitized on Map 5 and the zone it is located in to be 10% impervious. An explanation of

which land use type is given which impervious surface coefficient is found in the following table.

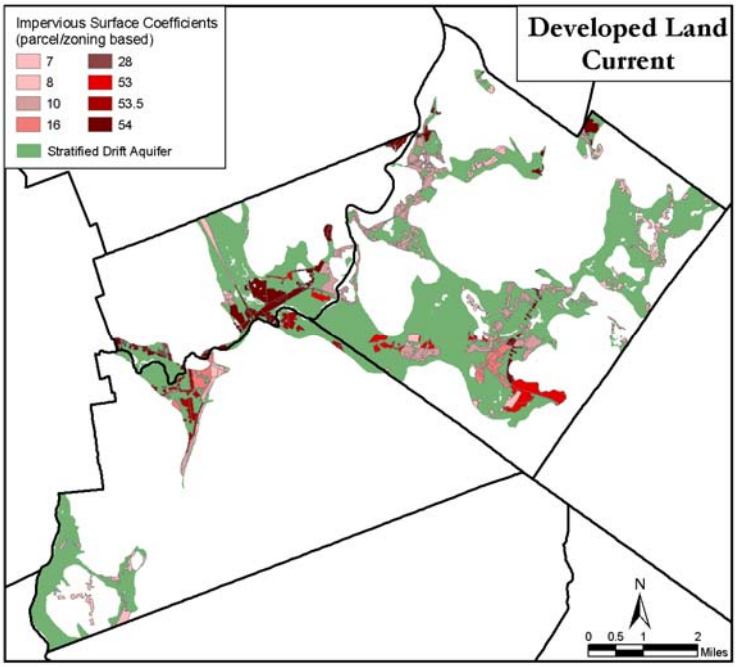
**Explanation of Land Use Types for Impervious Surface Coefficients:**

| Impervious Surface Coefficient | Type of Land Use For This 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 = 1-1 ½ acres) |
| 16.0 | Residential (Minimum Lot Size = ½-3/4 acres) |
| 28.0 | Residential (Minimum Lot Size = 1/8-1/4 acres) |
| 53.0 | Industrial |
| 53.5 | Commercial/Industrial |
| 54.0 | Commercial |

**Table 18.** 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 | 136.3 | - | - | 44.6 | 23.6 |
| 53.5 | - | - | 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** |

**Map 6.** Impervious Surface Analysis-Current



This information assists in determining the current status of impervious surfaces in the direct recharge area. Based on this impervious surface analysis, developed land is estimated to cover 2855.1 acres of the direct recharge area of the aquifer. Since 466 acres of the direct recharge area are surface water acres, these acres are not included in the following calculations. An estimated 27% of the direct recharge area of the aquifer (land area only) is currently developed as defined by the "Developed Land Mapping Standards" described at the beginning of this section. "Developed" does not equate to "impervious". By applying the impervious surface coefficients to these developed lands by zone, 755.4 acres of this developed land, or 7% of the direct recharge area of the aquifer (land area only), is estimated to be currently impervious. This analysis does not distinguish between different transmissivities; the towns might consider taking this analysis one step further by determining current estimates for impervious surfaces in areas with the highest transmissivities.

It is important to keep in mind that this estimate only illustrates the amount of impervious surfaces based on model coefficients for zoning types, not on actual zoning in the towns. In some cases this analysis may underestimate the amount of impervious surfaces on a developed parcel if the zoning ordinance of the town the parcel is located in allows for a greater percentage of impervious surfaces than the coefficients approximate. For example, the coefficients estimate an impervious surface coverage of 53% for developed parcels in an industrial zone, but the zoning ordinances of both Belmont and Tilton currently allow 75% lot coverage in the industrial zone. By comparing the maximum lot coverage tables and information found in the Reductions in Recharge section with the coefficients of the impervious surfaces analysis, you will have a clearer sense of these potential variations if lots are developed to maximum allowed imperviousness. This has implications both for the present estimate of impervious surfaces and for possible future increases in the impervious surface coverage in the direct recharge area of the aquifer.

The next step in this impervious surface analysis would be to project the impervious surface coefficients onto the current zoning which overlies the aquifer, in order to calculate the potential amount of impervious surfaces which might cover the direct recharge area of the aquifer if the three towns were to be fully built-out. The map and numbers derived from this type of analysis could be viewed as a starting point from which to examine potential future conditions, not as a factual representation of what lies ahead for the towns. The first components of these projections were carried out and are described below.

There are a number of assumptions which underlie these first components of future projections which should be carefully reviewed. Should the concepts underlying this approach be deemed a significant source of information for planning to the towns, a more comprehensive analysis could be conducted which addresses each of the assumptions outlined below. The files associated with this analysis, which could be used for future detailed analyses, are stored at LRPC.

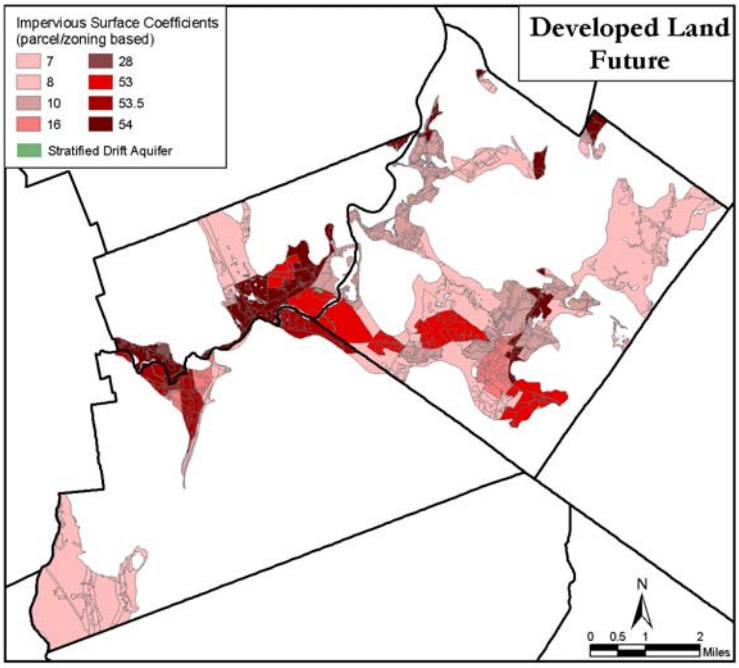
For this analysis it was assumed that there are no additional restrictions placed on the amount of impervious surfaces allowed in the direct recharge area of the aquifer in the

zoning ordinances of each town. It was also assumed that the impervious surface coefficients are a good estimate of impervious surfaces by zoning category, without taking into account that zoning ordinances might allow higher percentages of impervious surfaces in certain zones as described above. As was noted in earlier sections of this report, additional restrictions are in place in some cases, and high percentages of impervious surfaces are allowed in other cases, which could be incorporated into a next-step level of analysis.

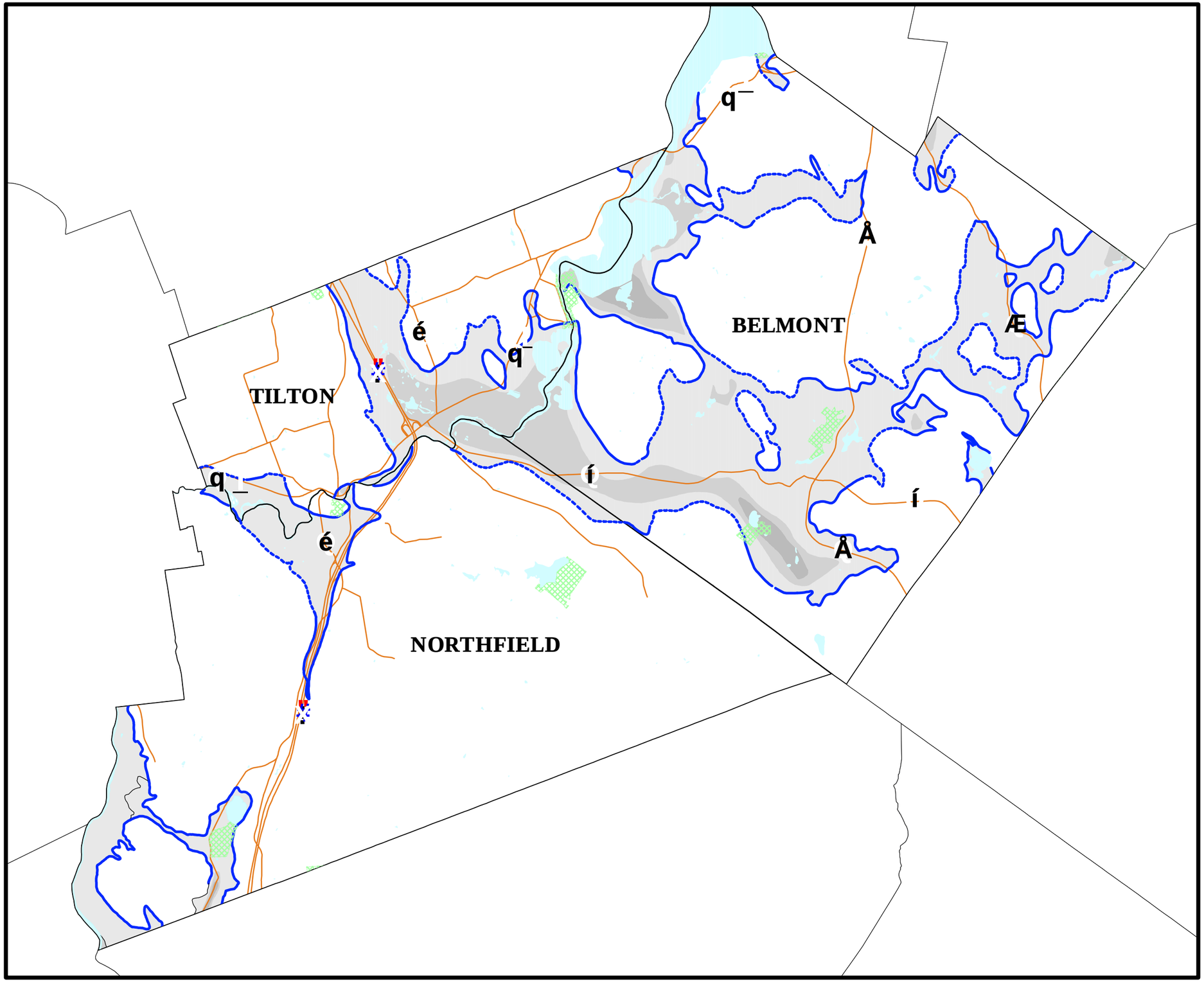
This analysis did not remove certain categories of "unbuildable areas", which include conservation lands and very steep slopes. As such, the resulting numbers may overestimate the amount of impervious surfaces which could potentially cover the direct recharge area of the aquifer. Conservation lands are fairly minimal in the direct recharge area of the aquifer and so would not have a big impact on the projections. Still, a next-step level of analysis could subtract these and any additional unbuildable areas identified in each town's zoning ordinance from the base map before carrying out the analysis to project impervious surfaces into the future.

Finally, just as in the current impervious surface analysis, it was assumed that all development in each zone conformed to that zone, without taking into account, for example, residential development in an industrial zone. Map 6.5 depicts this analysis based on the assumptions outlined above.

**Map 6.5.** Impervious Surface Analysis-Projected Based on Zoning



# Map 1: Stratified Drift Aquifer
# Belmont, Northfield, Tilton




Stratified Drift Aquifer Transmissivity
- Up to 1000 ft2/day
- 1000 to 2000 ft2/day
- 2000 to 4000 ft2/day

Surface water

Aquifer boundary
- Approximately located
- Inferred
- Concealed

Study Area boundary/closure line

Stream or Shoreline

Primary/Secondary Road

Conservation Lands

Public Water Supply data maintained by the NH Department of Environmental Services.
Stratified Drift Aquifer data provided by the U.S. Geological Survey NH/VT office.
Base map - generalized from 1:100,000-scale USGS digital line graph data provided by GRANIT.

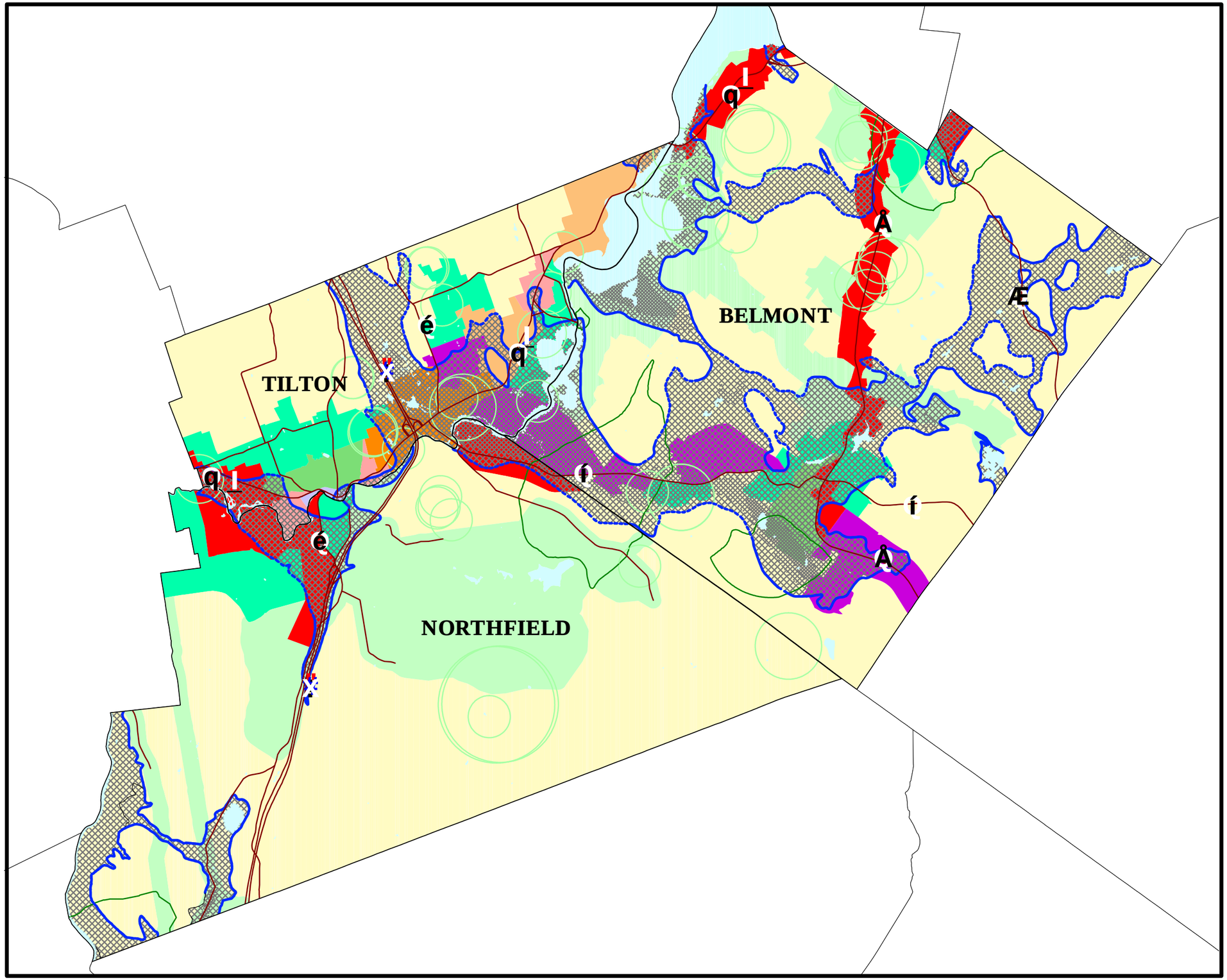
N

1 0 1 2 Miles

L · R · P · C

Map prepared July 30, 2003
NH Dept. of Environmental Services
In Cooperation with the
Lakes Region Planning Commission

# Map 2: Stratified Drift Aquifer and Zoning (2002)




Stratified Drift Aquifer Transmissivity (ft2/day)
- 0 - 1000 ft2/day
- 1000 - 2000 ft2/day
- 2000 - 4000 ft2/day

Tilton Zoning 2002
- 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)

Northfield Zoning 2002
- Commercial/Industrial (CI)
- Conservation (CONS)
- Residential (R1)
- Multi-Family Residential (R2)

Belmont Zoning 2002
- Commercial (C)
- Industrial (I)
- Rural (R)
- Residential Multi-Family (RM)
- Residential Single-Family (RS)
- Village (V)

Aquifer boundary
- Approximately located
- Inferred
- Concealed
- Study Area boundary/closure line
- Stream or Shoreline
- Wellhead Protection Areas - Gravel Wells
- Wellhead Protection Areas - Bedrock Wells

Stratified Drift Aquifer data provided by the U.S. Geological Survey NH/VT office.
Zoning - developed by the Lakes Region Planning Commission (current as of 2002)
Public Water Supply data maintained by NHDES monthly.
Base map - generalized from 1:100,000-scale USGS digital line graph data provided by GRANIT at Complex Systems Research Center, UNH.

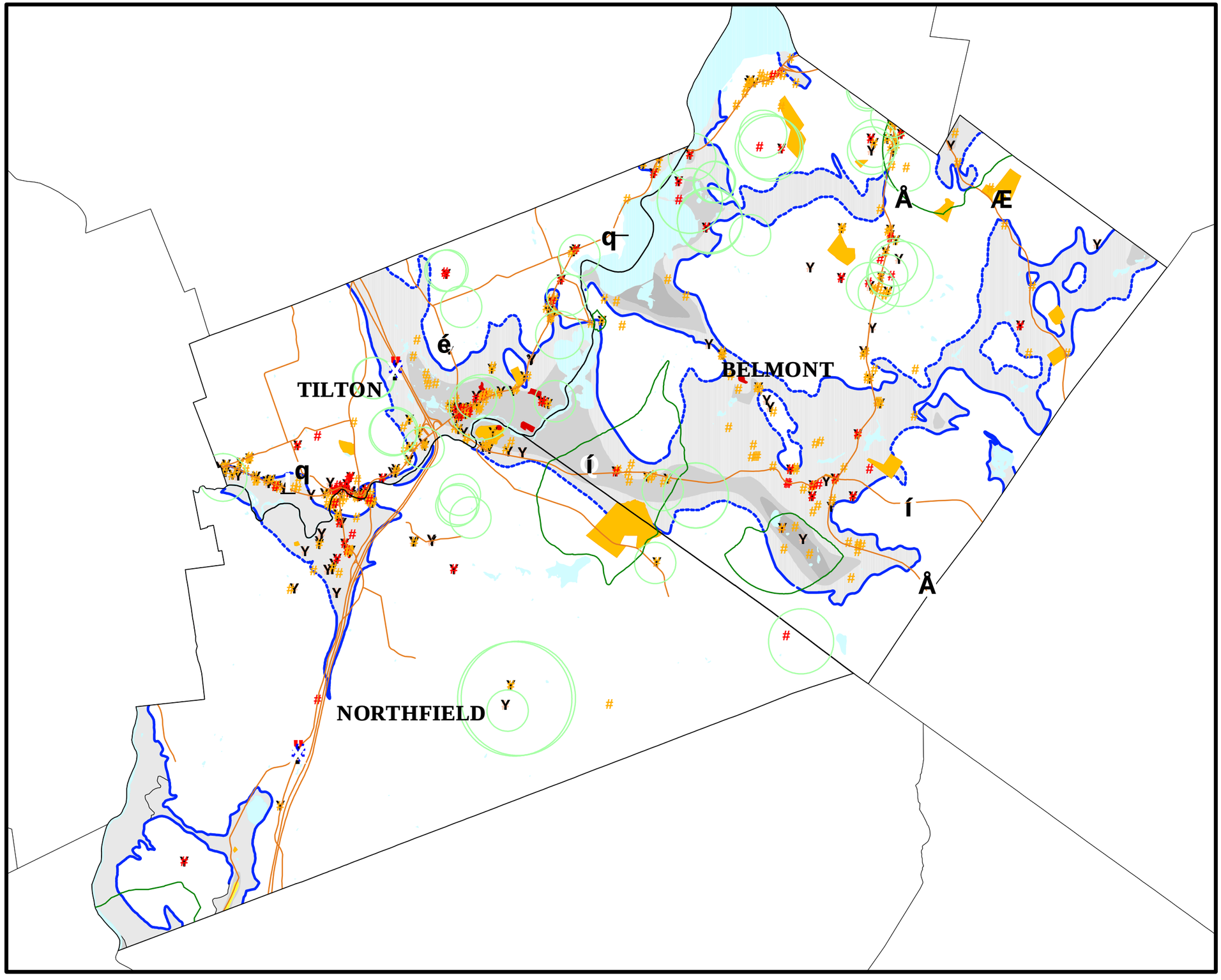
N

1 0 1 2 Miles

L · R · P · C

Map prepared September 4, 2003
NH Dept. of Environmental Services
In Cooperation with the
Lakes Region Planning Commission

# Map 3: Water Resources and Potential Contamination Sources




- # Known Contamination Source
- # Potential Contamination Source
- Y 2002 Local PCS Inventory by LRPC and town volunteers
- Known Contamination area
- Potential Contamination area

Stratified Drift Aquifer Transmissivity (ft2/day)
- 0 - 1000 ft2/day
- 1000 - 2000 ft2/day
- 2000 - 4000 ft2/day

Aquifer boundary
- Approximately located
- Inferred
- Concealed
- Study Area boundary/closure line
- Stream or Shoreline
- Stratified Drift Wellhead Protection Area
- Bedrock Wellhead Protection Area

Known/Potential contamination source data maintained by the NH Dept. of Environmental Services; continually locating sites/facilities.
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.
Zoning - developed by the Lakes Region Planning Commission (current as of 2002)
Base map - generalized from 1:100,000-scale USGS digital line graph data provided by GRANIT at Complex Systems Research Center, UNH.

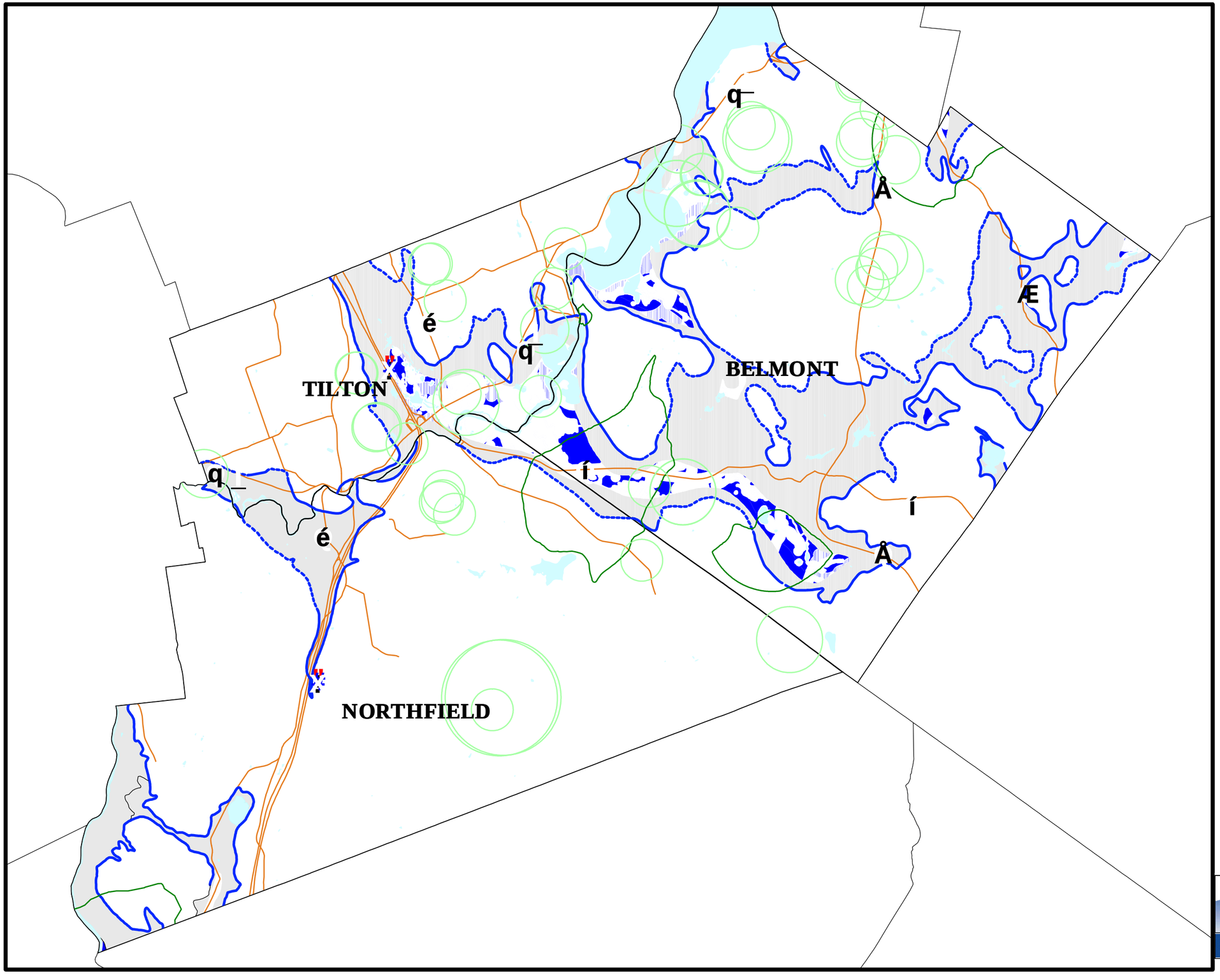
N

1 0 1 2 Miles

L · R · P · C

Map prepared September 4, 2003
NH Dept. of Environmental Services
In Cooperation with the
Lakes Region Planning Commission

# Map 4: Favorable Gravel Well Analysis Results 75gpm




Stratified drift aquifer potentially suitable for siting a 75 gpm well (transmissivity > 1000 ft2/day)

Stratified Drift Aquifer Transmissivity
Less than 1000 ft2/day

Surface water

Aquifer boundary
Approximately located
Inferred
Concealed
Study Area boundary/closure line
Stream or Shoreline
Primary/Secondary Road
Stratified Drift Wellhead Protection Area
Bedrock Wellhead Protection Area

Public Water Supply data maintained by the NH Department of Environmental Services. Monthly.
Stratified Drift Aquifer data provided by the U.S. Geological Survey NH/VT office.
Base map - generalized from 1:100,000-scale USGS digital line graph data provided by GRANIT.

N

1 0 1 2 Miles

L · R · P · C

Map prepared July 30, 2003
NH Dept. of Environmental Services
In Cooperation with the
Lakes Region Planning Commission