STRATIFIED-DRIFT AQUIFERS IN NEW HAMPSHIRE

WITH POTENTIAL TO SERVE

AS FUTURE, LARGE PUBLIC WATER-SUPPLIES:

STATUS, CIRCA 2000;

PROJECTED LOSSES, CIRCA 2025;

AND DATA ACCURACY

BY

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DISSERTATION

Submitted to the University of New Hampshire
In Partial Fulfillment of
the Requirements for the Degree of

Doctor of Philosophy
In
Natural Resources and Environmental Studies

December, 2007

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DEDICATION

This work is dedicated to you, living in the times after May 2005, upon whose shoulders others will stand; and to those who have lived in the times before then, upon whose shoulders we stand.

FOREWORD

World events have sharpened considerably in the 10 years since I started on this road. At the outset in 1997, I envisioned the possibility of climate refugees from dryer regions of the US, seeking out water-rich states such as NH in perhaps a century. Now in 2008, as we sense ever more keenly the possibilities of a US water crisis, peak oil, abrupt climate change and food shortages, it appears that environmental refugees may be seeking out such regions far sooner… on the order of a decade or two. The release of this three part study into the current and future availability of stratified-drift aquifers is well timed, as a result.

ACKNOWLEDGEMENTS

I would like first to express my gratitude to the members of my committee: Mimi Becker Tom Ballestero, David Brown, Rich Moore, and Rick Chormann; all of whom patiently worked with me throughout the long roller-coaster ride of this dissertation. Mimi, thanks for your social policy perspectives, for your input on how to promote the work after its completion, and for somehow finding the time to review this work this semester. David, a special thanks for willingly stepping in late in the project and sticking with it, even after leaving UNH. Tom, thank you for your strong technical questions and unparalleled turnaround of materials.

Special gratitude goes to Rick Chormann of the New Hampshire Geological Survey and Rich Moore of the US Geological Survey. Rick served as the state liaison on the aquifer studies, and Rich authored/coauthored several of the aquifer studies. Rick initially envisioned the general concept of using GIS to evaluate remaining high-yield stratified drift aquifer in NH, and later hired myself to develop the pilot project. Together they served on the steering committee of the pilot project, and patiently provided a vast amount of technical assistance to this dissertation. Their dedicated public service laid the foundation for this work.

Great gratitude also goes to Russ Congalton, my advisor, who has always remained upbeat and encouraging, with a long term outlook, and had a wealth of practical advice. Russ, I could not have had a better advisor.

More locally, thanks go to Ginny Harmon for her willingness to proofread, and her valiant attempts to rein my rampant hyphenation.

To Pat Proulx-Lough, thank you for your love, loyalty, patience and encouragement throughout this project. Simply stated, this work is as much yours as mine. Words cannot express my love for you.

To Audrey, and John, Thank you again for your love and laughter along the way. You have made the trip far more worthwhile, and much more fun than you know.

To Captain and Mrs. J. C. Lough, Thank you for 1000 gifts that I cannot explain…

…1000 cranes …1000 candles …Every day I will remember…

Laudate Dominum
May 21, 2008

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ABBREVIATIONS

ArcGIS	The specific geographic information system used for this study
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
FGWA	Favorable Gravel Well Analysis
GIS	Geographic Information System
GRANIT	The official New Hampshire GIS dataset repository
NH	New Hampshire
NHDES	New Hampshire Department of Environmental Services
NHDOT	New Hampshire Department of Transportation
NHGS	New Hampshire Geological Survey
NHTRI	New Hampshire Toxic Release Inventory
NRPC	Nashua Regional Planning Commission
PKCS	Potential and Known Contamination Sites
RCRA	Resource Conservation Recovery Act
Res/Com/Ind	Residential, Commercial, and Industrial Landcover
SJRWMD	St. John's River Water Management District
SPNHF	Society for the Protection of New Hampshire Forests
SPR	Sanitary Protective Radius
SWAP	Source-Water Assessment Program
T	Transmissivity (ft^2/d)
USGS	US Geological Survey
WHPA	Wellhead Protection Area

ABBREVIATIONS REGARDING STRATIFIED-DRIFT

b Saturated thickness

OSDA An area (mi^2) of Original Stratified-Drift Aquifer, as delineated by the USGS, for a region such as a town or state.

OSDA<75 An OSDA subset having potential for less than 75 gpm well yield.

OSDA75 An OSDA subset having potential for 75 gpm or greater well yield.

OSDA75L The area of OSDA75 lost to water quality setbacks at a given time.

OSDA75P The population residing on a given town's OSDA75 aquifer.

RSDA75 A subset of OSDA, and usually a further subset of OSDA75. These areas have the potential to supply a 75 gpm or greater well yield, after water quantity and minimum water quality considerations
An exception is **Low-T RSDA75,** areas of OSDA<75 which are neither 100% Till nor 100% Clay, and have sufficient saturated thickness to possibly yield 75 gpm under the Mazzafero equation.

OSDA<150 A subset of OSDA having the potential to supply less than a 150 gpm well yield.

OSDA150 A subset of OSDA having the potential to supply 150 gpm or greater well yield. It is also a subset of OSDA75.

OSDA150L An area of OSDA150 lost to water quality setbacks at a given time.

OSDA150P The population residing on a given town's OSDA150 aquifer.

RSDA150 A subset of OSDA, and further subset of OSDA150. These areas have the potential to supply a 150 gpm or greater well yield, after water quantity and minimum water quality considerations.
An exception is **Low-T RSDA150** areas of OSDA<150 which are neither 100% Till nor 100% Clay, and have sufficient saturated thickness to possibly yield 150 gpm under the Mazzafero equation.

T Transmissivity (ft^2/d)

Yield Class One of four mutually-exclusive, sequential, expected well-yield subsets of USGS transmissivity ranges, used to develop OSDA<75, OSDA75, OSDA<150 and OSDA150.

GEOGRAPHIC INFORMATION SYSTEM (GIS) GLOSSARY

Coverage	An ARC/INFO vector GIS data layer.
Layer	Digital vector or raster spatial data.
Overlay	To combine 2 or more vector GIS data layers to generate a resulting map.
Pixel	One cell in a grid of uniformly sized cells.
Point Feature	A vector GIS point in space, such as a contamination site or monument site. Point features can have one or more thematic attributes assigned to them.
Polygon Feature	A vector GIS area defined by its external boundary. Polygons can have one or more thematic attributes assigned to them.
Raster GIS	A GIS based on a uniform grid of pixels. Typically a single layer contains only 1 thematic attribute (e.g. soil type).
Thematic Attribute	Any theme or variable that can be assigned in space (e.g. elevation, landcover, etc.)
Vector GIS	A GIS based on defining spatial areas with a common thematic attribute by their external boundaries.
Rectify	The process of removing geometric distortions from a raster remotely-sensed image to produce an image geo-referenced to an accepted cartographic standard.

UNITS

ft	feet
ft^2/d	feet squared per day
$ft^3/d/gpm$	feet cubed per day per gallon per minute
gpm	gallons per minute
mi^2	miles squared

Abstract

STRATIFIED-DRIFT AQUIFERS IN NEW HAMPSHIRE WITH POTENTIAL TO SERVE AS FUTURE, LARGE PUBLIC WATER-SUPPLIES: STATUS, CIRCA 2000; PROJECTED LOSSES, CIRCA 2025; AND DATA ACCURACY

by

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University of New Hampshire, May 2008

Given the growing national water crisis, this research quantified and refined the states of stratified-drift aquifers with potential to yield 75+ gpm (OSDA75) and 150+ gpm (OSDA150) in New Hampshire for 2000 and 2025. Surface waters, cultural features and groundwater hazards from 13 federal/state datasets were buffered according to desired well yields, and then overlain within a geographic information system onto stratified-drift aquifer (OSDA) layer. Non-buffered, highly-transmissive polygons defined the aquifer areas remaining available with potential to meet 75+gpm or 150+ gpm well yields (RSDA75 or RSDA150). Aquifer losses for 2025 were modeled by principal-components regression as function of aquifer area and projected on-aquifer populations. Finally, the source OSDA area and RSDA estimates were reassessed using 1300 verification wells.

Results: OSDA encompasses 13.4% of New Hampshire, 41% of its population, and 58.3% of its groundwater hazards. The greatest population and

groundwater-hazard densities exist on the most vulnerable aquifer areas, OSDA75 and OSDA150. ***After overlay analysis, RSDA75 and RSDA150 were estimated as 118.4 mi^2 (9.5%) and 47.6 mi^2 (3.8%), respectively.*** Most towns have less than 0.5 mi^2 of RSDA75/150, while the majority of RSDA75/150 exists in relatively few towns. Regionally, the highly populated coast has minimal high-yield OSDA, while the more urban South and North each have about 5% and 2% of the state's RSDA75 and RSDA150, respectively.
1990-2000 population growth for Uplands and OSDA was 14% and 7% respectively. Projected OSDA75/150 losses for 2025 were unexpectedly low since historical OSDA population growth was lower than average; losses early in development are high, and the largest aquifers, (those forecast for the greatest population growth), accommodate additional people with lower per capita losses, since buffer overlap increases.

From error assessment of saturated thickness, 26% of all OSDA is either till, clay or unsaturated. ***Based on the Mazzafero equation, about 50% of the above RSDA75 and RSDA150 areas lack sufficient saturated thickness to sustain such high yields.***

In conclusion, high-yield stratified-drift aquifers are far less available, and far more threatened than commonly thought. Given the national situation, these future water resources need to be conserved to the greatest degree possible in the present.

INTRODUCTION

The Emerging Water Crisis in the United States

The United States (U.S.) is facing an impending water crisis, both in quantity and quality, over the long-term. A prime example of this is the High Plains Aquifer, the major alluvial aquifer immediately east of the Rocky Mountains. This key water resource has experienced substantial water-level declines (up to 175 ft) in several areas from 1940 to the present. While the rate of decline has generally slowed since 1980 (U.S. Geological Survey (USGS), 1994b), water-level declines exceeding 20 feet since 1980 are widespread in parts of southwestern Kansas, east-central New Mexico, and in the Oklahoma/Texas pan-handles (USGS, 2001).

A recent study in Texas predicts that by 2050, major areas of the southern High Plains Aquifer will have less than 50 feet of remaining saturated thickness, and that parts of the aquifer in six counties may be dry, if mitigating actions are not taken (Dutton et al., 2000). In Kansas, the Arkansas River has been transformed over a period of a few decades from a “gaining river” into a “losing or recharging stream” due to the cumulative effect of groundwater withdrawal in the central High Plains Aquifer (Kansas Department of Agriculture, 2001).

In addition to water-quantity issues, there are significant water-quality issues also associated with the High Plains Aquifer. These include nutrient enrichment of groundwater from confined animal feeding operations, the effects of saline groundwater from bedrock aquifers discharging into the aquifer, and the effects of agricultural and urban land-use practices on general groundwater quality (USGS, 2002).

The water crisis is emerging in other regions as well. In Arizona, the cities of Prescott, Tucson, and Phoenix are facing increasingly stretched water resources as populations have grown (U.S. Water News Online, July 2000). This situation is exacerbated by the fact that sufficient water flow does not appear to exist in the Colorado River basin to supply the full state allocations of the 1922 Colorado River Compact, due to original inaccuracies in flow measurements and subsequent climate variability (Montgomery, 1992).

A national perspective of developing water-quantity crises by region can be found in Figure 1, which depicts regional freshwater consumption relative to precipitation. Although water can originate outside its area of use, this graphic reveals that, in general, large areas of the western, mid-western and southwestern U.S. are facing growing water quantity problems. These areas are likely to have the least buffer for dealing with extreme drought events. The vulnerability of these areas is evident when the national map of Figure 1 is compared to the drought conditions for the U.S on April 30, 2002 (Figure 2).

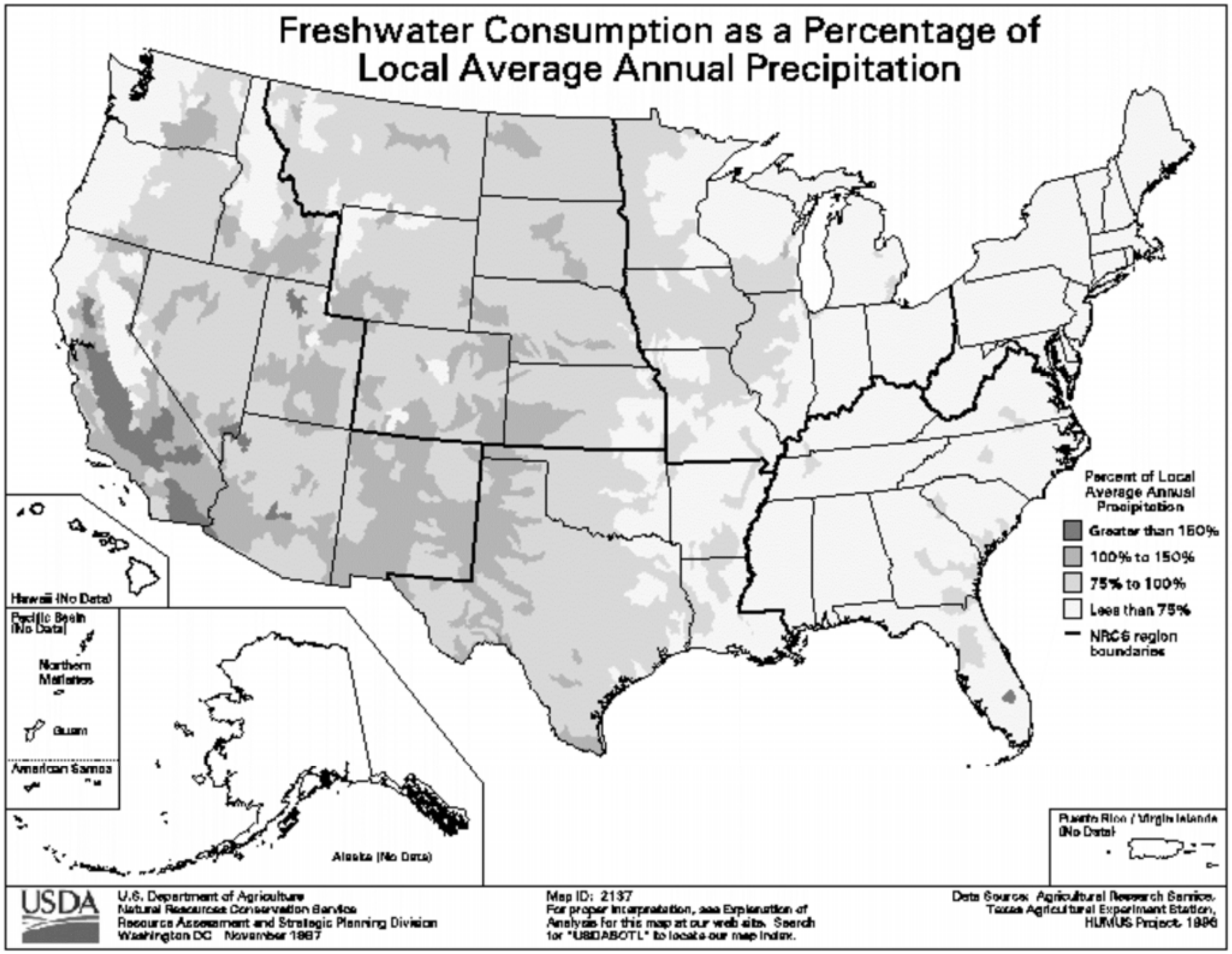

Figure 1. Average annual freshwater consumption (1985-1990) from all sources as a percent of local average annual precipitation (1960-1989, including snowfall) (Natural Resources Conservation Service, 1997).

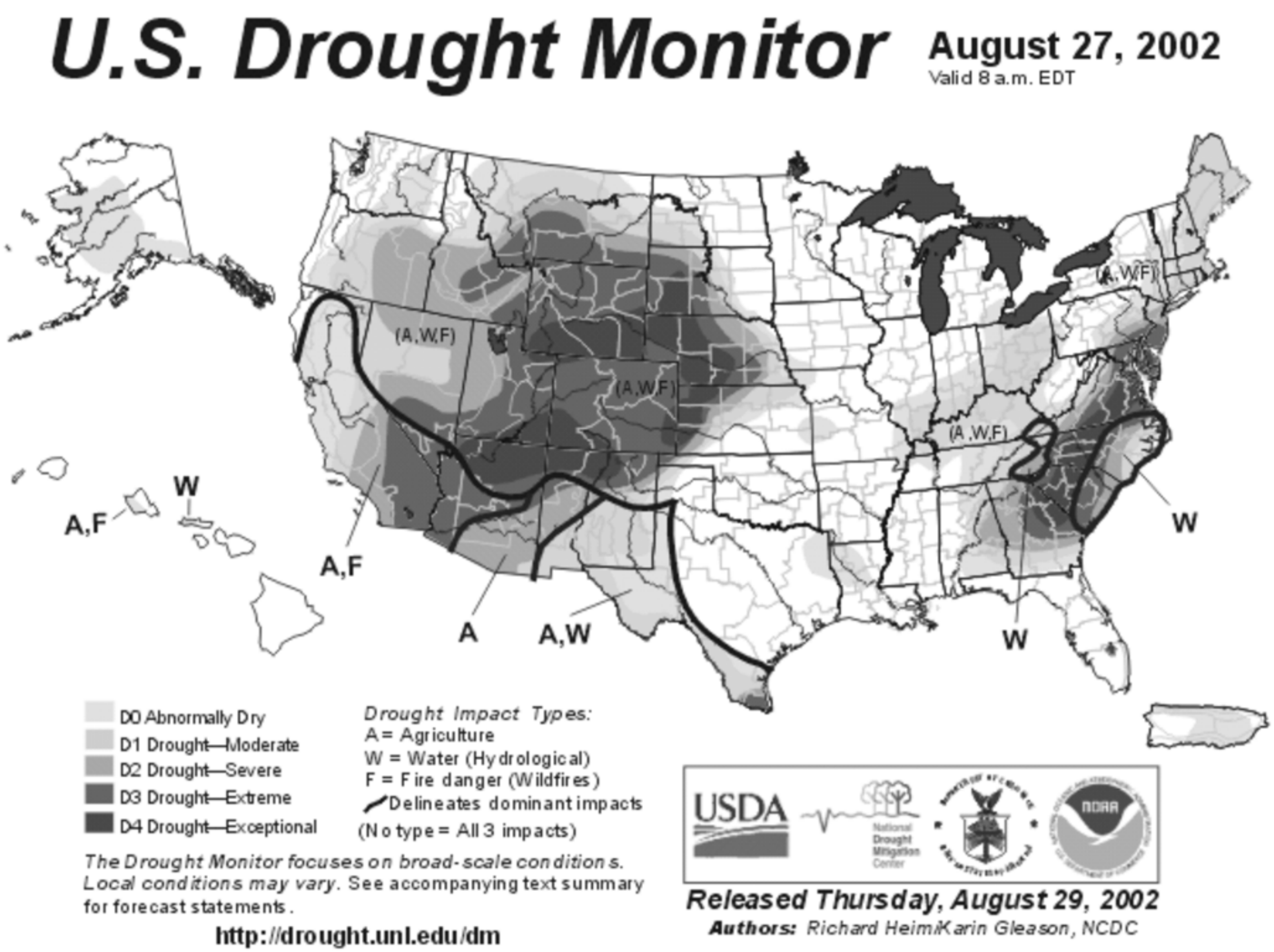

Figure 2. National drought conditions, August 27, 2002 (National Drought Mitigation Center, 2002).

While the East Coast was also experiencing drought, current withdrawals do not exceed precipitation on an average annual basis. This should provide some flexibility for the region in dealing with a multi-year drought.

Climate change may exacerbate such regional crises as the current predictive science indicates that the warming in the 21st century will be significantly larger than in the 20th century. Assuming no major interventions to reduce continued growth of world greenhouse gas emissions, scenarios indicate that temperatures in the U.S. will rise by about 5-9°F (3-5°C) on average in the next 100 years. This rise is very likely to be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Although there are some potential benefits to climate change, ecosystems and dependent populations that are already constrained by climate are still likely to face extreme stress. (U.S. Global Change Research Program (USGCRP), 2000).

The U.S. Water Crisis in Relation to New England

Similar to the continental U.S., the New England area is predicted to be warmer and wetter (punctuated by periodic, long-term droughts) over the next century (USGCRP, 2001). Global climate models used in the New England regional assessment predict a 6-10 F degree increase in average annual temperature. Although simplistic, such an increase would result in Boston having an average annual temperature between that of Richmond, VA and Atlanta, GA (USGCRP, 2001). Fortunately, water demand does not yet exceed supply in this area (Natural Resources Conservation Service (NRCS), 1997), and this is likely to mitigate the effects of extended periods of drought.

As potable water becomes increasingly scarce in the climate-restricted areas of the U.S., logic suggests that under-utilized surface-water will first experience greater demand. Eventually, however, populations may seek areas of less expensive, readily available water, such as in the humid regions of the U.S., the northwestern states and the east-coast states. This suggests that the remaining undeveloped water resources of these areas, including New Hampshire, should be conserved to the degree possible in the present.

The Value of Stratified-Drift Aquifers As Public Water-Supplies

One in four people in New Hampshire obtain their water from a public water-system supplied by groundwater, which is about the same as the national average ((Society for the Protection of New Hampshire Forests (SPNHF), 1998b; USGS, 1987; USGS, 1998)). Of the wells in New Hampshire, that serve as large public water-supplies, and produce as much as or more than 75 gpm, about 4 out of 10 are located in bedrock, while 6 of 10 high-yield wells are located in stratified-drift aquifers (New Hampshire Department of Environmental Services (NHDES), public water-supply database, 2003).

Stratified-drift consists of sorted and layered unconsolidated material deposited in melt-water streams flowing from glaciers or settled from suspension and quiet water bodies fed by melt-water streams (Medalie and Moore, 1995). This allows deposits of coarser grain size to store and/or rapidly transmit large quantities of water. For interested readers, Appendices A and B contains greater detail on stratified-drift aquifers, including key terms used later in this document such as transmissivity, hydraulic conductivity, and saturated thickness.

Public water-supply wells located in stratified-drift aquifers are the most productive of groundwater resources. Based on average total daily groundwater withdrawals in 1993, the few stratified-drift wells were about nine times as productive (18 million gal. per day) as all bedrock wells (2 million gal. per day)

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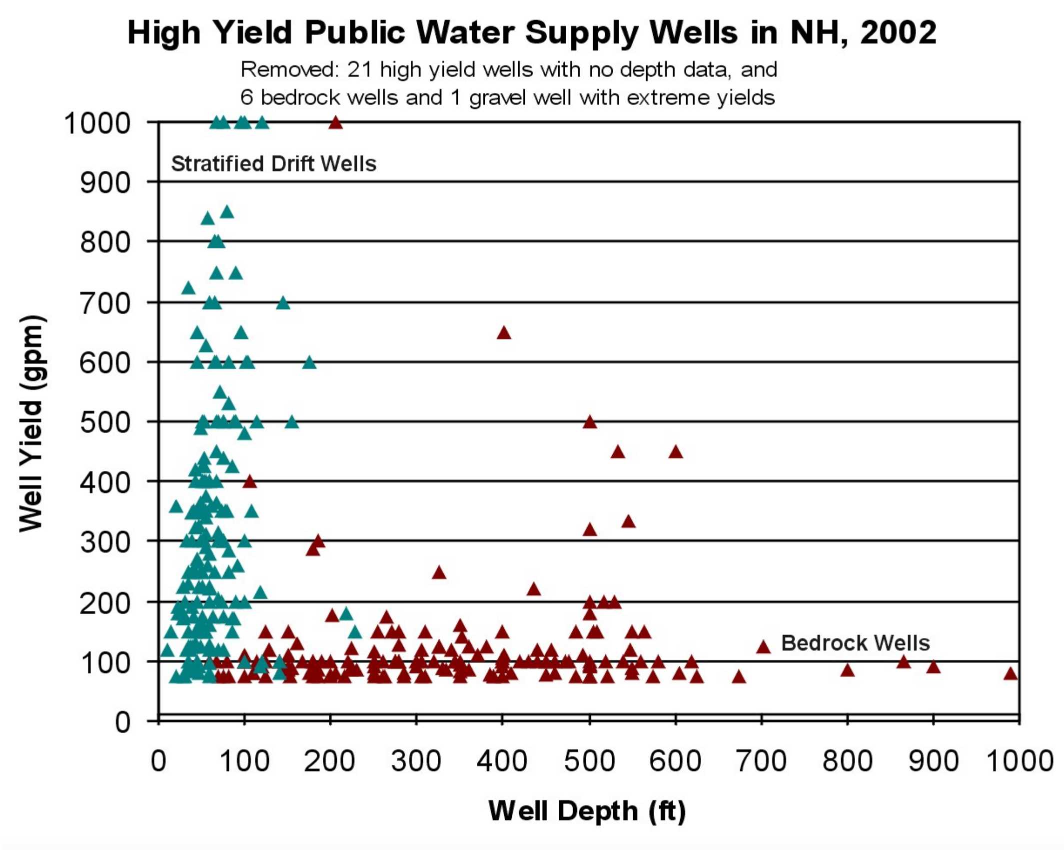

Figure 3. Pumping yields versus well depth for public water-supply wells in stratified drift and in bedrock, based on driller records. (NHDES Public Water-Supply Database, 2002)

(Frederick H. Chormann Jr, NHDES; written communication, 1993; in Medalie and Moore, 1995, p. 4). This difference is clearly evident in Figure 3, even though drilling records are known to have poor estimates of well yields.

Despite its value for public water supply, high-yield stratified drift is scarce, since stratified drift covers only a small part of New Hampshire's area (Figure 4.). Furthermore, these key water resources are increasingly constrained in New Hampshire due to mining for construction purpose, human development spreading across them, and their vulnerability to contamination.

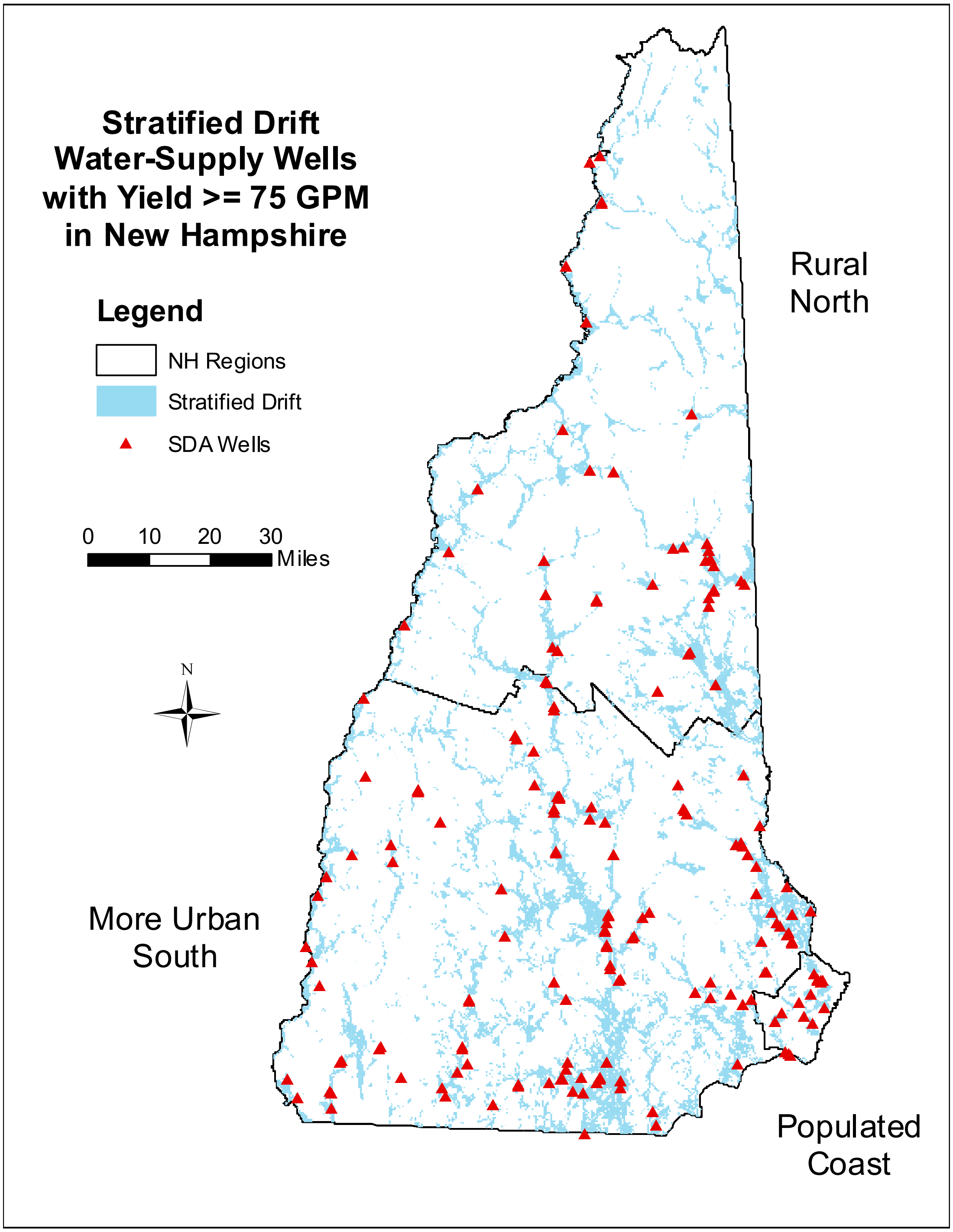

Figure 4. The distribution of stratified drift, and high-yield public water-supplies placed in stratified drift, for NH (NHDES Public Water Supply Database, 2002).

Research Questions

In light of the growing national water-crisis, there is a great need to identify and conserve remaining high-yield sand and gravel aquifers due to their importance as productive groundwater resources, their relative scarcity, and the dual threats of loss to contamination and development. Specifically natural resource managers and planners have a need to quantify the availability of high-yield stratified-drift aquifer, the rate of its loss, while understanding the limitations of such regional data, in order to use it appropriately in decision-making. Therefore, the specific objectives of this research are to:

1. Investigate and develop a GIS-based method to perform the spatial analysis, and apply the tool to summarize remaining stratified-drift aquifer with potential for high yield in New Hampshire, circa 2000.
2. Project the remaining stratified-drift aquifer with potential for high yield in New Hampshire to 2025 as a function of population.
3. Quantify the classification error existing in the USGS-delineated saturated-thickness data, and update the results of objectives 1 and 2 as needed.

A research question was constructed for each of the above objectives, and is addressed in the following three chapters. Each chapter contains an introduction, a literature review, a methods section, and a discussion section. The chapters are tied together in a final dissertation conclusion.

CHAPTER I

PRELIMINARY EVALUATION OF REMAINING STRATIFIED-DRIFT AQUIFERS IN NEW HAMPSHIRE, WITH POTENTIAL TO SERVE AS LARGE WATER SUPPLY, CIRCA 2000.

Introduction

Research Direction

Given the importance of stratified-drift aquifers as productive groundwater resources and their relative scarcity, state and local governments have moved to protect them over the past several decades. However, with the growing threats of development and contamination, there is a great need to identify, quantify and conserve the remaining sand and gravel aquifer areas that have potential to serve as future large municipal water-supplies. Therefore, the specific objectives of this research chapter are:

1) To investigate in greater detail the threat to potentially high-yield stratified-drift aquifers posed by development and contamination.
2) To investigate and analyze the quantity and location of remaining potentially high-yield stratified-drift aquifers in NH,
3) To identify opportunities for conservation for these aquifers in NH.

Literature Review

Geographic Information Systems and Public Water-Supplies

Geographic Information Systems (GIS) are effective tools to store, update, manage, analyze, and visualize spatial data. The ability to capture different snapshots in time, and to readily re-distribute the information, gives this approach a distinct advantage in capturing the dynamic nature of environmental data.

One of the most significant pioneering GIS efforts in New Hampshire is related to stratified-drift aquifers. Recognizing the value of these resources, the state of New Hampshire embarked on a cooperative program with the U.S. Geological Survey, beginning in 1985, to study the state's stratified-drift aquifers in detail (USGS, 1995). The project was completed in 1996, and produced both digital and paper maps of saturated-thickness and transmissivity (T), for the aquifers of 13 study areas, covering the state. Aquifer transmissivity was commonly estimated as the summation of horizontal transmissivities (each a product of horizontal hydraulic-conductivity (K) times saturated-thickness (b)) for multiple surficial, unconsolidated geologic layers. These calculations were estimated from USGS well logs and numerous private-driller logs. Consultant well pumping-test reports[1] were also used, if available (USGS, 1992a; USGS 1995). Perhaps the most common use of GIS in relation to public water-supplies has

[1] Transmissivity based on a driller log provides a 2-dimensional estimate, unless the aquifer is homogeneous, isotropic and of large extent. In addition, transmissivity estimated from driller logs are typically extremely coarse estimates since they do not recognize boundary conditions and other constraints, and they are a function of the pumping capability and patience of the driller. A pumping-test value provides a true 3-dimensional average of transmissivity. However, since such information is difficult to obtain for a statewide region, most transmissivity polygons in the USGS study were based on driller logs only.

been through the federal Source-Water Assessment Program (SWAP) (U.S. Environmental Protection Agency (USEPA), 1997; NHDES, 1999). This program mandated that surface and groundwater sources for all public drinking-water supplies across the nation be assessed for their vulnerability to potential contamination from point and non-point sources in their watersheds. These assessments were fairly complex, and given that each state program had to complete source-water assessments for thousands of public drinking-water sources, the use of geographic information systems was essential to completing the task within a reasonable time.

Individual SWAP assessments consisted of identifying surface water and groundwater sources, identifying contributing areas, and then compiling the potential contaminant inventory within those areas. This inventory was collected from a variety of sources including: the U.S. Environmental Protection Agency (USEPA), state environmental departments, local and county governments, and watershed groups. After inventory completion, a susceptibility analysis was run. This involved a series of rankings based on the characteristics of potential contaminants, and on the location of the contaminants in relation to the given water supplies. The end products of this analysis were maps showing critical areas within the watersheds that posed the greatest potential threat to water quality. These maps could be used later to develop a protection plan to address problem areas within the watershed (Faga and Misiti, 2001; US EPA, 1998). While the Federal Source-Water Assessment Program has been both laudable and necessary, it has focused exclusively on *existing water supplies, a trend which is common to many federal and state programs*. However, and 1994, the USGS performed research in Cape Cod to identify areas available *for future use* as public water-supply (USGS, 1994a). In this study, the authors, Harris and Steeves, assembled data on the six groundwater-flow cells of the Cape Cod aquifer. All lands were classified into one of four landuse categories: Undeveloped, Agricultural, Residential, and Business/Utility. Seven criteria (three of which were landuses) were selected for a regionally consistent constraint analysis to identify remaining potential public water-supply areas:

1) Restricted Use zones
   (national and state parks, private nature preserves and sanctuaries)
2) Wetland zones
3) Agricultural Landuse zones
4) Residential Landuse zones
5) Business (including Industrial)/Utility Landuse zones
6) Groundwater Contamination zones
7) Potential Saltwater Intrusion zones.

The landuse-based criteria were used to account for A) regional groundwater-quality conditions resulting from non-point source pollution, and B) state regulations concerning landuse near public water-supplies. Buffering of GIS features was used to simulate protective setbacks. Specific groundwater contamination zones were identified and buffered on the basis of data from the Massachusetts Military Reservation, the Massachusetts Bureau of Waste

Cleanup, and the Cape Cod Commission. Wetlands were identified from USGS digital maps, and buffered by 100 feet in accordance with regulations imposed by the Massachusetts Wetland Protection Act. Residential Landuse zones and Business/Utility Landuse zones were buffered by 400 feet in accordance with state laws on siting new public water-supply wells. On the other hand, Restricted Use and Agricultural Landuse zones were excluded from development as public water-supply, but without buffering.

Harris and Steeves allowed for potential saltwater intrusion areas required by using modeled hydraulic head contours, selected on the basis of:

1) Conservative well depth data,
2) An equal depth of vertical buffer to the saltwater interface,
3) The Ghyben-Herzenberg principle, which equates a depth of freshwater below sea-level to the groundwater elevation above sea-level.

Having assembled or created all necessary data, the authors then overlaid the layers in order of increasing limitation on the potential for public water-supply. In the final analysis only 5.6% of the total land area of Cape Cod remained available for development as a potential public water-supply.

A key weakness of the Harris and Steeves study (USGS, 1994a) in its application to other areas was that the analysis criteria related only to water quality. Water quantity was only considered in a general way as an afterthought by excluding those areas of the largest flow cell identified as moraine, which typically has low hydraulic conductivity.

A separate GIS-based study relating to the critical nature of existing and future water supplies in New Hampshire was performed by the Society for the Protection of New Hampshire Forests (SPNHF) in 1997. This effort investigated the necessity of a public water-supply land-conservation program for NH (NHDES, 2000). The underpinning of this study was a GIS analysis of the extent and protection for existing critical water-supply lands in the state. To perform this, USGS-delineated sand and gravel aquifers were screened for yield on the basis of transmissivity, and then overlain with source-water protection areas (defined as contributing areas to public water wells, or watershed lands within 4000 feet of a surface water intake). The derived critical-water-supply lands were analyzed for existing levels of water-supply protection on the basis of SPNHF data. The greatest protection was considered to be outright ownership of the land, followed by easements, and then other types of conservation such as private or public natural reserves. Of the critical water-supply lands in NH, only 11.8 percent were found to be protected through ownership or easement (SPNHF, 1998a).

A key component not considered in the SPNHF study was the reduction of water-supply land due to potential and known contamination issues, or due to regulatory requirements. This is important since critical water-supply lands will be scarcer where area is lost to water quality or regulatory constraints.

Scientific Advancement and Practical Value

This chapter documents the development and application statewide, of a GIS technique to identify remaining undeveloped stratified-drift aquifer areas with potential to serve as large public water-supplies. The work moved beyond Harris and Steeves' (USGS, 1994a) GIS analysis of potential future water supplies in Cape Cod by specifically including consideration for water quantity as a constraint. In addition, the effort required a significantly different approach for water-quality constraints since digital landuse zones are not available in all municipalities in NH. The work also differed from the 1998 SPNHF study by focusing on stratified drift only, and addressing factors that increase the scarcity of the resource such as aquifer areas subject to known or potential contamination, or any lands subject to regulatory requirements. Finally, the work quantified for the first time, the regional status of the New Hampshire's stratified-drift aquifers, providing a sense of how of these valuable resources are being invisibly fragmented by development, and the need for further conservation efforts.

Methods

The three specific questions of this research are detailed as follows:

TCHH2 Question 1

What is the true frequency of potential and known point source contamination within New Hampshire stratified-drift?

Pilot work performed by the author demonstrated that 54% of potential and known point-contamination sources lay within stratified-drift aquifer areas. However, this did not account for existing intact underground storage tanks, for local inventories of public water-supply threats generated under the Source Water Protection program, or for duplication in the data (NHDES, 1999a).

H_0: 65% of all potential and known point-contamination sources are significantly concentrated on stratified-drift aquifer.

TCHH2 Question 2

How much of the original USGS-delineated stratified-drift aquifer area in New Hampshire is currently available to serve as large municipal water-supply, after area considerations for water quantity, water quality, and regulatory requirements have been addressed?

The Favorable Gravel Well Analysis (FGWA), a constraints analysis for stratified drift, was developed by the author for the rural town of Henniker, New Hampshire (NHDES, 1999a). This limited pilot work suggested that approximately three quarters of all stratified drift in the state would be lost if water quantity and quality constraints appropriate to a 75 gpm water-supply well were considered.

H_0: Most municipalities in New Hampshire have 25% or less of their original stratified-drift aquifer able to be delineated as areas with potential to serve as large public water-supply.

TCHH2 Question 3

Where do the greatest opportunities exist for stratified-drift aquifer land conservation?

Figure 5 depicts New Hampshire Original Stratified-Drift Aquifers (OSDA), and 3 sub-regions, overlain with urban features derived from the 2001 satellite-based New Hampshire Landcover Assessment Project. This landcover assessment was performed by the official New Hampshire GIS dataset repository (GRANIT, Geographically Referenced Analysis and Information Transfer system). Generally, the Coast region is known to have smaller, lower yield aquifers, and to be highly populated. The more urban South region has higher yield aquifers than the coast, and a greater population than the North. The rural North region also has higher yield aquifers, about 20% less land area than the South, and much lower population than either the South or the Coast. The mentioned population trends are readily apparent as urbanization trends in Figure 5.

Table 1 reveals that on the basis of the 2001 New Hampshire Land Cover Assessment, the state is only 4.4% urbanized, with 1.6% classed as Residential/Commercial/Industrial, and 2.8% classed as Transportation.

Table 2 reveals that the South and the Coast regions are 3.7 and 8.6 times as urbanized as the North, respectively. Since humans prefer to develop lowlands and valleys, the greatest opportunities for high-yield aquifer conservation likely exist in the rural North.

H_0: The greatest opportunities for conservation reside in the rural North.

Landcover Class	mi^2	%NH
Res/Com/Ind	148.6	1.6%
Transportation	260.9	2.8%
Total Urbanized	409.5	4.4%

Table 1. Area and percentages of NH area for urban landcover classes derived from the 2001 New Hampshire Landcover Assessment. (GRANIT, 2005)

Area (mi^2)	Total	North	South	Coast
Urban	409.5	68.3	318.3	22.9
Region	9282.1	4046.0	5080.5	155.6
%Region	4.4%	1.7%	6.3%	14.7%

Table 2. Regional percentages for urban land cover derived from the satellite-based 2001 New Hampshire Landcover Assessment. (GRANIT, 2005)

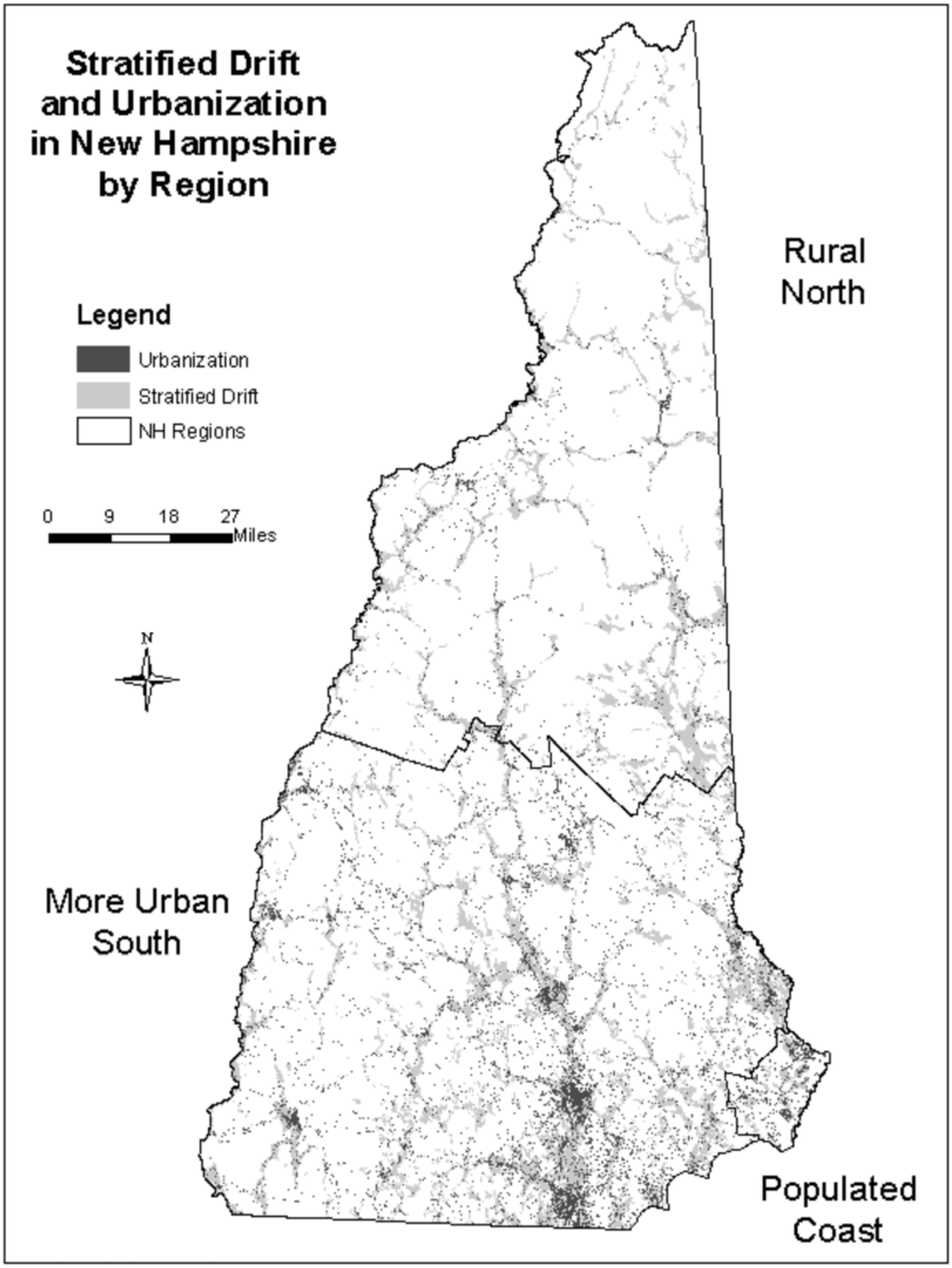

Figure 5. Original Stratified-Drift Aquifer (OSDA) in New Hampshire, overlain with urban features derived from the 2000 satellite-based New Hampshire landcover. Three depicted sub-regions are the rural North, more urban South and highly populated Coast. (NH Landcover 2001, GRANIT; USGS, 1996)

TCHH2 Preparation of Stratified-Drift Aquifer GIS Layer

To answer the research questions, a statewide GIS layer of stratified-drift aquifer was first assembled. Transmissivity data covering thirteen separate study areas from the 1984-96 USGS Stratified-Drift Aquifer Studies in New Hampshire were merged into one polygon feature coverage. Although the 13 study areas did not use identical ranges of transmissivity, the range overlap was such that the dataset could be utilized for the statewide analysis of this study.

Quality-control checks of the USGS and GRANIT stratified-drift coverages corrected a number of errors or inconsistencies, which included:

1) Attribute data where aquifer polygon maximum and minimum transmissivity values did not match associated transmissivity range codes. The attributes were corrected according to the transmissivity classes of nearby polygons.
2) Attribute data where aquifer polygon transmissivity range codes were inconsistent across study areas. For example, the transmissivity range-class-codes of the Nashua Regional Planning Commission (NRPC) study differed completely from those elsewhere in the state. To correct this, a range attribute was created to standardize the transmissivity classes and range codes throughout the 13 study areas.
3) Study area boundaries that were slightly misaligned in space. For example, the Nashua Region Planning Commission had to be spatially adjusted to match political boundaries, and align with neighboring studies.

4) Study area boundaries that overlapped. The Nashua Regional Planning Commission study was based on political boundaries, while all other studies were based on watersheds, or buffered watersheds. As a result, the NRPC, Lower Merrimack, Middle Merrimack and Lamprey studies shared considerable overlap. In this case, the four study areas were adjusted within GIS to eliminate the overlap, with the least transference of transmissivity polygons. The Nashua Regional Planning Commission study (political) boundaries were kept unchanged. The Lower Merrimack western boundary was clipped back to the NRPC boundary. Overlapping areas among the Middle Merrimack, Lamprey and Lower Merrimack studies were corrected by clipping to watershed divides.
5) Inconsistent treatment of surface water features between two study areas. Specifically, the Nashua Regional Planning Commission and Middle Connecticut studies did not clip the area of surface waters from stratified drift deposits, while the 11 remaining studies did so, creating accounting incompatibilities for transmissivity areas. To correct this, surface water polygons were clipped from the transmissivity coverages of the two mentioned studies.

TCHH2 Question 1 Method

To ascertain the true frequency of groundwater hazards on stratified drift in NH, it was necessary to overlay available federal and state GIS datasets for potential and known contamination sources onto USGS stratified-drift aquifer maps.

TCHH3 Potential and Known Contamination Sources (PKCS)

Thirteen federal and state GIS databases of potential and known contamination sources for 2003 were acquired for overlay analysis (Table 3). These thirteen databases of 2003 contained 24542 Points and 2209 polygons, for a total of 26751 features. Prior to overlay analysis, the data were scrutinized for duplicate points and polygons.

Two PKCS points were considered duplicates if they had identical coordinates, or if they lay within 1 ft of each other. In cases of duplication, the point contamination-type was assigned to that of greater groundwater hazard. For instance, a fuel tank that was listed both as an Underground Storage Tank (in ust_site), and as a Leaking Underground Storage Tank (in c_site) was identified with the active leaking underground storage tank. PKCS polygons were considered duplicates if they enclosed associated points from PKCS site datasets, or if the polygon was replicated in another dataset. As an example, all Resource Conservation Recovery Act (RCRA) polygons were replicated in the 2003 NHDES Groundwater Contamination Area Database (GIS dataset: c_area).

Coverage	Description	Source
1) ast	Above Ground Storage tank	NHDES
2) c_site	Known/Potential Contamination sites	NHDES
3) junkyd	Junkyard Locations (with at least 50 autos)	NHDES
4) loc_inv	Local Inventory of Groundwater Hazards	NHDES
5) nhtri	Toxic Release Inventory (air, water, land)	USEPA
6) npdes	National Pollution Discharge Elimination System Outfalls	NHDES
7) np_pt	Point/Non-Point Source Pollution sites.	NHDES
8) rcra_site	Hazardous Waste Generators (RCRA) Sites Includes small and large quantity waste generators.	NHDES
9) ust_site	Underground Storage Tanks.	NHDES
10) r_area	Hazardous Waste Generators (RCRA) polygons	NHDES
11) np_poly	Point/Non-Point Source Pollution polygons	NHDES
12) c_area	Known/Potential Contamination polygons	NHDES
13) pest	Pesticide Application Polygons	NH Dept of Agriculture

Table 3. Thirteen Potential and Known Contamination GIS Datasets for NH.

Finally, sand and gravel mines, and quarries, were removed from the data, since they did not necessarily restrict the development of a public water-supply in the area. While there are some below groundwater-table mines which should be included as constraints in this analysis, the NHDES Point/Non-Point-Source Pollution database does not identify them. After these considerations, 22588 unique points and polygons remained that were both unique and required setbacks under the Favorable Gravel Well Analysis (NHDES, 1999b).

For the contamination overlay-analysis, PKCS points and polygons that fell into the 0-2000 ft^2/d SDA transmissivity range were apportioned to the 0-1000 ft^2/d (86.7%) and 1000-2000 ft^2/d (13.3%) ranges on the basis of PKCS occurrence in these classes for 10 study areas elsewhere in the state. Upon completion of the above preparations, the unique PKCS points and polygons requiring buffers were overlain on the stratified-drift polygon features, and clipped to the SDA extent, within arcGIS (ESRI, 2004). The points were directly summarized by transmissivity range. Where a PKCS polygon overlaid multiple transmissivity ranges, its frequency count was weighted by its sub-area in each transmissivity range (i.e. a contamination polygon could only count for one event, regardless of the number of SDA polygons it intersected). This completed the preparation for question 1.

TCHH3 Method for Questions 2 and 3

Identification of remaining high-yield stratified drift having potential to serve as large water supplies, and summarizing opportunities for conservation required a technically demanding process within arcGIS due to the regional nature of the study. To perform this, the author refined the original Favorable Gravel Well Analysis (NHDES, 1999b). Aspects of water quantity, NHDES Regulations and water quality were considered, using a vector-based GIS buffering approach within arcGIS. Water-quantity limitations were addressed by masking those areas of the aquifer with insufficient transmissivity to meet the desired pumping rate on the basis of a simple relationship (presented later), and a simplifying assumption of no limiting aquifer boundaries.

While artificial recharge via aquifer storage and recovery systems (ASR) can be important for local water storage in advance of dry seasons, this factor was ignored in this study, given the regional extent of the research, and its focus on immediate yields rather than long term water availability over time. Water-quality limitations were addressed by applying setback-buffers within GIS for urban features, PKCS, and hydrography to NHDES requirements. A more conservative setback was used in cases where the potential for contamination or the hazard to public health was thought to be greater (NHDES, 1999a; NHDES, 1999b).

TCHH4 Sanitary Protective Radius (SPR) and Water Quality

The regulatory sanitary-protective radius for wellheads provides a link between water quantity and an absolute minimum water-quality protection in this study. NHDES well-siting rules establish an area around the well which must be maintained in a *natural state*. Unlike the larger wellhead protection area, the SPR is intended only to protect only the water quality in the ***immediate*** vicinity[2] of the well. It is a circle whose radius depends on the well's NHDES-permitted daily production volume (Appendix C).

[2] To demonstrate that the SPR provides only a measure of protection in the immediate vicinity of the wellhead, consider the fact that while a 75 gpm well requires only a 300 ft SPR, it would require an circular annual recharge-area with a radius of 923 ft, assuming no groundwater inflow, and an annual recharge of 23.6 inches, the norm for the Oyster River watershed in NH, over 1976-1986 (Lough, 1992). This demonstrates that SPR is an absolute minimum protection, and is by far smaller than a true wellhead protection area.

Within a Sanitary Protective Radius:

A) The water supplier must own the land, or control the land by perpetual easement.

B) Land uses or activities shall not pose a contamination risk to groundwater. Prohibited uses include septic-system leach fields, roads (except for pump-house access roads), parking lots, driveways, pesticide use, railroad rights-of-way, storage tanks for petroleum or chemicals, any building other than a pump house, detention basins for runoff, dumpsters, and debris.

C) No underground utilities or structures may be installed except for potable water, electrical, and communication conduits.

Consequently, cultural features need to be setback by at least the sanitary protective radius as function of the pumping rate of a given well.

TCHH4 Water Quantity

To utilize the USGS stratified-drift aquifer data as a rough approximation of water quantity, it was necessary to relate USGS-delineated transmissivity (ft^2/d) to well pumping rates (gpm), since NHDES regulations for large overburden wells are based on pumping rates (Appendix C). This was accomplished using a relationship derived from Krasny, (1993):

$$Q = 0.0736\ (gpm/ft^2/d) * T \qquad \text{Equation 1}$$

where Q = well yield (gpm)

T = transmissivity (ft^2/d)

The 13 USGS studies assigned 17 ranges of minimum and maximum transmissivities as unique attributes for any given digital polygon within the electronic aquifer maps. To be conservative, minimum (rather than maximum) transmissivity values for any given aquifer polygon were used to equate potential well yields. Of the remaining seventeen T-ranges, two key minimum transmissivities (Tmin) were identified:

A) Tmin = 1000 ft^2/d, approximately equal to a well yield of 75 gpm, which for this study, is considered the ***minimum*** sufficient to be of interest to municipal planners as a large-capacity water supply (Appendix C). A 75 gpm well yield requires a sanitary protective radius of 300ft.

B) Tmin = 2000 ft^2/d, approximately equal to a well yield of 150 gpm, which falls into the NHDES ***maximum*** sanitary protective radius of 400ft (Appendix C).

The above two minimum transmissivities bracket the upper and lower setback requirements for the Favorable Gravel Well Analysis (Table 4).

Favorable Gravel Well Analysis	**Well Yield**	**USGS Minimum Transmissivity**	**NHDES Sanitary Protective Radius**
Minimum cultural buffer	75 gpm	1000 ft^2/d	300 ft
Maximum cultural buffer	150 gpm	2000 ft^2/d	400 ft

Table 4. Well yields, transmissivities and sanitary protective radii, defining the upper and lower Favorable Gravel Well Analyses.

For further water-quantity analysis, the 17 USGS stratified-drift transmissivity ranges were assigned FGWA range codes, and then restructured into the 4 mutually exclusive-yield classes of Table 5**.**

Yield Class	Yield Range gpm	Description
C	<75	Unlikely to support a single large municipal well.
B	75-149	Potentially able to support moderate to high well yields.
A	≥150	Potentially able to support very high well yields.
U	Unknown	The USGS was unable to contour transmissivity for these areas.

Table 5. Four well-yield classes used to class 17 USGS transmissivity ranges.

Relationships between USGS-delineated transmissivity ranges, FGWA range codes, range area, four yield classes, and two aquifer classifications are outlined in Table 6. Definition of 1000 ft^2/d as a *minimum transmissivity of interest* creates a problem in three USGS studies, in that the transmissivity range 0-2000 ft^2/d encompasses that value. Consequently, T sub-areas of 0-1000 ft^2/d and 1000-2000 ft^2/d exist within the 0-2000 ft^2/d range. While these sub-area ranges cannot be identified spatially, their area values can be estimated on the basis of their occurrence in ten other USGS study areas. On this basis, neglecting differences in aquifer morphology, 14.4% of the 0-2000 ft^2/d range area was apportioned to yield class B (T = 1000-2000 ft^2/d), while 85.6% was apportioned to yield class C (T = 0-1000ft^2/d). Since the spatial information does not carry through, any 75 gpm constraints analysis map including the three USGS study areas that used this transmissivity range (Nashua Regional Planning

Commission, Pemigewasset, and Bellamy/Cocheco/Salmon Falls) will visually overstate the occurrence of potential 75 gpm aquifer.

The last two columns of Table 6 depict the relationship among several aquifer classes: OSDA (Original Stratified-drift aquifer for the state or a town), OSDA75 (Original Stratified-Drift Aquifer with potential to supply at least a 75 gpm well yield), and OSDA150 (Original Stratified-Drift Aquifer with potential to supply at least a 150 gpm well yield). For these last two categories of SDA, the Unknown yield class was apportioned to classes A, B and C (13.6%, 12.4%, and 74% respectively); on the basis of state ratios of these three yield classes.

USGS SDA Polygon Tmin (ft²/d)	USGS SDA Polygon Tmax (ft²/d)	FGWA Range Code	FGWA Range Area (mi²)	SDA %NH Area	Well Potential Yield Class (Mutually Exclusive)	Yield Class Area (mi²)	Yield Class %NH Area	OSDA and OSDA75 Subset	OSDA and OSDA150 Subset
0	500	2	49.1	0.5	C (<75 gpm)	821.9	8.9	Insufficient Yield	Insufficient Yield
0	1000	3	579.3	6.2					
500	1000	4	5.0	0.1					
0	2000	5	220.2	2.4	86.5% / 14.4%				
1000	2000	6	106.4	1.1	B (75-149 gpm)	138.1	1.5	OSDA75 = A+ B + 26.0% U = 3.5%NH Requires 300 ft SPR	
2000	3000	7	7.0	0.1	A (150+ gpm)	150.5	1.6		OSDA150 = A + 13.6% U =1.8%NH Requires 400 ft SPR
2000	4000	8	81.1	0.9					
3000	4000	9	3.0	0.0					
3000	99999	10	0.2	0.0					
4000	6000	11	0.1	0.0					
4000	8000	12	31.8	0.3					
4000	99999	13	9.8	0.1					
6000	99999	14	0.02	0.0					
8000	99999	15	17.5	0.2					
99999	99999	97	18.5	0.2	U (Unknown gpm)	134.5	1.4	Apportioned	Apportioned
99999	99999	98	10.4	0.1					
99999	99999	99	105.6	1.1					
		SDA Total	1245.0	13.4	Yield Class Total	1245.0	13.4		
		NH Total	9282.1	100.0	NH Total	9282.1	100.0		

Table 6. Aquifer transmissivity ranges, FGWA range codes, range areas, yield classes and Original Stratified-Drift Aquifer subsets. The USGS transmissivity ranges have considerable overlap since the ranges varied by study area. Consequently, range 5 (0-2000 ft^2/d) and yield class U were each apportioned as indicated on the basis of occurrence elsewhere in the state. OSDA75 is a subset of original stratified-drift aquifer (OSDA) that has potential to meet a 75 gpm or greater well yield. OSDA150 is a subset of OSDA75 that has potential to meet a 150 gpm or greater well yield.

TCHH4 Water Quality (Contamination, Hydrography)

TCHH5 Roads

Maintained public and private roads were buffered by the sanitary protective radius plus one-half the approximate right-of-way, based on road class. Discussions with the New Hampshire Department of Transportation indicated that the right-of-way can range from 50 feet for the smallest back-road to 150 feet for a super-highway. Seventy-five to 100 feet is considered common. Actual right-of-way values are site specific, and are not available as attributes in DOT or USGS road coverages (C. Brown, NHDOT, personal communication, 1996).

Public and private road coverages were obtained from the New Hampshire Department of Transportation (NHDOT). The private roads coverage had been developed under the Office of Emergency Management 911 Project. These coverages were reviewed for spatial overlap, GIS attributes, and obvious data errors. The coverages were then unioned into a single roads layer for the state, resulting in a considerably more detailed dataset than that of the pilot study. SPR buffers were assigned to maintained roads only, on the basis of the attribute functional class codes (F_class, Table 7). Final quality checks of the dataset, and buffering were subsequently performed in arcGIS.

F_Class	Type	Description	Net Buffer
0	Either	Non-Public and Private Roads	SPR+25
1	Rural	Principal Arterial – Interstate	SPR+75
2	Rural	Principal Arterial – Other	SPR+50
6	Rural	Minor Arterial	SPR+37.5
7	Rural	Major Collector	SPR+37.5
8	Rural	Minor Collector	SPR+25
9	Rural	Local	SPR+25
11	Urban	Principal Arterial – Interstate	SPR+75
12	Urban	Principal Arterial -- Other	SPR+50
14	Urban	Principal Arterial – Other	SPR+37.5
16	Urban	Minor Arterial	SPR+37.5
17	Urban	Collector	SPR+25
19	Urban	Local	SPR+25

Table 7. Buffers (SPR+½ right-of-way) for maintained public and private roads.

TCHH5 Potential and Known Contamination Sources

In Harris and Steeve's approach (USGS, 1994a), digital landuse zones were utilized as a means to infer underlying water quality. For the current study, 13 datasets representing potential and known groundwater contamination sources (PKCS) were obtained from NHDES and GRANIT (Appendices D and E). Potential sources include features (such as an intact underground storage tanks) that are listed with NHDES as potential groundwater hazards, without having active contamination. This includes remediated groundwater hazards. Known sources include features (such as leaking underground storage tanks) that are listed with NHDES as active ground water hazards, having known contamination currently being addressed.

The acquired datasets encompass both point and polygon GIS features, which had been scrutinized for duplication. Appropriate subsets of the datasets were buffered to remove areas from consideration as possible water-supply due to potential water-quality issues.

Two distinct buffers for these features were utilized on the basis of relative hazard: the sanitary protective radius or 1000 feet for features thought to be of greater hazard to the public (e.g. septage lagoons). Specific FGWA buffers for known contamination sources are identified in Appendix D. Specific FGWA buffers for potential contamination sources are identified in Appendix E.

Depending on well pumping rate, subsurface circumstances, contaminant properties and whether the nearby contamination is a point source or a plume , a 1000 foot setback can be an over-protective or under-protective for a large water-supply well. Review of NHDES contamination sites and discussions with five NHDES project managers revealed that most contamination plumes in NH SDA are much less than 1000 ft (Regan et al., personal communication, 1996). Consequently, 1000 ft was chosen as a compromise buffer between an adequate protection and a more conservative setback that would have constrained considerable excess land (NHDES 1999a, NHDES 1999b).

TCHH5 Hydrography

In addition to the prior water-quality considerations, there is an NHDES requirement that large overburden wells must be setback at least 50 feet from any surface water, including or wetlands as a means to control possible biologic and chemical contamination (NHDES, 1995, NHDES, 2007). In this study, wetlands received separate consideration from other surface waters, on the basis of a NHDES policy that resulted from the pilot project. Wetlands are extensive in New Hampshire, and public water-supplies can be developed on such features, provided the land is built up to avoid potential surface-water contamination of the wells ,and appropriate NHDES permits are obtained for disturbance of the wetland. Consequently, while Harris and Steeves removed wetlands from consideration, for the purposes of this study wetlands were retained as viable locations of water supply in the FGW analysis.

To satisfy the surface water setback requirement, 1:24000 USGS Hydrography Digital Line Graphs (DLG) for New Hampshire were obtained. Quality checking of this data revealed several attribute coding errors at the northern end of the state. In addition, a large number of wetland boundaries in the central part of the state were found to be incorrectly coded, creating problems for buffering. After corrections, final buffering was performed in arcGIS.

TCHH4 Spatial Overlay

Once all cultural features, hydrography and PKCS coverages had been assembled and buffered appropriately for both 75 gpm and 150+ gpm analyses, they were overlain within arcGIS onto the USGS SDA coverages. To provide information by town, political boundaries for the state were overlain as well. Quality control checks were performed after each step. These included monitoring the number of polygons resulting from the overlay process, updating the polygon areas, ensuring that the area sum of all stratified drift had not changed, and performing visual checks in a number of locations throughout the state to identify possible problems.

The final 75 and 150 gpm studies then consisted of 232,729 and 253,072 polygons, respectively. These statewide coverages were then analyzed for remaining areas of stratified-drift aquifer by town, and for opportunities for conservation. The final FGWA attribute data were imported to MS Access for cross-tabulation of remaining stratified drift by transmissivity range and town. These cross-tabulations were subsequently reworked within Microsoft Excel to apportion FGWA range code 5 (T = 0-2000 ft^2/d) between range codes 4 and 6 (T = 0-1000 ft^2/d, T = 1000-2000 ft^2/d); and to apportion the unknown yield class U (T = 99999) between yield classes A, B and C. This allowed reasonable estimation of RSDA75 and RSDA150 by state, region and town.

Results

Question 1

What is the true frequency of potential and known point-source contamination within New Hampshire stratified drift?

Table 8 displays the results of the overlay analyses of all PKCS points, including intact underground storage tanks, the NHDES local source water protection hazard inventory, and after elimination of duplication among datasets. From this table it can be seen that the greatest frequency of PKCS counts on SDA stemmed from the active sites of the NHDES Groundwater Contamination Database, followed by RCRA sites, intact underground storage tanks and local source-water protection inventory points. 13030 points and polygons, or 57.7% of all unique PKCS occurrences of interest reside on stratified drift. While this frequency of potential and known contamination sites on SDA is larger than observed in the pilot study, it is less than the hypothesized value of 65%. As a result, ***H_0 is rejected***.

Table 9 summarizes the occurrence of the PKCS counts by well-yield classes, and reveals further details on the threat of urban development. SDA in general, has a PKCS density per mi^2 approximately 8.3 times that of the upland areas of the state on average. Yield class A (150+ gpm) has the greatest PKCS density

Potential and Known Contamination Sources	Coverage	Feature Class	PKCS Type	*****************Features***************				Percent Unique Buffered Features on SDA
				Total	Unique	Buffered	on SDA	
Above Ground Fuel Storage Tank	Ast_site	Point	1	1151	1008	1008	579	2.6%
NHDES Groundwater Remedation	C_site	Point	2	6931	6850	6850	3898	17.3%
Junkyard of at least 50 autos	Junkyd	Point	3	162	162	162	82	0.4%
Source Water Local Hazard Inventory	Localinv	Point	4	1983	1977	1977	1118	4.9%
Toxic Release Inventory	Nhtri	Point	5	222	214	214	121	0.5%
National Point Discharge	Npdes	Point	6	410	406	406	187	0.8%
Non-Point Source Pollution	Np_pt	Point	7	2219	2218	1332	749	3.3%
Resource Conservation Recovery Act	Rcra_site	Point	8	6803	5568	5568	3497	15.5%
Underground Fuel Storage Tank	Ust_site	Point	9	4661	3231	3231	2049	9.1%
Resource Conservation Recovery Act	Rcra_area	Polygon	10	18	0	0	0	0.0%
Non-Point Source Pollution	Np_poly	Polygon	11	345	332	41	19	0.1%
NHDES Groundwater Remedation	C_area	Polygon	12	571	524	524	316	1.4%
Pesticide Application	Pest	Polygon	13	1275	1275	1275	415	1.8%
				26751	23765	22588	13030	57.7%

Table 8. Potential and Known Contamination Sources (PKCS) in New Hampshire by Stratified-Drift Yield Class, with redundancy eliminated. Frequency of PKCS occurrence on SDA as a percent of all PKCS is in gray.

Potential and Known Contamination Sources	PKCS Type	*****************Yield Class******************* C <75 GPM	B 75-150 GPM	A 150+ GPM	U Unknown	Upland	
Above Ground Fuel Storage Tank	1	390	41	110	38	429	Points
NHDES Groundwater Remedation	2	2527	396	588	387	2952	
Junkyard of at least 50 autos	3	59	15	7	1	80	
Source Water Local Hazard Inventory	4	782	102	187	47	859	
Toxic Release Inventory	5	74	7	30	10	93	
National Point Discharge	6	119	15	33	20	219	
Non-Point Source Pollution	7	510	88	81	70	583	
Resource Conservation Recovery Act	8	2164	309	600	424	2071	
Underground Fuel Storage Tank	9	1270	220	297	262	1182	
Resource Conservation Recovery Act	10	0	0	0	0	0	Polygons
Non-Point Source Pollution	11	13	3	2	1	22	
NHDES Groundwater Remedation	12	193	55	54	14	208	
Pesticide Application	13	297	36	52	29	860	
							Total
Total PKCS (#)		8398	1287	2041	1303	9558	22588
% "On SDA" PKCS		64.5%	9.9%	15.7%	10.0%	NA	NA
Yield Class Area (mi2)		821.9	138.1	150.5	134.5	8037.1	9282.1
PKCS Density (#/mi2)		10.2	9.3	13.6	9.7	1.2	NA
Yield Class %NH Area		8.9%	1.5%	1.6%	1.4%	86.6%	100.0%

Table 9. Potential and Known Contamination Sources in New Hampshire as distributed across stratified-drift yield classes. PKCS points and polygons that fell into the 0-2000 ft^2/d SDA transmissivity range were apportioned to the <75 (86.7%) and 75-150 (13.3%) yield classes on the basis of PKCS occurrence in these classes, elsewhere in the state. SDA has a PKCS density on average 8.3 times greater than that of upland areas. The 150+ gpm yield class has PKCS density 11.3 times that of upland areas.

of all, 13.5 occurrences per mi^2 on average, 11.3 times greater than upland areas of the state. Unfortunately, yield class A stratified drift is the most vulnerable to the spread of contamination as it is the most transmissive.

As mentioned earlier, 57.7% of all PKCS in New Hampshire occur on SDA, which occupies just 13.4% of the state's area. For comparison, after apportionment from yield class U, yield classes A and B occupy just 1.8% and 1.7% of the state's area.

Question 2

How much of the original USGS-delineated stratified-drift aquifer area in New Hampshire is currently available to serve as large municipal water-supply, after considerations for water quantity and water quality have been addressed?

In the following discussion, all SDA quantities include apportioned yield class U. Table 10 and Table 11 reveal that of the 1245 mi^2 of OSDA in NH, on average, only 9.5% (118.4 mi^2) remains with potential to serve a 75 gpm well after FGW analysis. Furthermore, only 3.8% (47.6 mi^2) remains with potential to serve as a 150 (or greater) gpm well, after FGW analysis. Since these numbers are far less than 25%, ***the null hypothesis is accepted***.

Table 10 and Table 11 also reveal that a far greater amount of OSDA is lost to water quantity considerations than to water quality considerations. 74.0% and

86.4% of all NH OSDA is removed to create OSDA75 and OSDA150 respectively. From these, an additional 16.5% and 9.7% is removed to create RSDA75 and RSDA150 respectively.

New Hampshire FGW Analysis (mi^2)			
Description	**75 gpm**	**150 gpm**	**Description**
OSDA	1245.0	1245.0	
Less Insufficient Water Quantity	921.4	1076.3	
OSDA75	323.6	168.7	**OSDA150**
Less Buffers for Water Quality	205.2	121.1	
RSDA75	**118.4**	**47.6**	**RSDA150**

Table 10. Areal summaries of 75 gpm and 150 gpm lands from the Favorable Gravel Well Analyses for NH.

FGW Analysis as Percent NH OSDA			
Description	**75 gpm**	**150 gpm**	**Description**
OSDA	100.0%	100.0%	
Less Insufficient Water Quantity	74.0%	86.4%	
OSDA75	26.0%	13.5%	**OSDA150**
Less Buffers for Water Quality	16.5%	9.7%	
RSDA75	**9.5%**	**3.8%**	**RSDA150**

Table 11. Percentage summaries of 75 gpm and 150 gpm from the Favorable Gravel Well Analyses for NH.

Figure 6 on the following page, depicts histograms of OSDA, RSDA75 and RSDA150 areas. As noted in SPNHF, 1998a, the amount of original stratified drift varies greatly among New Hampshire's towns. In Figure 6, this variability is demonstrated in the broad distribution of original aquifer area by town. Eleven NH towns have no OSDA, 30 towns have no remaining stratified-drift aquifer available for a 75 gpm well (RSDA75) after a constraints analysis. Fully 68 towns have no remaining stratified-drift aquifer available for a 150 gpm well (RSDA150) after the constraints analysis.

As indicated by the cumulative curves in Figure 6, the broad distribution of municipalities by OSDA area is significantly pushed to the left after both the RSDA75 and RSDA150 constraints analyses. This is largely driven by the 74% and 86.4% loss of aquifer area due to insufficient water quantity for single large wells (Table 11). Consequently, the RSDA75 and RSDA150 distributions take on the character of the OSDA75 and OSDA150 frequency distributions.

Figure 7 and Figure 8 depict the further loss and fragmentation of OSDA75 and OSDA150 due to setbacks applied for water quality factors. In both cases, large areas of the OSDA75 or OSDA150 exist in a relatively few towns, before the Favorable Gravel Well Analysis. After the analysis, both the RSDA75 and RSDA150 distributions have been skewed to the left by fragmentation. In both analyses, the majority of towns have very little aquifer remaining available.

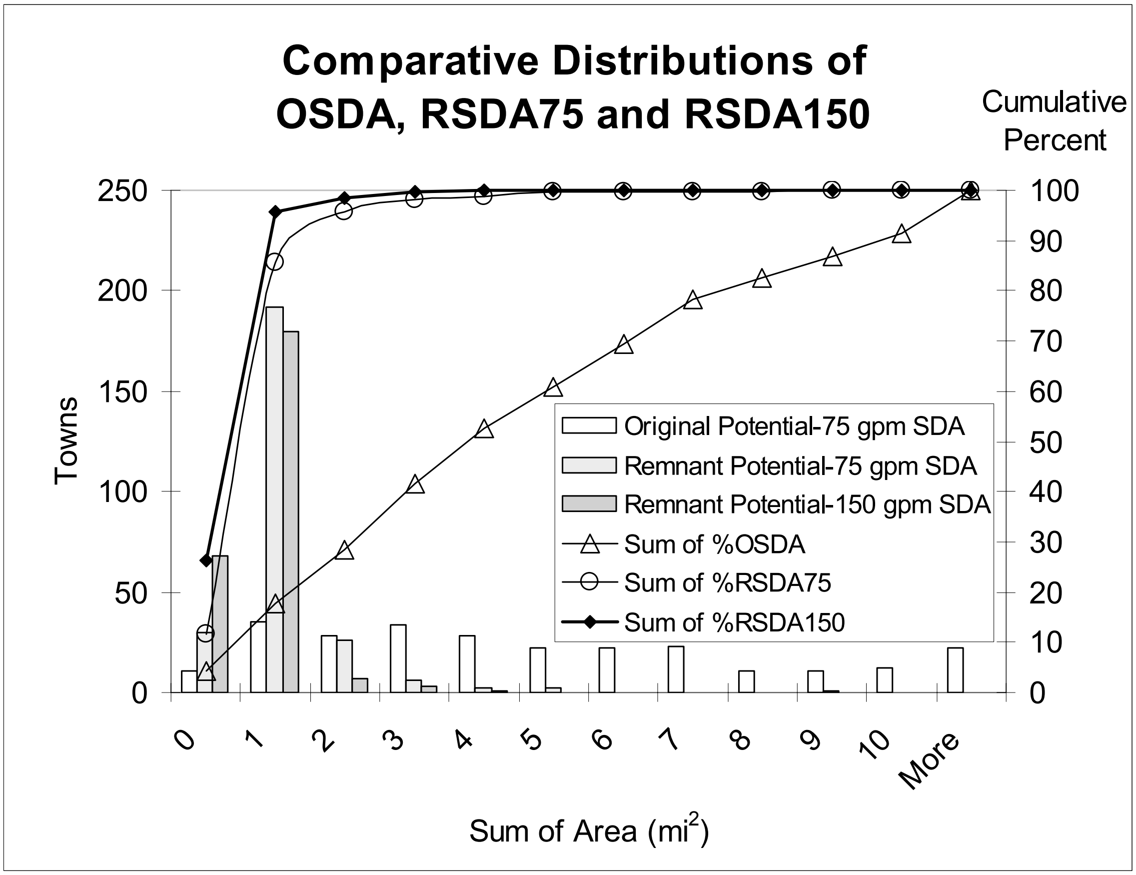

Figure 6. Histograms for original stratified-drift aquifer and remnant stratified-drift aquifer areas after Favorable Gravel Well Analyses for 75 and 150 gpm well yields. Of 1245 mi^2 OSDA, after water quantity and water quality considerations, RSDA75 contains 118.4 mi^2 (9.5%) and RSDA150 contains 47.6mi^2 (3.7%). (To assist in interpretation, the acronym definitions are listed again below.)

OSDA	The area of Original Stratified-Drift Aquifer, as delineated by the USGS, for a region such as a town or state.
RSDA75	A subset of OSDA with potential to supply a 75 gpm well yield, after both water quantity and water quality considerations. It is a subset of OSDA75.
RSDA150	A subset of OSDA with potential to supply a 150 gpm well yield, after both water quantity and water quality considerations. It is a subset of OSDA150.

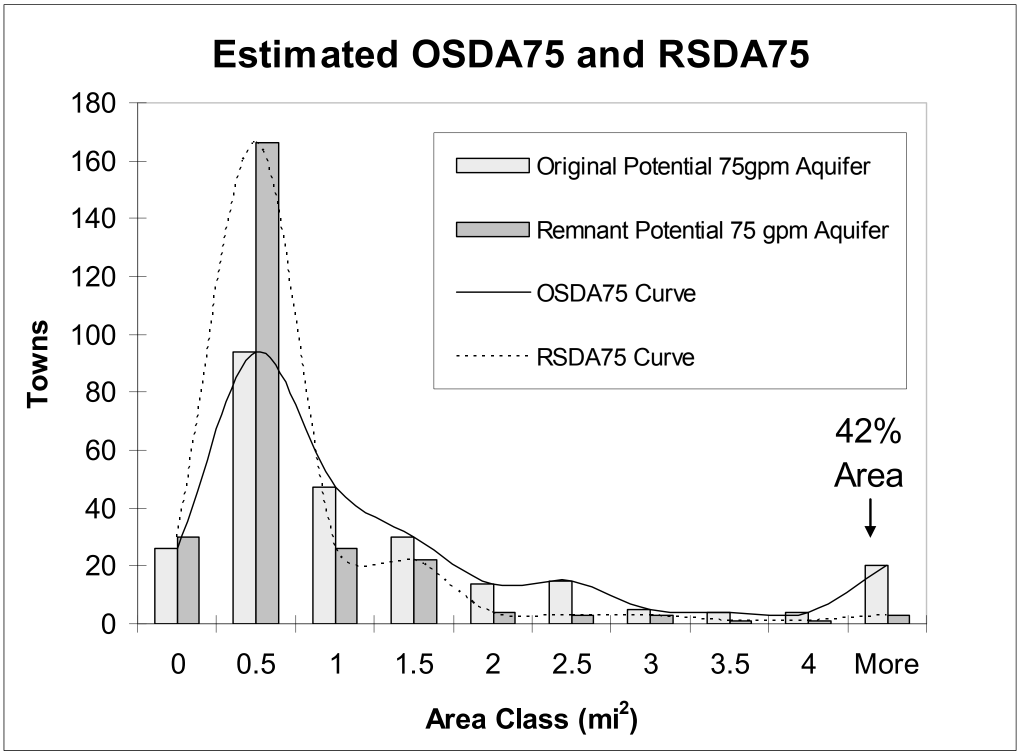

Figure 7. Histogram of OSDA75/RSDA75 area by towns. Consideration of water quality setbacks creates fragmentation of aquifer area that drives the RSDA75 distribution left. (Acronym definitions are listed again below.)

OSDA	The area of Original Stratified-Drift Aquifer, as delineated by the USGS, for a region such as a town or state.
OSDA75	A subset of OSDA with potential to supply at least a 75 gpm well yield, after water quantity considerations.
RSDA75	A subset of OSDA with potential to supply at least a 75 gpm well yield, after both water quantity and water quality considerations. It is a subset of OSDA75.

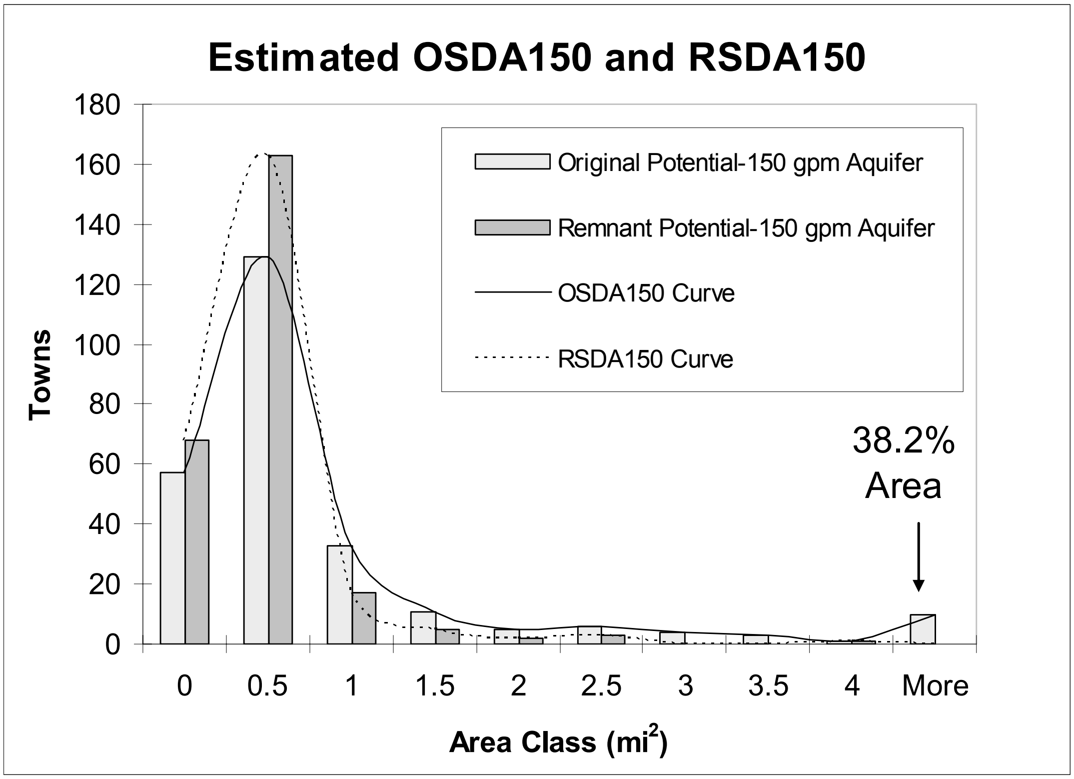

Figure 8. Histogram of OSDA150 and RSDA150 area by towns. Consideration of water quality setbacks further fragments aquifer area, driving the RSDA75 distribution left. (Acronym definitions are listed again below.

OSDA	The area of Original Stratified-Drift Aquifer, as delineated by the USGS, for a region such as a town or state.
OSDA150	A subset of OSDA with potential to supply at least a 150 gpm well yield, before water quality considerations. It is also a subset of OSDA75.
RSDA150	A subset of OSDA with potential to supply at least 150 gpm well yield, after both water quantity and water quality considerations. It is a subset of OSDA150.

Question 3

Where do the greatest opportunities exist for stratified-drift aquifer land conservation?

To answer this, OSDA, RSDA75 and RSDA150 data were summarized according to the three regions of Figure 5, as determined below:

A) Rural North, with a greater frequency of narrow, high transmissivity valley aquifers

B) More populated South with a mix of narrow valley aquifers and broad sand plains, including the cities of Nashua, Manchester and Concord;

C) Highly populated Coast, with smaller, lower yielding aquifers.

Table 12 reveals that the greatest opportunities for conservation (61.9 mi^2 RSDA 75 and 27.5 mi^2 RSDA150) exist in the North. On this basis, ***the null hypothesis is accepted***.

The comparisons of Table 13 reveal that the South has 65.7% of NH OSDA,; the North; 32.0%; and the Coast only 2.3%. Subtraction of low-transmissivity areas casues the Coast to lose the most, followed by the South, and finally by the North. Of each region's resulting OSDA75 or OSDA150, the highly populated Coast loses 83.8% and 90.8% to water quality setbacks, followed by the more urban South (69.9%, 784%), while the rural North loses the least (53.8%, 63.2%). As a result, the Coast is left with little RSDA75/150, and the North, despite 51.4% less OSDAh, is left with slightly more RSDA75 and RSDA150 than the South.

75 GPM FGW Analysis Estimated (mi2)					**150 GPM FGW Analysis** Estimated (mi2)				
Type	Total	Coast	South	North	Coast	South	North	Total	Type
All Land	9282.1	156	5080	4046	156	5080	4046	9282	All Land
OSDA	1245.0	28.7	818.3	397.9	28.7	818.3	397.9	1245.0	OSDA
- Quantity	921.4	24.3	633.3	263.8	27.5	725.6	323.2	1076.3	- Quantity
OSDA75	323.6	4.4	185.0	134.1	1.3	92.7	74.8	168.7	OSDA150
- Quality	205.2	3.7	129.2	72.2	1.2	72.7	47.3	121.1	- Quality
RSDA75	118.4	0.7	55.8	61.9	0.1	20.0	27.5	47.6	RSDA150

Table 12. Regional area summaries of the 75 gpm FGW analysis and the 150 gpm FGW analysis. To assist the reader, acronym definitions are relisted below.

75 GPM FGW Analysis Regional Comparisions					**150 GPM FGW Analysis** Regional Comparisions				
Type	NH	Coast	South	North	Coast	South	North	NH	Type
%NH OSDA	100	2.3	65.7	32.0	2.3	65.7	32.0	100	%NH OSDA
A %Reg OSDA Lost to Quantity	74.0	84.7	77.4	66.3	95.5	88.7	81.2	86.4	**A** %Reg OSDA Lost to Quantity
B %OSDA75 Lost to Quality	63.4	83.8	69.9	53.8	90.8	78.4	63.2	71.8	**B** %OSDA150 Lost to Quality
C RSDA75 %NH OSDA	9.5	0.1	4.5	5.0	0.0	1.6	2.2	3.8	**C** RSDA150 %NH OSDA

Table 13. Regional comparisons for the 75 gpm and 150 gpm FGW analyses: A) %OSDA lost to water quantity, B) % of OSDA75 or OSDA150 lost to water quality, and C) RSDA75 or RSDA150 as % of the state's 1245 mi^2 of OSDA.

OSDA — All Original Stratified-Drift Aquifer, as delineated by the USGS, for a region such as a town or state.

OSDA75 — A subset of OSDA with potential to supply a 75 gpm well yield, after water quantity considerations.

RSDA75 — A subset of OSDA with potential to supply a 75 gpm well yield, after both water quantity and water quality considerations. It is a subset of OSDA75.

OSDA150 — A subset of OSDA with potential to supply a 150 gpm well yield, after water quantity considerations. It is also a subset of OSDA75.

RSDA150 — A subset of OSDA with potential to supply a 150 gpm well yield, after both water quantity and water quality considerations. It is a subset of OSDA150.

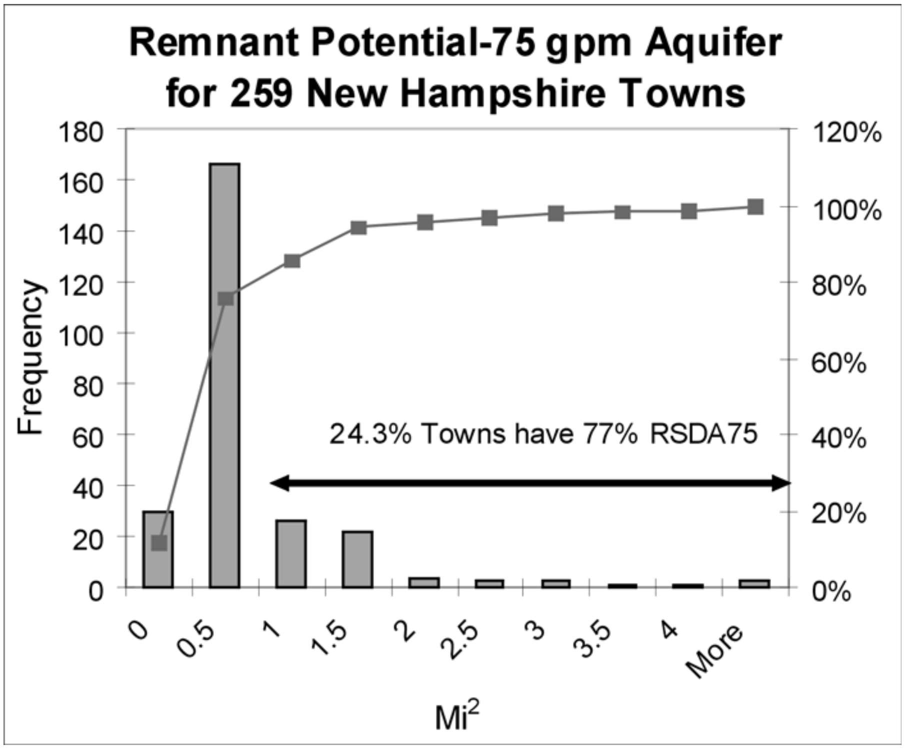

Figure 9. Histogram of remaining stratified-drift aquifer with potential to provide a well yield of 75 gpm or greater, in 259 New Hampshire towns.

RSDA75 Range (mi^2)	Towns	% Towns	RSDA75 mi^2	RSDA75 %Total
0	30	11.6%	0.0	0.0%
>0-0.001	5	1.9%	2.2E-03	0.0%
>0.001 - 0.5	161	62.2%	27.3	23.0%
>0.5 - 1.5	48	18.5%	45.4	38.3%
>1.5 - 4+	15	5.8%	45.8	38.7%
Total	259	100.0%	118.4	100.0%

Table 14. Frequency and area of remaining stratified-drift aquifer having potential for a well yield of 75 gpm or greater, for 259 NH towns.

Of New Hampshire's 1245 mi^2 of stratified drift, only 118.4 mi^2 remains available after constraints analysis for a 75 gpm or greater well yield. Figure 9 and Table 14 demonstrate that the majority (77%) of this amount resides in just 63 (24.3%) of 259 towns. Just 15 (5.8%) towns encompass 38.7% of the RSDA75.

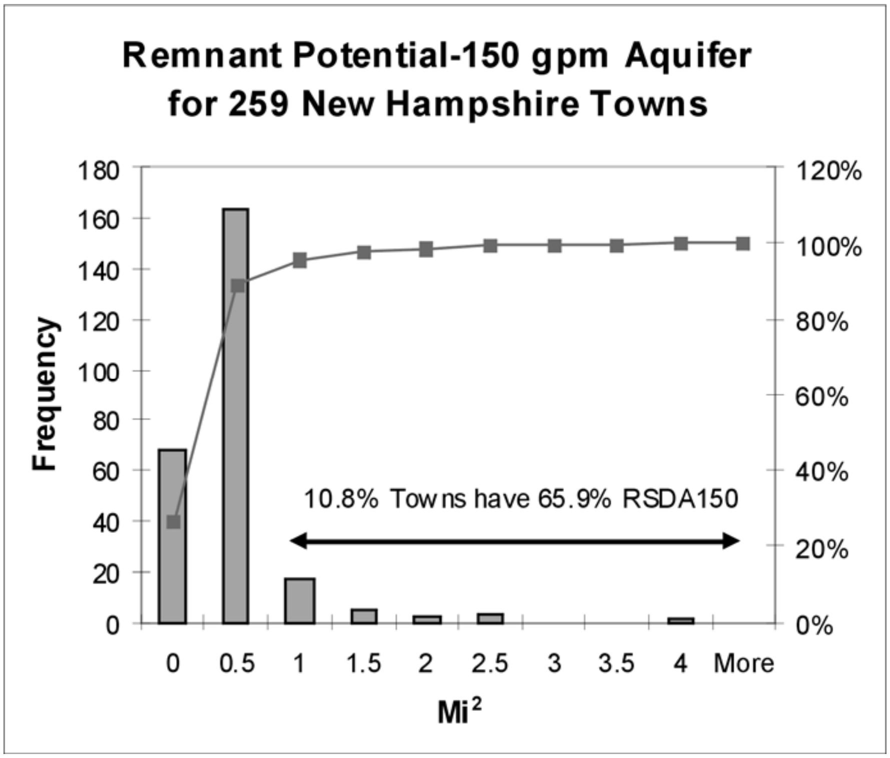

Figure 10. Histogram of remaining area of stratified-drift aquifer with potential to provide a well yield of 150 gpm or greater, in 259 New Hampshire municipalities.

RSDA150 Range (mi^2)	Towns	% Towns	RSDA150 mi^2	RSDA150 %Total
0	68	26.3%	0.0	0.0%
>0-0.001	12	4.6%	3.0E-03	0.0%
>0.001 - 0.5	151	58.3%	16.3	34.2%
>0.5 - 1.5	22	8.5%	17.3	36.4%
>1.5 - 4+	6	2.3%	14.0	29.5%
Total	259	100.0%	47.6	100.0%

Table 15. Tabulated frequency and area of remaining stratified-drift aquifer with potential for a well yield of 150 gpm or greater, for 259 NH towns.

Figure 10 and Table 15 reveal that of NH's 1245 mi^2 of OSDA, only 47.6 mi^2 remains available for a 150 gpm well yield or greater. Just 28 (10.8%) of 259 towns hold 65.9% of this area. Just 6 (2.3%) towns encompass 29.5% of NH RSDA150. Most NH towns retain less than 0.5 mi^2 of RSDA150.

Figure 11 and Figure 12 depict the RSDA75 and RSDA150 distributions by area by town. In both images, it is clear that the Nashua Region, the Saco River Region, and Pittsburg (the northernmost town) have the most remaining stratified drift after the FGW analyses. It should be noted that Pittsburg's OSDA was for the most part, classed as having Unknown Transmissivity. Therefore, Pittsburg's high RSDA75 and RSDA150 quantities are estimates based on yield class occurrence in the rest of the state.

Figure 13 and Figure 14 depict the RSDA75 and RSDA150 distributions in NH, which can be compared with Figure 5. Note that in Figure 13, the RSDA75 distribution is visually overstated, since A) it comprises at most 14.4% of the T=0-2000 ft^2/d class (i.e. the portion belonging to the non-delineated T=1000-2000 ft^2/d sub-region), and B) it integrates, at most, only 26% of T=Unknown. Similarly, in Figure 14, the RSDA150 distribution is visually overstated since it only incorporates at most only 13.6% of the class, T = Unknown.

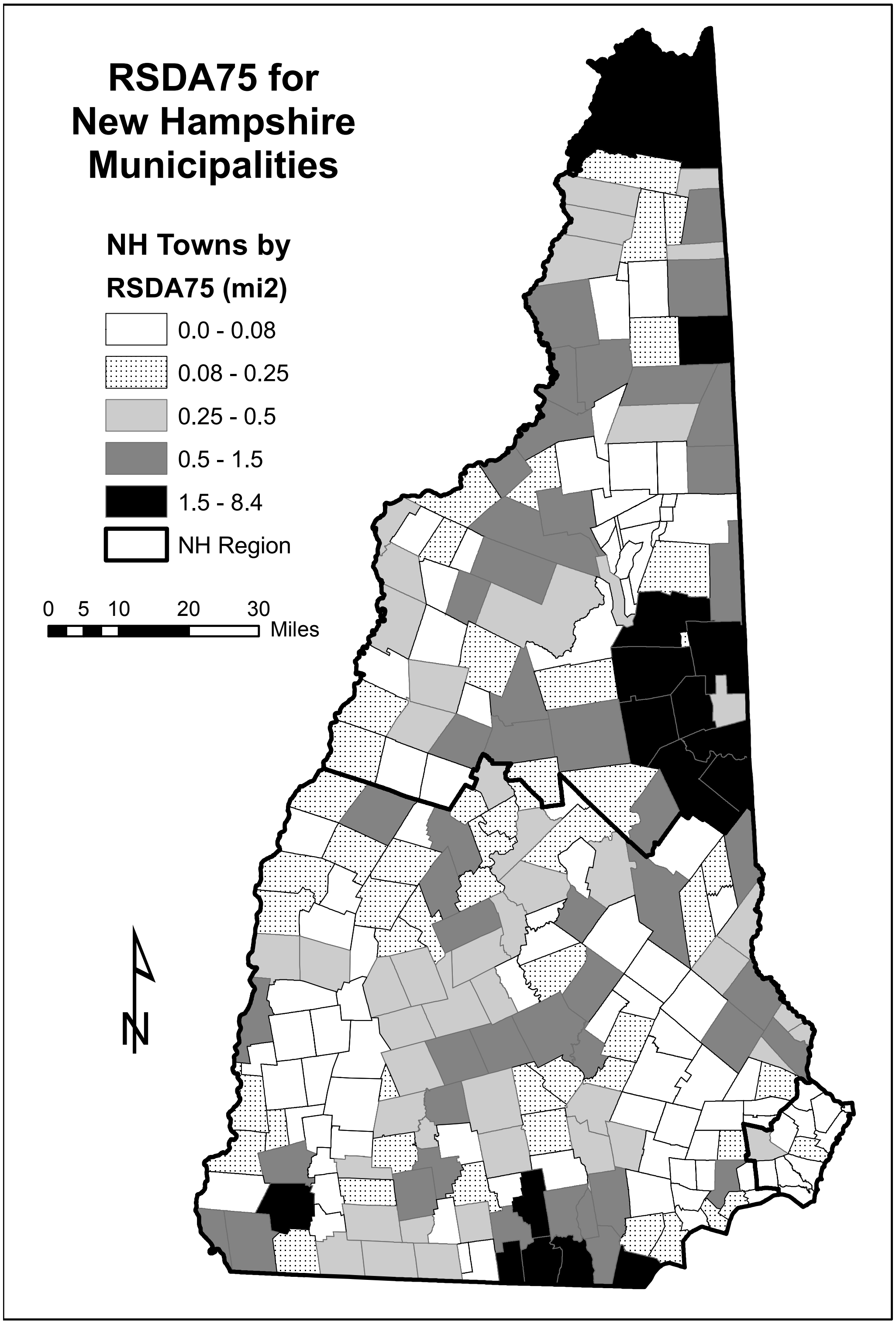

Figure 11. Area of RSDA75 by town. Pittsburg, the northernmost town, contains a large area of the Unknown yield class, which raising its RSDA75 by apportionment. (NHDES, 2003; USGS 1995; GRANIT, 2004)

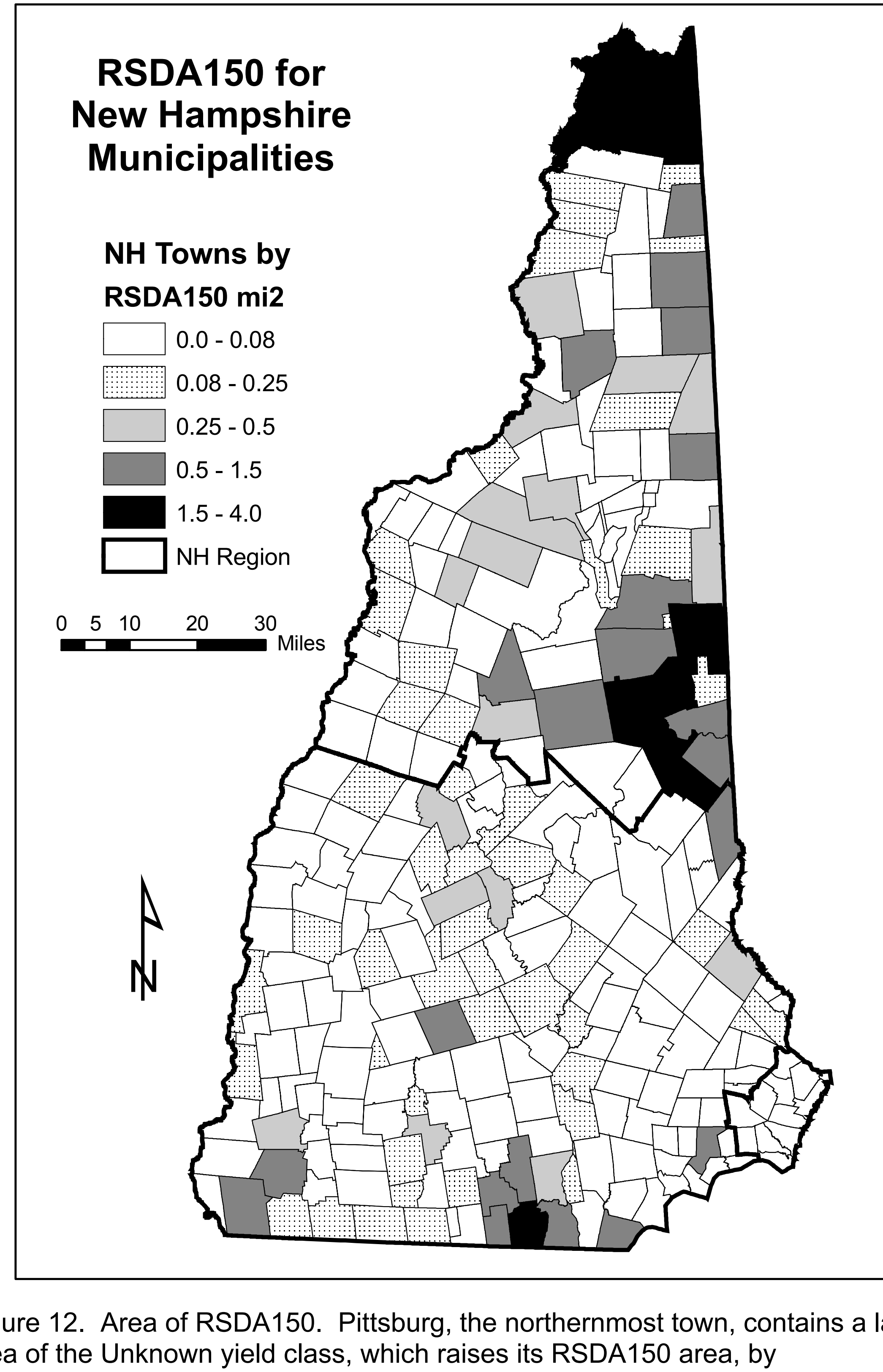

Figure 12. Area of RSDA150. Pittsburg, the northernmost town, contains a large area of the Unknown yield class, which raises its RSDA150 area, by apportionment. (NHDES, 2003; USGS 1995; GRANIT, 2004)

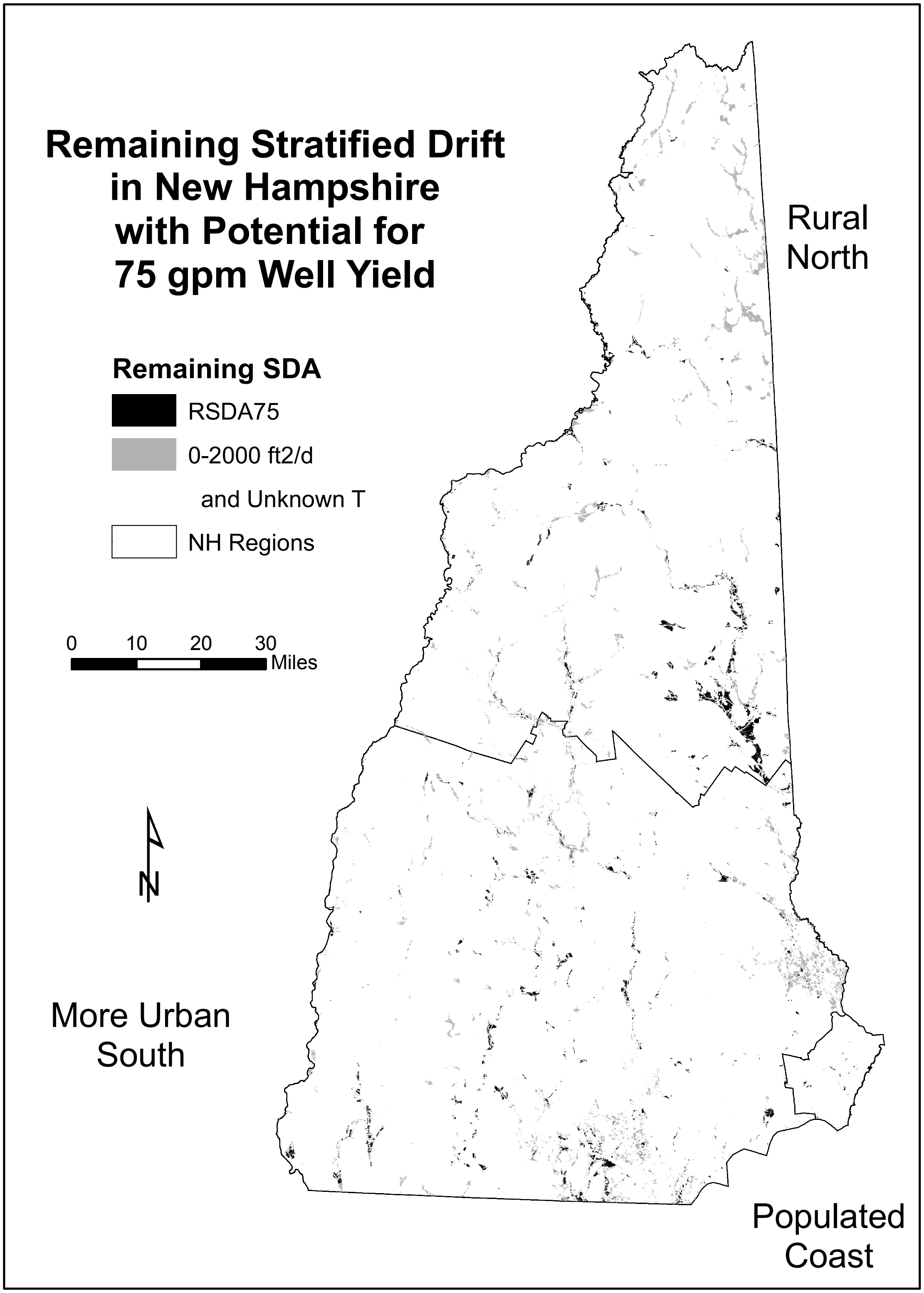

Figure 13. RSDA75 in New Hampshire. Areas in gray (Transmissivity = 0-2000 ft^2/d and Transmissivity = Unknown) visually overstate RSDA75 by 114.1 mi^2 (96.4%), although the statistical analysis is accurate.

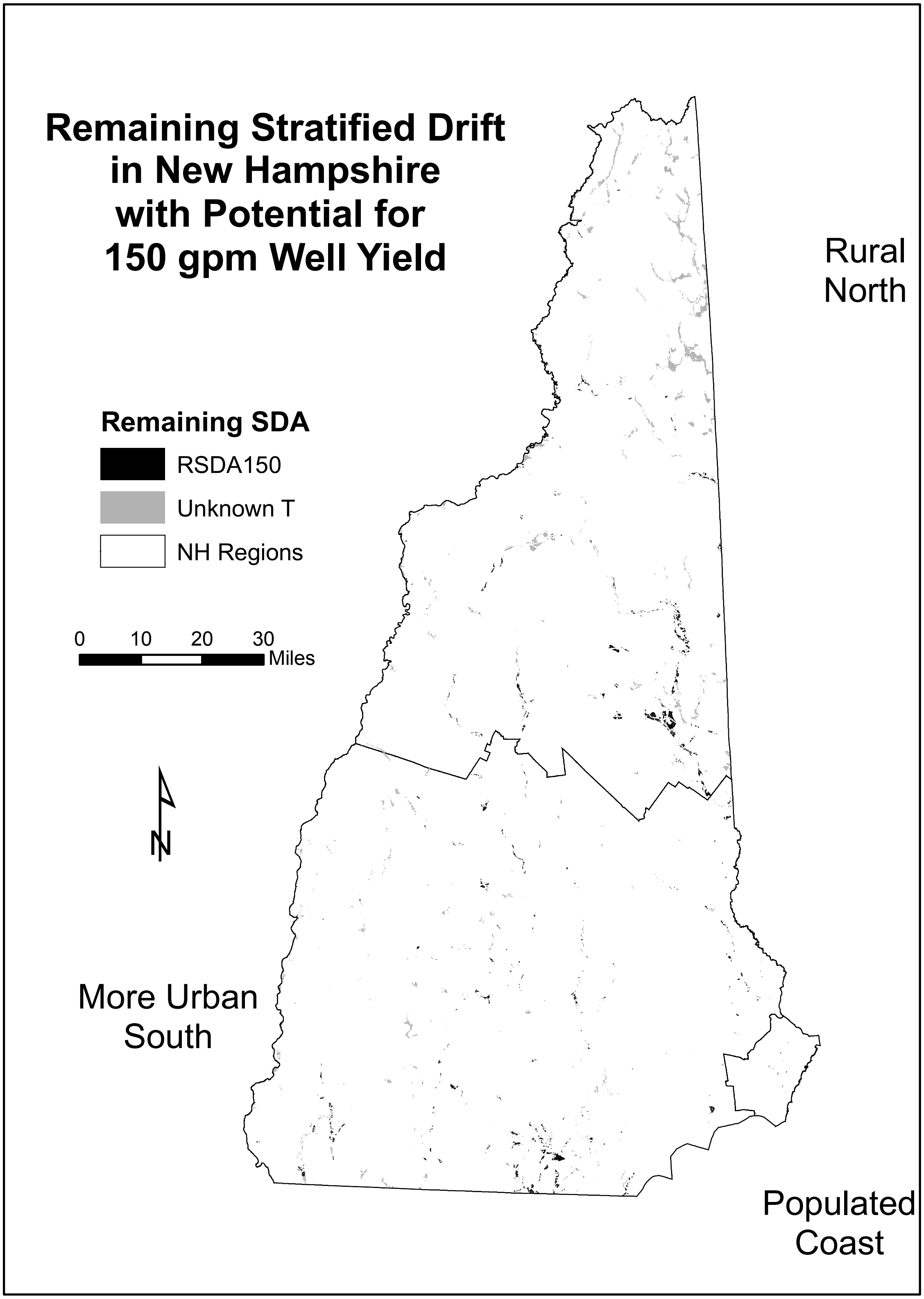

Figure 14. RSDA150 in New Hampshire. Areas in black (Transmissivity = Unknown) visually overstate RSDA150 by 57.1 mi^2 (120.4%).

Chapter I Conclusion

High yield stratified-drift aquifer is a valuable resource in New Hampshire in that it can supply quantities of readily potable water sufficient to be of interest to municipalities. This study focused on preliminary identification of stratified-drift aquifer areas with potential to serve as single, large water-supply wells. Such wells are far more productive than most bedrock wells, usually require less initial capital investment, and have lower operating costs than an equivalent set of smaller wells in lower-yield stratified drift.

In this research, the occurrence of potential and known contamination sites on stratified-drift aquifer was determined to be 57.7%, slightly higher than earlier estimates, but not as high as the hypothesized value. The elimination of duplication in the PKCS data counteracted increases due to the inclusion of intact underground storage tanks and the local source-water hazard inventory in the analysis. However, this research also determined that stratified drift in general, has a density of potential and known contamination sites on average 8.3 times that of upland areas. Furthermore, the highest yielding stratified-drift resources were found to have a density of potential and known contamination sites on average 11.3 times that of upland areas. This clearly demonstrates that stratified-drift water-resources are threatened by development, and the highest yielding stratified-drift areas are particularly threatened.

This research refined a GIS-based method for preliminary identification of higher yield stratified-drift areas likely to remain available after considerations for water quality and water quantity. The tool was applied on a statewide basis to summarize regional variation of these areas. After considerations for water quantity and water quality, only 9.5% and 3.8% of New Hampshire's 1245 mi^2 of stratified drift remained with potential to support a 75+ gpm well or a 150+ gpm well, respectively. This demonstrates unequivocally that stratified drift aquifers, the most productive water resources after surface water, are far more limited in New Hampshire than previously understood.

This limitation is more due to water quantity than water quality criteria. In the 75 gpm and 150 gpm Favorable Gravel Well Analyses, 77% to 87% of the total aquifer area was removed respectively for water quantity considerations.

Frequency analysis reveals that most towns have less than 0.5 mi^2 of either RSDA75 or RSDA150. In both cases, a relatively few towns have most of the remaining aquifer resources. This further emphasizes that remaining available high-yield areas are scarce.

From a state perspective, the greatest opportunities for conservation exist in towns with greater remaining SDA areas. From a regional perspective, the highly populated Coast has almost no higher yield stratified drift remaining available. The more urban South (20% larger and with twice as much OSDA as the North) has slightly less RSDA75 (55.7 mi^2) and RSDA150 (20.0 mi^2) respectively than the rural North (61.9 mi^2 and 27.3 mi^2). Consequently, opportunities for conservation exist in both the North and South, but the opportunities are somewhat greater in the rural North. On the other hand, the need for conservation may be greater in the South, and greatest in the more populated, coast which is relatively poor in high-yield aquifers.

In conclusion, higher-yield stratified drift, unaffected by contamination or other constraints, is far less available in NH than commonly thought, and needs to be conserved to the greatest degree possible in the present, given the growing water national water crisis. Given the scarcity of higher yield RSDA, the likelihood of increased population growth, and the potential for climate change in this century, the author recommends the following:

1) **Further delineation of the SDA yield class C**

   Aquifer yield-class C (yield < 75 gpm) encompasses three-quarters of all stratified drift. Identification of aquifer areas able to support 19–75 gpm wells would allow towns the possibility of greater aquifer conservation. Preliminary regression of the author suggest that 174 mi^2 (14%) NH resides in the 19-37 gpm yield category, and an additional 14%NH OSDA resides in 37-75 gpm yield category. Such sub-areas are especially critical for towns with little or no RSDA75. A caveat, however, is that such areas may be more susceptible to drought.

2) **Further Delineation of the SDA Yield Class U**

   Aquifer-yield class U encompasses about 11% of NH SDA. Given the scarcity of RSDA, NH as a state, could benefit from the delineation of transmissivity in rural areas where it has yet to be done. Conservation opportunities can be enhanced in rural areas, where water demand is lower and water quality issues can be fewer or more restricted in area.

3) **Systemic Identification of NH SDA Resilience to Drought**

   Identification of areas of fractured bedrock aquifer and stratified-drift aquifer that can be expected to have greater resilience to drought due to aquifer characteristics such as large contributing area, aquifer interconnectivity, relatively low anthropogenic demand, or historical low flows. This should be done systemically, and should include consideration of the influence of major water users on the statewide aquifer system.

4) **Update the Source Water Assessment Protection Index**

   The Source Water Protection Program's assessments could be updated to identify water supplies that may have a greater susceptibility to contamination as zones of contribution expand during drought.

5) **Increased Conservation Efforts**

   With the relative scarcity of RSDA75/RSDA150 quantified, the state might consider how to further encourage towns to conserve such areas. Towns with limited RSDA75/RSDA150 have an immediate need for conservation, while towns with larger amounts of RSDA75/RSDA150 have the greatest opportunities for longer term conservation.

CHAPTER II

PROJECTION OF HIGH YIELD STRATIFIED-DRIFT AQUIFER LOSSES IN NEW HAMPSHIRE TO 2025

Introduction

TCHH2 Value and Status of High Yield Stratified-Drift Aquifer

As discussed in the dissertation Introduction, water-supply wells located in stratified-drift aquifers are the most productive of groundwater resources. Their average yields far exceed those of public water-supply wells located in bedrock (USGS, 1995), and consequently, they serve large populations of people. However, these key water resources are very limited in area, and are increasingly constrained in New Hampshire due to mining for construction purposes, human development spreading across them, and their vulnerability to contamination.

The research of Chapter I revealed that as of 2000, 63.4% of high yield stratified-drift aquifers with potential for a 75 gpm or greater well yield had been lost to setbacks, primarily from features related to human development. Furthermore, development pressure on New Hampshire's stratified-drift aquifers is likely to continue over the following 20 years since:

- New Hampshire's population was estimated to have grown by 17.2% between 1990 and 2004, or twice the rate of the remainder of New England (SPNHF, 2005).
- The state's population has been projected to grow 28.4% between 2000-2025 (New Hampshire Office of Energy and Planning (NHOEP), 2004).

These projected populations assumed no significant change in energy prices. They also implicitly assumed no significant growth in population influx resulting from potential climate change.

TCHH2 Research Direction

Given the significant loss of high yield stratified-drift aquifers, and the anticipated continued pressure on these resources, this research investigated the relationship between population and high-yield aquifer loss in New Hampshire, and projected high-yield aquifer loss out to 2025.

Literature Review

This research builds on the prior work documented in Chapter I, which utilized a GIS-overlay analysis to determine remaining NH stratified-drift aquifer with potential to serve as a large municipal water-supply after considerations for water quantity and water quality in 2000.

The prior work utilized GIS datasets produced by the U.S. Geological Survey in cooperation with the state of New Hampshire (USGS, 1995). The project was completed in 1996, and produced both digital and paper maps of saturated-thickness and transmissivity (T), for the stratified-drift aquifers of 13 study areas covering New Hampshire. Aquifer transmissivity was delineated using horizontal hydraulic conductivities estimated from USGS drill logs, and consultant well pumping-test reports, where available (USGS, 1992a; USGS 1995).

The prior effort was, in large part, inspired by 1994 USGS research in Cape Cod to identify areas available for ***future*** use as public water-supply (USGS, 1994a). In that study, the authors, Harris and Steeves, assembled data on the six groundwater-flow cells of the Cape Cod aquifer. Seven criteria (three of which were landuses) were selected for a regionally consistent constraint-analysis to identify remaining potential public water-supply areas: The landuse-based criteria were used to account for: A) regional groundwater-quality conditions resulting from non-point source pollution, and B) state regulations concerning landuse near public water-supplies. Harris and Steeves also allowed for potential saltwater intrusion areas by using modeled hydraulic head contours.

Having assembled or created all necessary data, the authors then overlaid the layers in order of increasing limitation on the potential for public water-supply. In the final analysis, only 5.6% of the total land area of Cape Cod remained available for development as a potential public water-supply. A more complete review of this work is included in the Literature Review of Chapter I

A separate GIS-based study relating to the critical nature of existing and future water supplies in New Hampshire was performed by the Society for the Protection of New Hampshire Forests (SPNHF) in 1997. The effort investigated the necessity of a public water-supply land-conservation program for NH (NHDES, 2000). Derived critical water-supply lands (defined as the water supply source plus its NHDES-determined protection area) were analyzed for existing levels of water-supply protection based on SPNHF data. The greatest protection was considered to be outright ownership of the land, followed by easements, and then by other types of conservation such as private or public natural reserves. Of the critical water-supply lands in NH, only 11.8 percent were found to be protected through ownership or easement (SPNHF, 1998a). A more complete review of this work is included in the Literature Review of Chapter I.

The prior work of the author that formed a foundation for the current research extended the works of Harris and Steeves, and the SPNHF work by incorporating water quantity constraints based on aquifer transmissivity (Lough and Congalton, 2005). Unlike the SPNHF work, it focused purely on stratified-drift aquifers, and allowed for water quality constraints on potential water availability.

In that prior work, OSDA75 and OSDA150 referred to areas of Original Stratified-Drift Aquifer (OSDA) delineated by the USGS as having a transmissivity of at least 1000 ft^2/d or 2000 ft^2/d, respectively. The numeric suffixes indicated that the transmissivities of 1000 ft^2/d and 2000 ft^2/d had been related to ***potential*** well yields of 75 gpm and 150 gpm, respectively, based on a relationship derived from Krasny, 1993. These well yields were intentionally described as ***potential*** since by necessity, the analysis did not account for water budgets, contributing areas, boundary conditions, confining strata or errors resulting from spatial interpolations.

However, the potential well yields allowed determination of the setbacks required (300 or 400 ft) from cultural features, if one were to locate a 75 gpm or 150 gpm water-supply well on OSDA75 or OSDA150 (NHDES, 1995; NHDES, 1999a; NHDES, 199b; NHDES, 2005). These setbacks, plus others for surface water, and for potential or known contamination sites deemed a significant health hazard (e.g. septage sludge lagoons), were spatially overlain to approximate the

OSDA75 and OSDA150 remaining available for future large water-supply wells, as of 2000.

In Chapter I, RSDA75 and RSDA150 respectively referred to the areas of OSDA75 and OSDA150 that remained in a given town after the above analysis for minimum-protective water-quality setbacks had been carried out. In that work, OSDA75 was found to occupy just 3.5% of NH. As of 2000, 63.4% of this potential area for locating a 75 gpm well had been lost due to water quality buffers (OSDA75L). Just 36.6% remained available (RSDA75). OSDA150, a subset of OSDA75, was found to contain just 1.8% of NH area. Of this aquifer subset having potential for at least a 150 gpm well yield, 71.8% had been lost (OSDA150L) as of 2000, leaving 28.2% as RSDA150 (Figure 15). Table 16 contains these details.

While the prior research was valuable, it was limited to quantifying the amounts of aquifer lost, circa 2000. The research documented by this chapter, utilized the prior data on high-yield aquifer losses, on-aquifer populations in 2000, and population projections by town to estimate NH aquifer loss ***over time*** to 2025.

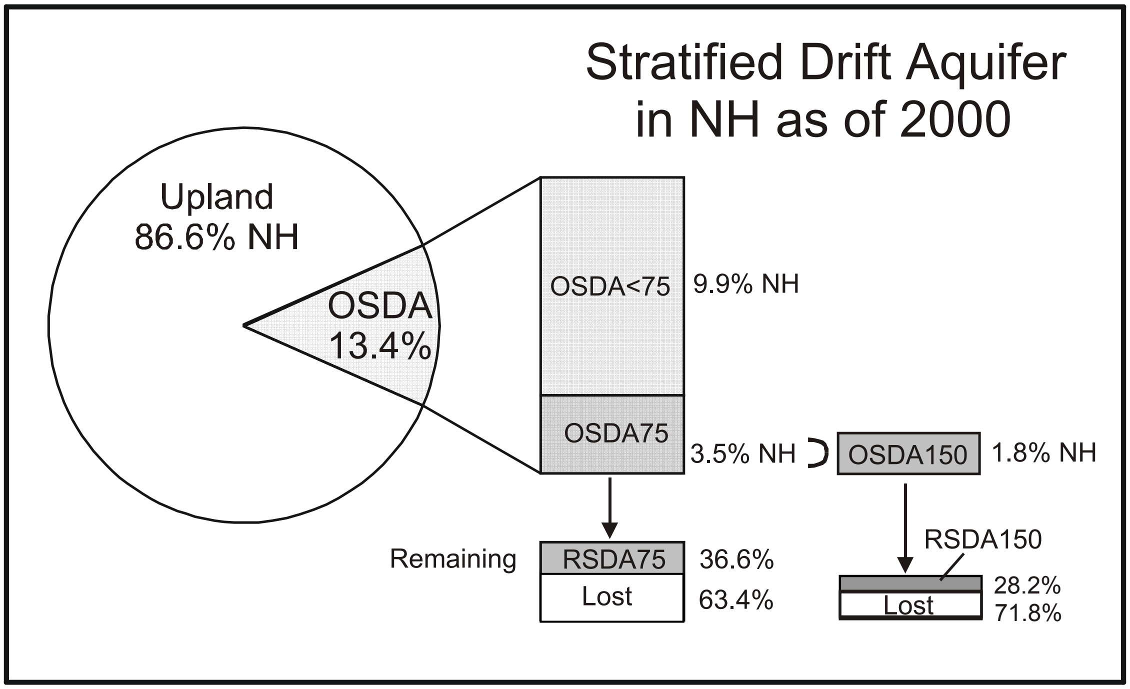

Figure 15. Upland areas, OSDA, OSDA<75, OSDA75, and OSDA150 as a percent of New Hampshire's area. Uplands and OSDA are mutually exclusive. OSDA<75 and OSDA75 are mutually exclusive subsets of OSDA. OSDA150 is a subset of OSDA75. After water quantity and water quality considerations for the year 2000, 63.4% of OSDA75 and 71.8% of OSDA150 had been lost to setbacks. 36.6% OSDA75 and 28.2% OSDA150 remained available for locating potential high yield wells (RSDA75 and RSDA150).

	OSDA75	**OSDA150**
Cultural Feature Setback (ft) Required	300 (75 gpm well)	400 (150 gpm well)
%NH Area	3.5	1.8
Original (mi^2)	323.6	168.7
Lost to Buffers	205.2 (-63.4%)	121.1 (-71.8%)
RSDA75 / RSDA 150	118.4 (36.6%)	47.6 (28.2%)

Table 16. Key characteristics for OSDA75, RSDA75, OSDA150 and RSDA150 in the year 2000 (Lough and Congalton, 2005).

Methods

The specific questions for this research were:

TCHH2 Question 1

How much OSDA75 may be lost to minimum-protective water-quality setbacks from development in NH by 2025?

TCHH2 Question 2

How much OSDA150 may be lost to minimum-protective water-quality setbacks from development in NH by 2025?

The New Hampshire Office of Energy and Planning has projected population out to 2025, for 234 of the state's 259 towns (NHOEP, 2005). By 2025, NHOEP expects that total state population will have grown by 28.4%.

Water-quality related losses of high-yield aquifer in New Hampshire were detailed in the Literature Review Section. These losses primarily resulted from state-required setbacks for cultural features.

Assuming that a relationship exists between population and the on-aquifer losses, and that on-aquifer populations will grow at the predicted state average (28.4% over 25 years), then interpolation suggests that the 63.4% OSDA75 and 71.8% OSDA150 losses of 2000 will grow to 81.1% and 91.9% respectively. Consequently, it was hypothesized that:

H_0: At least 81.1% of OSDA75 in New Hampshire will have been lost to water quality setbacks from development, as of 2025;

and

H_0: At least 91.9% of OSDA150 in New Hampshire will have been lost to water quality setbacks from development, as of 2025.

Method Overview

A key assumption in pursuing this work is that the historical factors affecting development such as energy prices, landuse practices and aquifer protection ordinances were constant in the source data, and will remain constant into the future. This simplifying assumption is necessary given the regional scope of this work, and the limited resolution in time and space of the underlying datasets. For instance, while a GIS layer for 1990 population exists, GIS layers for potential and known contamination sources in 1990 do not.

To address the research questions, populations on OSDA75 and OSDA150 were first quantified by town for 1990 and 2000. These data were coupled with town population projections to 2025 to estimate the on-aquifer populations (OSDA75P and OSDA150P) in 2025, using principal components regression.

Subsequently, OSDA75 and OSDA150 aquifer losses by town as of 2000 were regressed against their respective aquifer areas and on-aquifer populations. The resulting models were then driven by the projected OSDA75 and OSDA150 populations to estimate the aquifer losses by town in 2025 for the 75 gpm and

150 gpm well analyses (OSDA75L and OSDA150L), for four scenarios. The two hypotheses were then evaluated against the statewide summed aquifer-losses of the **most probable scenarios**. Finally, trend statistics regarding the possible impact of aquifer protection ordinances were evaluated, in light of the results of the aquifer loss modeling.

TCHH2 Data Sources

Four Geographic Information System (GIS) data layers were acquired for this research:

- Two 1:100000 U.S. Census Bureau TIGER (Topologically Integrated Geographic Encoding and Referencing) GIS files and associated population data (1990 and 2000). (Digital GIS data are not available for prior US censuses.)
- A 1:24000 transmissivity GIS layer for the state of New Hampshire, assembled from 13 separate study areas, obtained from the USGS.
- A 1:24000 GIS layer for the political boundaries of New Hampshire from the New Hampshire state GIS repository, GRANIT.

In addition, a tabulation of high yield stratified-drift aquifer lost by town in New Hampshire for year 2000 was acquired from prior research by the author (Lough and Congalton, 2005). Specifically, this tabulation listed by each town OSDA75L and OSDA150L which are the areas of OSDA75 and OSDA150 that were lost to considerations for water quantity and water quality, as of 2000.

TCHH3 TIGER Data

The TIGER data spatially delineate populations in New Hampshire to the census block level. A census block is the smallest geographic unit for which the Census Bureau tabulates "100 percent" data, the information collected in the form distributed to all households. Many blocks correspond to individual city blocks bounded by streets. However, blocks, especially in rural areas, can include many square miles, and may have boundaries that are not streets (U.S. Census Bureau, 2006). This variable spatial resolution was accepted for the research at hand as an acknowledged limitation of the dataset.

TCHH4 Tiger Data Preparation

In both the 1990 and 2000 TIGER files, large subsets of rural blocks did not include surface water polygons. Since accurate population densities were required for each census block for population reconstruction after any GIS overlay operation, surface water polygons were acquired from USGS Digital Line Graphs, and overlain onto these census blocks. All original population counts were then assigned to the land area of each original block.

TCHH3 USGS Transmissivity Layer

Transmissivity data covering thirteen separate study areas from the 1984-96 USGS Stratified-Drift Aquifer Studies in New Hampshire were merged into a single GIS polygon layer. Although the 13 study areas did not use identical ranges of transmissivity, the range overlap was such that the dataset could be utilized for the statewide analysis of this study.

TCHH4 USGS Data Preparation

Quality-control checks of the USGS stratified-drift coverages corrected a number of errors, which included:

- Attribute data where aquifer polygon maximum and minimum transmissivity values did not match associated transmissivity range codes.
- Attribute data where aquifer polygon transmissivity-range codes were inconsistent across study areas.
- Study area boundaries that were slightly misaligned in space (e.g. Nashua Region Planning Commission study area).
- Study area boundaries that overlapped (e.g. the Lower Merrimack study area overlapped both the Middle Merrimack and the Lamprey and Nashua Regional Planning Commission study areas).
- Inconsistent treatment of surface water features between two study areas (Nashua Regional Planning Commission and Middle Connecticut) and the remaining 11 study areas.
- Apportionment of overlapping USGS transmissivity ranges into mutually exclusive ranges based on occurrence elsewhere in the state.

TCHH2 GIS Overlay Operations

All GIS operations were carried out in arcGIS 9.0 (ESRI, 2004).

TCHH2 Populations and Stratified-Drift Aquifer

Population density attributes were created and calculated for the 1990 and 2000 US Census TIGER files. These files were then overlain on the statewide transmissivity map, and clipped with the NH political boundary layer (excluding the Isle of Shoals, which has no documented OSDA).

Polygon populations were then recalculated for the derivative GIS layer based on polygon area and the original population density attributes. Polygon attribute data were exported to MS Access for pivot table analysis of population by transmissivity and town. Three study areas (Nashua Regional Planning Commission, the Bellamy, Cocheco and Salmon Falls, and the Pemigiwasset) had Populations residing on polygons of 0-2000 ft^2/d transmissivity. These were apportioned to the ranges (0-1000 and 1000-2000 ft^2/d) based on occurrence in the 10 other study areas in the state.

Five population subsets were calculated for the state, and by town for 1990 and 2000: Uplands, OSDA, OSDA<75, OSDA75, and OSDA150. Populations residing on stratified drift of unknown transmissivity were aggregated within OSDA75 and OSDA150 according to the frequency of populations observed to reside on OSDA75 and OSDA150 elsewhere in the state.

The useful spatial resolution for the derivative GIS layer is 1:100000, the same as the general resolution of the US Census TIGER files. This was sufficient resolution for the purposes of the research at hand since the derivative data was to be aggregated to the town level for modeling, with the final product being a statewide summary of aquifer loss in 2025.

TCHH2 Aquifer Loss as a Function of Aquifer Size + Population

To estimate aquifer loss, model equations developed for the classes of high-yield aquifer losses (OSDA75L and OSDA150L) were based on the general equation:

$$L = c \cdot A^{b_1} \cdot P^{b_2} \qquad \textbf{Equation 2}$$

or

$$L = e^{b_0} \cdot A^{b_1} \cdot P^{b_2} \qquad \textbf{Equation 3}$$

where:

L = area (mi^2) of high-yield aquifer lost by town as of 2000
(i.e. OSDA75L or OSDA150L depending on analysis)

A = area (mi^2) of high-yield aquifer by town (a constant for each town)
(i.e. OSDA75 or OSDA150)

P = population on high-yield aquifer by town (i.e. OSDA75P, OSDA150P)

b_i = powers of the given variables, and of e

C = constant = e^{b0}

The above equations were constructed based on the fact that high-yield aquifer lost by town as of 2000 (L) was well correlated to both aquifer area (A) and on-aquifer population (P). Equation variables eliminated from consideration as model variables due to lower correlation to aquifer losses included aquifer losses by 6 types (e.g. roads, residential/commercial/industrial landuse, potential and known contamination sites) and remaining high-yield stratified drift. Losses due to hydrography could have been modeled as a separate variable, but were relatively small (6-8%), and are incorporated into the constant C of equation 2.

For data preparation, natural log transforms were used to remove positive skewness and normalize both aquifer area (A) and on-aquifer population (P). Of the 234 NH towns for which NHOEP projected populations to 2025, 215 had populations on OSDA75 and 181 had populations residing on OSDA150. In both cases, South Hampton, Piermont and Washington were eliminated visually during normalization as low end population outliers leaving 212 and 178 towns for model development.

These two town sets, encompassed 98.3% of OSDA75, and 93.5% of OSDA150 respectively. Figure 16A, Figure 16B, and Figure 16C depict the thin, 3-dimensional,oval-prism formed by OSDA75 aquifer lost (L), aquifer size (A) and aquifer population in 2000 (P) in natural-log space. Figure 16B (which is Figure 16A rotated to the right) demonstrates that aquifer lost approaches the original aquifer area as a limit. Figure 16C (which is a plan view of Figure 16B) demonstrates that, a strong correlation exists between the desired independent variables of aquifer size and aquifer population. A similar geometry exists for OSDA150 aquifer lost, aquifer area, and aquifer population in 2000. Since GIS data for key data do not exist for 1990, it is not possible to create a comparable 3-dimensional dataset (aquifer-loss/aquifer-size/aquifer-population) for 1990.

To address the inter-dependence of aquifer size and population, principal-components regression was utilized to generate predictive models within The Unscrambler, a data modeling software available from Camo.

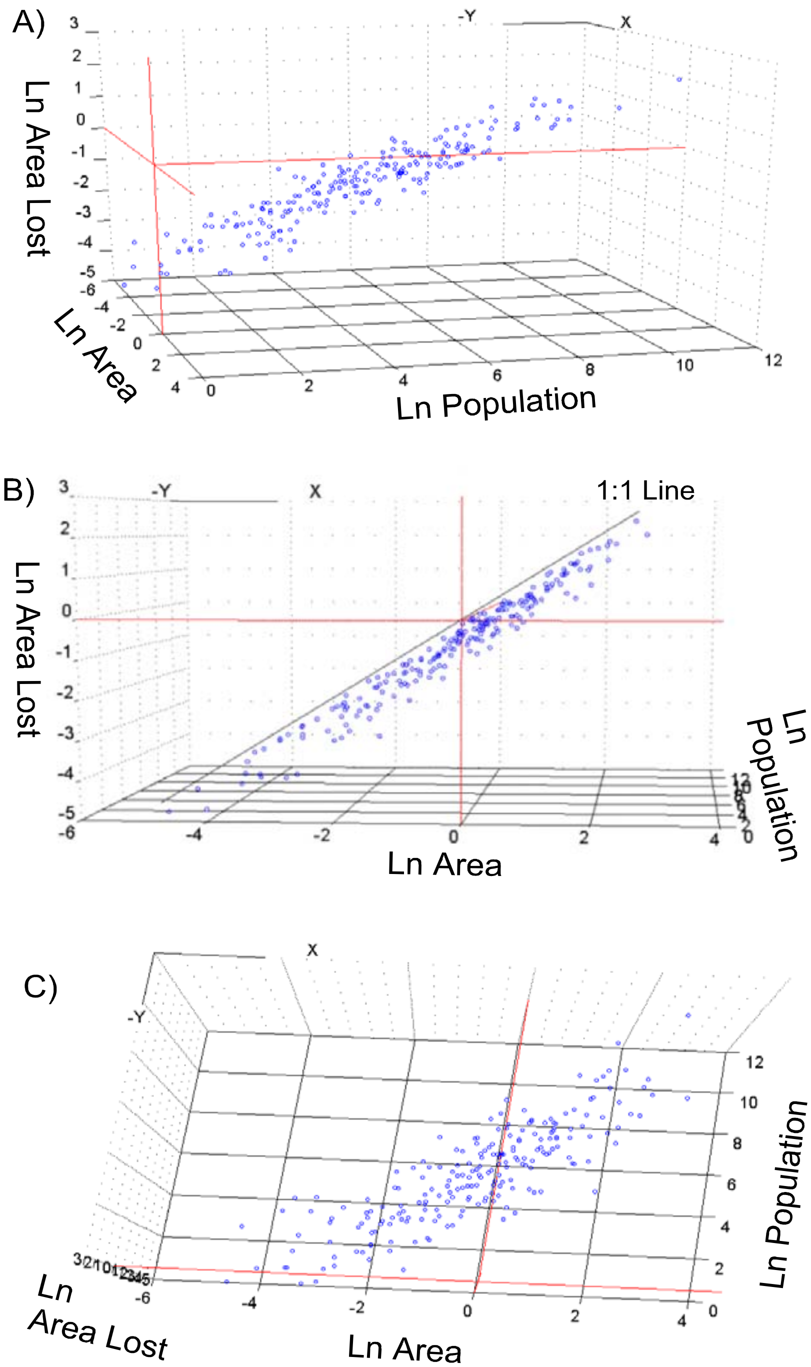

Figure 16. Three perspectives of stratified drift with potential to yield 75 gpm or greater aquifer lost (OSDA75L) by town as of 2000 vs. aquifer area and on-aquifer population. All points are natural-log transformed.

In this, principal-components analysis transformed ln-normalized coordinates for aquifer area and population to new variable coordinates with axes centered on the data cluster, and oriented to capture the maximum variances of the data cluster. In the new coordinate system, the data points were independent, and therefore could be regressed against ln-normalized aquifer losses by standard linear regression. The regression equation was then back-transformed to the original axes for final model calculations in original units (Camo, 2005).

The results of the OSDA75L and OSDA150L models are detailed in Table 17. Comparison of measured to predicted area lost reveals an r^2 of 0.97 for OSDA75L model (Figure 17), and an r^2 of 0.94 for the OSDA150L model.

Characteristic	OSDA75 Model	OSDA150L Model
%NH OSDA75	98.3%	NA
%NH OSDA150	NA	93.5%
C	0.297181	0.356876
B_0	-1.21341	-1.03037
B_1	0.816302	0.832147
B_2	0.148760	0.135459
r^2 : Measured to Predicted	0.97	0.94

Table 17. Characteristics of OSDA75L and OSDA150L aquifer-loss models.

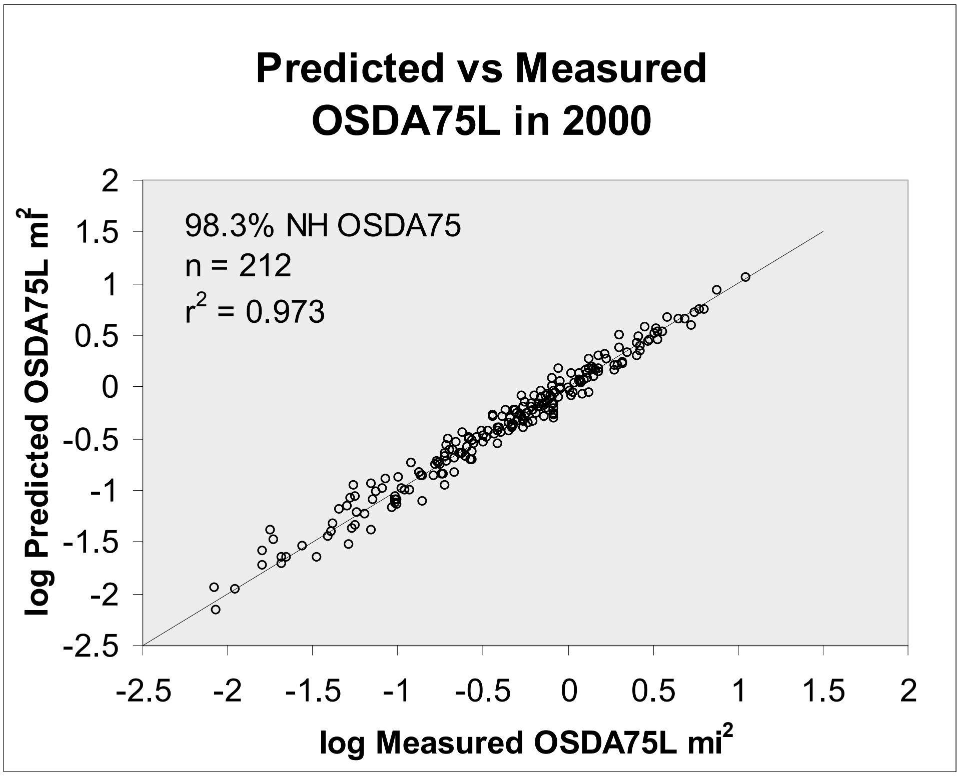

Figure 17. L2000 measured vs. predicted by principal components regression.

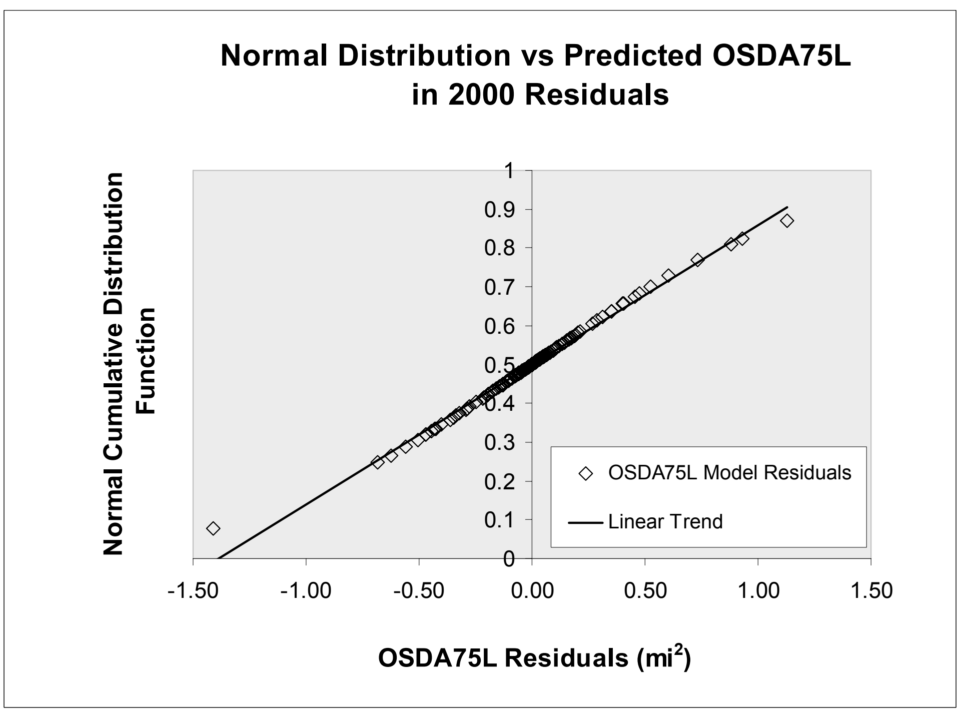

Figure 18. A plot of the residuals for the modeled OSDA75L (mi^2) in 2000 against the normal cumulative distribution function.

Plots of the modeled aquifer-loss residuals against a normal distribution proved a very good fit, implying that the model was relatively unbiased. Figure 18 displays the fit for the OSDA75L residuals for the year 2000 aquifer loss data. The equations were only considered valid on a town aquifer level, in data regions within or close to the regression-source data. Predictive accuracy for the summed losses of the state was expected to be greater than individual town losses, since the regression process seeks to minimize error within a data cluster.

Projected Populations on High-yield aquifer

The New Hampshire Office of Energy and Planning has projected a statewide 28.4% growth in population for 234 of 259 towns between 2000 and 2025. These data were used to project on-aquifer populations out to 2025, in order to drive the two aquifer-loss models. For comparison of results, four on-aquifer population-growth scenarios were developed (improbable, most probable, less probable and least probable), as described below.

Scenario A: Zero Growth of Aquifer Population:

Assumption: All population growth out to 2025 in all towns will occur outside of high-yield aquifer areas. High-yield aquifer populations remain stable to 2025. Given historical population growth on stratified drift, this scenario was deemed **Improbable.**

Scenario B: Below-Mean Growth of Aquifer Population:

Assumption: Population growth occurs in towns, on high-yield aquifers out to 2025, according to the characteristics observed in 1990-2000. This scenario, based on historical data, was deemed as the **Most Probable**.

Scenario C: Above-Mean Growth of Aquifer Population:

Assumption: Population growth occurs in towns, both on high-yield aquifer out to 2025, at a higher than historical growth rate, resulting in on-aquifer population increase for 2025 that is twice that of scenario B over scenario (zero growth) A. Scenario C, based on growth rates above historical data, was deemed **Less Probable**. Such a scenario might be possible if energy prices were to rise sufficiently to significantly reverse the decentralization away from town centers, observed since the 1960's.

Scenario D: Doubling of Aquifer Population:

Assumption: Population growth occurs in towns, both on high-yield aquifer out to 2025, at a far higher than historical growth rate, resulting in a doubling of the on-aquifer population by 2025 over scenario (zero growth) A. Such a scenario might result from extreme growth in energy prices (possibly reversing the decentralization trend mentioned above), and/or a large influx of population from outside the state. Since there is no historical precedent for this circumstance, Scenario D was deemed **Least Probable**.

TCHH3 Aquifer-Loss Estimates

Under each scenario, the projected 2025 town aquifer-losses were calculated as:

$$L_{2025} = \min(\text{measured } L_{2000} + \text{modeled } \Delta L_{(2000\text{-}2025)}, A) \qquad \textbf{Equation 4}$$

where:

L_{2025} = the estimated aquifer loss (mi^2) in 2025 for a given town's high-yield aquifer

L_{2000} = the measured aquifer loss (mi^2) as of 2000 for the given town

$\Delta L_{(2000\text{-}2025)}$ = the difference in modeled aquifer losses (mi^2) for the given town in 2000 and 2025

A = the area (mi^2) of the high-yield aquifer for the given town

The model equations were utilized to calculate incremental rather than absolute aquifer-loss estimates. Restricting the estimated loss to the minimum of (L_{2025}, A) by town ensured that physical reality was met. The estimated town aquifer-losses were summed along with the losses (as measured in 2000) of the few towns that either had no measured populations or were removed during normalization of the model data, to project the potential statewide high-yield aquifer lost under each scenario.

The evaluate the null hypothesis, the hypothesized projected high-yield aquifer loss for 2025 was compared to the amount of high-yield aquifer lost in the state for 2025 as modeled under the most likely circumstance, scenario B. Scenarios A, C and D provided comparative values for general reference.

Results

Population Accuracy

TIGER-derived statewide populations exceeded NHOEP published estimates by 127 and 226 people for the 1990 and 2000 censuses, representing 0.018% and 0.011% difference respectively. Consequently, the population accuracy of the dataset was sufficient for this study. The net differences stemmed from 25 sparsely populated rural areas where NHOEP does not formally track population, but TIGER-file data existed, and from a small population on the Isles of Shoals, which were excluded from the study.

State Populations on Uplands and Stratified Drift

Table 18 details the state population for 1990 and 2000 on upland areas and subsets of stratified drift. It reveals that over the decade, the state population grew 11.4%, while upland areas saw above-average population growth (14.2%), and stratified-drift aquifers experienced below-average population growth (7.7%).

	NH Population Subsets: 1990-2000					
	Total	**Upland**	**OSDA**	**OSDA<75**	**OSDA75**	**OSDA150**
2000 Census	1,235,777	732,380	503,397	362,118	141,279	87,660
1990 Census	1,109,244	641,218	468,026	337,621	130,405	80,840
Pop. Growth	126,533	91,162	35,371	24,497	10,874	6,820
%Change	11.4%	14.2%	7.7%	7.3%	8.3%	8.4%

Table 18. Growth for population subsets in New Hampshire between 1990 and 2000, as derived from US Census TIGER files. Upland population growth was almost twice as great as on-aquifer. Growth was greater on high yield areas than on low yield areas. Note: OSDA<75 and OSDA75 are mutually exclusive, while OSDA150 is a subset of OSDA75.

Consequently, while the total stratified-drift aquifer population grew by more than 35,000 people, the subset declined as a percent of the state population. Such a decline corresponds to the decentralization (population growth away from traditional town centers) observed by the New Hampshire Office of Energy and Planning since 1960 (NHOEP, 2004). The 14.2% growth in upland populations reflects this.

Table 18 also reveals that OSDA75 and OSDA150 experienced somewhat higher growth (8.3% and 8.4%) than lower yield SDA (OSDA<75, 7.3% growth).

		NH Population Subsets: 1990-2000 as %State				
	People	**Upland**	**OSDA**	**OSDA<75**	**OSDA75**	**OSDA150**
2000 Census	1,235,777	59.3%	40.7%	29.3%	11.4%	7.1%
1990 Census	1,109,244	57.8%	42.2%	30.4%	11.7%	7.3%
Difference	126,533	1.45	-1.45	-1.13	-0.33	-0.19
%NH Area	100%	85.6%	13.4%	9.9%	3.5%	1.8%

Table 19. Population subsets for New Hampshire between 1990 and 2000, expressed as a percentage of the state's total population, compared to occupied area. 40.7% of New Hampshire's population resided on stratified-drift aquifer, which occupies just 13.4% of New Hampshire's area. Note: OSDA<75 and OSDA75 are mutually exclusive, while OSDA150 is a subset of OSDA75.

Table 19 details the aquifer populations as percentages. These data revealed that, in 2000, fully 40.7% of New Hampshire's population resided on stratified-drift aquifer, which occupies just 13.4% of New Hampshire's area. This was in line with the prior observation that 57.7% of all potential and known contamination sites in New Hampshire existed on stratified drift in 2000 (Lough and Congalton, 2005) since development includes both human residency and places of occupation.

Table 20 reveals that despite having significantly lower-than-average relative-population-growth, stratified-drift aquifers have experienced higher than average changes in absolute population density. High-yield areas (OSDA75) experienced changes in population density three times that of upland areas and 2.5 times greater than the state average. The highest yielding areas (OSDA150) experienced the greatest absolute change, almost three times that of the state as a whole.

	Total Population Density					
	State	Upland	OSDA	OSDA<75	OSDA75	OSDA150
2000 Population Density (p/mi^2)	133.1	91.1	44.3	393.0	436.7	494.4
1990 Population Density (p/mi^2)	119.5	79.8	375.9	366.4	403.1	456.0
Change in Density (p/mi^2)	13.6	11.3	28.4	26.6	33.6	38.5
Annual %Change	1.14%	1.42%	0.76%	0.73%	0.83%	0.84%

Table 20. Change in population density by aquifer subset.

Table 20 also reveals that while stratified-drift aquifers dominate the absolute changes in population density, they are subordinate to uplands in annual percent rate of change in population density. This latter variable is equivalent to the percent change observed in the population subsets of Table 18.

In summary, while stratified-drift aquifers have shown population growth well below that of the state, about half that of upland areas; population densities on stratified drift were significantly greater than the state average, especially on higher yield stratified drift.

The Influence of Aquifer Protection Ordinances

Table 21 details characteristic statistics for towns understood to have aquifer protection as of 2006. 75 towns having high-yield aquifer, were identified from separate lists acquired from NHDES and NHOEP as having aquifer protection in place. This left 137 towns (of the 212 modeled towns) identified by default, as likely not having aquifer ordinances in place.

	Status	OSDA Pop. 2000	OSDA Pop. Δ1990	OSDA75 mi^2	OSDA75 Towns	Mean OSDA75 mi^2	OSDA75P Density (p/mi2) 2000	OSDA75P Density (p/mi2) %Δ1990	OSDA75 Lost by 2000	Lost Per Capita by 2000
Modeled Towns	Prot	87,122	7,635	149.0	75	1.99	585	9.6	98.7	0.0011
	UnProt	54,135	3,227	168.6	137	1.23	321	6.3	105.2	0.0019
T-Test Subsets	Pro	15976	1038	51.3	37	1.39	311	6.9	33.0	0.0021
	UnProt	14680	674	50.4	37	1.36	291	4.8	33.7	0.0023

Table 21. Key statistics for the protected and unprotected subsets of the 212 NH modeled towns, which together encompass 98.2% and 99.9% of all OSDA75 and the OSDA75 population in New Hampshire in 2000. The lower rows contain the statistics for the 37 protected/unprotected pairs used to calculate a T-statistic.

Table 21 reveals that compared to the 137 unprotected aquifer towns, the 75 protected-aquifer towns had 1.6 times the OSDA75 population, and 1.8 times the 1990-2000 population growth, despite having, about 12% (20 mi^2) less OSDA75 area. The 75 protected towns had a net per-capita loss of OSDA75 about half that of the unprotected towns. This suggests that aquifer ordinances may have protected stratified-drift aquifers, since we would expect them to see lower incremental OSDA75 losses per person due to increased restrictions on hazardous business/commercial landuses and due to restrictions on the amount of impermeable area. To calculate a T-statistic, 37 pairs of protected/unprotected-aquifer towns with the least (below-average) distance between them in log space (Log OSDA75, OSDA75P) were identified. This resulted in protected/unprotected town pairs that were most alike in area and population. A heteroscedastic T-Test of log-normalized per capita OSDA75-losses revealed a 57% likelihood that the protected and unprotected OSDA75 losses per capita as of 2000 were drawn from the same population. Consequently, it cannot be stated conclusively here that aquifer protection has reduced the amount of high yield aquifer losses occurring with population growth.

Scenarios for Stratified-Drift Aquifer Populations in 2025

Table 22 details year 2025 populations, the 2025 percent of the state population, and the percent change in population for OSDA75 and OSDA150, by scenario.

	2000-2025 Population Growth Scenarios	2025 Population	%NH Pop.	%ΔPop.	Description of Growth
OSDA75	A: Improbable	141,279	8.9	0.0	Zero
	B: Most Probable	168,175	10.6	19.1	**Below Average**
	C: Less Probable	193,586	12.3	38.2	Above Average
	D: Least Probable	282,558	17.8	100.0	Double Pop
OSDA150	A: Improbable	87,660	5.5	0.0	Zero
	B: Most Probable	104,839	6.7	19.6	**Below Average**
	C: Less Probable	122,018	7.7	39.2	Above Average
	D: Least Probable	175,320	11.1	100.0	Double Pop
	State Population	**1,586,300**	**100%**	**28.4%**	**Average**

Table 22. Projected Populations for 2025 and the percent growth from year 2000. Scenario B was based on historical population behavior 1990-2000.

Projected 2025 Aquifer Loss As %OSDA by Scenario				
Population Scenario	**2025 %OSDA75L**	Δ2000	**2025 %OSDA150L**	Δ2000
A: Improbable	63.4	0.0	71.8	0.0
B: Most Probable	65.6	2.2	74.2	2.4
C: Less Probable	67.0	3.6	75.7	3.9
D: Least Probable	70.6	7.2	79.2	7.4
Hypothesized	81.1	17.7	91.9	19.8

Table 23. Projected aquifer losses in 2025 under 3 population growth scenarios, and hypothesized loss based on interpolation of population to aquifer-lost ratios.
Table 23 summarizes the results of applying the aquifer loss equation to the three population growth scenarios for OSDA75 and OSDA150. Under **Scenario A (Improbable)**, no further population growth on high-yield aquifer was postulated, resulting in no further aquifer loss between 2000 and 2025. Under **Scenario C (Less Probable)**, on-aquifer populations grew at rates higher than the state average population growth, resulting in 67.0% and 75.7% net losses of OSDA75 and OSDA150 respectively by 2025, or incremental losses of an additional 3.6 and 3.9 percentage points respectively. Under **Scenario D (Least Probable)**, on-aquifer populations grew at rate 3.5 times that of state average population growth, resulting in a doubling of on-aquifer populations by 2025. Statewide losses of OSDA75 and OSDA150 grew to 70.6% and 79.2% by 2025. Incremental losses were an additional 7.2 and 7.4 percentage points respectively. Under **Scenario B, (Most Probable)**, predicted total OSDA75 and OSDA150 losses grew to 65.6% and 74.2%, respectively by 2025. These results were ***far less*** than the hypothesized 81.1% and 91.9%, respectively. Under the acceptance conditions laid out in the Methods section, both research hypotheses were rejected.

Discussion

The modeled incremental aquifer-losses of 2.2 and 2.4 percentage points for OSDA75 and OSDA150 respectively, are far lower than hypothesized, given the projected 28.4% state population growth for 2025. The hypothesized aquifer losses were based on linear interpolation relative to the projected state population growth. The models reveal that a highly nonlinear relationship exists, and the following sections explore the causative factors.

Relationship of State and On-Aquifer Populations

The hypotheses assumed that on-aquifer populations would grow at a rate similar to that for the state as a whole. However, Table 1 reveals that between 1990 and 2000, the actual OSDA75 population grew 8.3%, a rate approximately one quarter less than that of the state population as a whole (11.4%). While the lower growth rate certainly contributed to low modeled aquifer losses, the observation is disproportionate to their very low magnitude. Furthermore, the low growth rate cannot explain the extremely low aquifer losses of Scenario C, which was based on above-average on-aquifer population growth rates.

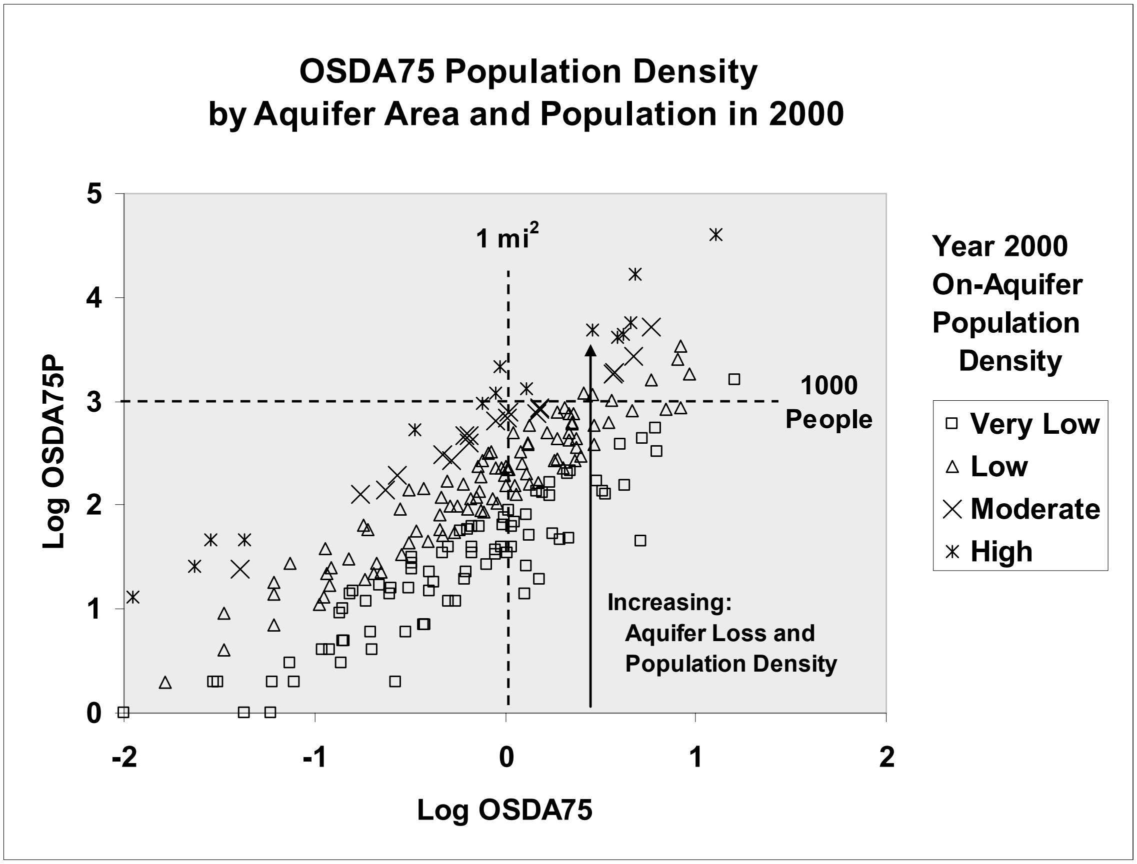

Figure 19. Aquifer development for OSDA75, and the line of theoretical maximum loss, for 212 NH towns (98.3% of the state's OSDA75).

Aquifer Development

Figure 19 depicts aquifer-development over time for OSDA75, and the theoretical maximum loss, derived from equation 2. As each town has a fixed amount of OSDA75 aquifer, a given town's aquifer progresses parallel to the vertical axis as population grows, and population density increases. Consequently, aquifer losses increase as the amount of developed lands increase.

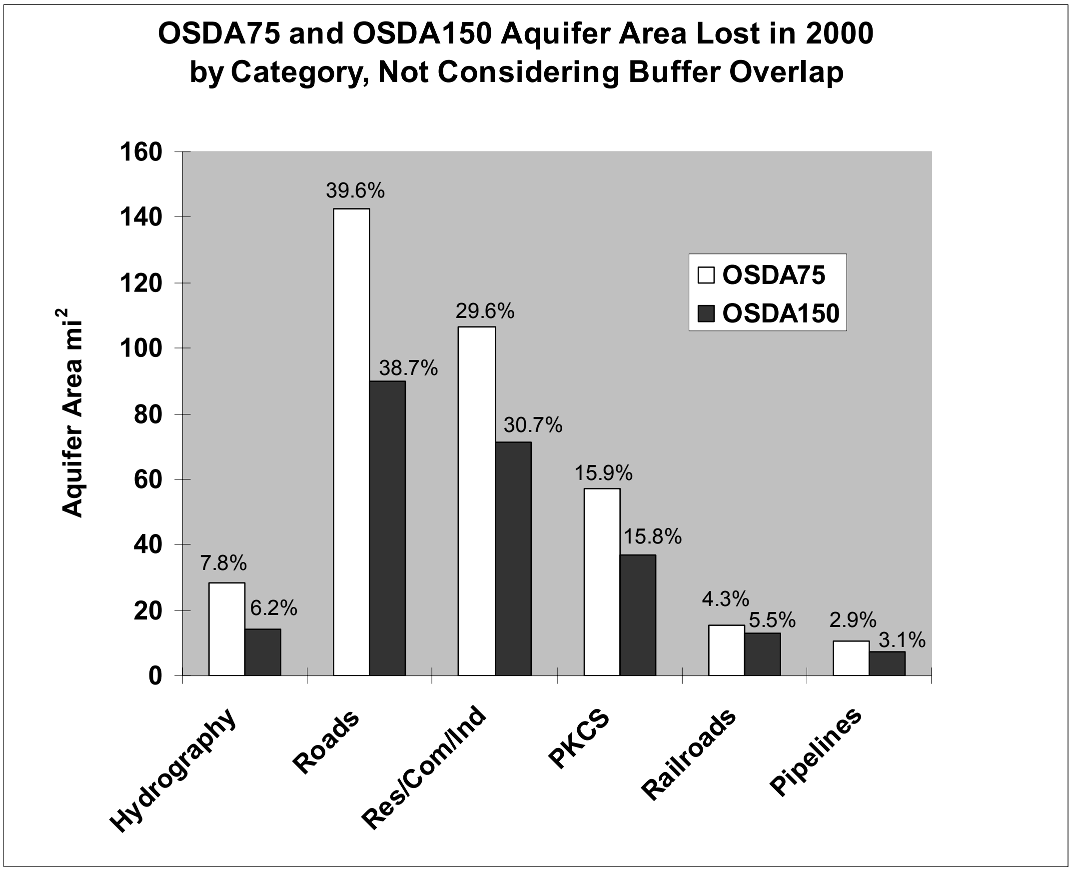

Figure 20. Potential OSDA75L and OSDA150L (aquifer area lost) as of 2000, by category, if buffer overlap is not considered. (PKCS = Potential/Known contamination. Res/Com/Ind = residential/commercial/industrial).

Buffer Overlap

Buffer overlap refers to the coinciding of setbacks for different features (e.g. buildings and roads) over the same spatial area. For this study, ***potential*** buffered area lost refers to aquifer area that would be lost if overlap were not considered. ***Actual*** buffered area lost refers to the aquifer area lost when overlap is considered. Figure 20 depicts the potential buffered area lost for OSDA75 and OSDA150 by six categories of landuse. By far the greatest aquifer losses result from road construction, followed by residential/commercial/industrial development, and potential and known contamination sites.

In terms of aquifer development, 6-8% area losses to 50 ft setbacks required for surface water buffers pre-exist any development losses. Initial population settlement then creates roads that have large (300-400 ft) buffers to each side of the road's right-of-way on the aquifer. Further residential, commercial and industrial development commonly takes place within the existing 650-850 ft corridor of road-buffered area, creating a large amount of buffer overlap.

Further potential and known contamination sites occur primarily within the commercial and industrial areas, creating yet further overlap. Minor amounts of further overlap results from railway lines and pipelines.

	OSDA75 Lost (300 ft Buffer)	**OSDA150 Lost (400 ft Buffer)**
Potential mi^2	360.4	232.6
Actual mi^2	205.4	121.2
Actual/Potential	57.0%	52.1%
Overlap	**43.0%**	**47.9%**

Table 24. Potential and actual OSDA75/OSDA150 area lost by 2000, and overlap percentages. Potential area lost is the sum of all buffers, if overlap is ignored.

Table 24 compares actual to potential aquifer losses in 2000. It reveals that the 75 gpm (300 ft cultural buffer) and 150 gpm (400 ft cultural buffer) analyses had 43.0% and 47.9% buffer overlap, respectively.

Figure 21 classifies NH OSDA75 aquifers on a town level as having high or low buffer overlap in the year 2000 analysis. The high/low overlap threshold was set to the observed average, a ratio of 0.57, of actual to potential aquifer lost. The graphic reveals that while high buffer overlap can occur at any size of aquifer, in general, moderate to large-sized, higher population-density aquifers (see Figure 19 for comparison) more frequently have high buffer overlap. This indicates that, as one would expect, more densely populated areas have greater buffer overlap, and are likely to have lower aquifer-loss per capita with population influx.

Aquifer Fragmentation

Aquifer fragmentation refers to the polygon density (polygons/mi^2) of RSDA75 or RSDA150 after the spatial overlay analysis.

In Figure 22, a high/low fragmentation-index threshold was set to 112 fragments RSDA75/mi^2. The threshold was determined visually to optimize the high/low subset contrast. The graphic reveals that, in general, smaller aquifers more frequently have high fragmentation of RSDA75. Such fragmentation will likely increase the difficulty of locating a high-quality, high yield well in these areas. Conversely, the lower frequency of high fragmentation in large aquifers should correlate to generally decreased difficulty of locating a high yield well in these areas.

Finally, Figure 22, when compared to Figure 19, reveals that smaller aquifers of both high and low population density can have high fragmentation, reflecting a greater vulnerability to population changes.

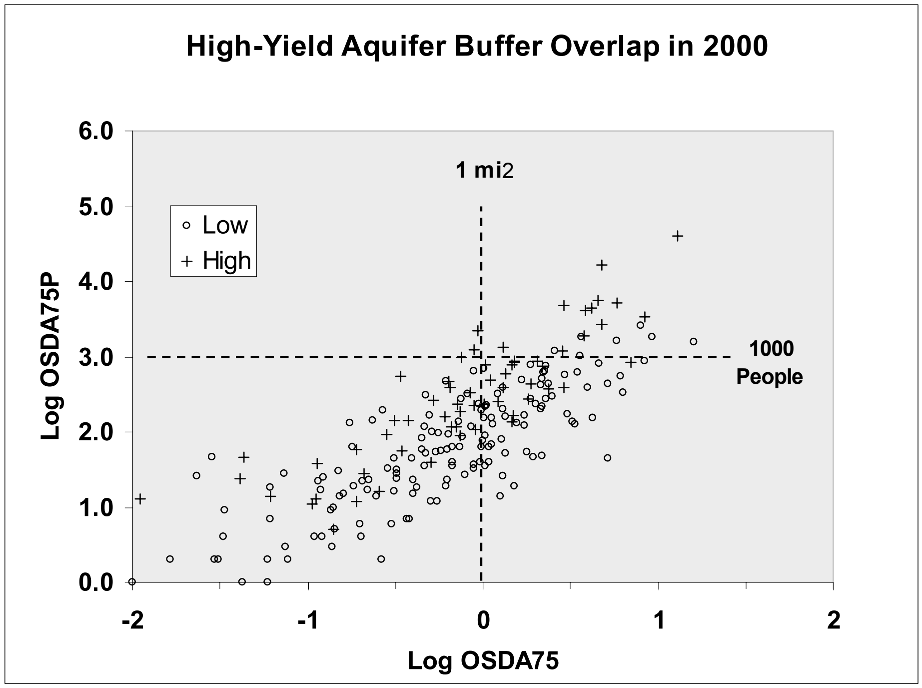

Figure 21. Relative OSDA75 buffer overlap as of 2000.

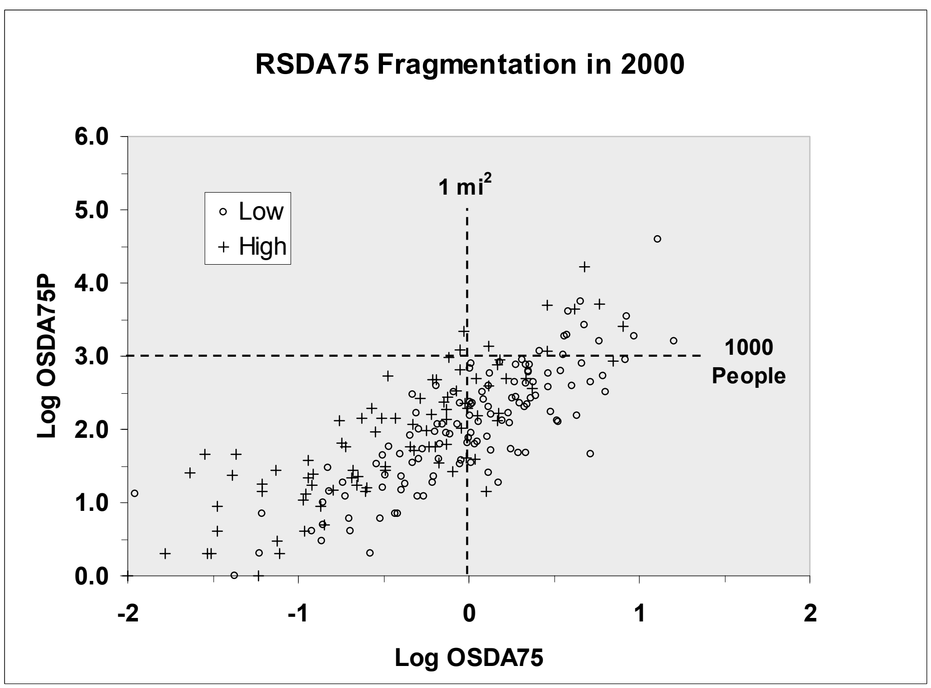

Figure 22. Fragmentation of OSDA75 aquifers as of 2000. The high/low threshold = 112 fragments RSDA75/mi^2. Aquifers with higher population densities (see Figure 19) in general have higher fragmentation of RSDA75.

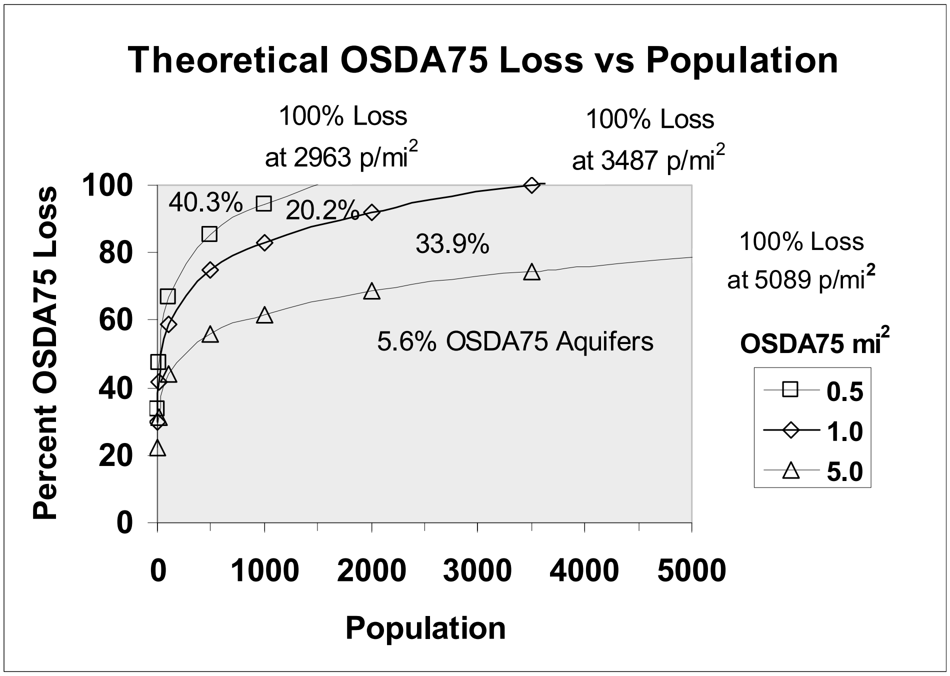

Figure 23. Theoretical %OSDA75 loss versus aquifer population. The percentages of OSDA75 aquifers are indicated between the plotted class lines. The theoretical density of 100% loss is indicated at the end of each line.

Aquifer Response to Population Increase

Figure 23 depicts theoretical OSDA75-loss curves (based on Equation 2 and Table 2) in response to population growth for towns with OSDA75 aquifers of 0.5, 1.0 and 5.0 mi^2. Also indicated are the percentages of the 212 studied OSDA75 aquifers bracketed by these areas, and the population densities of 100% loss. The figure demonstrates that relatively small changes in on-aquifer population can rapidly drive the 120 NH towns having 0.5 mi^2 or less of OSDA75 towards 100% loss. Towns with higher quantities of OSDA75 have much lower aquifer losses in response to equivalent changes in population, and they achieve theoretical 100% loss at much higher population densities. This implies that larger aquifers historically have accommodated greater population densities.

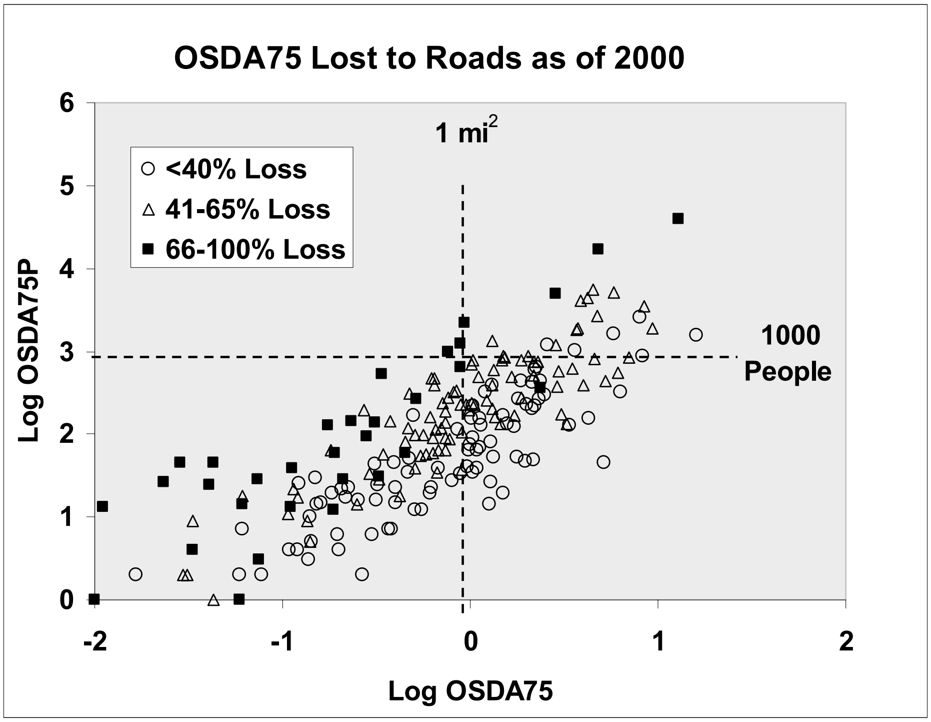

Figure 24. OSDA75 lost to road buffers in 2000 by aquifer size and population.

High Aquifer Losses in Early Development

For the 40.3% of the 212 studied OSDA75 aquifers that were less than or equal to 0.5 mi^2, Figure 23 also reveals that high aquifer losses exist in early development, including 6-8% for pre-existing surface water buffers. Further large losses stem from buffer corridors tied to road construction for initial populations. Smaller OSDA75 aquifers are particularly vulnerable to losses from road construction for either on-aquifer or off-aquifer populations (Figure 24).

While high early losses are also likely the case for larger aquifers, their relative magnitude cannot be accurately represented in Figure 23, since Figure 19 reveals that there were no source data for the aquifer loss models in that region.

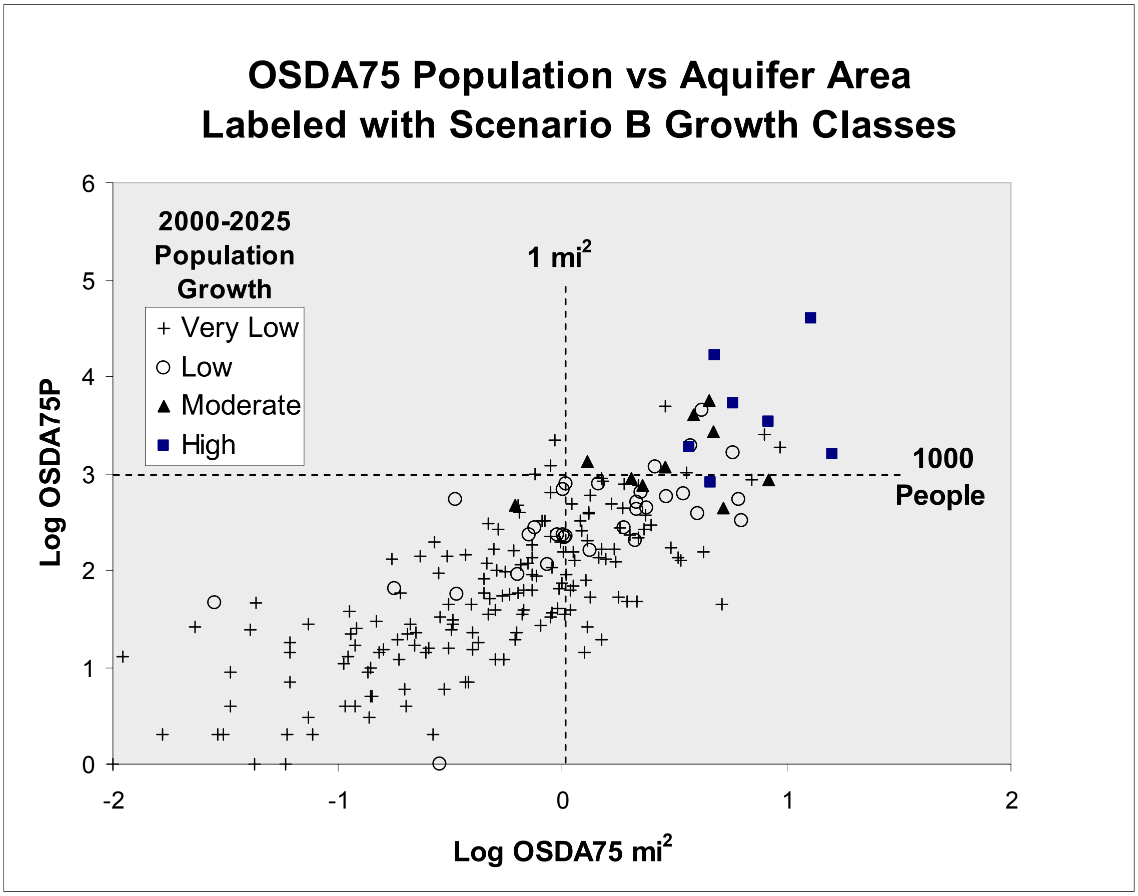

Figure 25. Town OSDA75P growth classes for 2000-2025, under Scenario B versus aquifer size and aquifer population in 2000.

Location of On-Aquifer Population Growth

Figure 25 depicts town OSDA75P growth classes for 2000-2025 against aquifer size and population in 2000. Seventeen large-aquifer towns (mean OSDA75 = 5.4 mi^2), and having moderate to high projected population growth, encompass 2/3 of the total projected 25 year on-high-yield aquifer growth. Consequently, most of the population growth was projected to occur on large aquifers that historically accommodated higher population densities with lower aquifer losses.

Projected RSDA75 in 2025

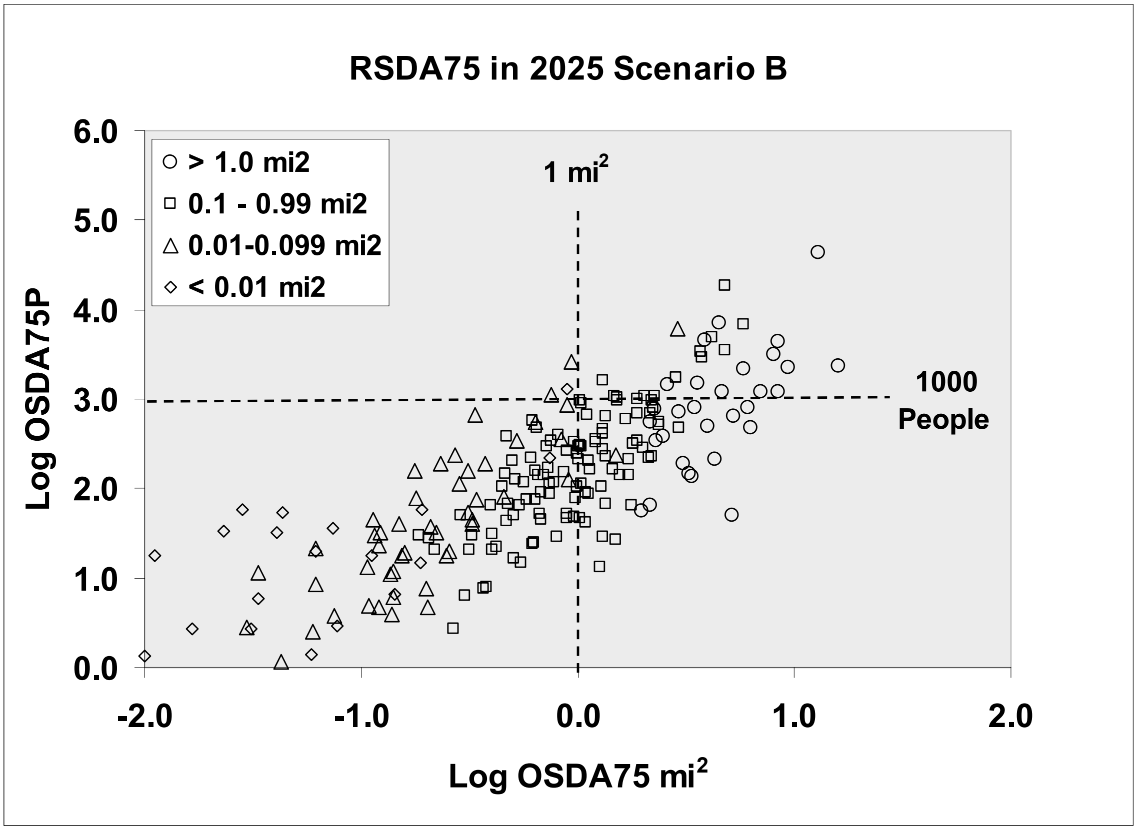

Figure 26. Projected remaining stratified-drift aquifer in 2025 for 212 towns in New Hampshire.

Figure 26 depicts the projected remaining stratified-drift aquifer in 2025 for the 212 modeled towns in New Hampshire. Generally speaking, larger aquifers tend to have larger quantities of RSDA75, although exceptions exist. For example, Portsmouth and Newington, located on the coast, stand out as having moderate quantities of OSDA75 and very little anticipated RSDA75 for 2025.

As mentioned in the Results section, Table 21 (Results) suggests that aquifer protection ordinances may have reduced the amount of OSDA75 lost per capita in those towns. However, a student's T-statistic, could not definitively conclude that the protected and unprotected OSDA75-aquifer-losses-per-capita were from different populations.

Furthermore, while the data preparation for the T-Test attempted to control area and population differences, the methodology did not address the impact of different types of aquifer protection, ordinance stringency, or the date implemented. Differences in population and the spatial area of protection would also have to be accounted for. Perhaps more importantly, Table 21 reveals that the protected aquifers were, in general, large aquifers, with high population densities. The aquifer-loss modeling study revealed that such aquifers have an enhanced ability to absorb population growth with a lower per capita aquifer loss. Consequently, it is inappropriate to draw any conclusions on the impact of aquifer protection, from the readily available data used in this study.

Chapter II Conclusion

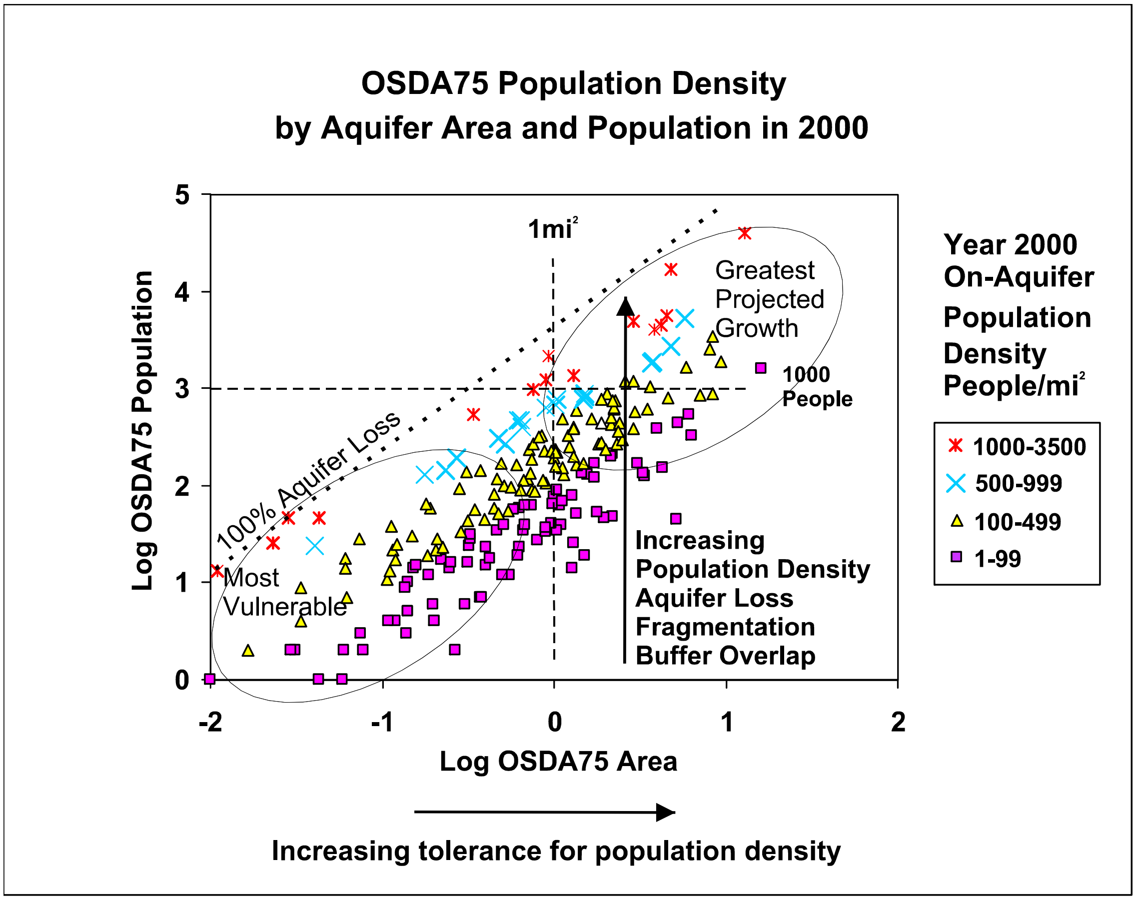

Figure 27. The status of OSDA75 as of 2000 for 212 towns in NH, representing 98.3 % of the state's aquifer with potential to yield 75 gpm.

Figure 27 summarizes the situation for 212 the studied town OSDA75 aquifers. As development occurs, population density, fragmentation and buffer overlap increase, resulting in higher aquifer losses. Smaller aquifers are more vulnerable to high early development-related losses. In general, larger aquifers experience lower fragmentation and higher buffer overlap rates. In addition, larger aquifers have historically accommodated higher population densities with lower per capita aquifer loss. Since the projected population growth was the greatest on larger aquifers, and since on-aquifer population growth has historically been ½ that of upland growth, the projected aquifer losses for 2025 were extremely low.

Prior work revealed that 63.4% and 71.8% of NH's stratified-drift aquifers with potential to yield at least 75 gpm and 150 gpm, respectively, was no longer available for locating such wells after minimum regulatory setbacks for water quality were considered. Given such a significant loss of water resources, this study has projected future high-yield aquifer losses as a function of population out to 2025, when state's population is expected to have grown 28.4%.

Preliminary analysis revealed that as of 2000, 40.7% of NH's population resided on stratified drift (13.4% NH). 11.4% lived on OSDA75, occupying just 3.5% NH land area. 7.1% of the state's population resided on OSDA150, occupying just 1.8% NH land area. Both of these population subsets grew at rates lower than the state average between 1990 and 2000. The relative populations (as a percent of state) on these aquifer subsets also decreased somewhat between 1990 and 2000, reflecting a trend towards town decentralization. However, the absolute populations on these aquifer subsets also increased over the same period, resulting in higher OSDA75 and OSDA150 population densities. OSDA150, the most transmissive subset, had both the greatest population density and the greatest increase in population density over the decade.

To address the study objective, principal components regression was used to develop highly predictive relationships of OSDA75 and OSDA150 aquifer losses. These models were then driven by on-aquifer population estimates to forecast aquifer losses as of 2025.

The **most probable** projections revealed that OSDA75 aquifer losses are expected to grow an additional 2.2% to a 65.6% net area loss; and that OSDA150 aquifer losses are expected to grow an additional 2.4% to a 74.2% net area loss. These projected losses were far less than those hypothesized based on the projected growth in state population. The hypothesized losses were linear interpolations based on population growth, while actual aquifer losses were found to be highly non-linear functions of aquifer size and population. Reasons for the nonlinearity include:

- High early aquifer losses occur as the result of pre-existing hydrography and initial road construction.
- Subsequent development results in significant setback overlap, reducing further per capita aquifer losses.
- Larger high-yield aquifers historically have accommodated greater population densities with lower aquifer loss.

Finally, since the greatest population increases are projected to occur on the largest aquifers, these populations are absorbed with lower losses.

<u>CAVEAT</u>: This conclusion should not be interpreted as NH towns need be unconcerned about protecting their future water resources. The conclusion only indicates that the loss of Favorable Gravel Well Analysis areas (i.e. where large public water wells can located according to minimum state regulatory setbacks, and without consideration of physical water budgets, or aquifer boundary conditions), occurs at a slower rate on larger, more populated high-yield aquifers. The regulatory setbacks used are by far smaller than true wellhead protection areas for any large public water supply. Since the Favorable Gravel Well Analysis is a preliminary GIS-based analysis, the existence of any available FGW area does not guarantee that it is free of contamination, or exists in sufficient quantity***.***

CHAPTER III

EVALUATION OF THE ACCURACY OF CLASSED SATURATED THICKNESS IN THE STRATIFIED-DRIFT AQUIFERS OF NEW HAMPSHIRE

Introduction

The Value of Stratified-Drift Aquifers

One in four people in New Hampshire obtain their water from public water systems[3] using sources supplied by groundwater, which is about the same as the national average (SPNHF, 1998b; USGS, 1987; USGS, 1998).

In 2003, 3882 individual wells were registered with the New Hampshire Department of Environmental Services (NHDES) as active public water-sources drawing on groundwater. Of these, the vast majority were bedrock wells. Only 624 (16%) were wells known to be placed in stratified-drift aquifers.

Despite their relatively low numbers as public water-supply sources, stratified-drift wells are particularly important due to their tremendous capability to yield large amounts of potable water. Based on average total daily groundwater

[3] A water system has been defined by the federal government to be any public or private water supply that serves 15 or more connections, or 25 or more people for at least 60 days annually (US Government, Code of Federal Regulations, 2002).

withdrawals in 1993, the few stratified-drift wells were about nine times as productive (18 million gal. per day) as all bedrock wells (2 million gal. per day) (Frederick H. Chormann Jr, NHDES; written communication, 1993; in Medalie and Moore, 1995, p. 4). For interested readers, greater detail on stratified-drift aquifers is contained in the dissertation Introduction and in Appendices A and B.

Knowledge of Data Limitations

To manage water resources in NH, state and federal regulators, town planners, conservation officers and environmental consultants depend heavily on stratified-drift aquifer maps developed by the US Geological Survey in a cooperative project with the New Hampshire Department of Environmental Services, over 1984-1996. To utilize the maps appropriately, such managers could benefit from concrete knowledge of the data limitations of the USGS contouring of saturated thickness or transmissivity. In particular, a knowledge of the data accuracy can help determine the kind of model that should be used for a given water resource management task (Bates and Evans, 1996), or it would can help define the uncertainty existing in a given town's stratified-drift aquifer map. However, no such accuracy assessment has been performed to date.

Research Direction

Given the importance of stratified-drift aquifers as productive groundwater resources, the relative scarcity of these resources, and the need for good management decisions on local, state and federal levels, the specific objective of this research is to quantify the classification accuracy of the stratified-drift saturated-thickness maps.

Literature Review

Spatial Error Analysis

A useful way to organize thinking about error in spatial datasets is to view the dataset as having a life cycle. This life cycle consists of a series of processes starting with data collection and continuing through to final archive of the product (Figure 28). This model allows error/accuracy assessment to be viewed as an integral part of each process in the life cycle (Goodchild, 2000). From Goodchild's perspective, accuracy is a dynamic property of the life cycle, and as such, requires effective transport of metadata (data about the dataset) when the dataset is transferred to different custodians.

While Goodchild's dataset life cycle is a solid, general model, it applies only to a single dataset. Derivative datasets (i.e. derived from multiple GIS data layers) have a somewhat different life cycle (Figure 29). Such products involve no direct data collection, no direct accuracy assessment, and begin existence as a distinct dataset at the time of analysis (Step VI). In addition, each source-layer contributes its own error to the derivative product. In Figure 29, organizations rather than individuals are indicated as custodians since multiple individuals within an organization can have responsibility for an original dataset (as in Figure 28). In any case, typically the originating organization holds responsibility for maintaining the accuracy of its datasets.

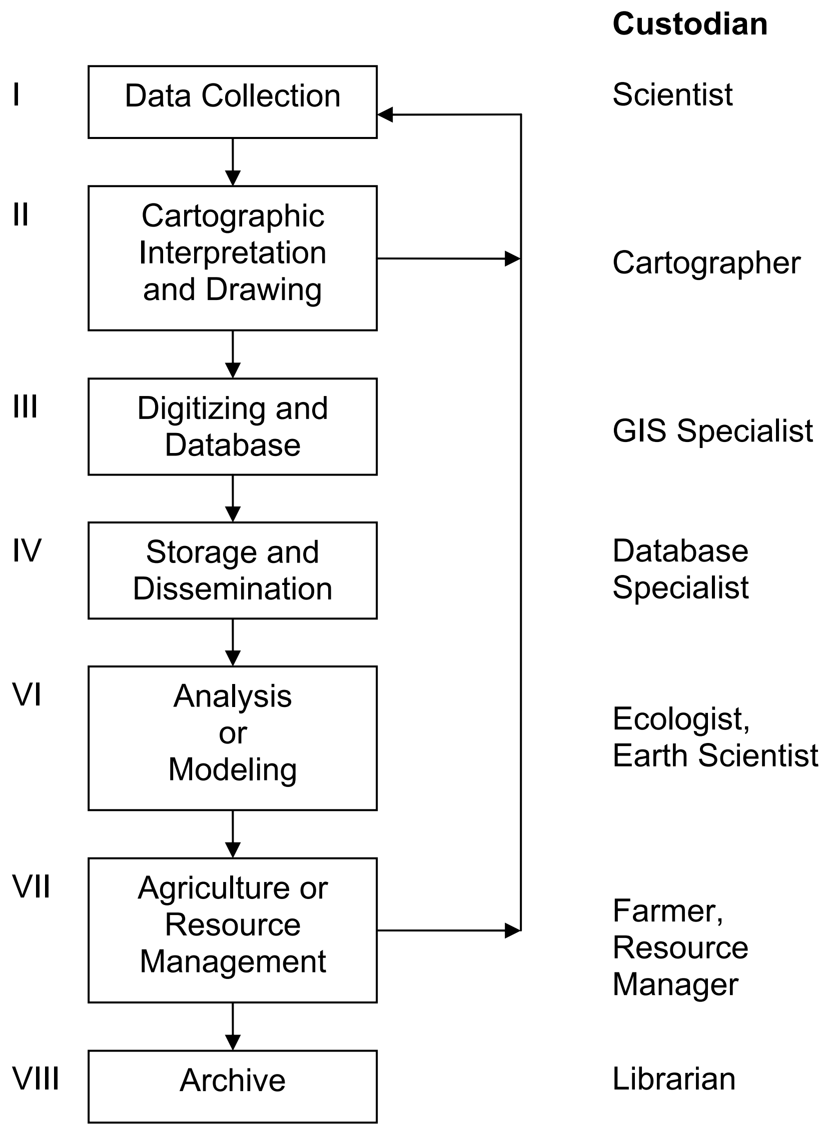

Figure 28. The life cycle of a natural resource database.
(Source: Goodchild, 2000)

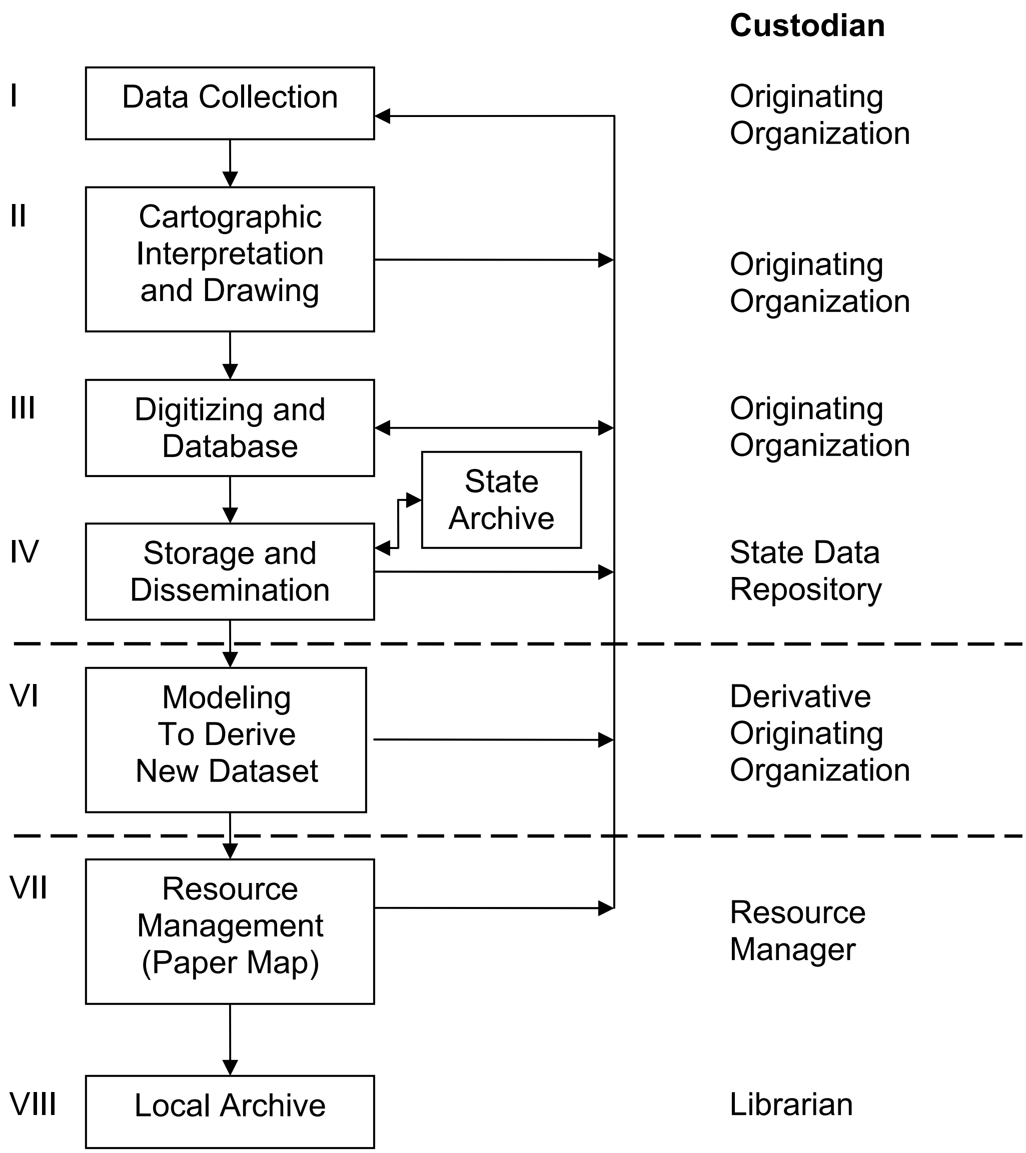

Figure 29. Life cycle of a derivative map, developed from multiple original layers. (Source: Adapted from Goodchild, 2000)

Lewis and Hutchinson (2000) observed that all spatial datasets contain both spatial and attribute errors, and that spatial errors can vary significantly in size as a function of dataset scale. In addition, both spatial and attribute errors are often spatially auto-correlated. Finally, where continuous spatial variation is represented on a grid or lattice or as a set of contours, there is residual attribute error. In light of these and other errors that can occur in spatial datasets, Lewis and Hutchinson argue that knowledge of whether a dataset has sufficient quality for its intended use is as important as its absolute accuracy.

In the book, Assessing the Accuracy of Remotely Sensed Data: Principles and Practices (Congalton and Green, 1999), the authors present the error matrix as a primary analysis tool for classification errors in remote sensing. This tool allows one to distinguish the producer's accuracy and the user's accuracy; to analyze errors of commission and omission, and allows the option of performing further statistical analysis. While designed with raster data in mind, it can also be used for examining error in discretized vector map-data as well (i.e. residual attribute error). Consequently, such an approach can be used to evaluate the accuracy of contoured transmissivity, saturated thickness, or water level data, provided sufficient independent verification points exist.

Review of the literature for accuracy assessments performed on large heterogeneous areas of mapped transmissivity or saturated thickness revealed little. Copty and Findikakis (1998) used a Monte Carlo method to predict a hydraulic-conductivity field based on limited existing data, leading to subsequent use of a series of groundwater flow and contaminant transport runs to quantify estimates of uncertainty in groundwater-remediation schemes. Kupfersberger and Bloschl (1994) examined the potential to use cokriging of abundant saturated-thickness data to augment limited transmissivity data; a concept which may prove useful in future updates of the USGS aquifer data. To make use of spatial uncertainty, Vassolo et al. (1998) used Monte Carlo methods to simulate realizations of aquifer recharge and transmissivity. For each realization, particle tracking was used to delineate the capture zone. Superpositioning of the set of resulting capture zones was used to define the wellhead protection area.

Where this research will, augment the prior research of Chapter I into remaining stratified-drift aquifer with potential for serving as large water supplies (Lough, 2006), key terms and results are briefly reviewed.

In the prior work, OSDA150 referred to Original Stratified-Drift Aquifer (OSDA) delineated by the USGS as having a transmissivity of at least 2000 ft^2/d, respectively. The numeric suffix “150” indicated that a transmissivity of 2000 ft^2/d had been related to ***potential*** well yield of 150 gpm, based on a relationship derived from Krasny, 1993. This well yield was intentionally described as ***potential*** since. by necessity, the analysis did not account for water availability, contributing areas, boundary conditions, or errors resulting from spatial interpolations. The potential well yields determined which state-required sanitary protective radius should be used for locating a new well (e.g. 400 ft from cultural features, if one were to locate a 150 gpm water-supply well on OSDA150 (NHDES), 1995; NHDES, 1999a; NHDES, 1999b; NHDES, 2005). These setbacks, plus others for surface water, and for potential or known contamination sites deemed a significant health hazard (e.g. septage-sludge lagoons), were spatially overlain to preliminarily determine the remaining OSDA150 area available for locating future large water-supply wells (RSDA150). From the analysis, OSDA was found to occupy just 13.4% of NH. OSDA150, those areas having the highest transmissivities, covered just 1.8% of NH area. Of this subset, 71.8% had been lost (OSDA150L) as of 2000, leaving 28.2% remaining as RSDA150 (Figure 15).

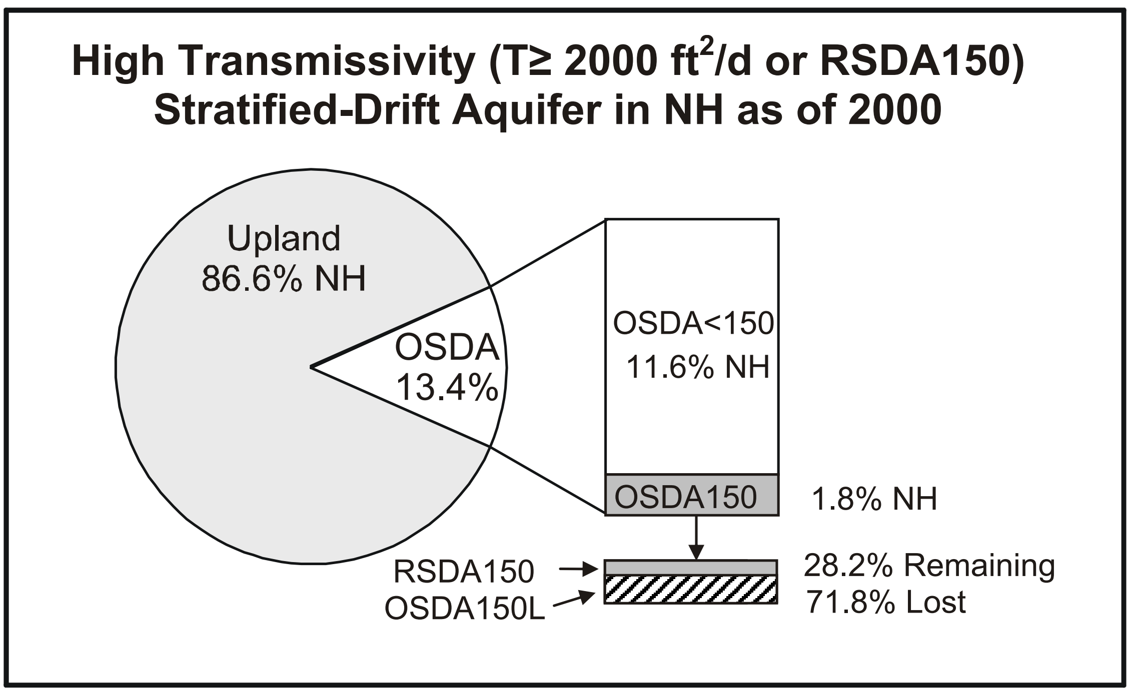

Figure 30. Uplands, OSDA, OSDA150 as a percent of New Hampshire's area. OSDA150 is the highest transmissivity subset (T≥2000ft^2/d) of OSDA. As of 2000, 71.8% of OSDA150 had been lost to setbacks (OSDA150L), leaving 28.2% available (RSDA150).

Methods

Method Overview

From hereon-in, the term “**saturated thickness”** will be used interchangeably with its common algebraic symbol, **“b”**. The term **“b-interval”** refers to the standard saturated-thickness contour-intervals of 20 ft or 40 ft. The term **“b-class”** refers to classifications of saturated thickness (e.g. 0-20 ft or 100-120 ft).

The objective of this final chapter is to quantify the classification accuracy of the stratified-drift saturated-thickness maps. This was achieved by constructing error matrices similar to Table 25**,** based on well logs archived by the New Hampshire Geological Survey, and water tables determined from 1:24000 topographic maps.

USGS Mapped Saturated Thickness	**Classed Saturated Thickness (ft) in Verification Well**				**Row Totals**	**User Accuracy**
	0-40	40-80	80-120	120-160		
0-40 ft	N_{11}	n_{12}	n_{13}	n_{14}	Σn_{1j}	$n_{11}/\Sigma n_{1j}$
40-80	N_{21}	n_{22}	n_{23}	n_{24}	Σn_{2j}	$n_{22}/\Sigma n_{2j}$
80-120	N_{31}	n_{32}	n_{33}	n_{34}	Σn_{3j}	$n_{33}/\Sigma n_{3j}$
120-160	N_{41}	n_{42}	n_{43}	n_{44}	Σn_{4j}	$n_{44}/\Sigma n_{4j}$
Column Totals	Σn_{i1}	Σn_{i2}	Σn_{i3}	Σn_{i4}	$\Sigma\Sigma n_{ij}$	
Producer Accuracy	$n_{11}/\Sigma n_{i1}$	$n_{22}/\Sigma n_{i2}$	$n_{33}/\Sigma n_{i3}$	$n_{44}/\Sigma n_{i4}$	**Overall Accuracy** $(n_{11}+n_{22}+n_{33}+n_{44})/\Sigma\Sigma n_{ij}$	

Table 25. A sample error matrix to compare USGS interpolated saturated thickness against classed saturated-thickness values of verification wells for study areas having a standard 40 ft saturated-thickness contour-interval.

TCHH3 Data Sources

The following Geographic Information System (GIS) data layers were utilized:

- A 1:24000 GIS layer of stratified drift aquifer boundaries for the state of New Hampshire, assembled from the 13 separate USGS study areas, and obtained from the USGS
- A 1:24000 saturated-thickness GIS layer for the state of New Hampshire, assembled from 13 separate study areas, obtained from the USGS and GRANIT, the NH state GIS data repository
- 45039 georeferenced well points and driller logs, obtained from the New Hampshire Geological Survey
- USGS raster graphics of the 7.5 minute topographic quadrangles in NH, acquired from GRANIT, the NH state GIS data repository

TCHH3 Data Preparation

Initial quality-control checks of the GIS layers corrected a number of errors, which included:

- Study area boundaries that were slightly misaligned in space (e.g. Nashua Region Planning Commission study area).
- Georeferenced well positions residing outside the state.

TCHH3 GIS Operations

All GIS operations were carried out in arcGIS 9.0 (ESRI, 2004). All datasets utilized NAD 1983 State Plane Feet for New Hampshire FIPS zone 2800 as a coordinate system.

Of the 45039 georeferenced wells, 10446 wells were identified by GIS overlay as residing on stratified-drift aquifer as delineated in the 13 USGS stratified-drift study areas. Of these, 2385 met the following criteria:

- to have been drilled after completion of the USGS studies
- to have a defined (as opposed to Unknown) transmissivity range (i.e. Wells areas could not be located in areas where the USGS had not defined transmissivity. See Chapter I, Table 6)
- to have a defined saturated thickness
- to have depth to bedrock data greater than 10 ft
- to have been located by field verification

Subsequent review revealed considerable clustering that resulted from the field geo-referencing process (e.g. entire sub-divisions had been located at the same time). To reduce spatial auto-correlation, the wells were then re-sampled to ensure a minimum distance of 1000 feet between points. Subsequent to this, land surface and water table elevations were interpolated manually within the GIS environment, based on the USGS 7.5 minute quadrangles and USGS water table contours. An additional 206 wells were subsequently eliminated due to insufficient contour data or surface water evidence for calculating a water table value, or for acquiring a saturated-thickness class. Of the remaining verification wells, 186 consisted of 100% till (i.e. not stratified drift), while 91 wells were identified as having basal tills, which required obtaining depth-to-till data from NHGS to calculate saturated thickness (as explained in the following section). Prior to actually calculating the saturated thickness for the verification wells, the set was subjected to a rigorous quality control process that included:

- Correction of elevation label errors in USGS 7.5 min topographic maps
- Screening of well location errors as determined through attribute data
- Screening of calculations for anomalous values (e.g. depth to water table)
- Screening for appropriate use and conversion of land elevation contours and water table contours. (USGS elevation contour intervals varied among 10, 20 and 40 ft for standard quadrangles and between 3 and 6 m for metric quadrangles. USGS water tables were always expressed in ft.)
- Comparison between driller logged elevation and calculated elevation
- Recalculation of land elevation and water table and comparison to the original calculations

Upon completion of this screening, the final set of verification wells contained 1300 locations, of which 1114 were (non-till) stratified-drift wells, for which saturated thickness was subsequently calculated.

TCHH3 Calculation of Saturated Thickness

The saturated thickness of a stratified-drift aquifer is defined as the difference between the water table and the bottom of the aquifer, whether bedrock or the top of a basal till. (Moore et al. 1994) (Figure 31).

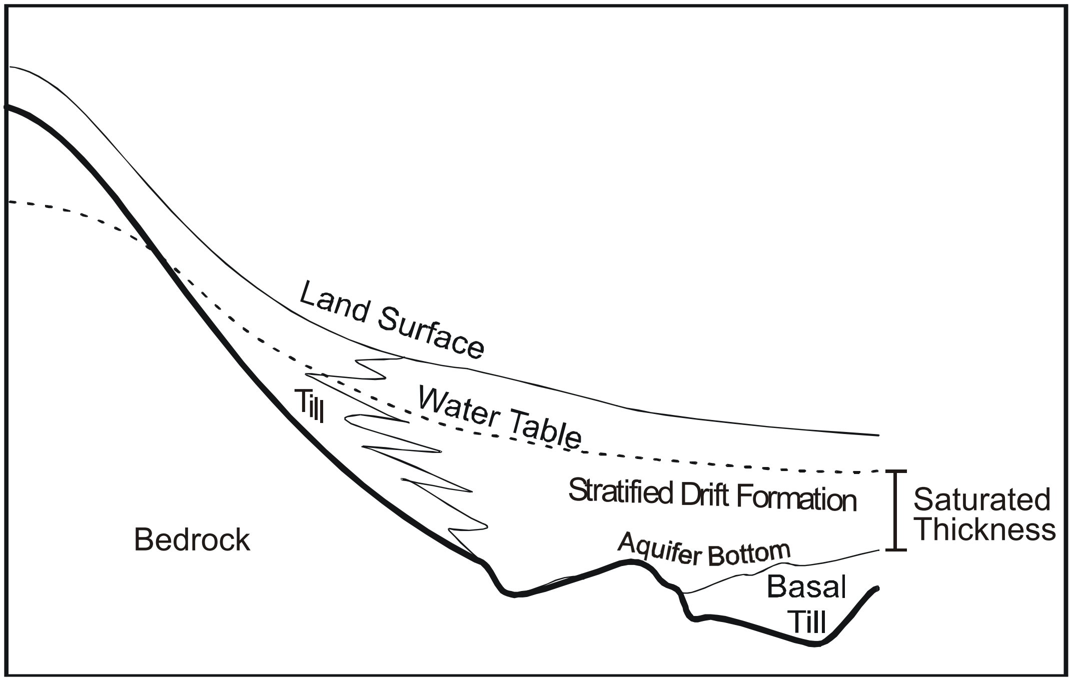

Figure 31. Saturated thickness is the depth of the saturated portion of a stratified drift overburden formation. The bottom of the aquifer can be bedrock or basal till.

To calculate saturated thickness, the depth to the water table is subtracted from depth to bedrock, or from depth to basal till, if one existed (Equations 4 and 5).

$$b = \min(D_{bk} - D_{wt}), (D_{bt} - D_{wt}) \qquad \textbf{Equation 1}$$

$$= \min[(D_{bk} - (E_{ls} - E_{wt})), (D_{bt} - (E_{ls} - E_{wt}))] \qquad \textbf{Equation 2}$$

where

b = saturated thickness (ft)

D_{bk} = depth to bedrock below ground surface (ft bgs)

D_{wt} = depth to the water table below ground surface (ft bgs)

D_{bt} = depth to the basal till below ground surface (ft bgs)

E_{ls} = land surface elevation (ft msl)

E_{wt} = water table elevation (ft msl)

Finally, the dataset was reviewed a last time to identify and verify the nature of unusual values of this variable. As a caveat, it should be noted that errors in horizontal and vertical accuracy of map derived water table and well elevation washed out for any given well. Inaccuracies in actual location, or in driller-logged depth to bedrock or depth to till were ignored out of practicality.

Upon this, semi-variogram analyses were performed within arcGIS for calculated b-values of the 1114 non-till subset, and for a dense well subset (NRPC, 273 wells). Using a variety of lag distances and search directions, both analyses generated pure nugget results. Consequently, it was concluded that no spatial autocorrelation existed for the calculated saturated-thickness samples, or that if a spatial autocorrelation existed it was too weak to detect.   Thus, the minimum sampling distance of 1000 feet between points was validated as having been effective in reducing spatial autocorrelation,

With quality control checks complete, each well was associated within arcGIS to a mapped saturated-thickness class. Subsequently, an actual b-class was assigned for the well, based on the mapped saturated-thickness contours used in the vicinity of the well. Table 26 details the mapped b-intervals that were used, in addition to the contouring exceptions in each study area.

ID	USGS Study Area	Standard ST Interval (ft)	Class Exceptions	Comment
1	Upper Connecticut River	40		
2	Middle Connecticut River	40	0-20 20-40	Numerous
3	Pemigewasset River	40		
4	Saco River	40		
5	Lake Winnipesaukee	20		
6	Lower Connecticut River	40		
7	Contoocook River	40		
8	Upper Merrimack River	20		
9	Bellamy/Cocheco/Salmon Falls R	20	0-10 10-20	Few
10	Middle Merrimack River	20		
11	Exeter/Lamprey/Oyster Rivers	20		
12	Lower Merrimack River	20	0-10 10-20	Few
13	Nashua Regional Planning Comm	20	0-10 10-20	Numerous

Table 26. USGS stratified-drift aquifer study areas, their numeric ID, mapped saturated-thickness contour-intervals, interval-class exceptions and comments on those exceptions.

Figure 32 depicts the same information visually. Study areas that utilize the standard 20 ft saturated-thickness contour-interval resided in the South-central and southeastern areas of the state. Study areas utilizing the standard 40 ft saturated-thickness contour-interval resided in the southwestern and northern portions of the state.

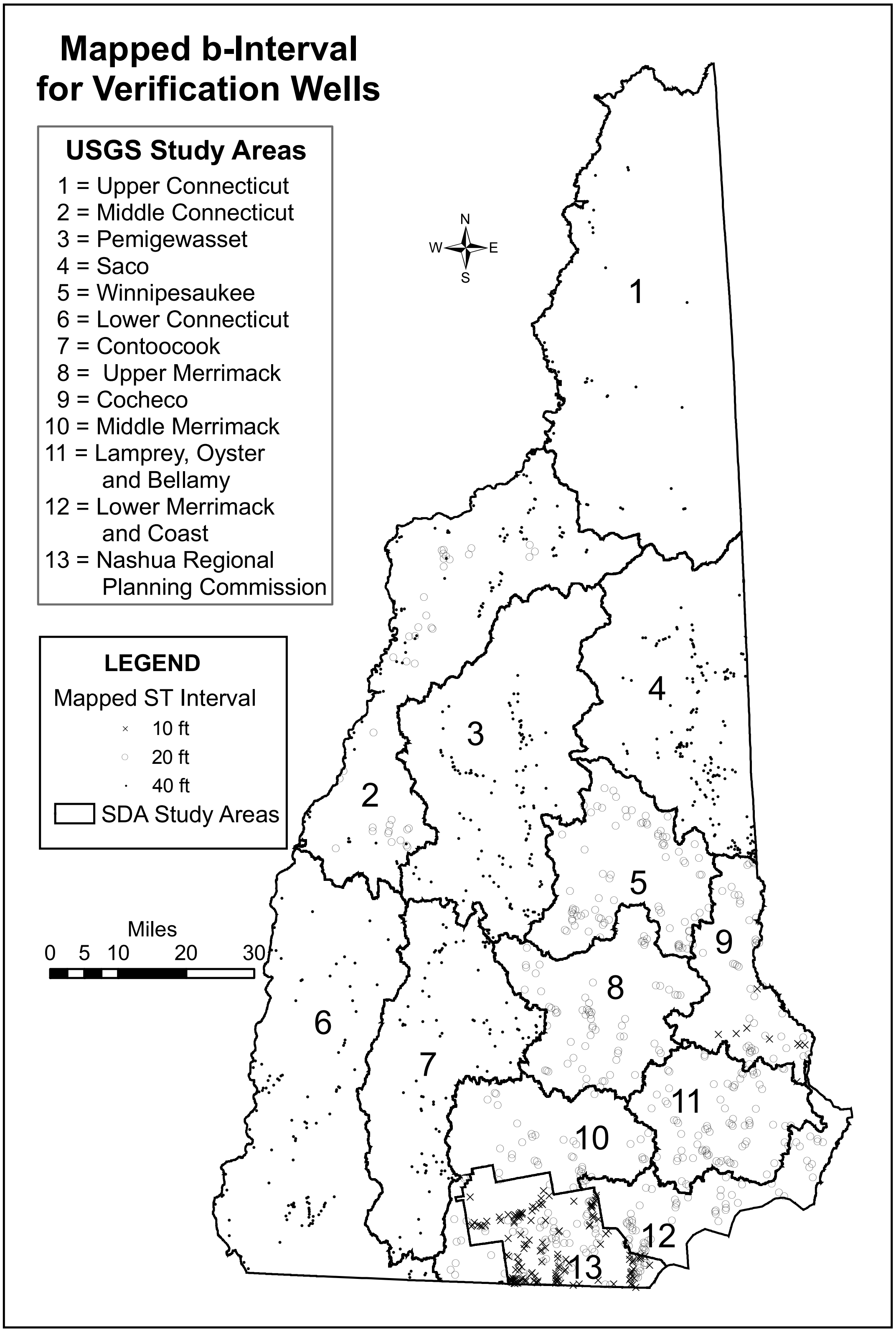

Figure 32. Mapped saturated-thickness contour-interval classes for the 1300 verification wells. b-Interval = 10 ft implies the given well had either a 0-10 or 10-20 ft classification in a study area with a standard 20 ft b-interval.

Results

Saturated-Thickness Interval Error-Matrices

Tables 27A and 27B present error matrices for studies with standard 20 ft and 40 ft saturated-thickness contour-intervals. The seven USGS study areas using a 20 ft contour interval were the Lower Merrimack, Middle Merrimack, Upper Merrimack, Lamprey/Exeter/Oyster, Bellamy/Cocheco/Salmon Falls, Nashua Regional Planning Commission and Winnipesaukee. The Nashua Regional Planning Commission study routinely included 0-10 and 10-20 ft b-classes, while the Lower Merrimack and Bellamy/Cocheco/Salmon Falls studies occasionally included those intervals.

The six USGS study areas using a 40 ft contour-interval were the Lower Connecticut, Middle Connecticut and Upper Connecticut, Pemigiwasset, Contoocook and Saco. However, the Middle Connecticut Study included numerous 0-20 and 20-40 ft saturated-thickness contours, which were also used by the 20 ft b-interval studies.

With 674 and 626 wells respectively, the 20 ft and 40 ft b-interval error matrices contained roughly an equal number of samples. Each matrix cell of the two matrices contains a count of verification wells that fell into the cell's ***mapped*** b-class and ***actual*** b-class.

The tables identify three kinds of saturated-thickness classification errors:

1) Saturated thickness was under-classed. b was greater than mapped and available water may be greater than thought. This is a desirable error.
2) A well's saturated thickness was over-classed. b was less than mapped, and less water might be available than thought. This is an undesirable error.
3) A well’s overburden was delineated as stratified drift when it was actually till. While such a well often has a saturated overburden, it is highly unlikely to have a high water yield. In this circumstance, the well was considered over-classed. This is also an undesirable error.

In the error matrices, the correctly-classed values of each matrix appear in the diagonal, formatted in gray background. Counts of verification wells that were under-classed appear to the upper right of the diagonal, while those over-classed appear to the lower left of the diagonal. Each under-classed and over-classed cell has a color-coded background to indicate the number of class intervals from the diagonal, providing a sense of the magnitude of the classification discrepancies. Wells that proved to be actually till appear in the first class on the left. In alignment with the USGS stratified drift studies, the aquifer, itself, is defined as the stratified-drift formation, whether saturated or not. Consequently, of the 111 unsaturated wells, those that had been mapped to b-classes 0-10, 0-20 or 0-40 ft, were considered to have been appropriately classed.

A — Error Matrix for 20ft Saturated-Thickness Interval Studies

Mapped b-Class	Actual Saturated-Thickness (ft) Class: Till	0-10	10-20	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	200-220	Total Wells	User %Acc
0-10	14	72	25	na	24	8	5	1	1						150	48.0
10-20	7	19	15	na	21	9	3	2	1						77	19.5
0-20	58	na	na	86	46	28	11	6		1					236	36.4
20-40	8	9	6	19	31	19	12	1		1		1			107	29.0
40-60	3	3	2	6	17	12	9	4	3	1					60	20.0
60-80	1			3	4	7	10	1	1			Under-classed		1	28	35.7
80-100	3					1	1	1	1	1					8	12.5
100-120							1			1		1			3	0.0
120-140								3	1				1		5	0.0
140-160					Over-classed										0	na
160-180												Correctly-			0	na
180-200													classed		0	na
200-220															0	na
Total	94	103	48	114	143	84	52	19	8	5	0	2	1	1	Wells	674
Producer %Accuracy	0.0	69.9	31.3	75.4	21.7	14.3	19.2	5.3	0.0	0.0	na	0.0	0.0	0.0	Overall Accuracy	33.7%

B — Error Matrix for 40ft Saturated-Thickness Interval Studies

Mapped b-Class (ft)	Actual Saturated-Thickness Class (ft): Till	0-20	20-40	0-40	40-80	80-120	120-160	160-200	200-240	240-280	280-320	Total Wells	User %Acc
0-20	3	13	2	na	5	3		1				27	48.1
20-40	2	4	2	na	1	1	1					11	18.2
0-40	59	na	na	194	90	30	10	6	1	1		391	49.6
40-80	17		2	27	37	26	10	2	1	1		123	30.1
80-120	7			6	12	15	4	5		1		50	30.0
120-160	3		1	1		4	5		3	Under-classed		17	29.4
160-200	1					1	1		1			4	0.0
200-240												0	na
240-280					Over-classed			1	1	Correctly-		2	0.0
280-320									1		classed	1	0.0
Total	92	17	7	228	145	80	31	15	8	3	0	626	Wells
Producer %Accuracy	0.0	76.5	28.6	85.1	25.5	18.8	16.1	0.0	0.0	0.0	na	Overall Accuracy	42.5%

Class Offset from Diagonal
0
1
2
3
4
5
6

186 wells (14.3%) were 100% till.
111 wells (8.5%) were unsaturated.

Table 27A and Table 27B. The 20 ft and 40 ft b-interval saturated thickness error matrices for the 13 USGS study areas.

Discussion

Tables 27A and 27B reveal that the saturated-thickness overall class-accuracies are 33.7% and 42.5% for the 20 ft and 40 ft b-interval studies, respectively.

Map-User Accuracy and Class Offsets

In the error matrices, map-user accuracy is the percent of correctly-classed verification wells relative to the total wells in a given mapped b-class.

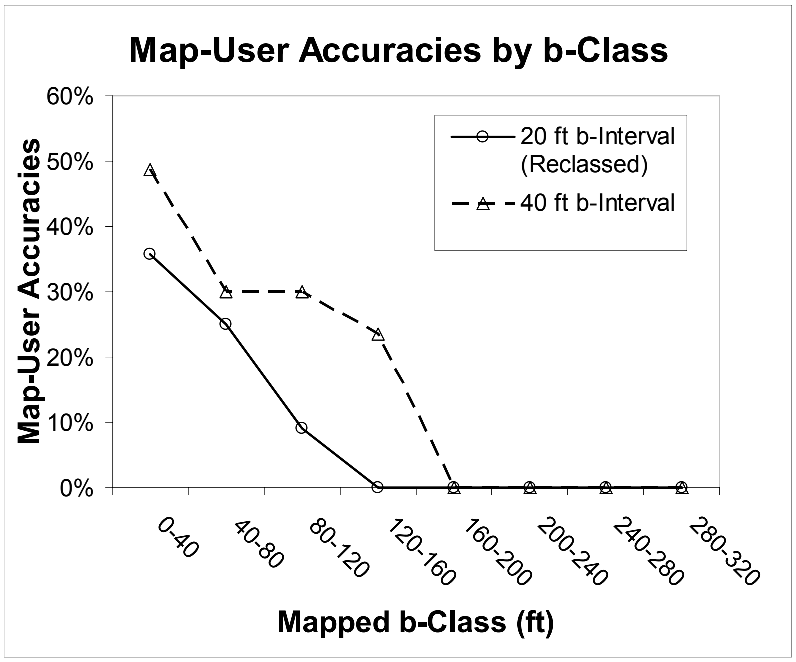

Figure 33. Map-user accuracies by mapped b-class (ft).

Figure 33 compares map-user accuracies of the 40 ft b-interval study areas with those of the 20 ft b-interval study areas, after reclassification for comparison. Comparing classes reveals that the 40 ft b-interval map-user accuracies were between 4 and 30 percentage points more accurate. In addition, map-user accuracies decreased with increasing saturated-thickness class for both b-interval studies. Map-user accuracy is greatest in the lowest classes (under 40 ft) which contain large portions of the data, as reflected in the median values of Table 28.

Statistics for 1003 Positive Saturated Thickness Wells					
b-Interval	**Wells**	**Min (ft)**	**Max (ft)**	**Mean (ft)**	**Median (ft)**
20ft	503	0.3	214.4	35.3	27.4
40ft	500	0.1	250.0	60.5	47.8
			Mean (ft)	**43.6**	

Table 28. Summary statistics for the 1003 verification wells having positive (>0) saturated thickness values.

Figure 33 also reveals that map-user accuracy approached zero above 140 ft for the 20 ft b-interval studies, and above 180 ft for the 40 ft b-interval, respectively.

To further examine the accuracy decay with increasing b-value, exceedance probabilities were generated for the non-till verification wells of the 20 ft and 40 ft b-interval study areas.

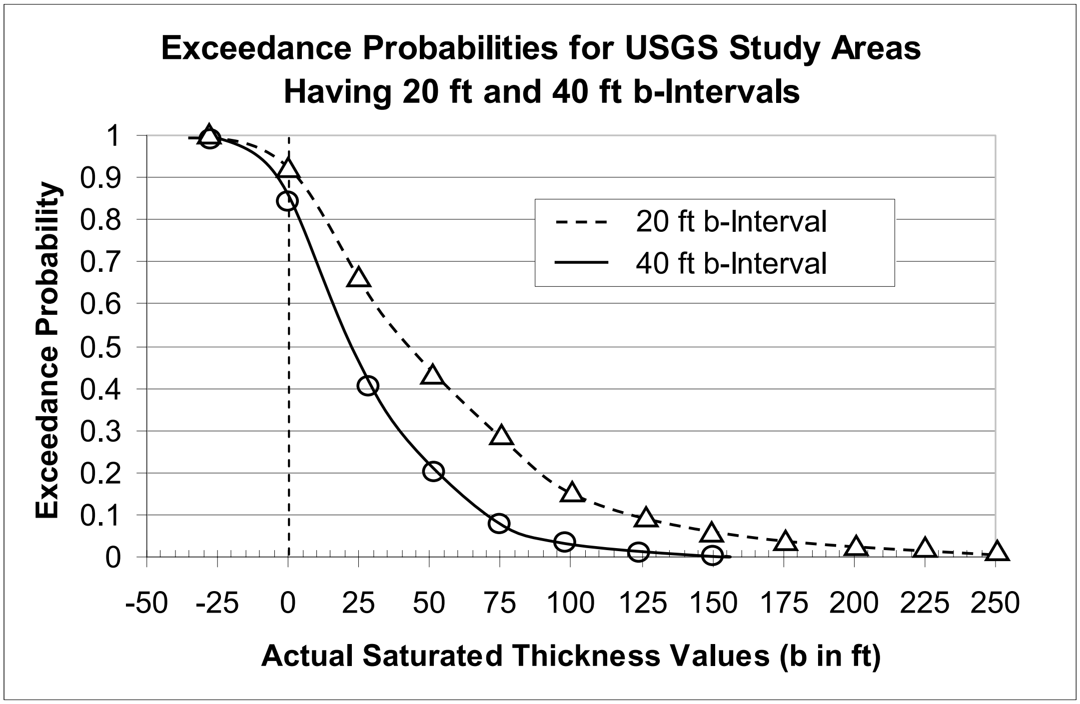

Figure 34**.** Exceedance probabilities for the USGS study areas having 20 ft and 40 ft saturated-thickness intervals. 186 wells consisting of 100% till have been removed from consideration in this analysis. 111 wells had a negative saturated thickness, indicating a water table that was below the top of till or top of bedrock elevation.

Figure 34 demonstrates that in the 20 ft and 40 ft b-interval distributions, less than 5% of b-values equal or exceed 83 ft and 160 ft, respectively. As a result, wide-area spatial interpolations of b will more reflect higher-frequency, shallower b-values, thus creating accuracy decay with increasing b. In addition, with increasing mapped-b, over-classification dominates under-classification (Figure 35 and Figure 36). These observations all suggest that the deeper sand and gravel wells are infrequent, hard to locate, and tend to be somewhat over-classed in USGS saturated-thickness maps, especially in the midrange.

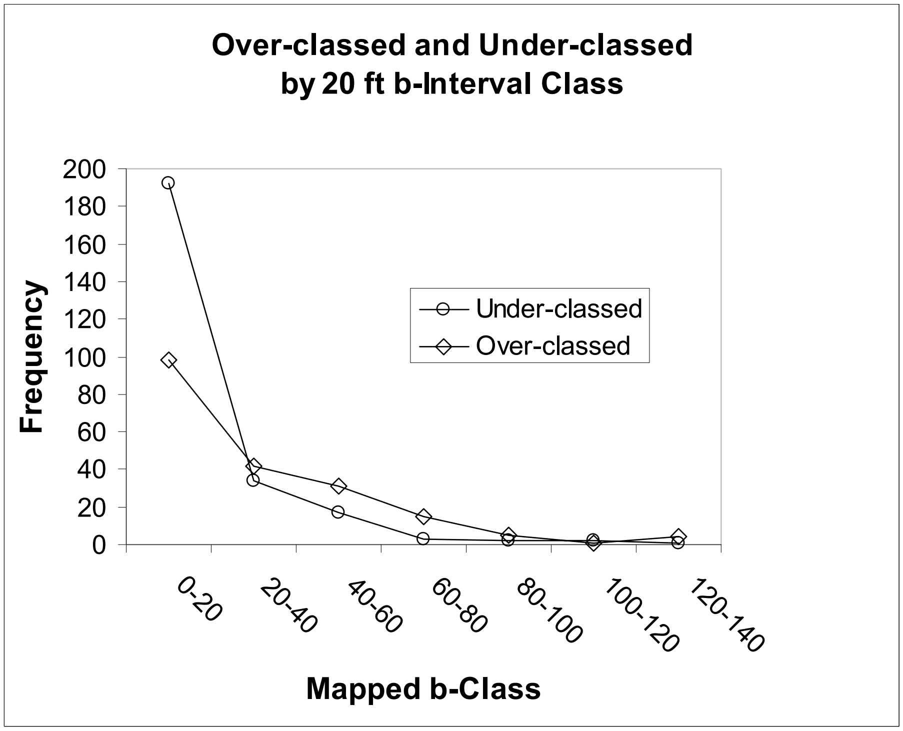

Figure 35. Wells over-classed and under-classed by class for the 20 ft b-interval USGS studies. The 0-10 and 10-20 classes are included in the 0-20 class.

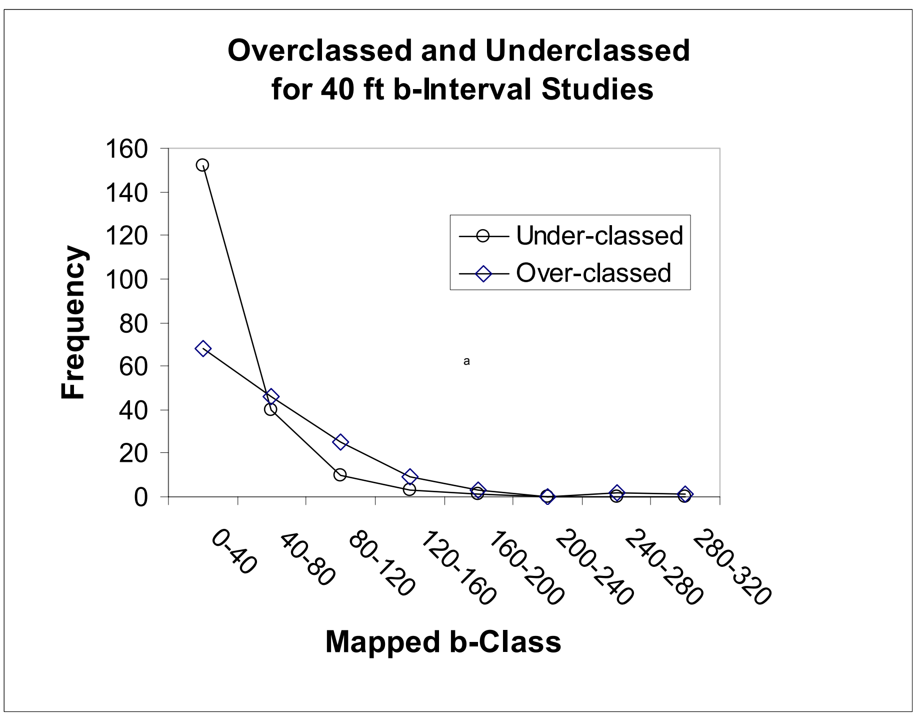

Figure 36. Over-classed and under-classed wells for the 40 ft b-interval USGS studies. The 0-20 and 20-40 classes are included in the 0-40 class.

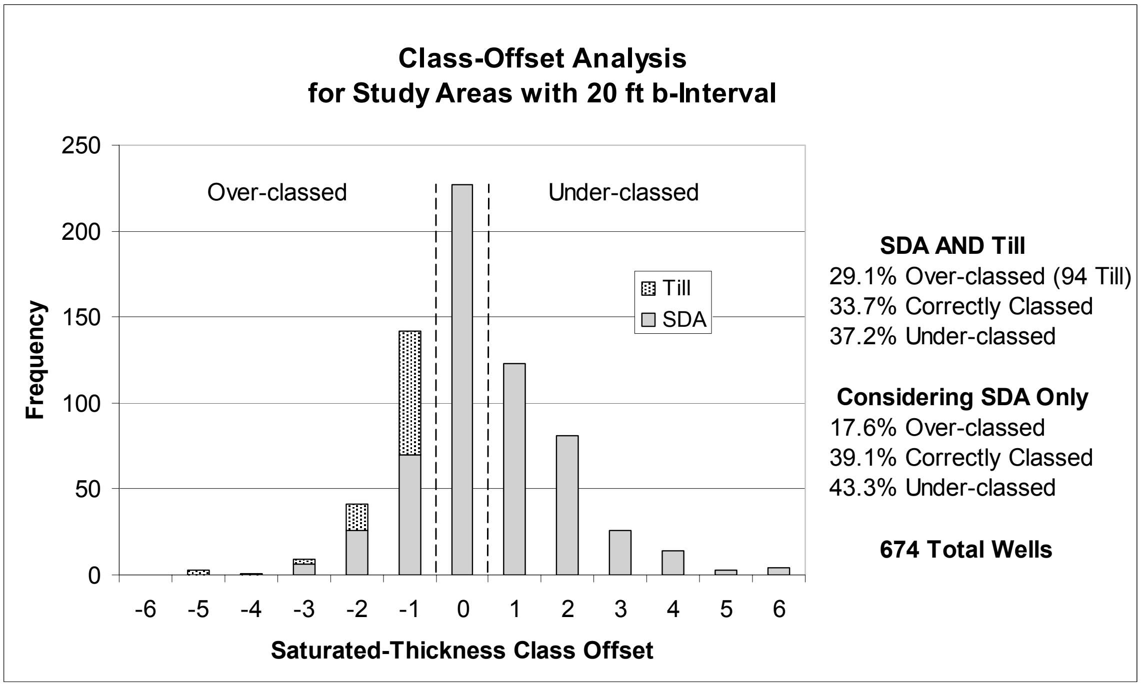

Figure 37. The class-offset analysis for 20 ft b-interval studies.

Figure 37 depicts the class-offset analyses for the seven 20 ft b-interval study areas. The class-offsets of the 674 verification wells form an approximate normal distribution around the correctly-classed category “0”. 33.7% were correctly classed, while 29.1% were over-classed, and 37.2% were under-classed. Consequently, 70.9% of the wells equaled or exceeded their mapped class of b. Figure 37 also reveals that till comprises about 50% of the first offset over-classification category. About 13.9% of the 674 wells were comprised of till.

Considering accuracy and precision as distinct in the scientific sense, Figure 37 reveals that the saturated-thickness contours of the 20 ft b-interval studies are accurate, but imprecise.

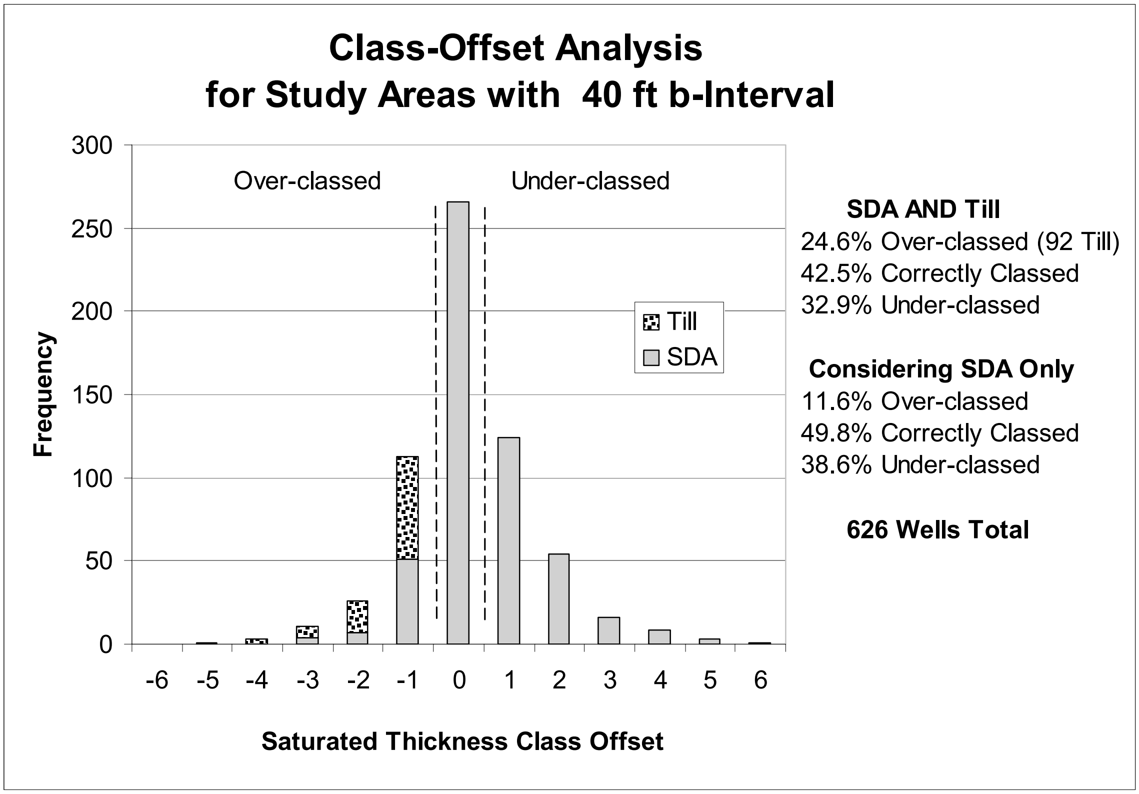

Figure 38**.** The class-offset analysis for the 40 ft b-interval studies.

Figure 38 depicts the class offsets for the 40 ft b-interval study areas. As in Figure 37, the class-offsets of the 626 verification wells form an approximately normal distribution around the correctly-classed category “0”. In this case, 42.5% were correctly classed, while 24.6% were over-classed, and 32.9% were under-classed. Consequently, 75.4% of the wells equaled or exceeded their mapped class of b. Similar to Figure 37, 14.7% of the 626 wells were classed as till, with the majority included in the first offset over-classification category. In addition, Figure 38 also reveals that like the 20 ft b-interval studies, the saturated-thickness contours of the 40 ft b-interval studies are accurate, but imprecise.

Transmissivity vs. Saturated-Thickness

Table 29 and Table 30 contain the saturated-thickness error matrices for the 268 and 1032 wells that mapped to $T \geq 2000$ ft^2/d (**High-T)** and $T < 2000$ ft^2/d **(Low-T)**, respectively. The well data for the 20 ft and 40 ft b-Interval study areas have been integrated such that the likelihood of higher yield generally increases with increasing saturated thickness. However, this likelihood is not a certainty for any individual well since the transmissivity is the product of hydraulic conductivity and saturated thickness, and the hydraulic conductivity for any given well is usually not known.

Table 29 and Table 30 reveal that wells mapped to high transmissivity are less accurately b-classed than those mapped to low transmissivities (32.1% vs. 39.4% overall accuracies). The Under/Over-classification analyses suggest that the saturated thickness of wells mapped to high and low transmissivities will be correctly classed or under-classed 60.1% and 76.5% of the time, respectively. Generally, high-transmissivity wells are more commonly over-classed (39.9%), while low-transmissivity wells are more commonly under-classed (23.4%). Wells that have over-classed saturated thickness may have overstated transmissivities. Wells that have under-classed saturated thickness may have understated transmissivities.

Error Matrix for Saturated Thickness for Wells Mapped to T>=2000 ft^2/d

Actual Saturated Thickness Class (b in ft)

Map Class	100% Till	0-10	0-20	10-20	0-40	20-40	40-60	40-80	60-80	80-100	80-120	100-120	120-140	120-160	140-160	160-180	160-200	180-200	200-220	200-240	220-240	240-260	240-280	260-280	280-320	Total	%Acc
0-10		14		1		1																				16	87.5
0-20																										-	na
10-20	1	9		8		7	6		1			1														33	24.2
0-40	1				1			2			2			1						1						8	12.5
20-40	1	6	1	5		12	6		2																	33	36.4
40-60		1	1			8	9		5	2																26	34.6
40-80	13				9	1		24			18			7			1									73	32.9
60-80	1					4	4		4										1							14	28.6
80-100	3						1		1																	5	0
80-120	5				5			8			10			2			4									34	29.4
100-120													1													1	0
120-140										3		1						1								5	0
120-160	3				1	1					4			4						2						15	26.7
140-160																										-	na
160-180																										-	na
160-200	1										1			1												3	0
180-200																										-	na
200-220																										-	na
200-240																										-	na
220-240																										-	na
240-260																										-	na
240-280																	1			1						2	0
260-280																										-	na
280-320																										-	na
Total	29	30	2	14	16	34	26	34	13	5	35	2	1	15	-	-	6	1	1	4	-	-	-	-	-	268	32.1%

Underclassed

Overclassed

Correctly Classed

Under-classed - 75 = 28.0%
Correctly classed = 86 = 32.1%
Over-classed = 107 = 39.9%

Increasing likelihood of greater well yield,but not a certainty in all cases.

Table 29. The saturated-thickness error-matrix for wells that mapped to transmissivity greater than or equal to 2000 ft^2/d.

Error Matrix for Saturated Thickness for Wells Mapped to T<2000 ft^2/d

Actual Saturated Thickness Class (b in ft)

Map Class	100% Till	0-10	0-20	10-20	0-40	20-40	40-60	40-80	60-80	80-100	80-120	100-120	120-140	120-160	140-160	160-180	160-200	180-200	200-220	200-240	220-240	240-260	240-280	260-280	280-320	Total	%Acc
0-10	14	58		24		23	8		5	1		1														134	43.3
0-20	61		99			48	28	5	11	6	3		1				1									263	37.6
10-20	6	10		7		14	3		2	2																44	15.9
0-40	58				193			88			28			9			6						1			383	50.4
20-40	9	3	22	1		21	13	1	10	1	1		1	1	1											85	24.7
40-60	3	2	5	2		9	3		4	2		3	1													34	8.8
40-80	4				18	1		13			8			3			1			1			1			50	26.0
60-80			3				3		6	1		1														14	42.9
80-100										1		1	1													3	33.3
80-120	2				1			4			5			2			1						1			16	31.3
100-120									1						1											2	0
120-140																										-	na
120-160														1						1						2	0
140-160																										-	na
160-180																										-	na
160-200																				1						1	0
180-200																										-	na
200-220																										-	na
200-240																										-	na
220-240																										-	na
240-260																										-	na
240-280																										-	na
260-280																										-	na
280-320																				1						1	0
Total	157	73	129	34	212	116	58	111	39	14	45	6	4	16	2	-	9	-	-	3	-	-	3	-	-	1032	39.4%

Underclassed

Overclassed

Correctly Classed

Under-classed = 383 = 37.1%
Correctly classed = 407 = 39.4%
Over-classed = 242 = 23.4%

Increasing likelihood of greater well yield,but not a certainty in all cases.

Table 30. The saturated-thickness error-matrix for wells that mapped to transmissivity less than 2000 ft^2/d.

Mazzafero Analyses of b-Sufficiency for Sustained Yields

To infer the transmissivity subsets that might have insufficient or sufficient saturated thickness to sustain yields of 75 or 150 gpm, the 1300 verification wells were mapped within GIS to associated minimum and maximum transmissivities, T_{min} and T_{max}.

Initially, to evaluate the representativeness of the 1300 sample wells for OSDA subsets, plots were generated of log %1300 wells versus the log %area for T-classes of OSDA, Low-T RSDA75, (OSDA<75 after water quality setbacks), RSDA75, Low-T RSDA150 (OSDA<150 after water quality setbacks), and RSDA150 in NH (Figure 39, Figure 40 and Figure 41). All datasets exclude 134.5 mi^2 of OSDA for which the USGS transmissivity was undefined, and two negligible transmissivity ranges ($T \geq 3000$ ft^2/d and $T \geq 6000$ ft^2/d) which had no sample wells as a result.

Review of the plots reveals that while a small bias is evident towards higher transmissivities, the well sample subsets are reasonably representative of the transmissivity-range areas in NH, and therefore the well percentages can be used to draw inferences regarding the above T-class subsets.

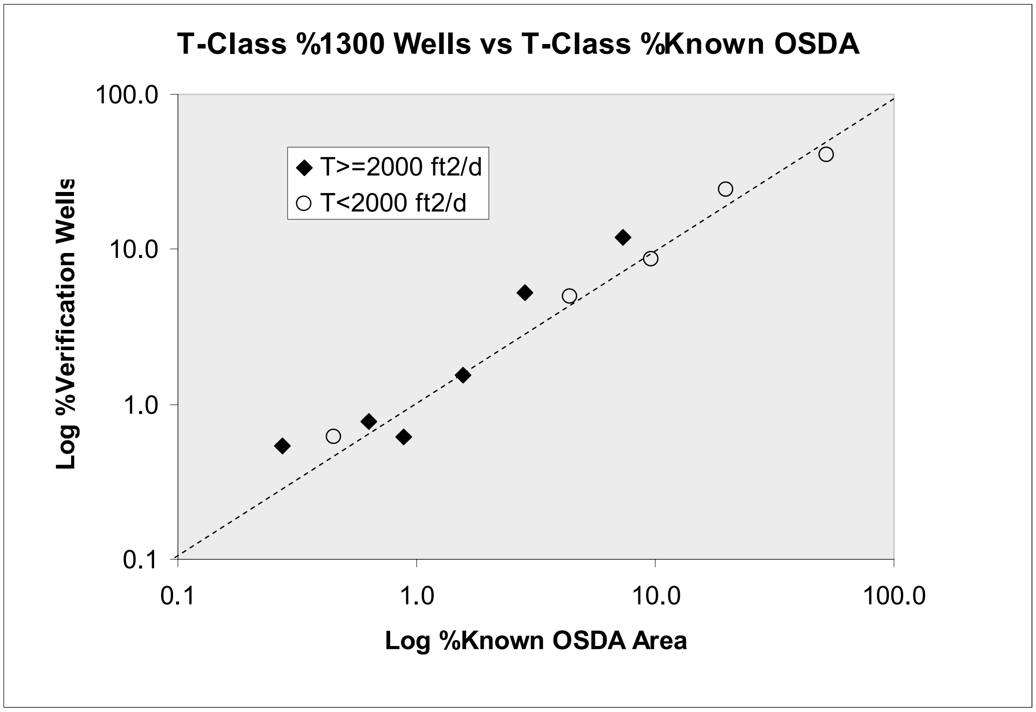

Figure 39. Evaluation of the representativeness the 1300 verification wells of the stratified-drift aquifer originally delineated by the USGS (OSDA).

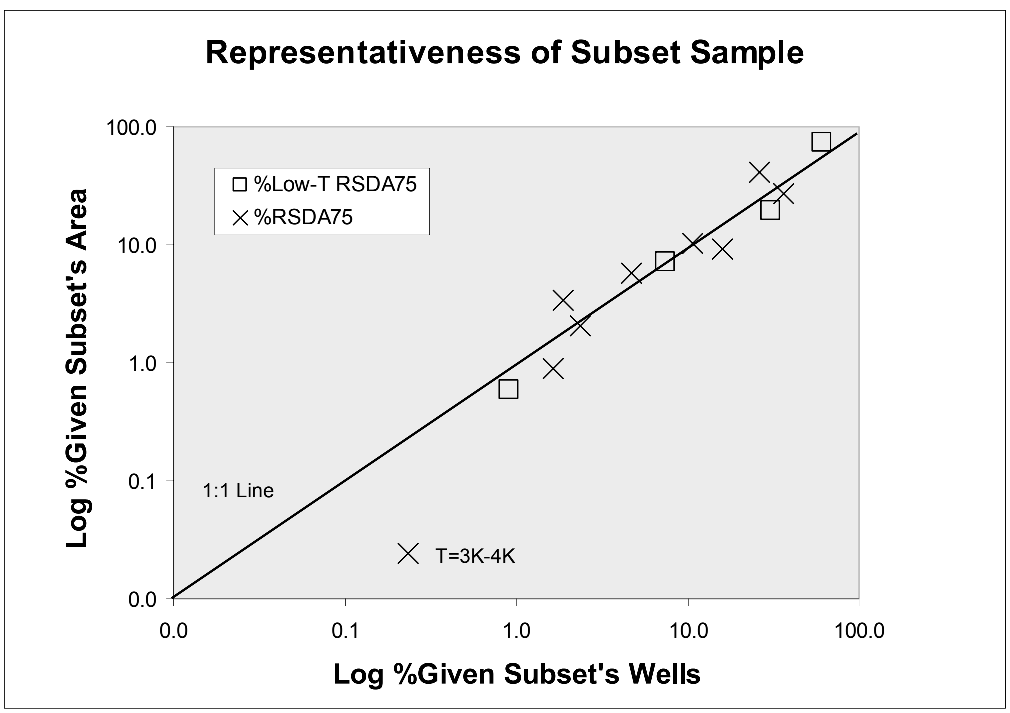

Figure 40. Evaluation of the representativeness for RSDA75 and Low-T RSDA75. Note that the T=3000-4000 ft2/d class is of negligible area in comparison to other T-classes.

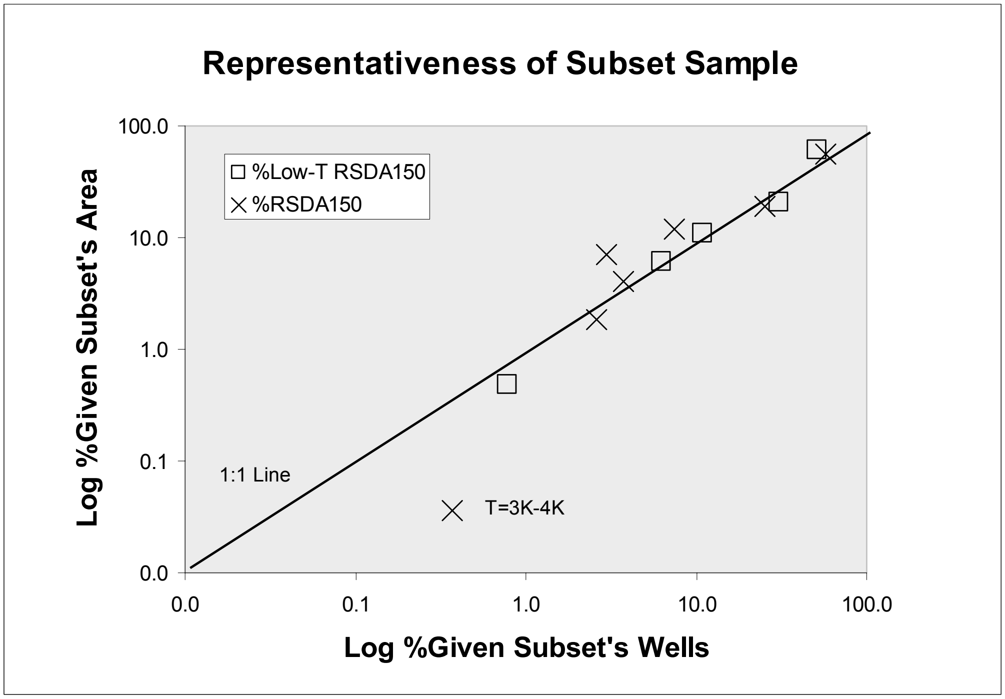

Figure 41. Evaluation of the representativeness of verification wells for RSDA150 and Low-T RSDA150. Note that the T=3000-4000 ft2/d class is of negligible area in comparison to other T-classes.

TCHH3 The Mazzafero Transmissivity-Yield Equation

In 1980, the USGS developed a relationship for approximating stratified-drift aquifer (SDA) well yield for mapped stratified-drift aquifers (Mazzaferro, 1980) (Equation 3).

$$Q = T * b_T / c \qquad \textbf{Equation 6}$$

where

Q = Mazzaferro potential well yield (gpm)

T = Transmissivity (ft^2/d) mapped for a region

b_T = Saturated thickness (ft) mapped for the given transmissivity T

c = conversion constant, 750 ($ft^3/d/gpm$)

The Mazzaferro relationship is somewhat more flexible than the Krasny equation used in Chapter I (Equation 1) since that it utilizes two USGS mapped variables (T and b) rather than 1 (i.e. T), to estimate general aquifer yields. Since transmissivity is the product of hydraulic conductivity and saturated thickness, the true independent variables are K and b when the equation is expressed as:

$$Q = K * (b_T)^2 / c \qquad \textbf{Equation 7}$$

where

K = hydraulic conductivity (ft/d)

Q, b_T and c are defined as above

The Mazzaferro equation will result in the same pumping yield as the Krasny equation when saturated thickness = 55.2 ft (Figure 42). Lower saturated thickness results in lower yield estimates than the Krasny equation. Higher saturated thickness results in greater yield estimates than the Krasny equation.

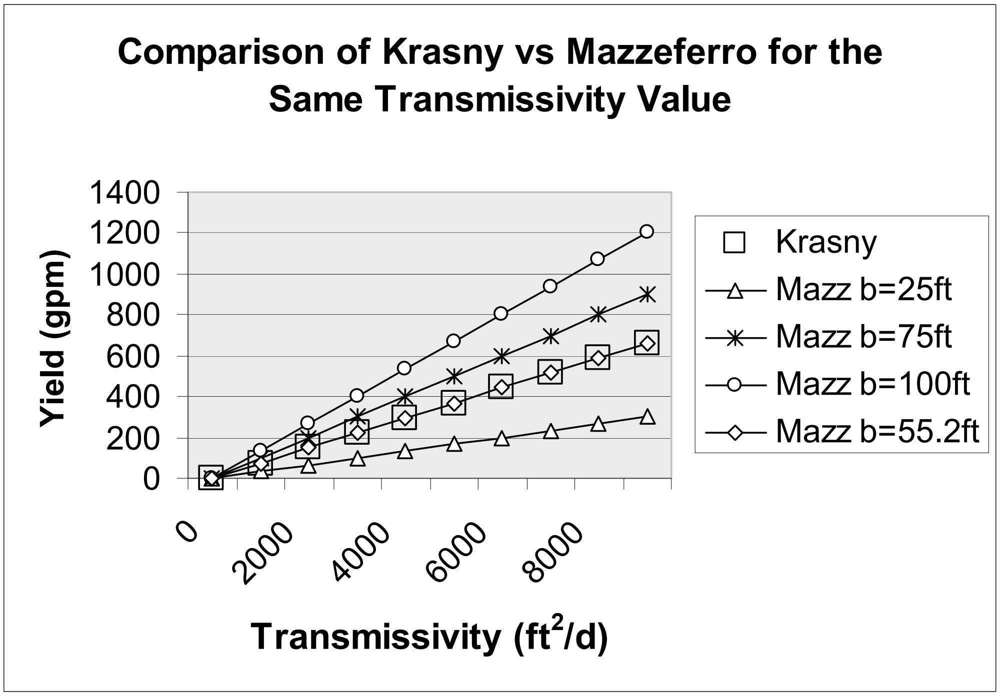

Figure 42. Theoretical yields of the Krasny and Mazzaferro equations by saturated thickness.

This study assumes that under ideal conditions (i.e. no error in mapped b or T), the two-variable Mazzaferro equation is more accurate than the one-variable Krasny equation. Given this, the Mazzaferro equation was used in conjunction with the quantified accuracies of saturated-thickness maps, to refine Chapter I estimates of remaining stratified-drift aquifer having potential to yield 150 gpm (Lough, 2006).

Solving Equation 3 for the saturated thickness gives:

$b_T = 750 * Q / T$ **Equation 8**

Substituting the minimum (T_{min}) and maximum (T_{max}) transmissivities of each well into the equation results in upper and lower threshold saturated-thickness values.

$b_{Tmin} = 750 * Q / T_{min}$ **Equation 9**

$b_{Tmax} = 750 * Q / T_{max}$ **Equation 10**

(Note: $T_{max} > T_{min}$ while $b_{Tmax} < b_{Tmin}$)

Between these threshold values (i.e. for transmissivities $\{ T : T_{min} < T \leq T_{max} \}$), a well has sufficient saturated thickness, not to be ruled out as possibly sustaining a given yield, Q, under the assumptions of the Mazzaferro equation.

In addition, to the above equations, as a rule, saturated-thickness values of 40 ft or greater have the best potential to achieve sustained high-yields (Mazzaferro, 1980). Furthermore, unsaturated wells, or wells with overburden consisting of low hydraulic-conductivity deposits (e.g. 100% till, 100% clay) are highly unlikely to sustain a high yield. Based on the Mazzaferro equation and these observations, criteria were developed to generate four subsets of well-likelihood to sustain high-yields (Table 31).

Criteria for Four Categories of Well Likelihood To Sustain a Long-Term Yield Q

Unlikely	Less Likely	Likely	More Likely
100% Till or 100% Clay or Unsaturated or ($b<b_{Tmax}$)	$b \geq b_{Tmax}$ and $b<40$	$b_{Tmax} \leq b < b_{Tmin}$ and $b \geq 40$	$b \geq b_{Tmin}$ and $b \geq 40$

Table 31. Criteria of 4 classes of well-likelihood to sustain a long term yield, Q, given $\{ T : T_{min} < T \leq T_{max} \}$,

For each well in the two transmissivity subsets (Low T: T<2000, High T: T≥2000), actual saturated thickness and overburden composition were screened to the criteria of Table 31 for a desired yield of 150 gpm. Table 32 contains the resultant matrix of 1300 verification wells classed by mapped transmissivity and actual saturated thickness. Note that unsaturated wells and 100% clay wells have been integrated with till in the leftmost class. Perpendicular dashed lines divide the matrix into high and low transmissivity, and saturated thickness above and below 40 ft. Gray shades delineate the regions in which the Mazzaferro equation is satisfied for $Q \geq 150$ gpm. For comparison, the gray-shading in Table 33 delineates the region in which the simpler Krasny equation (used in the research of Chapter I) is satisfied for $Q \geq 150$.

Table 34 and Table 35 summarize verification-well percentages for the Low-T RSDA150/75 and RSDA150/75 subset elements within transmissivity/saturated-thickness matrices. The four classes of likelihood are general estimates only. Exceptions to every category can be expected, since the hydraulic conductivity is unknown for any well, and errors exist in overburden notes of the well logs.

				Class Matrix of Saturated Thickness vs Transmissivity																				
Q=150 gpm				Actual Saturated Thickness Class (b in ft)																				
b_{Tmax}	b_{Tmin}	Tmin	Tmax	Uns|Clay|Till	0-10	0-20	10-20	0-40	20-40	40-60	40-80	60-80	80-100	80-120	100-120	120-140	120-160	140-160	160-200	180-200	200-240	240-280	Total	
225	112500	1	500	23		13			21	4		4											65	Low-T OSDA150
113	112500	1	1000	142		64		123	29	30	69	16	9	26	2	1	9	1	6		3	3	533	
113	225	500	1000	5		1		Q<150	1	1	Q<150					Mazzaferro Q=150							8	
56	112500	1	2000	97	36	4	32	31	45	14	20	12	4	10	1	1	3		3		1		314	
56	113	1000	2000	22		12		21	9	8	18	4	1	9	3	1	4		Q>150		Low T		112	
38	56	2000	3000					2	1		1			3			2		1		High T		10	OSDA150
28	56	2000	4000	28	13	2	5	7	21	9	27	7	2	19	1		8		3	1	1		154	
28	38	3000	4000		Mazzaferro			2			1			3			1						7	
19	28	4000	6000		Q<150			Q=150		1						Mazzaferro Q>150							1	
14	28	4000	8000	17	1		8	5	6	11	2	3	3	7	1		1		1		2		68	
11	28	4000	10,000	1					1		3			1		1	1						8	
11	14	8000	10,000	4	1		1		3	5		3		1					1		1		20	
		Grand Total		339	51	96	46	191	137	83	141	49	19	79	8	4	29	1	15	1	8	3	1300	
									b<40	b>=40														

Table 32. Verification wells classed by transmissivity and actual saturated thickness. Unsaturated or 100% clay wells have been integrated with the till class to the left. Values for b_{Tmax} and b_{Tmin} are displayed in the left columns. Assuming {T: Tmin ≤ T < Tmax}, the approximate ranges of classes satisfying the Mazzaferro equation for Q≥150 gpm are gray-shaded. Empty columns are not displayed. Transmissivities of “0” or “99999” are replaced with “1” and “10,000”, for calculations.

Krasny Yield Models on the Classed Transmissivity/Saturated-Thickness Matrix																							
				Actual Saturated Thickness Class (b in ft)																			
(ft)		(ft^2/d)																					
b_{Tmax}	b_{Tmin}	Tmin	Tmax	Unsat|Clay|Till	0-10	0-20	10-20	0-40	20-40	40-60	40-80	60-80	80-100	80-120	100-120	120-140	120-160	140-160	160-200	180-200	200-240	240-280	Total
225	112500	1	500																				65
113	112500	1	1000																				533
113	225	500	1000																				8
56	112500	1	2000																				314
56	113	1000	2000																				112
38	56	2000	3000																				10
28	56	2000	4000																				154
28	38	3000	4000																				7
19	28	4000	6000																				1
14	28	4000	8000																				68
11	28	4000	10,000																				8
11	14	8000	10,000																				20
		Grand Total		339	51	96	46	191	137	83	141	49	19	79	8	4	29	1	15	1	8	3	1300

Low-T RSDA75
T<1000 ft^2/d
0.856*(T=0-2000 ft^2/d)
921.4 mi^2
875/1300 wells

Krasny RSDA75
T>= 1000 ft^2/d
0.144*(T=0-2000 ft^2/d)
323.6 mi^2
425/1300 wells

Low-T RSDA150
T<2000 ft^2/d
1076.3 mi^2
1032/1300 wells

Krasny RSDA150
T>= 2000 ft^2/d
168.7 mi^2
268/1300 wells

Table 33. The Krasny-derived OSDA and RSDA subsets of the T/b matrix. For comparison to Table 34 and Table 35, the dark-gray shaded area represents those transmissivities that have the potential to yield 150 gpm or greater under the simpler Krasny-derived transmissivity-yield relationship used in Chapter I. Together, the light and dark gray shaded areas represent those transmissivities that have the potential to yield 75 gpm or greater under the Krasny relationship used in Chapter I. The statistics developed for each of the four models apply equally to OSDA and RSDA subsets.

Matrix of Transmissivity Class vs Saturated-Thickness Class

Q=150 gpm (ft) b_{Tmax}	b_{Tmin}	(ft²/d) Tmin	Tmax	Unsat|Clay|Till	0-10	0-20	10-20	0-40	20-40	40-60	40-80	60-80	80-100	80-120	100-120	120-140	120-160	140-160	160-200	180-200	200-240	240-280	Total	
225	112500	1	500																				65	Low-T RSDA150
113	112500	1	1000																				533	
113	225	500	1000																				8	
56	112500	1	2000																				314	
56	113	1000	2000																				112	
38	56	2000	3000																				10	RSDA150
28	56	2000	4000																				154	
28	38	3000	4000																				7	
19	28	4000	6000																				1	
14	28	4000	8000																				68	
11	28	4000	10,000																				8	
11	14	8000	10,000																				20	
		Grand Total		339	51	96	46	191	137	83	141	49	19	79	8	4	29	1	15	1	8	3	1300	

Actual Saturated Thickness Class (b in ft)

Low-T RSDA150 (1032 Wells)
UnLikely 89.1%
Likely 10.2%
b_{Tmax}
Low-T RSDA150 b-Sufficiency = 10.9%
b_{Tmin}
More Likely 0.7%

RSDA150 (268 Wells)
UnLikely 32.4%
7.5%
More Likely to Sustain 150 gpm 44.4%
Less Likely 15.7%
Krasny RSDA150 b-Sufficiency = 44.4 + 7.5 = 51.9%

Table 34. General matrix subsets of likelihood for sufficient saturated thickness to sustain Q = 150 gpm for the 1300 well transmissivity/saturated-thickness class matrix. The b_{Tmax} and b_{Tmin} curves are approximate and unusually shaped due to overlapping class boundaries. The curves are also specific to the Mazzaferro equation for Q =150 gpm.

Class Matrix of Saturated Thickness vs Transmissivity for Q>=75 gpm

Q=75 gpm				Actual Saturated Thickness Class (b in ft)																			
b_{Tmax}	b_{Tmin}	Tmin	Tmax	Unsat|Clay|Till	0-10	0-20	10-20	0-40	20-40	40-60	40-80	60-80	80-100	80-120	100-120	120-140	120-160	140-160	160-200	180-200	200-240	240-280	Total
113	56250	1	500																				65
56	56250	1	1000																				533
56	113	500	1000																				8
28	56250	1	2000																				314
28	56	1000	2000																				112
19	28	2000	3000																				10
14	28	2000	4000																				154
14	19	3000	4000																				7
9	14	4000	6000																				1
7	14	4000	8000																				68
6	14	4000	10,000																				8
6	7	8000	10,000																				20
		Grand Total		339	51	96	46	191	137	83	141	49	19	79	8	4	29	1	15	1	8	3	1300
				b<40						b>=40													

Low-T RSDA75 (rows 1–4); RSDA75 (rows 4–12)

Low-T RSDA75 (875 Wells)

RSDA75 (425 Wells)

UnLikely 76.5%

3.4%

b_{Tmax}

Likely 20.1%

More Likely 0.0%

Low-T RSDA75 b-Sufficiency = 20.1%

4.9%

b_{Tmin}

UnLikely 34.9%

More Likely 41.4%

Less Likely 18.8%

Krasny RSDA75 b-Sufficiency = 41.4 + 4.9 = 46.3%

Table 35. Mazzaferro-based saturated thickness sufficiency estimates for Krasny-based RSDA75 and for Low-T RSDA75 (OSDA<75 remaining after 75 gpm water-quality setbacks). The b_{Tmax} and b_{Tmin} curves are approximate and unusually shaped due to overlapping class boundaries. The curves are also specific to the Mazzaferro equation for Q =75 gpm.

Mazzaferro-Updated OSDA/RSDA Statistics							
Aquifer Subset	**T-Range**	**Area (mi2)**	**b-Sufficiency Factor**	**Updated Area (mi2)**	**%OSDA**	**Low-T + High-T NH RSDA75**	
2000 RSDA75	Low-T	366.8	0.210	77.0	6.2%		
	High-T	**118.4**	0.463	**54.8**	**4.4%**	131.9	10.6%
2025 RSDA75*	**High-T**	111.3	0.463	51.5	4.1%	-	
2000 RSDA150	Low-T	368.7	0.109	40.2	3.2%		
	High-T	**47.6**	0.519	**24.7**	**2.0%**	64.9	5.2%
2025 RSDA150*	**High-T**	43.5	0.519	22.6	1.8%	-	

Table 36. RSDA75 and RSDA150 after being updated for Mazzaferro likelihood of sufficient saturated thickness to sustain a long-term 75 or 150 gpm well yield, for 2000 and 2025. * There are no Low-T RSDA projections for 2025.

Table 36 details the quantities, the percentages of the high and low transmissivity wells for the subsets of Table 34, and the calculated portions of Low T OSDA (OSDA<150) and RSDA150 that might have sufficient saturated thickness to yield 150 gpm. Table 36 suggests that ***conservatively***, ***only 24.7 mi^2 of the 47.6 mi^2 RSDA150 identified in Chapter I may actually have sufficient saturated thickness to sustain a long term 150 gpm yield. Consequently, the actual amount of RSDA150 appears to be less than previously quantified.*** While up to 40.2 mi^2 may be additionally available in low transmissivity areas, such locations will be sparse and may not have sufficient water available in surrounding areas.

Table 36 also suggests that ***conservatively***, ***only 54.8 mi^2 of the 118.4 mi^2 RSDA75 identified in Chapter I may actually have sufficient saturated thickness to sustain a long term 75 gpm yield. Consequently, the actual amount of RSDA75 appears to be less than previously quantified.*** While up to 77.0 mi^{2}may be additionally available in low transmissivity areas, such locations will be sparse, likely difficult to locate, and would require careful checking of water availability.

From Chapter II, the projected 2025 RSDA75 and RSDA150 for NH can be derived by subtracting projected 2025 OSDA75L and OSDA150L for NH from the known amounts of OSDA75 and OSDA, respectively. Table 36 reveals that the ***updated estimates*** of the projected 2025 RSDA75 and RSDA150 for NH are 51.5 mi^2 and 22.6 mi^2, respectively. Clearly, the impacts of the Mazzaferro b-sufficiency analyses are far greater than the modeled incremental losses due to population growth by 2025.

Updated 75 GPM FGW Analysis Estimated (mi2)					Updated 150 GPM FGW Analysis Estimated (mi2)				
Type	**Total**	**Coast**	**South**	**North**	**Coast**	**South**	**North**	**Total**	**Type**
RSDA75	118.4	0.7	55.8	61.9	0.1	20.0	27.5	47.6	**RSDA150**
Updated RSDA75	54.8	0.3	25.8	28.7	0.06	10.4	14.3	24.7	**RSDA150**
%NH OSDA	4.4%	0.0%	2.1%	2.3%	0.0%	0.8%	1.1%	2.0%	**%NH OSDA**

Table 37. Regional estimates of RSDA75 and RSDA150 (Table 12) updated by the b-sufficiency factors determined in Chapter III.

The b-sufficiency analysis of Chapter III also allows updating the regional RSDA estimates of Chapter I. Again, the RSDA estimates for each region drop by about one half. Technically each region should have its distinct b-sufficiency factor; however, such data area not available as yet.

Chapter III Conclusion

The USGS transmissivity and their underlying saturated thickness maps have served as key references for town and state planners looking to manage water resources in New Hampshire for over a decade. Since, knowledge of the accuracy of these products is essential to using them correctly, this research focused on quantifying the classification accuracy of the USGS saturated-thickness contour maps. To achieve this, a database was developed of 1300 wells that had been located in stratified drift after the USGS maps had been completed. Just over fourteen percent of the wells were found to consist of till as opposed to sand and gravel. Saturated thickness was calculated for the 1114 remaining wells, and error matrices of USGS-mapped saturated-thickness classes vs. actual saturated-thickness classes were constructed and reviewed.

Analysis of 20 ft and 40 ft b-Interval Error Matrices

Overall accuracy for the 674 verification wells in the 7 USGS aquifer study-areas that utilized a 20 ft saturated-thickness contour-interval was determined to be 33.7%. Overall accuracy for the 626 verification wells in the 6 USGS aquifer study-areas that utilized a 40 ft saturated-thickness contour-interval was determined to be 42.5%.

In both matrices, integrated map-user accuracies declined from highs of 48% in the shallowest classes to zero in classes for depths greater than 100 ft and 160 ft for the 20 ft and 40 ft b-interval groups, respectively. Exceedance-probability graphs revealed that wells of these depths were relatively rare, and therefore were more likely to be difficult-to-contour, local minima in bedrock topography. Consequently, the decline in map-user accuracy with increased depth can be seen as bias of b-contour-maps towards more frequent wells of shallower-bedrock depth. Also, in both matrices, under-classifications exceeded over-classifications for the lowest saturated-thickness classes, while over-classifications exceeded under-classifications in the midrange. Over-classifications were about equal with under-classifications for wells in high-range b-classes.

Class-offset analyses revealed that both the 20 ft and 40 ft b-interval study areas had approximately normal distributions around the correctly classed category. Classification errors extended to plus and minus 5 class-offsets for both well subsets. Based on these observations, the USGS contoured saturated-thickness data can be described scientifically as accurate, but imprecise.

Mazzafero b-Sufficiency Analysis

While not part of the original research proposal, the saturated-thickness accuracy-assessment was used to refine the current and projected estimates of the RSDA75 and RSDA150 contained in Chapter I and Chapter II. For this purpose, matrices of saturated thickness versus transmissivity range were generated for the 268 and 1032 verification wells having high ($T \geq 2000$ ft^2/d) and low ($T<2000$ ft^2/d) transmissivities, respectively. High-T wells were generally less accurate and more prone to over-classification then low-T wells. Low-T wells were generally more accurate, but more prone to under-classification.

Since the verification wells were found to be generally representative of the transmissivity-range areas in NH for OSDA, RSDA and Low-T RSDA subsets, these data were capable of refining the RSDA estimates of Chapters I and II. ***This study suggests that roughly one half of the regional RSDA estimates, the current (2000) RSDA and projected (2025) RSDA estimates may have insufficient saturated thickness to sustain a high well yield, based on the Mazzafero yield equation.*** This research also suggests that some large quantities of OSDA<75 and OSDA<150 remain available after appropriate water quality setbacks, in conjunction with sufficient saturated thickness to yield 75 or 150 gpm. However such areas are likely to be sparse, difficult to locate, and would require careful checking of water availability in surrounding Low-T areas.

CHAPTER IV

DISSERTATION CONCLUSION

Overview

The emerging national water crisis has created a great need to identify and protect future water-supply lands in the more humid areas of the country, including New Hampshire. For this dissertation, three inter-connected research projects have been completed that together examine the present and future availability of the state's most productive groundwater resources, stratified-drift aquifers.

Chapter I documents the development of a GIS-based method for preliminary identification of remaining stratified-drift aquifers having potential to serve as large water supplies. The method first employed aquifer transmissivity classes to crudely approximate potential water yield. After this, contamination setbacks were overlain on the transmissivity classes to sift out the remaining available aquifer areas. This simple approach was chosen over an analytical or numerical-modeling approach due to the regional scope of the study, and a general sense of the accuracy limitations of the USGS-delineated aquifer maps. Once developed, the methodology was applied throughout the state, and the results were summarized, to determine the status of potentially high-yield stratified-drift aquifers by state sub-regions, and by the state as a whole.

Chapter II details the research performed in estimating the further loss of potentially high-yield stratified-drift aquifer by 2025, based on the results of Chapter I. Initially, on-aquifer populations and population trends were summarized, using US Census data for 1990 and 2000. Subsequently, principal components regression was used to determine an equation for aquifer loss by town as a function of aquifer area and the resident aquifer-population as of 2000. This spatial model was then driven through time, out to 2025, for four scenarios of aquifer-population growth, which were based on population projections developed by the New Hampshire Office of Energy and Planning. **Scenario B** based on historical data was deemed the **most probable,** and was used to test the research hypotheses.

Chapter III adapted error-matrix analysis, a technique commonly used in remote sensing, to analyze the classification accuracy of the USGS-delineated saturated-thickness maps, which served as a basis for the USGS classed transmissivity maps. Quantifying the accuracy of the saturated-thickness maps like this, provided a sense of the accuracy of the RSDA estimates of Chapter I.

While not part of the original proposed research, the saturated-thickness accuracy-assessment was extended to further bracket the potentially high-yield RSDA results of Chapter I, and to infer the quantity of similar yield areas that might exist in areas of low transmissivity ($T<2000ft^2/d$). For this purpose, matrices of saturated thickness versus transmissivity range were generated for the 268 and 1032 verification wells having high (T≥ 2000 ft^2/d, or OSDA150) and low (T<2000 ft^2/d) transmissivities, respectively. The RSDA figures of Chapters I and II were then refined using the Mazzaferro yield equation, and other criteria.

Chapters 1-3 each contain a detailed conclusion. The following section broadly summarizes the key results of the overall dissertation.

TCHH1 Aquifer Populations

Humans have a tremendous inclination to reside and work on NH's stratified-drift aquifer.

- ***Approximately 4 in 10 people reside on OSDA, which from an updated assessment, constitutes just 13.4% of NH.***
- ***11.4% of the population in 2000 lived on OSDA75 (3.5% NH), while 7.3% of resided on OSDA150 (1.8% NH)**, **a subset of OSDA75.***

TCHH1 Contamination Sources

Almost 6 in 10 of known and potential contamination sources exist on OSDA. This figure reasonably agrees with the OSDA population statistic above since human impacts include both residential and business development.

TCHH1 Population Growth 1990-2000

From 1990-2000, Upland populations grew at almost twice the average rate of OSDA populations, reflecting a continuing population movement away from traditional town centers that began about 1960. Upland populations grew 1.42% annually compared to 0.77% annually for OSDA

TCHH1 Population Density

OSDA75 and OSDA150, which are the most transmissive and contaminant-vulnerable aquifer subsets, had the greatest population densities (4.8 and 5.4 times that of upland areas,), and the greatest increases in absolute population density (33.6 and 38.5 p/mi^2) over 1990-2000. This is somewhat different than observed on an annual rate change basis. In this case, Upland areas had the highest value, due to having the highest percent change in absolute population over 1990-2000.

TCHH1 Saturated Thickness Sufficiency Analysis

A 1300 verification-well study revealed that approximately half of any OSDA75, OSDA150, RSDA75, or RSDA150 area determined from the USGS stratified-drift aquifer maps using the univariate Krasny equation is likely to have insufficient saturated thickness to sustain high yield on the basis of the bivariate Mazzafero equation. Subsequent OSDA and RSDA estimates are labeled as ***updated*** to reflect when b-sufficiency factors have been applied.

TCHH1 Remaining Potentially High-Yield Stratified-Drift Aquifer

Stratified-drift aquifers are by far more limited in New Hampshire than previously understood. After water quantity, quality considerations, and b-sufficiency analysis, only 4.4% and 2.0% of New Hampshire's 1245 mi^2 of stratified drift remained available, with the potential to support a 75+ gpm well or a 150+ gpm well respectively, circa 2000. Since hydraulic conductivities, water budgets, aquifer boundaries and wellhead protection areas were not considered, the actual figures may be even lower.

TCHH1 Town RSDA Endowment

A large majority of towns have relatively small amounts of remaining high-yield stratified-drift aquifer. Three fourths of NH towns have less than 0.5 mi^2 RSDA75. Almost 9 of 10 NH towns have less than 0.5 mi^2 of all RSDA150.

TCHH1 Local Opportunities for Conservation

Conversely, the greatest opportunities for conservation exist in the relatively few towns, which together, have the greatest quantity of the remaining potentially high-yield aquifer resources. 24.3% of all NH towns encompass three-fourths of RSDA75. 10.8% of all NH towns encompass two thirds of all RSDA150. (See Figure 11 and Figure 12 of Chapter I).

TCHH1 Regional Opportunities for Conservation

Regionally, the smaller extent, rural North has somewhat greater opportunities for aquifer conservation than the larger, more-urban South. The highly populated Coast has almost no potentially high-yield stratified-drift aquifer remaining available, a resource issue that the public is already aware of. The more urban South (20% larger and with twice as much OSDA as the North) has slightly less (b-sufficiency updated) RSDA75 and RSDA150 (25.8 mi^2 and 10.4 mi^2) respectively than the rural North (28.7 mi^2 and 14.3 mi^2). Consequently, while opportunities for conservation exist in both the North and South, the opportunities are somewhat greater in the rural North. (See Figure 11 and Figure 12 of Chapter I.)

<u>TCHH1 Projected Stratified-Drift Aquifer Losses in 2025</u>

Regulatory-related losses of areas of potentially high-yield stratified-drift aquifer are projected to be only marginally higher in 2025 than in 2000, primarily due to:

- ***A) Greater population growth projected by NHOEP for towns with large aquifers, and***
- ***B) The fact that larger, more populated aquifers have greater ability to accommodate further population increases with a lower per capita loss.***

<u>CAVEAT</u>: This conclusion should not be interpreted as NH towns need be unconcerned about protecting their future water resources. The conclusion only indicates that the loss of Favorable Gravel Well Analysis areas (i.e. where large public water wells can located according to MINIMUM state regulatory setbacks, and without consideration of physical water budgets, or of aquifer boundary conditions), occurs at a slower rate on larger, more populated high-yield aquifers. The regulatory setbacks used are by far, much smaller than true wellhead protection areas for any large public water supply. Furthermore, since the Favorable Gravel Well Analysis is a preliminary GIS-based analysis, the existence of any available FGW area does not guarantee that it is free of contamination, or exists in sufficient quantity*.*

Despite the facts that:

A) OSDA75 and OSDA150 losses were 63.4% and 71.8% as of 2000,

a B) Both aquifer subsets had the highest historical population densities and historical density increases, and

C) The state population is projected to grow 28% over 2000-2025,

the modeled OSDA75 losses of the **most probable scenario** were projected to grow only 2.2 percentage points to a 65.6%, while OSDA150 aquifer losses were projected to grow only 2.4 percentage points to 74.2 % by 2025. These surprising figures resulted from the coincidence of several factors. First, on-aquifer population growth has historically been ½ that of upland growth, so on-aquifer population growth will be less than the state average. More importantly, aquifer loss is a highly non-linear function of aquifer size and population. This nonlinearity stems from:

- High early aquifer losses that occur as the result of pre-existing hydrography and initial road construction.
- Subsequent development that results in significant setback overlap, reducing further per capita aquifer losses.
- Larger high-yield aquifers that accommodate greater population densities with lower aquifer loss.

Finally the greatest population increases are projected to occur on the largest aquifers. Since larger aquifers have historically accommodated higher population densities with lower per capita aquifer loss (due to the nonlinear model), the projected population increases are absorbed with lower aquifer losses.

This work was performed without the benefit the b-sufficiency study of Chapter III. 65.6% OSDA75L and 74.2 % OSDA150L corresponds to 111.3 mi^2 RSDA75 and 43.5 mi^2 RSDA150 in 2025. Applying the b-sufficiency factors of Chapter III drops these values by about one half to 51.5 mi^2 RSDA75 and 22.6 mi^2 RSDA150 in 2025, further emphasizing the scarcity of these valuable resources.

TCHH1 Aquifers Most Vulnerable to Development

Smaller OSDA75 or OSDA150 aquifers are particularly vulnerable to losses from road construction for either on-aquifer or off-aquifer populations. The same is true for towns which have moderately-sized aquifers with little RSDA. Larger aquifers will tend to have greater fragmentation which will attenuate such an impact.

TCHH1 The Impact of Aquifer Protection Ordinances

Aquifers having protection ordinances might be expected to experience fewer aquifer losses due to restrictions on the amount of impermeable surface allowed. However, the seventy-five OSDA75 aquifers identified as having aquifer protection in place as of 2006, tended to be densely-populated and have above-average aquifer area. Consequently, as determined in Chapter II, these aquifers are more likely to absorb greater numbers of people with lower per capita aquifer-losses than smaller, less-densely populated aquifers. As a result, it cannot be stated conclusively from this study that aquifer protection has reduced the amount of high

yield aquifer losses occurring with population growth. This was verified by a Student's T-Test of log-normalized per capita OSDA75-losses for protected and unprotected aquifer subsets. A more detailed analysis may be possible after 2010, when new census data will become available, provided that far more detailed data can be collected and verified regarding types of aquifer protection, dates of implementation and spatial areas involved.

TCHH1 Classification Error in Saturated-Thickness Maps

***The USGS contoured saturated-thickness data can be described in scientific terms as accurate, but imprecise*, based on the following factors:**

- Overall accuracy for the 674 verification wells in the 7 USGS aquifer study-areas that utilized a 20 ft saturated-thickness contour-interval was determined to be 33.7%.
- Overall accuracy for the 626 verification wells in the 6 USGS aquifer study-areas that utilized a 40 ft saturated-thickness contour-interval was determined to be 42.5%.
- Class-offset analyses revealed that both the 20 ft and 40 ft saturated-thickness-interval groups had approximately normal distributions around the correctly classed category.
- Classification errors extended to ±5 class-offsets for both 20 ft and 40 ft saturated-thickness-interval groups.

TCHH1 Trend of Classification Accuracy with Depth

Accuracy of the USGS saturated-thickness classes decreases significantly with depth. In both 20 ft and 40 ft saturated-thickness-interval matrices, map-user accuracies declined from highs of 48% in the combined lower classes, to 0% in classes for depths greater than 100 ft and 160 ft for the 20 ft and 40 ft b-interval groups, respectively. This decline in map-user accuracy with increased depth appears to be a bias in contouring of saturated-thickness towards more frequently represented wells in shallower-bedrock depths.

TCHH1 Transmissivity and Saturated-Thickness Classification Accuracy

High-T wells ($T \geq 2000\ ft^2/d$, or OSDA150), were generally less accurate in saturated-thickness classification accuracy, and more prone to over-classification (an undesirable error) then low-T wells ($T < 2000\ ft^2/d$).

Low-T wells were generally more accurate classed, but more prone to under-classification (a desirable error).

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APPENDICES

APPENDIX A

EXPLANATION OF WELL TYPES

Well Type	**Description**
Artesian:	Hydrologically, “artesian” refers to a well with a water level rising above ground. New Hampshire drillers often use it to refer to bedrock wells.
Bedrock:	Wells located in structural bedrock instead of overburden sands and gravels.
Dug Well:	A shallow well, typically less than 25 feet, dug manually or by excavator in sand and gravel materials.
Gravel Packed Well:	A well drilled into sand and gravel materials, which is lined with a pipe that is screened on its lower end. The screen is packed externally with a highly conductive uniform sand.
Gravel well:	A well drilled into sand and gravel materials, which is lined with a pipe that is screened at its lower end. The screen is not necessarily packed externally with a conductive uniform sand.
Driven Point Wells:	Wells are constructed by driving pipe into sand and gravel materials without drilling. The bottom end of the pipe is pointed and has screened for subsections for water entry.
Infiltration Wells:	A well in stratified drift that is located close enough to surface water to induce infiltration from it.
Spring:	A naturally existing depression in overburden materials, accompanied by a relatively active influx of water. Springs are typically small, and are often located on toe-slopes of hills.

APPENDIX B

STRATIFIED-DRIFT AQUIFERS

The following material on stratified-drift aquifers has been excerpted from A Guide to Identifying Potentially Favorable Areas to Protect Future Municipal Wells in Stratified-Drift Aquifers, Volume I, NH Department of Environmental Services (1999).

Stratified-Drift Aquifers

Stratified-drift aquifers are commonly referred to as sand-and-gravel aquifers because they often are predominantly composed of sand and gravel deposits. Although "stratified drift" is the geologically more precise term, both descriptions may generally be used interchangeably without creating confusion. An understanding of these aquifers is critical to the protection of groundwater resources and development of public and private water systems.

In order to understand the stratified-drift map, which is the base map used for the favorable gravel-well analysis, it is helpful to understand some of the terminology used to describe groundwater. This section of the guide describes some general concepts about stratified-drift aquifers and groundwater. Key words are given in bold text where they are first mentioned and/or defined.

Aquifer: An aquifer is any geologic formation which can transmit significant quantities of water to wells and springs. The term has been used to describe both unconsolidated sediments and the underlying bedrock. Any formation containing a layer or zone which is relatively permeable (i.e., able to transmit water with relative ease), which is saturated (i.e., filled to capacity with water), and lies adjacent to a less permeable material can generally be considered an aquifer. Aquifers may be in till, fractured bedrock, or stratified drift.

Till: Till refers to the unsorted mixture of earth material which was carried beneath, within, or on top of a glacier and then deposited. Deposits of till, generally 10-25 feet thick, cover the majority of the hill-slopes and upland areas of New Hampshire. There are a variety of till types, but most exhibit a wide range in particle size from boulders to fine silts and clays. These materials were incorporated into the glacier as it advanced southeasterly across what is now New Hampshire. Underneath the glacier, material was smeared along the land's surface as compact deposits of lodgment till or basal till. Less dense deposits of ablation till were draped across the landscape when the glacier stagnated and melted in place. Many private water wells are dug in till. Although yields vary greatly seasonally and in different wells, well yields from till are generally less than 5 gallons per minute.

Bedrock: Bedrock is the solid material that underlies all unconsolidated material (soil, till, stratified drift) and makes up the earth's crust. In New Hampshire, where porous rock such as limestone or sandstone is rare, groundwater is available in fractures, or cracks, in bedrock. Hence, fractured bedrock formations can serve as aquifers. The vast majority of home wells constructed since 1984 have been drilled in bedrock. While almost any site in New Hampshire can support a well with sufficient yield to serve a single-family home, relatively few sites can support a municipal water supply well. Stratified-Drift Aquifers: Stratified-drift material, unlike till, is composed of glacial sediments transported and deposited by melt-water. It is stratified or sorted into discrete horizontal or dipping layers which reflect changes in depositional environments as the last continental ice sheet retreated 10,000 to 14,000 years ago. In general, the coarser sand and gravel deposits were laid down closer to the melting glacier, in swift-moving water. Among these ice-contact deposits are eskers, kames, kame terraces, and ice- contact deltas. All are characterized by sorted deposits in discrete layers.

Sand and gravel deposits are often buried or surrounded by more fine-grained outwash sediments which were "washed out" of the melting ice front as it retreated further to the north. Where melt-water streams entered standing bodies of water, glacial lake deltas were formed. The finest sediments settled to the lake bottom in quieter water while coarser material formed fan-shaped delta deposits in the lake at the mouth of the stream. Over time, deltas advanced over the fine-grained lake bottom sediments into deeper waters of the lake.

Development of groundwater supplies in New Hampshire has been most successful in thick, saturated deposits of sand and gravel. These are stratified-drift aquifers. The coarser deposits are characterized by their high hydraulic conductivity which allows effective groundwater movement and storage. In contrast, fine-grained glacial lake sediments, in spite of their high capacity to store water, have a very low hydraulic conductivity because water is retained in the small pore spaces by the force of surface tension which inhibits free drainage.

Hydraulic conductivity: Hydraulic conductivity is an indication of the ease with which water may pass through a given porous material. In this report, it is measured in feet per day.

Saturated Thickness: Saturation is said to occur in a porous, permeable formation when all of the interconnected pores or fractures are filled with water. The saturated thickness of a stratified-drift aquifer is the difference between the elevation of the water table and the elevation of bedrock (or the bottom of the aquifer). This distance is measured in feet.

Transmissivity: Transmissivity is the product of the hydraulic conductivity of the aquifer material and the saturated thickness of the aquifer. Transmissivity measures the ability of the aquifer to produce water. Values of transmissivity are in units of feet squared per day (ft^2/d). It is important to understand that the most productive areas are characterized by deposits having both high hydraulic conductivity and significant saturated thickness.

APPENDIX C

NHDES SANITARY PROTECTIVE RADII FOR WATER-SUPPLY WELLS

Permitted Daily Production Volume (gpd)	Permitted Daily Production Volume (gpm)	Sanitary Protective Radius (ft)	FGWA Comment
< 14,401	<10	150	Insufficient Quantity
14,401 - 28,800	10 – 20	175	Insufficient Quantity
28,801 - 57,600	20 – 40	200	Insufficient Quantity
57,601 - 86,400	40 – 60	250	Insufficient Quantity
86,401 - 115,200	60 – 80	300	75 gpm radius
115,201 - 144,000	80 – 100	350	No Equivalent USGS Transmissivity
> 144,000	>100	400	150 gpm radius

Table 38**.** NHDES Sanitary Protective Radii for Water-Supply Wells. The sanitary protective radii required by NHDES as a function of yield. The 300 ft and 400 ft radii apply to the 75 gpm and 150+ gpm yield classes of this study.

APPENDIX D

BUFFERS USED IN THE FAVORABLE GRAVEL WELL ANALYSIS FOR POTENTIAL CONTAMINATION SOURCES

DES Project Type	Description	Buffer (ft)
AST	Above ground storage tank	SPR
GWRELDET	Sites which have groundwater release detection permits and no other defined project type	1000
HOLDING TANK	Example: temporary storage of garage wastes	SPR
TRI	Toxic Release Inventory (air)	SPR
LAND/PRP	Proposed landfill	1000
LAND/LN	Lined landfills	
LWW/LAG	Lined wastewater lagoon	1000
MINING SITES	Sand/gravel or bedrock mine	0
OLD DUMP	Old Dump Sites (non-landfill)	SPR
PESTICIDES	Property boundaries reported as pesticide application.	SPR
RCRA	Resource Conservation & Recovery Act- registered hazardous waste handlers	SPR
REMED/RCHG	Remediation recharge-treated or remediated groundwater discharged to groundwater	0
SALT STORAGE COVERED	Covered salt storage	1000
STORM DRAINS	Storm drains	SPR
TRANS.STA	Solid waste transfer stations with groundwater permits	1000
UST	Underground storage tank facilities	SPR
Cultural Features	Other cultural features than those above	SPR

Table 39. Buffers for Potential Contamination Sites. SPR indicates that the sanitary protective radius is the buffer used in the Favorable Gravel-Well Analysis (NHDES 1998b).

APPENDIX E

BUFFERS USED IN THE FAVORABLE GRAVEL WELL ANALYSIS FOR KNOWN CONTAMINATION SOURCES

NHDES Project Type	Description	Buffer (ft)*
CERCLA	Superfund Site	1000
COMPLAINTS	Complaints or referrals (town files)	1000
FUEL	Leaking bulk storage facilities of fuel oil	1000
H_2O SAMPLE	Isolated groundwater sample	1000
HAZWSTE	Hazardous waste project	1000
JUNKYD	Junkyards with more than 50 autos	1000
LAND/UNLN	Existing unlined landfill or landfill closure	1000
LAST	Leaking above ground bulk storage facilities containing motor fuel	1000
LUST	Leaking underground storage tank	1000
MOST	Leaking motor oil storage tank	1000
NPDES	Pollution discharge to surface water	1000
OPUF	Leaking residential or commercial heating tanks	1000
RAPIDINF	Rapid infiltration basins	1000
SALT STORAGE UNCOVERED	Uncovered salt storage	1000
SEPT/LAG	Septage lagoons	1000
SEPTIC	Subsurface wastewater disposal >20,000 gpd	1000
SITEEVAL	Unsolicited site assessment/hazwaste types	1000
SLUD/LAG	Sludge lagoons	1000
SLUDGAP	Sludge application sites	SPR
SNOW DUMPS	Snow Dumps	1000
SPILL/RLS	Spill or release	1000
SPRAYIRR	Spray irrigation projects	SPR
STUMP/DEMO	Municipal or commercial stump or demo dump	1000
TRI	Toxic releases to air and water inventory	SPR
UIC	Underground injection control-discharge of benign wastewaters not requiring a groundwater discharge permit or request to cease a discharge	SPR
UWW/LAG	Unlined wastewater lagoons	1000

Table 40. Buffers for Known Contamination Sites. SPR indicates that the sanitary protective radius is the buffer used in the Favorable Gravel-Well Analysis (NHDES 1998b).

APPENDIX F

PROTECTED AND UNPROTECTED AQUIFER PAIRS BY TOWN, ASSEMBLED FOR STATISTICAL T-TEST

Aquifer-Protection Town-Pairs for T-Test					
Aquifer Protection			No Known Aquifer Protection		
FIPS	Town	2000 OSDA75L per Capita (mi^2/p)	FIPS	Town	2000 OSDA75L per Capita (mi^2/p)
1005	Alton	3.87E-03	9090	Haverhill	5.91E-03
1025	Gilford	1.05E-02	5040	Jaffrey	1.31E-02
1040	Meredith	4.55E-03	15155	Rye	4.32E-03
1050	Sanbornton	1.36E-02	9185	Wentworth	1.15E-02
3060	Madison	1.43E-03	3040	Freedom	1.98E-03
5070	Rindge	1.94E-03	9160	Plymouth	3.22E-03
5115	Winchester	6.20E-03	13010	Andover	6.56E-03
7020	Berlin	1.03E-02	9120	Lisbon	9.91E-04
7145	Northumberland	3.16E-03	7195	Stratford	2.89E-03
9010	Ashland	6.18E-03	9100	Holderness	4.08E-03
9015	Bath	4.03E-03	3085	Tuftonboro	7.64E-03
9055	Easton	4.33E-03	13130	Webster	7.68E-03
9070	Franconia	6.77E-03	7050	Columbia	1.35E-02
9135	Lyme	8.16E-03	9095	Hebron	1.64E-03
11030	Deering	1.15E-03	13080	Hopkinton	2.44E-03
11055	Hancock	2.12E-03	9065	Enfield	2.74E-03
11115	New Boston	4.98E-03	9115	Lincoln	6.96E-03
11120	New Ipswich	2.69E-03	1055	Tilton	3.20E-03
11145	Weare	2.81E-03	17005	Barrington	1.02E-03
11150	Wilton	1.68E-02	7120	Lancaster	3.06E-03
13020	Bow	3.04E-03	9190	Woodstock	1.09E-02
13075	Hooksett	9.60E-04	5035	Hinsdale	2.12E-03
13090	Newbury	1.62E-03	13025	Bradford	7.87E-03
13100	Northfield	3.19E-03	9130	Lyman	2.09E-02
13105	Pembroke	1.89E-03	13085	Loudon	1.71E-03
15010	Auburn	5.38E-03	7190	Stewartstown	8.25E-03
15015	Brentwood	2.65E-03	5065	Richmond	1.41E-03
15055	Exeter	2.49E-03	13055	Epsom	2.42E-03
15125	North Hampton	1.56E-03	11040	Goffstown	9.25E-03
15140	Plaistow	8.15E-03	9085	Hanover	1.67E-03
17015	Durham	6.58E-03	19060	Springfield	6.52E-03
17020	Farmington	2.38E-03	7045	Colebrook	3.04E-03
17045	New Durham	2.02E-03	9150	Orford	1.12E-03
17050	Rochester	2.96E-03	5045	Keene	3.02E-03
17060	Somersworth	2.18E-03	17040	Milton	3.68E-03
19010	Charlestown	6.04E-03	15095	Londonderry	6.89E-03
19050	Newport	5.91E-04	13060	Franklin	7.66E-04

APPENDIX G

CHARACTERISTICS OF 1300 VERIFICATION WELLS

Characteristics for 1300 Verification Wells

Table-Specific Acronyms

WRB: New Hampshire Geologic Survey well identification number
AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom
STI: Saturated Thickness Interval for the Study Area
OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

						Depth (ft bgs) to		Interpolated (ft msl)		Saturated Thickness (ft)					
											Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
1	002.0092	07-AUG-1998	saco	40	1	260	0	520.0	513.7	na	na	na	0	40	O
2	007.0267	20-OCT-1989	nrpc	20	1	99	0	250.0	216.0	na	na	na	60	80	O
3	007.0269	10-NOV-1989	nrpc	20	1	15	0	271.0	268.7	na	na	na	0	10	O
4	015.0658	08-APR-1998	coch	20	1	28	0	0.0	0.0	na	na	na	20	40	O
5	015.0705	31-DEC-1998	coch	20	1	15	0	0.0	0.0	na	na	na	10	20	O
6	020.1775	11-JUL-1997	mdmk	20	1	26	0	240.0	237.0	na	na	na	0	20	O
7	033.0162	29-MAR-1988	nrpc	20	1	35	0	342.8	324.8	na	na	na	0	10	O
8	033.0181	07-OCT-1988	nrpc	20	1	74	0	260.5	244.0	na	na	na	20	40	O
9	033.0799	24-OCT-1997	nrpc	20	1	10	0	421.0	414.0	na	na	na	0	10	O
10	043.0039	22-JUN-1998	saco	40	1	20	0	517.3	512.2	na	na	na	0	40	O
11	071.0288	19-MAR-1998	lamp	20	1	55	0	105.0	87.9	na	na	na	0	20	O
12	074.0050	09-DEC-1998	saco	40	1	60	0	0.0	0.0	na	na	na	0	40	O
13	078.0356	12-JUN-1997	lamp	20	1	25	0	152.0	134.5	na	na	na	0	20	O
14	089.0517	11-NOV-1997	lamp	20	1	15	0	165.0	153.8	na	na	na	0	20	O
15	089.0577	13-MAY-1998	lamp	20	1	11	0	190.0	158.0	na	na	na	0	20	O
16	098.0007	17-DEC-1985	cont	40	1	100	0	699.0	678.0	na	na	na	0	40	O
17	118.0233	27-NOV-1998	pemi	40	1	100	0	581.0	556.1	na	na	na	0	40	O
18	119.0353	14-APR-1989	nrpc	20	1	20	0	206.7	200.0	na	na	na	10	20	O
19	119.0637	26-JUL-1994	nrpc	20	1	24	0	224.7	200.0	na	na	na	0	10	O
20	119.0642	30-SEP-1994	nrpc	20	1	18	0	247.1	234.0	na	na	na	0	10	O
21	119.0712	12-JAN-1995	nrpc	20	1	30	0	218.5	214.0	na	na	na	0	10	O
22	129.0564	22-NOV-1997	lwmk	20	1	12	0	0.0	0.0	na	na	na	0	20	O
23	135.0424	29-MAY-1997	lamp	20	1	12	0	0.0	0.0	na	na	na	0	20	O
24	159.0313	18-OCT-1995	nrpc	20	1	40	0	294.5	281.0	na	na	na	0	10	O
25	159.0323	21-DEC-1993	nrpc	20	1	20	0	291.0	273.5	na	na	na	0	10	O
26	167.0693	13-AUG-1997	mdmk	20	1	15	0	500.0	499.1	na	na	na	40	60	O
27	171.0189	26-SEP-1996	lamp	20	1	31	0	0.0	0.0	na	na	na	0	20	O
28	188.0411	29-OCT-1992	nrpc	20	1	12	0	0.0	0.0	na	na	na	0	10	O
29	200.0732	30-DEC-1997	lamp	20	1	65	0	175.0	160.0	na	na	na	20	40	O
30	207.0065	10-NOV-1997	lwmk	20	1	40	0	108.7	82.2	na	na	na	0	20	O
31	211.0042	06-MAY-1985	lamp	20	1	10	0	0.0	0.0	na	na	na	0	20	O
32	212.0214	03-SEP-1997	saco	40	1	40	0	678.0	662.0	na	na	na	0	40	O
33	236.0227	26-NOV-1997	pemi	40	1	80	0	560.0	556.0	na	na	na	40	80	O
34	256.0789	29-NOV-1994	lwmk	20	1	30	0	0.0	221.0	na	na	na	0	20	O
35	239.0388	31-AUG-2000	winn	20	1	75	0	554.0	540.0	na	na	na	0	20	O
36	149.0387	11-AUG-1999	saco	40	1	25	0	490.0	478.0	na	na	na	0	40	O
37	016.0255	17-AUG-1999	saco	40	1	90	0	533.0	520.0	na	na	na	40	80	O
38	258.0438	23-SEP-1999	winn	20	1	12	0	721.0	718.0	na	na	na	0	20	O
39	016.0258	25-SEP-1999	saco	40	1	135	0	631.3	626.9	na	na	na	80	120	O
40	014.0343	30-SEP-1999	upmk	20	1	10	0	522.0	505.0	na	na	na	0	20	O
41	002.0099	02-JUL-1999	saco	40	1	70	0	478.0	475.0	na	na	na	40	80	O
42	196.0613	30-JUL-1999	lwmk	20	1	23	0	98.4	98.0	na	na	na	0	20	O
43	088.0284	27-JAN-2000	saco	40	1	65	0	389.0	386.4	na	na	na	40	80	O
44	079.0397	14-JUN-2000	upmk	20	1	15	0	0.0	0.0	na	na	na	0	20	O
45	187.0464	26-JUL-2000	saco	40	1	40	0	0.0	0.0	na	na	na	0	40	O
46	135.0528	04-OCT-2000	lamp	20	1	30	0	159.0	133.5	na	na	na	20	40	O
47	015.0832	23-OCT-2000	lamp	20	1	45	0	170.0	160.0	na	na	na	0	20	O
48	039.0068	23-OCT-2000	mdct	40	1	155	0	1567.7	1564.0	na	na	na	40	80	O
49	088.0287	09-NOV-2000	saco	40	1	165	0	465.0	415.0	na	na	na	40	80	O
50	088.0288	15-DEC-2000	saco	40	1	12	0	413.5	408.4	na	na	na	0	40	O

Characteristics for 1300 Verification Wells

Table-Specific Acronyms

WRB: New Hampshire Geologic Survey well identification number

AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom

STI: Saturated Thickness Interval for the Study Area

OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Depth (ft bgs) to Bedrock	Depth (ft bgs) to Till	Interpolated (ft msl) Land Elev	Interpolated (ft msl) Water Table	Saturated Thickness (ft) Calc ST	Actual Class Min	Actual Class Max	Mapped Class Min	Mapped Class Max	OCU
51	016.0273	21-DEC-2000	saco	40	1	130	0	736.2	730.4	na	na	na	0	40	O
52	079.0465	16-JAN-2001	upmk	20	1	10	0	370.0	366.0	na	na	na	0	20	O
53	138.0129	15-AUG-2001	mdct	40	1	20	0	696.6	642.7	na	na	na	0	20	O
54	075.0189	31-MAY-2001	saco	40	1	40	0	438.0	417.5	na	na	na	0	40	O
55	241.0617	18-MAY-2001	coch	20	1	40	0	610.0	600.0	na	na	na	20	40	O
56	061.0595	24-MAY-2000	lamp	20	1	55	0	290.0	248.6	na	na	na	0	20	O
57	015.0947	04-APR-2001	coch	20	1	50	0	168.4	156.9	na	na	na	40	60	O
58	258.0513	05-JUN-2001	winn	20	1	35	0	614.1	601.9	na	na	na	0	20	O
59	239.0462	20-JUL-2001	winn	20	1	90	0	762.0	710.5	na	na	na	0	20	O
60	187.0527	08-AUG-2001	saco	40	1	180	0	409.0	407.0	na	na	na	120	160	O
61	032.0080	06-JUN-2002	coch	20	1	21	0	685.2	664.5	na	na	na	0	20	O
62	033.0459	12-FEB-1992	nrpc	20	1	10	0	257.5	231.0	na	na	na	0	10	O
63	075.0140	25-AUG-1998	saco	40	1	70	0	464.5	440.0	na	na	na	40	80	O
64	093.0709	05-AUG-1997	mdmk	20	1	20	0	176.0	168.8	na	na	na	0	20	O
65	165.0035	30-AUG-1989	nrpc	20	1	100	0	190.6	173.2	na	na	na	10	20	O
66	167.0682	16-SEP-1997	mdmk	20	1	70	0	429.0	0.0	na	na	na	0	20	O
67	178.0320	07-OCT-1997	lwmk	20	1	55	0	0.0	0.0	na	na	na	0	20	O
68	188.0304	01-JUL-1989	nrpc	20	1	26	0	152.6	148.8	na	na	na	0	10	O
69	200.0721	05-SEP-1997	lamp	20	1	12	0	207.0	205.4	na	na	na	0	20	O
70	164.1264	03-JAN-2003	winn	20	1	10	0	521.0	504.0	na	na	na	0	20	O
71	247.1426	30-JUL-2001	mdmk	20	1	48	0	394.3	380.0	na	na	na	0	20	O
72	249.0103	30-MAY-2002	pemi	40	1	22	0	623.9	592.6	na	na	na	0	40	O
73	243.0346	04-OCT-2002	cont	40	1	56	0	426.2	409.8	na	na	na	0	40	O
74	247.1446	20-JUL-2000	cont	40	1	62	0	488.0	470.0	na	na	na	0	40	O
75	233.0418	19-AUG-2002	saco	40	1	60	0	443.6	423.0	na	na	na	80	120	O
76	239.0500	25-APR-2002	winn	20	1	25	0	610.6	608.6	na	na	na	0	20	O
77	010.0115	04-SEP-2002	pemi	40	1	18	0	0.0	0.0	na	na	na	0	40	O
78	148.0196	09-SEP-2002	coch	20	1	20	0	0.0	0.0	na	na	na	0	10	O
79	239.0502	24-SEP-2002	winn	20	1	30	0	0.0	0.0	na	na	na	0	20	O
80	075.0192	31-OCT-2002	saco	40	1	235	0	452.5	426.7	na	na	na	40	80	O
81	014.0424	16-NOV-2002	upmk	20	1	60	0	515.0	500.0	na	na	na	0	20	O
82	029.0628	23-NOV-2002	lamp	20	1	25	0	0.0	0.0	na	na	na	0	20	O
83	207.0090	05-DEC-2002	lwmk	20	1	12	0	69.2	58.0	na	na	na	20	40	O
84	016.0296	10-DEC-2002	saco	40	1	35	0	593.5	589.3	na	na	na	40	80	O
85	052.0575	11-DEC-2002	saco	40	1	80	0	481.5	476.4	na	na	na	0	40	O
86	088.0339	12-FEB-2003	saco	40	1	115	0	460.0	436.4	na	na	na	0	40	O
87	170.0418	17-FEB-2003	coch	20	1	60	0	535.0	0.0	na	na	na	80	100	O
88	046.0357	19-FEB-2003	upmk	20	1	60	0	355.0	338.7	na	na	na	0	20	O
89	231.0265	15-NOV-2001	cont	40	1	12	0	838.0	827.0	na	na	na	0	40	O
90	212.0278	06-FEB-2002	saco	40	1	220	0	721.7	673.7	na	na	na	0	40	O
91	112.0277	28-AUG-2002	mdct	40	1	99	0	776.7	772.2	na	na	na	0	20	O
92	187.0541	07-DEC-2001	saco	40	1	165	0	409.0	407.0	na	na	na	160	200	O
93	182.0682	29-OCT-2001	upmk	20	1	12	0	587.0	578.0	na	na	na	0	20	O
94	183.0776	28-FEB-2002	lamp	20	1	25	0	0.0	0.0	na	na	na	0	20	O
95	149.0454	03-JAN-2002	saco	40	1	45	0	523.7	506.8	na	na	na	0	40	O
96	149.0455	18-JUN-2002	saco	40	1	185	0	476.0	464.9	na	na	na	120	160	O
97	149.0459	05-APR-2002	saco	40	1	115	0	478.0	446.0	na	na	na	80	120	O
98	131.0155	24-OCT-2001	upct	40	1	46	0	878.0	862.0	na	na	na	0	40	O
99	116.0433	11-APR-2002	cont	40	1	375	0	774.1	764.0	na	na	na	0	40	O
100	098.0174	15-NOV-2002	cont	40	1	246	0	882.8	840.0	na	na	na	0	40	O

Characteristics for 1300 Verification Wells

Table-Specific Acronyms

WRB: New Hampshire Geologic Survey well identification number
AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom
STI: Saturated Thickness Interval for the Study Area
OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Depth (ft bgs) to Bedrock	Depth (ft bgs) to Till	Interpolated (ft msl) Land Elev	Interpolated (ft msl) Water Table	Calc ST	Saturated Thickness (ft) Actual Class Min	Actual Class Max	Mapped Class Min	Mapped Class Max	OCU
101	088.0340	14-NOV-2001	saco	40	1	15	0	418.6	414.5	na	na	na	40	80	O
102	088.0345	02-MAY-2002	saco	40	1	15	0	422.0	407.0	na	na	na	0	40	O
103	075.0193	23-MAY-2002	saco	40	1	180	0	484.0	480.0	na	na	na	0	40	O
104	052.0585	06-MAR-2002	saco	40	1	80	0	443.1	430.2	na	na	na	0	40	O
105	052.0588	18-JUL-2002	saco	40	1	90	0	462.9	449.0	na	na	na	40	80	O
106	052.0589	10-JUL-2002	saco	40	1	50	0	488.8	480.0	na	na	na	0	40	O
107	052.0597	22-APR-2002	saco	40	1	45	0	0.0	0.0	na	na	na	0	40	O
108	051.0589	19-JUL-2000	upmk	20	1	42	0	375.0	333.2	na	na	na	0	20	O
109	015.0973	29-MAY-2002	coch	20	1	50	0	0.0	0.0	na	na	na	0	10	O
110	061.0787	20-JUN-2003	lamp	20	1	14	0	312.0	295.0	na	na	na	0	20	O
111	143.0727	02-NOV-2002	upmk	20	1	10	0	0.0	0.0	na	na	na	0	20	O
112	006.1208	21-MAY-2003	winn	20	1	10	0	640.0	635.8	na	na	na	0	20	O
113	015.1084	19-SEP-2003	lamp	20	1	25	0	146.5	141.0	na	na	na	0	20	O
114	223.0614	01-AUG-2003	coch	20	1	35	0	522.0	517.0	na	na	na	10	20	O
115	241.0705	08-JUL-2003	saco	40	1	15	0	0.0	0.0	na	na	na	0	40	O
116	079.0520	27-AUG-2003	upmk	20	1	25	0	310.0	298.5	na	na	na	0	20	O
117	021.0657	12-SEP-2003	winn	20	1	80	0	503.5	496.5	na	na	na	0	20	O
118	010.0128	17-MAR-2003	pemi	40	1	10	0	0.0	0.0	na	na	na	0	40	O
119	002.0123	18-JUN-2003	saco	40	1	45	0	1278.0	1245.5	na	na	na	0	40	O
120	052.0602	09-JUN-2003	saco	40	1	135	0	452.0	420.0	na	na	na	0	40	O
121	036.0521	17-APR-2003	mdct	40	1	67	0	896.6	871.4	na	na	na	20	40	O
122	058.0145	01-JUL-2003	pemi	40	1	123	0	802.6	788.9	na	na	na	0	40	O
123	187.0557	13-MAR-2003	saco	40	1	125	0	410.0	407.0	na	na	na	80	120	O
124	193.0475	16-OCT-2003	upct	40	1	37	0	1599.0	1597.0	na	na	na	0	40	O
125	197.0237	23-MAY-2003	pemi	40	1	22	0	556.6	554.0	na	na	na	0	40	O
126	202.0625	05-DEC-2001	lwct	40	1	10	0	0.0	0.0	na	na	na	0	40	O
127	236.0308	05-MAR-2003	pemi	40	1	44	0	707.4	674.4	na	na	na	40	80	O
128	236.0310	20-MAR-2003	pemi	40	1	115	0	582.2	554.2	na	na	na	80	120	O
129	236.0314	18-JUN-2003	pemi	40	1	35	0	660.0	634.6	na	na	na	0	40	O
130	253.0209	18-APR-2002	cont	40	1	20	0	768.4	728.1	na	na	na	0	40	O
131	253.0229	03-APR-2003	cont	40	1	25	0	667.0	655.0	na	na	na	0	40	O
132	145.0143	06-NOV-2003	mdct	40	1	28	0	0.0	0.0	na	na	na	0	20	O
133	016.0334	21-OCT-2003	saco	40	1	115	0	660.0	632.5	na	na	na	40	80	O
134	016.0337	23-DEC-2003	saco	40	1	120	0	547.5	511.0	na	na	na	40	80	O
135	036.0580	20-OCT-2003	mdct	40	1	55	0	814.3	810.0	na	na	na	20	40	O
136	037.0619	19-DEC-2003	lamp	20	1	12	0	325.0	321.3	na	na	na	0	20	O
137	061.0821	05-DEC-2003	lamp	20	1	12	0	437.0	431.0	na	na	na	0	20	O
138	067.0355	13-OCT-2003	coch	20	1	85	0	10.0	2.0	na	na	na	10	20	O
139	239.0547	23-DEC-2003	winn	20	1	92	0	528.3	517.5	na	na	na	0	20	O
140	259.0094	13-NOV-2003	pemi	40	1	49	0	687.0	648.0	na	na	na	0	40	O
141	183.0874	14-NOV-2003	lamp	20	1	18	0	453.0	451.0	na	na	na	0	20	O
142	231.0307	29-JAN-2004	cont	40	1	60	0	909.1	906.0	na	na	na	0	40	O
143	031.0244	25-MAY-2004	pemi	40	1	15	0	600.0	586.0	na	na	na	0	40	O
144	249.0122	23-MAY-2004	pemi	40	1	50	0	610.1	592.6	na	na	na	0	40	O
145	172.0355	24-APR-2004	pemi	40	1	180	0	710.0	661.8	na	na	na	0	40	O
146	239.0560	02-APR-2004	winn	20	1	80	0	580.0	561.0	na	na	na	0	20	O
147	164.1454	08-APR-2004	winn	20	1	58	0	522.1	515.9	na	na	na	0	20	O
148	129.0873	03-JUN-2004	lwmk	20	1	15	0	0.0	0.0	na	na	na	0	20	O
149	239.0564	24-JUN-2004	winn	20	1	13	0	0.0	0.0	na	na	na	0	20	O
150	006.1337	14-JUN-2004	winn	20	1	15	0	539.0	536.8	na	na	na	20	40	O

Characteristics for 1300 Verification Wells																
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								Interpolated		Saturated Thickness (ft)						
						Depth		(ft msl)			Actual		Mapped			
		Date	USGS	(ft)		(ft bgs) to		Land	Water	Calc	Class		Class			
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU	
151	052.0653	23-JUN-2004	saco	40	1	75	0	419.1	412.7	na	na	na	0	40	O	
152	002.0135	08-JUN-2004	saco	40	1	50	0	560.0	553.7	na	na	na	0	40	O	
153	052.0655	19-JUN-2004	saco	40	1	165	0	495.3	470.3	na	na	na	120	160	O	
154	006.1354	07-JUL-2004	winn	20	1	20	0	553.7	520.0	na	na	na	0	20	O	
155	052.0661	26-JUL-2004	saco	40	1	165	0	443.1	407.0	na	na	na	80	120	O	
156	164.1483	15-MAR-2004	winn	20	1	30	0	561.0	541.0	na	na	na	0	20	O	
157	021.0720	05-MAY-2004	winn	20	1	10	0	802.0	760.0	na	na	na	0	20	O	
158	016.0350	01-SEP-2004	saco	40	1	120	0	729.1	726.2	na	na	na	0	40	O	
159	061.0853	13-OCT-2004	upmk	20	1	50	0	530.0	520.0	na	na	na	20	40	O	
160	203.0704	02-DEC-2004	coch	20	1	18	0	253.0	0.0	na	na	na	10	20	O	
161	187.0651	05-NOV-2004	saco	40	1	50	0	741.0	722.2	na	na	na	0	40	O	
162	149.0528	07-DEC-2004	saco	40	1	145	0	482.0	441.0	na	na	na	40	80	O	
163	052.0682	05-JAN-2005	saco	40	1	35	0	472.0	447.2	na	na	na	0	40	O	
164	210.0600	26-NOV-2004	pemi	40	1	60	0	517.9	480.0	na	na	na	0	40	O	
165	040.0285	11-MAY-2005	winn	20	1	40	0	0.0	0.0	na	na	na	0	20	O	
166	016.0371	09-JUN-2005	saco	40	1	135	0	812.4	800.0	na	na	na	0	40	O	
167	091.0825	17-JUN-2005	upmk	20	1	130	0	630.0	625.0	na	na	na	80	100	O	
168	241.0868	22-JUN-2005	saco	40	1	110	0	576.6	558.0	na	na	na	40	80	O	
169	118.0398	24-MAY-2005	pemi	40	1	55	0	571.9	567.3	na	na	na	0	40	O	
170	088.0421	07-JUL-2005	saco	40	1	227	0	435.0	408.5	na	na	na	80	120	O	
171	225.1006	08-JUN-2005	lamp	20	1	19	0	0.0	0.0	na	na	na	0	20	O	
172	182.0847	11-AUG-2005	upmk	20	1	18	0	585.0	580.0	na	na	na	0	20	O	
173	063.1856	30-AUG-2005	lwmk	20	1	65	0	208.3	206.0	na	na	na	80	100	O	
174	015.1232	01-SEP-2005	coch	20	1	45	0	0.0	0.0	na	na	na	40	60	O	
175	090.0824	08-JUL-2005	winn	20	1	55	0	1000.0	993.2	na	na	na	0	20	O	
176	190.0266	09-NOV-2005	cont	40	1	100	0	724.0	706.0	na	na	na	0	40	O	
177	203.0787	29-NOV-2005	coch	20	1	38	0	0.0	0.0	na	na	na	10	20	O	
178	025.0326	04-NOV-2005	mdct	40	1	13	0	996.2	988.5	na	na	na	0	40	O	
179	052.0730	12-DEC-2005	saco	40	1	14	0	460.0	453.4	na	na	na	0	40	O	
180	233.0538	23-DEC-2005	saco	40	1	17	0	0.0	0.0	na	na	na	0	40	O	
181	127.0359	07-MAR-2006	lamp	20	1	54	0	123.4	120.5	na	na	na	0	20	O	
182	108.0469	01-JUN-2006	mdct	40	1	73	0	499.0	460.0	na	na	na	0	40	O	
183	067.0402	25-MAY-2006	coch	20	1	14	0	0.0	0.0	na	na	na	0	10	O	
184	048.0122	15-JUN-2006	upct	40	1	13	0	1531.2	1525.6	na	na	na	0	40	O	
185	088.0476	19-JUN-2006	cont	40	1	100	0	640.0	631.4	na	na	na	0	40	O	
186	187.0553	19-FEB-2003	saco	40	1	70	50	440.0	408.7	na	na	na	40	80	O	
187	247.1610	15-OCT-2004	mdmk	20	2	29	na	685.0	637.9	-18.1	0	20	20	40	O	
188	236.0402	03-MAY-2005	pemi	40	2	15	na	631.0	598.0	-18.0	0	40	40	80	O	
189	119.0597	20-MAY-1994	nrpc	20	2	38	na	353.0	302.5	-12.5	0	10	20	40	O	
190	119.0608	18-NOV-1994	nrpc	20	2	22	na	343.7	309.5	-12.2	0	10	10	20	O	
191	033.0262	20-AUG-1990	nrpc	20	2	10	na	292.0	270.0	-12.0	0	10	20	40	O	
192	051.0652	22-SEP-2003	upmk	20	2	30	na	339.0	297.0	-12.0	0	20	60	80	O	
193	033.1140	22-NOV-2005	nrpc	20	2	10	na	197.8	176.8	-11.0	0	10	10	20	O	
194	139.0179	05-OCT-1994	nrpc	20	2	20	na	208.5	180.0	-8.5	0	10	10	20	O	
195	007.0461	12-JUL-1994	nrpc	20	2	14	na	248.0	226.2	-7.8	0	10	10	20	O	
196	156.0526	27-JUN-2000	nrpc	20	2	15	na	165.0	142.5	-7.5	0	10	10	20	O	
197	135.0521	19-SEP-2000	lamp	20	2	25	na	185.9	154.0	-6.9	0	20	20	40	O	
198	007.0284	06-OCT-1988	nrpc	20	2	18	na	271.0	248.0	-5.0	0	10	10	20	O	
199	176.0413	30-JAN-2003	lamp	20	2	12	na	118.0	102.0	-4.0	0	20	20	40	O	
200	170.0580	15-SEP-2005	winn	20	2	18	na	607.8	586.0	-3.8	0	20	20	40	O	

Characteristics for 1300 Verification Wells

Table-Specific Acronyms

WRB: New Hampshire Geologic Survey well identification number
AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom
STI: Saturated Thickness Interval for the Study Area
OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

								Interpolated		Saturated Thickness (ft)					
						Depth		(ft msl)			Actual		Mapped		
		Date	USGS	(ft)		(ft bgs) to		Land	Water	Calc	Class		Class		
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU
201	067.0390	05-DEC-2005	coch	20	2	10	na	25.0	11.3	-3.7	0	10	20	40	O
202	139.0148	12-JAN-1993	nrpc	20	2	15	na	145.3	127.3	-3.0	0	10	20	40	O
203	139.0418	15-SEP-2005	nrpc	20	2	10	na	216.0	203.7	-2.3	0	10	10	20	O
204	119.1332	14-JUN-2006	nrpc	20	2	12	na	184.0	170.3	-1.7	0	10	10	20	O
205	189.0300	29-JUN-2001	upmk	20	2	13	na	241.0	227.0	-1.0	0	20	20	40	O
206	078.0552	17-DEC-2002	lamp	20	2	21	na	150.0	128.0	-1.0	0	20	40	60	O
207	033.0724	18-OCT-1996	nrpc	20	2	18	na	265.7	247.0	-0.7	0	10	10	20	O
208	133.0123	13-OCT-1998	lwct	40	2	15	na	452.8	437.2	-0.6	0	40	40	80	O
209	119.0543	09-NOV-1993	nrpc	20	2	38	na	241.0	203.0	0.0	0	10	20	40	O
210	139.0164	14-JAN-1994	nrpc	20	2	20	na	182.2	162.2	0.0	0	10	10	20	O
211	021.0787	25-JUL-2006	winn	20	2	15	na	480.0	465.0	0.0	0	20	20	40	O
212	165.0052	11-JUN-1992	nrpc	20	2	17	na	226.4	210.0	0.6	0	10	10	20	O
213	037.0641	21-SEP-2004	mdmk	20	2	25	na	337.0	314.0	2.0	0	20	20	40	O
214	091.0658	17-JUL-2001	upmk	20	2	30	na	652.2	625.0	2.8	0	20	40	60	O
215	067.0311	11-APR-1999	coch	20	2	20	na	171.3	154.3	3.0	0	10	20	40	O
216	139.0162	08-SEP-1993	nrpc	20	2	31	na	191.5	163.7	3.2	0	10	20	40	O
217	017.0123	08-MAY-2002	mdct	40	2	46	na	743.7	701.0	3.3	0	20	20	40	O
218	156.0304	29-NOV-1989	nrpc	20	2	19	na	223.0	207.5	3.5	0	10	10	20	O
219	033.0205	15-JUN-1988	nrpc	20	2	10	na	236.2	230.0	3.8	0	10	20	40	O
220	119.0296	13-MAY-1988	nrpc	20	2	25	na	194.6	173.4	3.8	0	10	20	40	O
221	119.1329	14-DEC-2005	nrpc	20	2	21	na	215.0	198.5	4.5	0	10	10	20	O
222	239.0409	04-JAN-2001	winn	20	2	12	na	511.0	504.0	5.0	0	20	20	40	O
223	119.0647	29-APR-1995	nrpc	20	2	15	na	208.0	198.0	5.0	0	10	10	20	O
224	139.0091	27-DEC-1990	nrpc	20	2	27	na	209.0	187.7	5.7	0	10	10	20	O
225	112.0274	10-MAY-2001	mdct	40	2	18	na	467.6	455.7	6.1	0	40	40	80	O
226	139.0304	30-APR-1998	nrpc	20	2	17	na	132.0	121.2	6.2	0	10	40	60	O
227	188.0443	26-JUL-1993	nrpc	20	2	26	na	151.2	131.6	6.4	0	10	40	60	O
228	139.0068	23-JUN-1988	nrpc	20	2	21	na	132.0	118.0	7.0	0	10	40	60	O
229	020.2409	29-MAR-2002	mdmk	20	2	18	na	192.0	182.0	8.0	0	20	40	60	O
230	232.0277	17-MAR-1988	lwct	40	2	25	na	536.4	521.0	9.6	0	40	40	80	O
231	239.0394	16-JUN-2000	winn	20	2	20	na	514.0	504.0	10.0	0	20	40	60	O
232	135.0634	08-JUL-2004	coch	20	2	22	na	170.0	158.0	10.0	0	10	10	20	O
233	170.0602	19-JUN-2006	winn	20	2	20	na	539.0	529.5	10.5	0	20	20	40	O
234	119.0522	21-JUN-1993	nrpc	20	2	11	na	202.0	201.8	10.8	10	20	20	40	O
235	028.0248	10-OCT-2005	cont	40	2	15	na	824.0	820.0	11.0	0	40	40	80	O
236	093.1285	20-JUL-2006	mdmk	20	2	33	na	177.0	156.6	12.6	0	20	20	40	O
237	078.0002	15-MAR-1984	lamp	20	2	28	na	165.0	150.0	13.0	0	20	20	40	O
238	013.0900	07-MAR-2005	mdmk	20	2	40	na	313.0	286.0	13.0	0	20	20	40	O
239	171.0280	10-JUL-2006	lamp	20	2	24	na	114.0	103.0	13.0	0	20	20	40	O
240	006.1471	11-AUG-2005	winn	20	2	23	na	593.2	584.1	13.9	0	20	60	80	O
241	241.0759	09-APR-2004	coch	20	2	25	na	596.1	585.2	14.1	0	20	20	40	O
242	036.0680	24-APR-2006	mdct	40	2	17	na	993.9	991.0	14.1	0	20	20	40	O
243	188.0227	22-AUG-1988	nrpc	20	2	22	na	146.7	139.5	14.8	10	20	20	40	O
244	159.0299	21-SEP-1993	nrpc	20	2	27	na	280.0	268.0	15.0	10	20	20	40	O
245	211.0546	29-AUG-1997	lamp	20	2	20	na	217.0	212.0	15.0	0	20	20	40	O
246	242.0233	29-NOV-2000	lwct	40	2	60	na	472.4	428.0	15.6	0	40	40	80	O
247	036.0454	26-AUG-2002	mdct	40	2	22	na	960.8	954.9	16.1	0	20	20	40	O
248	015.1275	08-MAY-2006	coch	20	2	20	na	198.0	195.0	17.0	10	20	40	60	O
249	188.1292	21-JAN-2002	nrpc	20	2	25	na	135.5	127.6	17.1	10	20	20	40	O
250	258.0614	23-JAN-2004	winn	20	2	52	na	648.5	614.0	17.5	0	20	20	40	O

Characteristics for 1300 Verification Wells

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						Depth		Interpolated		Saturated Thickness (ft)					
						(ft bgs) to		(ft msl)			Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
251	078.0681	04-OCT-2005	lamp	20	2	30	na	155.0	142.5	17.5	0	20	40	60	O
252	021.0752	12-SEP-2005	winn	20	2	34	na	505.7	489.9	18.2	0	20	40	60	O
253	119.0289	18-MAR-1988	nrpc	20	2	34	na	203.0	187.3	18.3	10	20	20	40	O
254	146.0300	06-JUN-2006	mdct	40	2	40	na	420.0	398.3	18.3	0	20	20	40	O
255	051.0585	18-JUL-2000	upmk	20	2	60	na	360.0	319.0	19.0	0	20	60	80	O
256	180.0231	23-OCT-2003	lwmk	20	2	31	na	103.0	91.0	19.0	0	20	20	40	O
257	217.0038	29-JUN-2004	coch	20	2	25	na	196.0	190.0	19.0	10	20	40	60	O
258	241.0723	15-JUL-2003	coch	20	2	30	na	520.0	509.3	19.3	0	20	20	40	O
259	188.1406	10-JUL-2003	nrpc	20	2	27	na	129.3	121.7	19.4	10	20	20	40	O
260	045.0630	10-NOV-2003	lwct	40	2	47	na	319.7	292.6	19.9	0	40	40	80	O
261	232.0746	02-AUG-2004	lwct	40	2	25	na	463.1	458.0	19.9	0	40	40	80	O
262	135.0620	06-NOV-2003	lamp	20	2	50	na	144.0	114.0	20.0	20	40	40	60	O
263	241.0863	02-JUN-2005	saco	40	2	30	na	627.4	617.5	20.1	0	40	40	80	O
264	202.0630	22-AUG-2003	lwct	40	2	28	na	1053.1	1046.6	21.5	0	40	40	80	O
265	090.0825	05-JUL-2005	winn	20	2	30	na	552.0	545.0	23.0	20	40	40	60	O
266	122.1115	29-NOV-2003	nrpc	20	2	36	na	121.4	109.2	23.8	20	40	40	60	O
267	139.0422	16-MAR-2006	nrpc	20	2	55	na	132.0	100.8	23.8	20	40	40	60	O
268	035.0463	20-DEC-2005	pemi	40	2	37	na	570.0	557.1	24.1	0	40	80	120	O
269	188.0274	19-SEP-1989	nrpc	20	2	42	na	154.2	137.1	24.9	20	40	60	80	O
270	007.0384	21-JUN-1993	nrpc	20	2	36	na	230.0	219.0	25.0	20	40	40	60	O
271	020.2373	20-JUN-2002	lwmk	20	2	47	na	215.0	193.0	25.0	20	40	60	80	O
272	220.0081	19-AUG-2003	upct	40	2	38	na	1080.0	1067.0	25.0	0	40	40	80	O
273	187.0618	12-MAY-2004	saco	40	2	60	na	569.0	534.1	25.1	0	40	40	80	O
274	188.0222	12-SEP-1988	nrpc	20	2	38	na	155.0	142.2	25.2	20	40	40	60	O
275	232.0802	21-APR-2006	lwct	40	2	46	na	475.7	456.1	26.4	0	40	80	120	O
276	047.0154	25-SEP-2000	lwct	40	2	45	na	346.1	327.6	26.5	0	40	40	80	O
277	022.0083	18-OCT-2001	cont	40	2	45	na	710.0	692.0	27.0	0	40	40	80	O
278	188.0879	19-OCT-1999	nrpc	20	2	30	na	131.9	129.0	27.1	20	40	40	60	O
279	233.0558	29-OCT-2003	saco	40	2	33	na	487.3	483.0	28.7	0	40	40	80	O
280	112.0220	18-NOV-1998	mdct	40	2	30	na	460.0	459.0	29.0	20	40	40	80	O
281	074.0094	29-APR-2006	saco	40	2	45	na	499.0	483.3	29.3	0	40	40	80	O
282	036.0414	07-OCT-1999	mdct	40	2	35	na	944.0	938.8	29.8	20	40	40	80	O
283	241.0510	06-APR-1999	saco	40	2	34	na	562.0	559.0	31.0	0	40	40	80	O
284	051.0686	22-MAR-2004	cont	40	2	50	na	370.5	351.9	31.4	0	40	40	80	O
285	148.0149	31-JUL-1997	lamp	20	2	45	na	95.4	82.3	31.9	20	40	40	60	O
286	139.0382	07-NOV-2000	nrpc	20	2	55	na	138.0	116.0	33.0	20	40	40	60	O
287	232.0708	10-OCT-2003	lwct	40	2	47	na	603.7	590.6	33.9	0	40	40	80	O
288	249.0135	25-JUN-2005	pemi	40	2	35	na	539.0	538.0	34.0	0	40	40	80	O
289	167.1067	02-MAY-2005	mdmk	20	2	57	na	668.0	645.2	34.2	20	40	60	80	O
290	002.0085	19-JUN-1997	saco	40	2	40	na	1241.0	1235.2	34.2	0	40	80	120	O
291	038.0411	16-JUN-2004	upmk	20	2	48	na	327.7	314.1	34.4	20	40	40	60	O
292	016.0229	25-OCT-1997	saco	40	2	45	na	594.9	585.0	35.1	0	40	40	80	O
293	090.0808	24-SEP-2004	winn	20	2	40	na	523.7	519.3	35.6	20	40	40	60	O
294	241.0546	14-APR-1999	saco	40	2	60	na	602.0	577.8	35.8	0	40	40	80	O
295	079.0346	21-APR-1999	upmk	20	2	45	na	313.8	305.0	36.2	20	40	40	60	O
296	165.0085	16-JUN-1994	nrpc	20	2	38	na	113.9	113.0	37.1	20	40	40	60	O
297	122.1151	15-SEP-2004	nrpc	20	2	48	na	139.8	130.0	38.2	20	40	40	60	O
298	007.0339	11-SEP-1991	nrpc	20	2	65	na	221.0	194.2	38.2	20	40	60	80	O
299	241.0755	05-APR-2004	saco	40	2	47	na	488.6	480.0	38.4	0	40	40	80	O
300	025.0289	29-JUL-2004	mdct	40	2	62	na	1074.7	1051.3	38.6	20	40	120	160	O

Characteristics for 1300 Verification Wells

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								Interpolated		Saturated Thickness (ft)					
						Depth		(ft msl)			Actual		Mapped		
		Date	USGS	(ft)		(ft bgs) to		Land	Water	Calc	Class		Class		
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU
301	122.1076	19-JUL-2002	nrpc	20	2	54	na	114.9	100.0	39.1	20	40	40	60	O
302	038.0333	19-SEP-2002	upmk	20	2	88	na	312.3	263.7	39.4	20	40	40	60	O
303	203.0402	16-FEB-1999	coch	20	2	65	na	250.0	225.1	40.1	40	60	60	80	O
304	021.0767	11-OCT-2005	winn	20	2	50	na	487.5	482.0	44.5	40	60	60	80	O
305	007.1138	07-NOV-2005	nrpc	20	2	62	na	228.5	211.4	44.9	40	60	60	80	O
306	111.0004	12-DEC-1997	saco	40	2	55	na	505.1	498.0	47.9	40	80	80	120	O
307	254.0067	23-SEP-1987	nrpc	20	2	53	na	476.7	472.0	48.3	40	60	60	80	O
308	183.0768	24-OCT-2001	lamp	20	2	67	na	157.0	140.0	50.0	40	60	60	80	O
309	117.0173	17-SEP-2001	lwct	40	2	68	na	334.6	316.9	50.3	40	80	80	120	O
310	165.0190	31-OCT-2003	nrpc	20	2	64	na	203.7	190.0	50.3	40	60	60	80	O
311	057.0187	17-MAY-2006	mdct	40	2	67	na	876.0	860.0	51.0	40	80	80	120	O
312	007.0390	11-SEP-1993	nrpc	20	2	66	na	232.0	220.0	54.0	40	60	80	100	O
313	015.1112	18-FEB-2004	coch	20	2	59	na	153.0	150.0	56.0	40	60	60	80	O
314	241.0935	26-APR-2006	saco	40	2	95	na	620.0	585.9	60.9	40	80	80	120	O
315	078.0649	01-JUL-2005	lamp	20	2	70	na	122.5	117.0	64.5	60	80	100	120	O
316	232.0720	31-JUL-2003	lwct	40	2	85	na	476.6	460.0	68.4	40	80	80	120	O
317	039.0090	04-JUN-2004	mdct	40	2	76	na	1469.2	1464.2	71.0	40	80	80	120	O
318	088.0415	07-FEB-2005	saco	40	2	95	na	430.0	407.0	72.0	40	80	80	120	O
319	236.0303	15-AUG-2002	pemi	40	2	91	na	600.0	581.4	72.4	40	80	80	120	O
320	086.0225	06-OCT-2004	mdct	40	2	86	na	1086.8	1077.3	76.5	40	80	80	120	O
321	186.0191	13-DEC-2003	mdct	40	2	100	na	422.0	398.9	76.9	40	80	80	120	O
322	242.0313	05-MAR-2004	lwct	40	2	90	na	264.4	252.8	78.4	40	80	80	120	O
323	090.0028	23-DEC-1985	winn	20	2	85	na	510.0	504.0	79.0	60	80	80	100	O
324	161.0494	16-JUN-2005	coch	20	2	97	na	430.0	413.0	80.0	80	100	120	140	O
325	187.0407	07-MAY-1997	saco	40	2	130	na	460.0	418.0	88.0	80	120	120	160	O
326	052.0683	11-JAN-2005	saco	40	2	100	na	476.7	470.0	93.3	80	120	120	160	O
327	148.0195	23-SEP-2002	coch	20	2	130	na	156.3	120.0	93.7	80	100	120	140	O
328	232.0656	18-DEC-2001	lwct	40	2	115	na	515.0	500.0	100.0	80	120	120	160	O
329	206.0234	12-AUG-2005	pemi	40	2	120	na	527.0	509.0	102.0	80	120	160	200	O
330	161.0474	27-MAY-2005	coch	20	2	134	na	438.0	413.0	109.0	100	120	120	140	O
331	252.0225	14-MAY-2004	mdct	40	2	130	na	1030.9	1017.0	116.1	80	120	120	160	O
332	035.0186	28-APR-1998	pemi	40	2	190	na	645.9	605.5	149.6	120	160	160	200	O
333	206.0185	30-JAN-2002	pemi	40	2	208	na	520.0	500.0	188.0	160	200	240	280	O
334	242.0328	10-AUG-2005	lwct	40	2	243	na	301.8	275.6	216.8	200	240	280	320	O
335	033.0161	31-MAR-1988	nrpc	20	2	11	na	410.1	366.0	-33.1	0	10	0	10	C
336	033.0697	11-JUN-1996	nrpc	20	2	10	na	324.8	286.4	-28.4	0	10	0	10	C
337	145.0157	30-AUG-2005	mdct	40	2	21	na	933.6	886.7	-25.9	0	40	0	40	C
338	138.0167	02-MAY-2003	mdct	40	2	16	na	724.4	683.0	-25.4	0	20	0	20	C
339	119.0300	04-MAY-1988	nrpc	20	2	22	na	255.9	210.0	-23.9	0	10	0	10	C
340	087.0235	28-NOV-2005	pemi	40	2	40	na	446.5	382.9	-23.6	0	40	0	40	C
341	230.0102	16-MAY-2005	lwct	40	2	18	na	561.3	520.0	-23.3	0	40	0	40	C
342	139.0155	07-JUL-1992	nrpc	20	2	10	na	212.0	179.0	-23.0	0	10	0	10	C
343	021.0762	06-MAY-2005	winn	20	2	10	na	886.8	854.8	-22.0	0	20	0	20	C
344	033.0797	05-DEC-1997	nrpc	20	2	10	na	347.8	319.6	-18.2	0	10	0	10	C
345	119.0555	29-OCT-1992	nrpc	20	2	19	na	280.0	244.0	-17.0	0	10	0	10	C
346	234.0152	06-AUG-2001	mdmk	20	2	15	na	955.6	924.0	-16.6	0	20	0	20	C
347	120.0432	15-JAN-1998	mdmk	20	2	10	na	280.0	253.5	-16.5	0	20	0	20	C
348	206.0216	02-APR-2004	pemi	40	2	38	na	614.5	560.0	-16.5	0	40	0	40	C
349	143.0595	15-MAR-2000	upmk	20	2	25	na	369.0	328.2	-15.8	0	20	0	20	C
350	119.1229	17-NOV-2003	nrpc	20	2	10	na	230.1	205.0	-15.1	0	10	0	10	C

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Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Depth (ft bgs) to Bedrock	Depth (ft bgs) to Till	Interpolated (ft msl) Land Elev	Interpolated (ft msl) Water Table	Calc ST	Saturated Thickness (ft) Actual Class Min	Actual Class Max	Mapped Class Min	Mapped Class Max	OCU
351	233.0416	29-MAY-2002	saco	40	2	20	na	470.0	435.7	-14.3	0	40	0	40	C
352	206.0182	29-MAY-2002	pemi	40	2	26	na	640.0	600.0	-14.0	0	40	0	40	C
353	223.0682	29-SEP-2005	upct	40	2	35	na	932.8	884.2	-13.6	0	40	0	40	C
354	251.0188	08-MAY-2002	lwct	40	2	17	na	364.2	334.6	-12.6	0	40	0	40	C
355	094.0079	14-NOV-2001	upct	40	2	40	na	1090.0	1037.6	-12.4	0	40	0	40	C
356	256.1601	10-SEP-1998	lwmk	20	2	12	na	210.0	185.7	-12.3	0	20	0	20	C
357	036.0684	29-MAR-2006	mdct	40	2	18	na	1025.0	995.0	-12.0	0	20	0	20	C
358	089.0550	26-SEP-1998	lamp	20	2	15	na	176.3	150.0	-11.3	0	20	0	20	C
359	241.0927	10-APR-2006	saco	40	2	26	na	641.8	605.2	-10.6	0	40	0	40	C
360	033.0757	06-FEB-1997	nrpc	20	2	13	na	376.3	352.8	-10.5	0	10	0	10	C
361	174.0541	09-SEP-2003	mdmk	20	2	10	na	1017.0	996.6	-10.4	0	20	0	20	C
362	033.0135	23-FEB-1988	nrpc	20	2	10	na	429.0	410.0	-9.0	0	10	0	10	C
363	119.0421	09-JUL-1991	nrpc	20	2	21	na	370.0	340.0	-9.0	0	10	0	10	C
364	119.0440	04-NOV-1991	nrpc	20	2	14	na	239.5	217.1	-8.4	0	10	0	10	C
365	207.0103	26-APR-2004	lwmk	20	2	42	na	108.0	57.7	-8.3	0	20	0	20	C
366	007.0465	30-NOV-1994	nrpc	20	2	20	na	296.5	268.3	-8.2	0	10	0	10	C
367	159.0821	25-JUL-2002	nrpc	20	2	16	na	269.0	245.0	-8.0	0	10	0	10	C
368	221.0135	08-JUN-2005	upct	40	2	12	na	1193.8	1173.9	-7.9	0	40	0	40	C
369	258.0630	10-MAY-2004	winn	20	2	13	na	591.7	571.1	-7.6	0	20	0	20	C
370	033.0252	24-JUN-1990	nrpc	20	2	19	na	257.5	231.0	-7.5	0	10	0	10	C
371	033.0643	12-APR-1995	nrpc	20	2	52	na	369.0	309.7	-7.3	0	10	0	10	C
372	086.0167	10-APR-2001	mdct	40	2	13	na	1099.8	1080.0	-6.8	0	40	0	40	C
373	098.0222	24-OCT-2005	cont	40	2	36	na	902.5	860.0	-6.5	0	40	0	40	C
374	134.0431	06-JUL-2005	mdct	40	2	62	na	483.3	415.0	-6.3	0	40	0	40	C
375	232.0694	26-NOV-2003	lwct	40	2	25	na	487.9	457.0	-5.9	0	40	0	40	C
376	033.0680	20-JUL-1995	nrpc	20	2	35	na	340.6	300.0	-5.6	0	10	0	10	C
377	188.0656	29-MAY-1996	nrpc	20	2	15	na	169.1	148.8	-5.3	0	10	0	10	C
378	035.0433	03-JUN-2005	pemi	40	2	15	na	607.1	586.9	-5.2	0	40	0	40	C
379	187.0427	11-NOV-1998	saco	40	2	35	na	540.0	500.0	-5.0	0	40	0	40	C
380	204.0137	12-DEC-2005	coch	20	2	28	na	91.6	59.0	-4.6	0	10	0	10	C
381	117.0187	09-JUL-2003	lwct	40	2	15	na	277.6	258.3	-4.3	0	40	0	40	C
382	036.0642	17-JUN-2005	mdct	40	2	18	na	835.7	814.1	-3.6	0	20	0	20	C
383	033.0576	14-JUL-1994	nrpc	20	2	12	na	371.7	356.2	-3.5	0	10	0	10	C
384	051.0813	19-SEP-2005	upmk	20	2	25	na	320.0	291.8	-3.2	0	20	0	20	C
385	143.0725	14-APR-2003	upmk	20	2	18	na	362.0	341.0	-3.0	0	20	0	20	C
386	089.0884	29-SEP-2004	lamp	20	2	23	na	184.0	158.0	-3.0	0	20	0	20	C
387	007.0356	09-APR-1992	nrpc	20	2	10	na	265.0	252.0	-3.0	0	10	0	10	C
388	187.0548	25-SEP-2003	saco	40	2	26	na	563.5	535.0	-2.5	0	40	0	40	C
389	119.1260	17-JUN-2004	nrpc	20	2	22	na	224.1	200.0	-2.1	0	10	0	10	C
390	119.0479	15-OCT-1992	nrpc	20	2	25	na	372.0	345.0	-2.0	0	10	0	10	C
391	159.0234	22-MAY-1991	nrpc	20	2	14	na	291.0	275.0	-2.0	0	10	0	10	C
392	190.0219	31-OCT-2001	cont	40	2	20	na	719.0	697.2	-1.8	0	40	0	40	C
393	119.0443	20-DEC-1991	nrpc	20	2	10	na	211.7	200.0	-1.7	0	10	0	10	C
394	159.0339	15-FEB-1995	nrpc	20	2	27	na	410.0	381.5	-1.5	0	10	0	10	C
395	007.0681	08-JAN-1998	nrpc	20	2	10	na	273.0	261.5	-1.5	0	10	0	10	C
396	241.0816	04-SEP-2004	coch	20	2	11	na	513.3	501.0	-1.3	0	20	0	20	C
397	033.0544	27-SEP-1993	nrpc	20	2	18	na	441.0	422.0	-1.0	0	10	0	10	C
398	204.0134	05-APR-2005	coch	20	2	19	na	140.0	120.0	-1.0	0	10	0	10	C
399	058.0192	15-JUN-2005	pemi	40	2	40	na	870.0	829.0	-1.0	0	40	0	40	C
400	098.0238	16-JUN-2006	mdmk	20	2	17	na	876.9	859.3	-0.6	0	20	0	20	C

Characteristics for 1300 Verification Wells

Table-Specific Acronyms

WRB: New Hampshire Geologic Survey well identification number

AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom

STI: Saturated Thickness Interval for the Study Area

OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

								Interpolated		Saturated Thickness (ft)					
						Depth		(ft msl)			Actual		Mapped		
		Date	USGS	(ft)		(ft bgs) to		Land	Water	Calc	Class		Class		
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU
401	119.1188	28-MAY-2003	nrpc	20	2	28	na	267.4	239.0	-0.4	0	10	0	10	C
402	215.0059	10-NOV-2005	cont	40	2	17	na	1066.7	1049.4	-0.3	0	40	0	40	C
403	119.1287	16-MAY-2005	nrpc	20	2	16	na	313.0	297.0	0.0	0	10	0	10	C
404	136.0131	01-DEC-1999	lwct	40	2	10	na	1187.7	1177.8	0.1	0	40	0	40	C
405	256.1848	20-OCT-2004	lwmk	20	2	15	na	255.7	241.0	0.3	0	20	0	20	C
406	155.1018	16-DEC-2004	winn	20	2	12	na	520.0	508.5	0.5	0	20	0	20	C
407	119.1318	09-JAN-2006	nrpc	20	2	18	na	199.5	182.0	0.5	0	10	0	10	C
408	188.0455	03-SEP-1993	nrpc	20	2	14	na	136.2	123.0	0.8	0	10	0	10	C
409	181.0055	30-APR-2001	upct	40	2	11	na	881.5	871.3	0.8	0	40	0	40	C
410	142.1950	13-APR-2000	lwmk	20	2	20	na	240.0	221.0	1.0	0	20	0	20	C
411	159.0240	19-SEP-1991	nrpc	20	2	18	na	290.0	273.0	1.0	0	10	0	10	C
412	188.0334	21-NOV-1990	nrpc	20	2	10	na	149.0	140.0	1.0	0	10	0	10	C
413	095.0117	03-AUG-2004	lwct	40	2	35	na	1034.0	1000.0	1.0	0	40	0	40	C
414	139.0409	28-MAR-2005	nrpc	20	2	20	na	210.0	191.0	1.0	0	10	0	10	C
415	221.0141	03-NOV-2005	upct	40	2	11	na	1287.5	1277.5	1.0	0	40	0	40	C
416	188.0416	03-DEC-1992	nrpc	20	2	14	na	144.0	131.3	1.3	0	10	0	10	C
417	119.1167	05-APR-2002	nrpc	20	2	18	na	201.8	185.2	1.4	0	10	0	10	C
418	139.0146	10-JUN-1992	nrpc	20	2	30	na	245.0	216.5	1.5	0	10	0	10	C
419	122.1163	25-MAR-2005	nrpc	20	2	13	na	210.3	199.3	2.0	0	10	0	10	C
420	253.0198	13-NOV-2003	cont	40	2	35	na	710.0	677.2	2.2	0	40	0	40	C
421	094.0077	01-JUN-2001	upct	40	2	25	na	1032.7	1010.0	2.3	0	40	0	40	C
422	254.0330	06-APR-2004	nrpc	20	2	22	na	645.7	626.0	2.3	0	10	0	10	C
423	191.0159	03-JUN-2005	mdct	40	2	47	na	441.0	396.3	2.3	0	40	0	40	C
424	033.0127	05-JAN-1988	nrpc	20	2	22	na	348.1	328.6	2.5	0	10	0	10	C
425	252.0229	13-AUG-2004	mdct	40	2	25	na	907.2	884.8	2.6	0	40	0	40	C
426	013.0530	13-JUL-1998	mdmk	20	2	13	na	341.0	330.6	2.6	0	20	0	20	C
427	052.0421	21-AUG-1997	saco	40	2	28	na	513.5	488.2	2.7	0	40	0	40	C
428	139.0071	13-JUL-1988	nrpc	20	2	35	na	218.0	185.8	2.8	0	10	0	10	C
429	033.0810	24-FEB-1998	nrpc	20	2	20	na	292.0	275.1	3.1	0	10	0	10	C
430	119.0709	11-SEP-1995	nrpc	20	2	32	na	230.0	201.2	3.2	0	10	0	10	C
431	033.0382	08-MAY-1991	nrpc	20	2	26	na	285.4	262.8	3.4	0	10	0	10	C
432	188.0314	19-OCT-1990	nrpc	20	2	20	na	167.3	150.8	3.5	0	10	0	10	C
433	057.0153	10-JUL-2003	mdct	40	2	21	na	969.8	952.3	3.5	0	40	0	40	C
434	027.1274	25-APR-2006	upmk	20	2	12	na	242.0	233.6	3.6	0	20	0	20	C
435	139.0075	07-DEC-1988	nrpc	20	2	30	na	208.0	181.7	3.7	0	10	0	10	C
436	021.0784	18-APR-2006	winn	20	2	15	na	780.0	768.8	3.8	0	20	0	20	C
437	139.0135	18-MAY-1992	nrpc	20	2	30	na	208.0	182.0	4.0	0	10	0	10	C
438	167.0701	13-OCT-1997	mdmk	20	2	20	na	553.0	537.0	4.0	0	20	0	20	C
439	113.0170	26-JUL-2002	pemi	40	2	25	na	621.0	600.0	4.0	0	40	0	40	C
440	256.1126	01-SEP-1996	lwmk	20	2	20	na	221.7	205.8	4.1	0	20	0	20	C
441	044.0770	26-JUN-2002	lamp	20	2	17	na	372.5	360.0	4.5	0	20	0	20	C
442	119.1293	25-JUL-2005	nrpc	20	2	45	na	211.6	171.1	4.5	0	10	0	10	C
443	119.0409	16-JAN-1991	nrpc	20	2	12	na	191.9	184.5	4.6	0	10	0	10	C
444	119.1280	14-FEB-2005	nrpc	20	2	21	na	221.5	205.2	4.7	0	10	0	10	C
445	020.2511	15-JUL-2004	mdmk	20	2	17	na	258.5	246.3	4.8	0	20	0	20	C
446	139.0145	17-SEP-1992	nrpc	20	2	47	na	222.0	180.0	5.0	0	10	0	10	C
447	152.0140	15-JUL-2003	lwct	40	2	10	na	1184.4	1179.5	5.1	0	40	0	40	C
448	047.0256	24-APR-2006	lwct	40	2	16	na	529.1	518.2	5.1	0	40	0	40	C
449	112.0319	27-APR-2004	mdct	40	2	15	na	1143.8	1134.0	5.2	0	20	0	20	C
450	225.0945	30-MAR-2004	lamp	20	2	17	na	134.8	123.0	5.2	0	20	0	20	C

Characteristics for 1300 Verification Wells

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								Interpolated		Saturated Thickness (ft)					
						Depth		(ft msl)			Actual		Mapped		
		Date	USGS	(ft)		(ft bgs) to		Land	Water	Calc	Class		Class		
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU
451	183.0942	17-AUG-2004	lamp	20	2	11	na	192.0	186.4	5.4	0	20	0	20	C
452	007.0402	26-JUL-1993	nrpc	20	2	10	na	253.0	248.6	5.6	0	10	0	10	C
453	145.0146	27-APR-2004	mdct	40	2	18	na	740.0	727.8	5.8	0	20	0	20	C
454	142.2181	21-APR-2003	lwmk	20	2	17	na	241.0	230.0	6.0	0	20	0	20	C
455	231.0315	19-MAY-2004	cont	40	2	10	na	722.0	718.0	6.0	0	40	0	40	C
456	013.0849	27-MAY-2004	mdmk	20	2	15	na	261.0	252.0	6.0	0	20	0	20	C
457	096.0194	25-APR-2005	pemi	40	2	10	na	878.0	874.0	6.0	0	40	0	40	C
458	159.0962	14-SEP-2005	nrpc	20	2	18	na	307.0	295.0	6.0	0	10	0	10	C
459	259.0096	27-JUL-2004	pemi	40	2	20	na	768.8	754.9	6.1	0	40	0	40	C
460	004.0142	22-JAN-1999	upmk	20	2	17	na	480.0	469.4	6.4	0	20	0	20	C
461	044.0551	27-APR-1998	lamp	20	2	23	na	196.0	179.5	6.5	0	20	0	20	C
462	112.0353	07-MAY-2005	mdct	40	2	16	na	612.2	603.1	6.9	0	40	0	40	C
463	134.0357	27-AUG-2002	mdct	40	2	19	na	868.0	856.0	7.0	0	40	0	40	C
464	091.0679	03-APR-2003	upmk	20	2	23	na	679.0	663.0	7.0	0	20	0	20	C
465	200.1116	14-NOV-2003	lamp	20	2	18	na	210.0	199.0	7.0	0	20	0	20	C
466	032.0111	25-OCT-2004	coch	20	2	24	na	562.0	545.0	7.0	0	20	0	20	C
467	119.0335	31-OCT-1988	nrpc	20	2	27	na	238.0	218.4	7.4	0	10	0	10	C
468	036.0568	13-OCT-2003	mdct	40	2	18	na	952.6	942.2	7.6	0	20	0	20	C
469	033.1141	05-NOV-2005	nrpc	20	2	12	na	285.4	281.0	7.6	0	10	0	10	C
470	161.0259	02-SEP-1997	coch	20	2	20	na	451.3	439.0	7.7	0	20	0	20	C
471	007.0447	02-MAY-1994	nrpc	20	2	30	na	271.1	249.0	7.9	0	10	0	10	C
472	179.0415	13-APR-2004	upmk	20	2	25	na	420.0	403.0	8.0	0	20	0	20	C
473	156.0295	07-JUN-1989	nrpc	20	2	10	na	214.0	212.1	8.1	0	10	0	10	C
474	165.0087	02-SEP-1994	nrpc	20	2	35	na	236.9	210.0	8.1	0	10	0	10	C
475	021.0687	14-APR-2004	winn	20	2	20	na	811.9	800.0	8.1	0	20	0	20	C
476	186.0213	15-AUG-2005	mdct	40	2	27	na	710.2	691.3	8.1	0	20	0	20	C
477	140.0281	13-SEP-2001	mdct	40	2	18	na	895.0	885.2	8.2	0	40	0	40	C
478	125.0192	16-OCT-2003	upct	40	2	19	na	1141.7	1130.9	8.2	0	40	0	40	C
479	253.0259	07-JAN-2005	cont	40	2	10	na	670.0	668.3	8.3	0	40	0	40	C
480	139.0122	05-SEP-1991	nrpc	20	2	25	na	222.0	205.5	8.5	0	10	0	10	C
481	206.0240	01-NOV-2005	pemi	40	2	20	na	611.5	600.0	8.5	0	40	0	40	C
482	044.0813	16-MAY-2003	lamp	20	2	10	na	209.0	207.7	8.7	0	20	0	20	C
483	165.0038	30-AUG-1989	nrpc	20	2	24	na	199.5	184.3	8.8	0	10	0	10	C
484	021.0606	14-OCT-1998	winn	20	2	17	na	602.8	594.6	8.8	0	20	0	20	C
485	031.0202	06-JUN-2003	pemi	40	2	15	na	577.0	570.8	8.8	0	40	0	40	C
486	098.0235	28-MAR-2006	mdmk	20	2	20	na	880.0	868.8	8.8	0	20	0	20	C
487	164.1571	22-SEP-2005	winn	20	2	10	na	505.1	504.0	8.9	0	20	0	20	C
488	007.0347	03-APR-1992	nrpc	20	2	10	na	280.0	279.0	9.0	0	10	0	10	C
489	083.0284	20-MAY-2002	coch	20	2	12	na	260.0	257.0	9.0	0	20	0	20	C
490	008.0273	03-JUN-2004	pemi	40	2	15	na	660.0	654.0	9.0	0	40	0	40	C
491	254.0108	27-FEB-1991	nrpc	20	2	17	na	618.0	610.1	9.1	0	10	0	10	C
492	033.0966	23-APR-1999	nrpc	20	2	12	na	263.5	260.7	9.2	0	10	0	10	C
493	258.0659	09-AUG-2004	winn	20	2	10	na	535.2	534.4	9.2	0	20	0	20	C
494	033.0654	26-JUL-1995	nrpc	20	2	18	na	308.7	300.0	9.3	0	10	0	10	C
495	188.1363	05-JUN-2003	nrpc	20	2	20	na	131.6	121.0	9.4	0	10	0	10	C
496	183.0562	27-JUL-1998	lamp	20	2	26	na	458.5	442.0	9.5	0	20	0	20	C
497	119.1180	05-MAY-2003	nrpc	20	2	21	na	204.4	193.0	9.6	0	10	0	10	C
498	233.0505	18-MAY-2005	saco	40	2	39	na	472.3	443.0	9.7	0	40	0	40	C
499	164.1466	06-JUL-2004	winn	20	2	14	na	530.0	525.8	9.8	0	20	0	20	C
500	167.1046	03-NOV-2004	mdmk	20	2	20	na	541.0	530.8	9.8	0	20	0	20	C

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						Depth (ft bgs) to		Interpolated (ft msl)		Saturated Thickness (ft)					
											Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
501	039.0100	07-JUL-2005	mdct	40	2	14	na	1268.4	1264.3	9.9	0	40	0	40	C
502	033.0188	10-OCT-1988	nrpc	20	2	23	na	423.0	410.0	10.0	10	20	10	20	C
503	241.0818	06-OCT-2004	saco	40	2	30	na	578.0	558.0	10.0	0	40	0	40	C
504	231.0357	17-JUN-2005	cont	40	2	20	na	727.0	717.0	10.0	0	40	0	40	C
505	077.0732	14-JUL-2006	mdct	40	2	29	na	1213.9	1195.0	10.1	0	40	0	40	C
506	139.0123	08-AUG-1991	nrpc	20	2	40	na	191.0	161.5	10.5	10	20	10	20	C
507	253.0189	14-SEP-2000	cont	40	2	35	na	683.0	658.6	10.6	0	40	0	40	C
508	170.0471	26-SEP-2003	winn	20	2	40	na	870.4	841.0	10.6	0	20	0	20	C
509	025.0235	23-APR-2001	mdct	40	2	38	na	1102.4	1075.1	10.7	0	40	0	40	C
510	094.0101	01-JUN-2006	upct	40	2	16	na	920.0	914.9	10.9	0	40	0	40	C
511	020.1261	14-SEP-1993	lwmk	20	2	14	na	223.0	220.0	11.0	0	20	0	20	C
512	028.0195	11-AUG-2003	cont	40	2	25	na	654.0	640.0	11.0	0	40	0	40	C
513	014.0484	23-DEC-2003	upmk	20	2	20	na	547.0	538.0	11.0	0	20	0	20	C
514	007.0264	02-AUG-1989	nrpc	20	2	21	na	211.0	201.0	11.0	10	20	10	20	C
515	013.0749	21-MAR-2001	mdmk	20	2	16	na	326.0	321.1	11.1	0	20	0	20	C
516	177.0287	27-MAY-2005	lwct	40	2	16	na	865.0	860.3	11.3	0	40	0	40	C
517	241.0851	22-APR-2005	saco	40	2	36	na	600.0	575.4	11.4	0	40	0	40	C
518	208.0823	25-SEP-1998	lwmk	20	2	12	na	167.3	167.0	11.7	0	20	0	20	C
519	005.0345	04-APR-2006	lwct	40	2	43	na	523.3	492.0	11.7	0	40	0	40	C
520	099.0453	27-JAN-2004	lwmk	20	2	24	na	90.9	78.7	11.8	0	20	0	20	C
521	143.0872	24-MAR-2006	upmk	20	2	50	na	405.0	366.8	11.8	0	20	0	20	C
522	063.1671	26-AUG-2002	lwmk	20	2	17	na	297.0	291.9	11.9	0	20	0	20	C
523	210.0491	23-APR-2002	pemi	40	2	20	na	633.0	625.0	12.0	0	40	0	40	C
524	022.0127	30-MAR-2006	cont	40	2	50	na	678.0	640.0	12.0	0	40	0	40	C
525	187.0461	07-MAY-1999	saco	40	2	40	na	625.8	598.2	12.4	0	40	0	40	C
526	219.0148	14-JUN-2000	lwct	40	2	23	na	1141.7	1131.9	12.7	0	40	0	40	C
527	028.0249	14-OCT-2005	cont	40	2	20	na	819.2	812.0	12.8	0	40	0	40	C
528	159.0297	10-SEP-1993	nrpc	20	2	26	na	272.0	259.0	13.0	10	20	10	20	C
529	061.0767	21-NOV-2001	lamp	20	2	25	na	438.0	426.0	13.0	0	20	0	20	C
530	210.0500	27-NOV-2002	pemi	40	2	26	na	648.0	635.0	13.0	0	40	0	40	C
531	146.0282	10-JUN-2004	mdct	40	2	27	na	411.2	397.2	13.0	0	40	0	40	C
532	129.0977	05-MAY-2006	lwmk	20	2	20	na	128.0	121.0	13.0	0	20	0	20	C
533	230.0074	19-MAR-2001	lwct	40	2	18	na	617.9	613.0	13.1	0	40	0	40	C
534	008.0264	13-MAY-2003	pemi	40	2	15	na	658.0	656.2	13.2	0	40	0	40	C
535	152.0133	14-MAR-2003	lwct	40	2	15	na	1161.4	1159.8	13.4	0	40	0	40	C
536	151.0184	04-AUG-2003	lwct	40	2	16	na	962.0	959.4	13.4	0	40	0	40	C
537	112.0330	03-AUG-2004	mdct	40	2	22	na	1208.5	1200.0	13.5	0	20	0	20	C
538	119.0699	18-NOV-1995	nrpc	20	2	25	na	201.8	190.5	13.7	10	20	10	20	C
539	224.0093	25-NOV-2003	upct	40	2	56	na	927.3	885.0	13.7	0	40	0	40	C
540	140.0367	05-MAY-2005	mdct	40	2	16	na	848.3	846.0	13.7	0	40	0	40	C
541	187.0763	09-MAY-2006	saco	40	2	18	na	619.0	614.7	13.7	0	40	0	40	C
542	039.0102	05-OCT-2005	mdct	40	2	24	na	1391.7	1381.5	13.8	0	40	0	40	C
543	242.0267	01-NOV-2002	lwct	40	2	27	na	324.1	311.1	14.0	0	40	0	40	C
544	028.0193	29-AUG-2002	cont	40	2	23	na	669.0	660.0	14.0	0	40	0	40	C
545	089.0842	27-MAY-2004	lamp	20	2	15	na	148.0	147.0	14.0	0	20	0	20	C
546	020.1729	12-SEP-1996	mdmk	20	2	15	na	256.0	255.0	14.0	0	20	0	20	C
547	061.0902	18-OCT-2005	lamp	20	2	33	na	280.0	261.1	14.1	0	20	0	20	C
548	172.0356	21-APR-2004	winn	20	2	24	na	549.8	540.0	14.2	0	20	0	20	C
549	033.0430	07-OCT-1991	nrpc	20	2	28	na	291.0	277.4	14.4	10	20	10	20	C
550	033.0653	30-JUN-1995	nrpc	20	2	20	na	241.5	236.0	14.5	10	20	10	20	C

Characteristics for 1300 Verification Wells

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- WRB: New Hampshire Geologic Survey well identification number
- AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom
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- OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

						Depth		Interpolated		Saturated Thickness (ft)					
						(ft bgs) to		(ft msl)			Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
551	256.1655	27-JUL-2001	lwmk	20	2	18	na	163.5	160.0	14.5	0	20	0	20	C
552	138.0197	30-SEP-2005	mdct	40	2	46	na	781.3	750.0	14.7	0	20	0	20	C
553	077.0686	01-NOV-2004	mdct	40	2	27	na	1207.2	1195.0	14.8	0	40	0	40	C
554	112.0297	22-JUL-2002	mdct	40	2	40	na	683.0	658.0	15.0	0	20	0	20	C
555	188.0273	07-NOV-1988	nrpc	20	2	25	na	138.8	128.9	15.1	10	20	10	20	C
556	021.0723	10-NOV-2004	winn	20	2	27	na	808.2	796.6	15.4	0	20	0	20	C
557	152.0137	11-SEP-2002	lwct	40	2	25	na	1171.5	1162.0	15.5	0	40	0	40	C
558	033.1112	22-JUN-2005	nrpc	20	2	25	na	236.2	226.9	15.7	10	20	10	20	C
559	020.2419	24-JUN-2003	mdmk	20	2	28	na	177.0	164.8	15.8	0	20	0	20	C
560	079.0345	26-MAY-1999	upmk	20	2	20	na	302.0	298.0	16.0	0	20	0	20	C
561	230.0097	23-SEP-2004	lwct	40	2	65	na	561.0	512.0	16.0	0	40	0	40	C
562	248.0329	25-APR-2006	cont	40	2	25	na	389.0	380.0	16.0	0	40	0	40	C
563	149.0389	19-AUG-1999	saco	40	2	30	na	460.0	446.2	16.2	0	40	0	40	C
564	028.0258	16-MAR-2006	cont	40	2	28	na	657.8	646.1	16.3	0	40	0	40	C
565	243.0418	26-AUG-2005	cont	40	2	46	na	422.0	392.4	16.4	0	40	0	40	C
566	008.0316	13-DEC-2005	pemi	40	2	21	na	652.5	648.0	16.5	0	40	0	40	C
567	256.1615	03-APR-2001	lwmk	20	2	22	na	225.4	220.0	16.6	0	20	0	20	C
568	008.0303	09-JUN-2005	cont	40	2	18	na	655.0	653.6	16.6	0	40	0	40	C
569	202.0038	06-FEB-1986	cont	40	2	29	na	1059.0	1047.0	17.0	0	40	0	40	C
570	167.0969	01-AUG-2003	mdmk	20	2	18	na	520.0	519.0	17.0	0	20	0	20	C
571	210.0633	11-JAN-2006	pemi	40	2	22	na	630.0	625.0	17.0	0	40	0	40	C
572	102.0087	26-OCT-2003	pemi	40	2	25	na	680.0	672.2	17.2	0	40	0	40	C
573	204.0124	07-FEB-2003	coch	20	2	31	na	135.7	122.0	17.3	10	20	10	20	C
574	033.0534	23-JUL-1993	nrpc	20	2	18	na	236.6	236.0	17.4	10	20	10	20	C
575	029.0709	16-OCT-2003	lamp	20	2	31	na	141.5	128.0	17.5	0	20	0	20	C
576	256.1844	03-DEC-2004	lwmk	20	2	20	na	174.0	171.5	17.5	0	20	0	20	C
577	095.0120	20-SEP-2005	lwct	40	2	21	na	976.9	973.4	17.5	0	40	0	40	C
578	043.0046	14-AUG-2000	saco	40	2	35	na	508.5	491.2	17.7	0	40	0	40	C
579	139.0180	26-SEP-1994	nrpc	20	2	38	na	175.4	155.1	17.7	10	20	10	20	C
580	013.0759	10-SEP-2001	mdmk	20	2	20	na	319.0	316.8	17.8	0	20	0	20	C
581	129.0919	27-JUL-2005	lwmk	20	2	19	na	139.0	138.0	18.0	0	20	0	20	C
582	007.0233	24-OCT-1988	nrpc	20	2	22	na	245.5	241.5	18.0	10	20	10	20	C
583	025.0276	21-NOV-2003	mdct	40	2	24	na	1352.8	1347.1	18.3	0	20	0	20	C
584	232.0742	02-AUG-2004	lwct	40	2	19	na	458.7	458.0	18.3	0	40	0	40	C
585	119.0619	28-DEC-1994	nrpc	20	2	35	na	366.5	350.0	18.5	10	20	10	20	C
586	044.0835	31-MAY-2005	lamp	20	2	26	na	207.7	200.3	18.6	0	20	0	20	C
587	164.1570	06-JUL-2005	winn	20	2	30	na	575.7	564.4	18.7	0	20	0	20	C
588	210.0635	29-MAR-2006	pemi	40	2	40	na	651.7	630.5	18.8	0	40	0	40	C
589	170.0424	07-NOV-2001	winn	20	2	25	na	592.0	586.0	19.0	0	20	0	20	C
590	168.0503	09-JUL-2004	cont	40	2	27	na	856.0	848.1	19.1	0	40	0	40	C
591	020.1684	22-APR-1996	mdmk	20	2	38	na	232.0	213.2	19.2	0	20	0	20	C
592	247.1155	11-AUG-1999	mdmk	20	2	20	na	512.0	511.3	19.3	0	20	0	20	C
593	187.0769	07-AUG-2006	saco	40	2	22	na	421.7	419.2	19.5	0	40	0	40	C
594	041.0239	02-NOV-2001	lwct	40	2	38	na	458.3	440.0	19.7	0	40	0	40	C
595	089.0531	29-APR-1998	lamp	20	2	21	na	179.0	177.7	19.7	0	20	0	20	C
596	007.1047	12-MAY-2003	nrpc	20	2	23	na	261.5	258.2	19.7	10	20	10	20	C
597	009.0178	12-MAR-2002	cont	40	2	40	na	610.0	590.0	20.0	0	40	0	40	C
598	199.0120	15-OCT-2004	upct	40	2	47	na	1488.0	1461.0	20.0	0	40	0	40	C
599	092.0110	18-MAR-2005	lwct	40	2	27	na	785.8	779.2	20.4	0	40	0	40	C
600	244.0079	18-FEB-2002	pemi	40	2	35	na	850.9	836.6	20.7	0	40	0	40	C

Characteristics for 1300 Verification Wells

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						Depth (ft bgs) to		Interpolated (ft msl)		Saturated Thickness (ft)					
											Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
601	172.0219	01-DEC-1998	pemi	40	2	40	na	595.7	576.6	20.9	0	40	0	40	C
602	172.0384	05-JAN-2005	pemi	40	2	50	na	609.1	580.0	20.9	0	40	0	40	C
603	006.1527	17-JAN-2006	winn	20	2	40	na	528.1	509.0	20.9	20	40	20	40	C
604	253.0186	25-MAR-2002	cont	40	2	25	na	675.0	671.0	21.0	0	40	0	40	C
605	243.0422	22-NOV-2005	cont	40	2	22	na	631.0	630.0	21.0	0	40	0	40	C
606	210.0506	01-OCT-2003	pemi	40	2	65	na	446.8	404.2	22.4	0	40	0	40	C
607	152.0105	14-OCT-1998	lwct	40	2	28	na	1165.5	1160.0	22.5	0	40	0	40	C
608	190.0194	13-SEP-2002	cont	40	2	63	na	835.8	795.4	22.6	0	40	0	40	C
609	245.0307	11-AUG-2004	lwct	40	2	25	na	1452.9	1450.5	22.6	0	40	0	40	C
610	003.0269	20-OCT-2004	pemi	40	2	30	na	931.8	924.4	22.6	0	40	0	40	C
611	067.0383	17-MAR-2005	coch	20	2	36	na	73.2	60.0	22.8	20	40	20	40	C
612	112.0322	11-JUN-2004	mdct	40	2	37	na	700.0	685.9	22.9	0	40	0	40	C
613	167.0915	09-JAN-2002	mdmk	20	2	35	na	315.0	303.0	23.0	20	40	20	40	C
614	162.0123	28-OCT-2005	mdct	40	2	45	na	480.0	458.1	23.1	0	40	0	40	C
615	188.1375	01-JUL-2003	nrpc	20	2	28	na	140.4	136.2	23.8	20	40	20	40	C
616	210.0547	19-DEC-2003	pemi	40	2	27	na	461.0	457.9	23.9	0	40	0	40	C
617	008.0323	11-MAY-2006	pemi	40	2	46	na	740.0	718.0	24.0	0	40	0	40	C
618	117.0136	17-AUG-1999	lwct	40	2	36	na	452.8	441.2	24.4	0	40	0	40	C
619	188.1503	24-OCT-2003	nrpc	20	2	42	na	147.6	130.0	24.4	20	40	20	40	C
620	202.0546	15-SEP-2001	lwct	40	2	30	na	1050.4	1044.9	24.5	0	40	0	40	C
621	125.0200	21-JUN-2004	upct	40	2	26	na	1149.0	1147.8	24.8	0	40	0	40	C
622	015.1155	24-SEP-2004	coch	20	2	29	na	152.1	147.9	24.8	20	40	20	40	C
623	146.0245	05-DEC-2001	mdct	40	2	45	na	418.0	398.0	25.0	0	40	0	40	C
624	010.0129	05-MAY-2003	pemi	40	2	50	na	567.8	542.8	25.0	0	40	0	40	C
625	258.0644	09-JUL-2004	winn	20	2	28	na	537.0	534.0	25.0	20	40	20	40	C
626	073.0070	15-DEC-2005	mdct	40	2	55	na	1150.0	1120.0	25.0	0	40	0	40	C
627	241.0638	13-JUL-2001	saco	40	2	30	na	498.3	493.8	25.5	0	40	0	40	C
628	177.0216	08-DEC-2001	lwct	40	2	28	na	692.3	690.0	25.7	0	40	0	40	C
629	196.0743	12-MAR-2004	lwmk	20	2	32	na	123.0	116.7	25.7	20	40	20	40	C
630	005.0323	07-FEB-2005	lwct	40	2	29	na	1302.5	1299.2	25.7	0	40	0	40	C
631	028.0189	08-NOV-2001	cont	40	2	42	na	840.2	824.6	26.4	0	40	0	40	C
632	025.0333	26-MAY-2006	mdct	40	2	29	na	1063.0	1060.4	26.4	0	40	0	40	C
633	097.0182	27-SEP-2000	lwct	40	2	49	na	1039.4	1017.1	26.7	0	40	0	40	C
634	191.0102	25-MAY-1999	mdct	40	2	45	na	608.0	590.0	27.0	0	40	0	40	C
635	183.0831	17-APR-2002	lamp	20	2	46	na	165.0	146.0	27.0	20	40	20	40	C
636	008.0237	18-MAR-2002	cont	40	2	51	na	636.5	613.5	28.0	0	40	0	40	C
637	165.0201	19-APR-2005	nrpc	20	2	37	na	177.0	168.0	28.0	20	40	20	40	C
638	045.0032	30-NOV-1984	lwct	40	2	36	na	767.7	759.8	28.1	0	40	0	40	C
639	253.0014	21-NOV-1985	cont	40	2	55	na	693.0	666.1	28.1	0	40	0	40	C
640	096.0177	19-OCT-2003	pemi	40	2	30	na	839.5	838.0	28.5	0	40	0	40	C
641	049.0224	22-JUN-2004	upct	40	2	35	na	1258.2	1252.0	28.8	0	40	0	40	C
642	009.0207	12-JUN-2003	cont	40	2	67	na	802.0	764.0	29.0	0	40	0	40	C
643	098.0180	20-DEC-2001	cont	40	2	70	na	845.0	804.8	29.8	0	40	0	40	C
644	164.1569	29-SEP-2005	winn	20	2	35	na	520.0	514.8	29.8	20	40	20	40	C
645	088.0128	22-MAR-1989	saco	40	2	42	na	420.0	408.0	30.0	0	40	0	40	C
646	202.0552	14-MAY-2001	lwct	40	2	50	na	1200.8	1180.8	30.0	0	40	0	40	C
647	107.0217	10-MAY-2006	cont	40	2	35	na	682.0	677.0	30.0	0	40	0	40	C
648	138.0194	25-AUG-2005	mdct	40	2	47	na	773.1	756.2	30.1	0	40	0	40	C
649	007.1110	28-APR-2005	nrpc	20	2	42	na	216.2	205.0	30.8	20	40	20	40	C
650	021.0772	10-JAN-2006	winn	20	2	40	na	844.7	835.6	30.9	20	40	20	40	C

Characteristics for 1300 Verification Wells

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											Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
651	242.0225	05-NOV-1999	lwct	40	2	34	na	510.2	507.4	31.2	0	40	0	40	C
652	196.0760	04-FEB-2005	lwmk	20	2	37	na	128.0	122.2	31.2	20	40	20	40	C
653	115.0103	18-MAY-2004	pemi	40	2	35	na	503.7	500.0	31.3	0	40	0	40	C
654	204.0123	08-JUL-1999	coch	20	2	47	na	124.7	109.6	31.9	20	40	20	40	C
655	143.0687	12-JUN-2002	upmk	20	2	60	na	394.1	366.2	32.1	20	40	20	40	C
656	241.0910	28-OCT-2005	saco	40	2	39	na	597.0	590.3	32.3	0	40	0	40	C
657	233.0330	22-JUL-1997	saco	40	2	75	na	490.0	448.0	33.0	0	40	0	40	C
658	236.0306	10-JUN-2002	pemi	40	2	62	na	581.7	552.7	33.0	0	40	0	40	C
659	112.0321	04-MAY-2004	mdct	40	2	58	na	805.0	780.0	33.0	0	40	0	40	C
660	241.0799	17-AUG-2004	saco	40	2	50	na	600.0	583.0	33.0	0	40	0	40	C
661	165.0170	08-JUL-2003	nrpc	20	2	49	na	174.2	158.6	33.4	20	40	20	40	C
662	240.0247	25-SEP-2002	lwct	40	2	40	na	790.1	783.7	33.6	0	40	0	40	C
663	039.0075	01-NOV-2002	mdct	40	2	45	na	1389.3	1378.0	33.7	0	40	0	40	C
664	025.0304	29-APR-2005	mdct	40	2	44	na	1076.6	1066.3	33.7	0	40	0	40	C
665	249.0116	23-JUL-2003	pemi	40	2	50	na	704.1	688.0	33.9	0	40	0	40	C
666	048.0090	12-OCT-2002	upct	40	2	50	na	1101.5	1085.7	34.2	0	40	0	40	C
667	136.0206	02-JUL-2004	lwct	40	2	39	na	1206.0	1201.2	34.2	0	40	0	40	C
668	119.0551	18-NOV-1993	nrpc	20	2	70	na	217.2	181.8	34.6	20	40	20	40	C
669	159.0926	12-NOV-2004	nrpc	20	2	44	na	276.7	267.6	34.9	20	40	20	40	C
670	253.0222	06-NOV-2002	cont	40	2	45	na	688.0	678.0	35.0	0	40	0	40	C
671	233.0461	05-JUN-2004	saco	40	2	40	na	560.0	555.0	35.0	0	40	0	40	C
672	008.0235	16-AUG-2002	cont	40	2	40	na	639.4	634.6	35.2	0	40	0	40	C
673	232.0738	23-JUN-2004	lwct	40	2	45	na	499.8	490.0	35.2	0	40	0	40	C
674	021.0683	23-MAR-2004	winn	20	2	85	na	682.3	632.6	35.3	20	40	20	40	C
675	191.0141	08-JUL-2003	mdct	40	2	65	na	460.0	430.5	35.5	0	40	0	40	C
676	074.0079	24-NOV-2003	saco	40	2	70	na	525.1	490.6	35.5	0	40	0	40	C
677	161.0394	05-AUG-2003	coch	20	2	39	na	417.0	414.0	36.0	20	40	20	40	C
678	025.0259	02-JUN-2003	mdct	40	2	46	na	1084.0	1074.0	36.0	0	40	0	40	C
679	220.0089	03-AUG-2005	upct	40	2	75	na	1140.0	1101.0	36.0	0	40	0	40	C
680	243.0343	22-JUL-2002	cont	40	2	80	na	463.9	420.0	36.1	0	40	0	40	C
681	143.0661	18-DEC-1998	upmk	20	2	65	na	403.0	374.2	36.2	20	40	20	40	C
682	112.0041	03-DEC-1987	mdct	40	2	65	na	673.4	645.0	36.6	20	40	20	40	C
683	259.0102	05-AUG-2005	pemi	40	2	40	na	718.2	714.8	36.6	0	40	0	40	C
684	241.0880	20-JUL-2005	coch	20	2	40	na	605.2	602.0	36.8	20	40	20	40	C
685	241.0828	09-NOV-2004	saco	40	2	38	na	618.5	617.4	36.9	0	40	0	40	C
686	075.0223	07-MAY-2004	saco	40	2	80	na	503.0	460.0	37.0	0	40	0	40	C
687	052.0603	14-MAY-2003	saco	40	2	45	na	442.6	434.7	37.1	0	40	0	40	C
688	122.1141	12-JUL-2004	nrpc	20	2	46	na	167.8	158.9	37.1	20	40	20	40	C
689	203.0764	26-JUL-2005	coch	20	2	50	na	225.0	212.1	37.1	20	40	20	40	C
690	078.0590	10-NOV-2003	lamp	20	2	50	na	162.0	150.0	38.0	20	40	20	40	C
691	248.0267	19-JAN-2004	cont	40	2	43	na	465.0	460.0	38.0	0	40	0	40	C
692	156.0610	09-OCT-2004	nrpc	20	2	57	na	221.9	202.9	38.0	20	40	20	40	C
693	045.0611	30-MAY-2003	lwct	40	2	65	na	255.9	229.1	38.2	0	40	0	40	C
694	256.1119	11-SEP-1997	lwmk	20	2	42	na	173.1	170.0	38.9	20	40	20	40	C
695	116.0425	26-JUN-2002	cont	40	2	60	na	925.0	904.0	39.0	0	40	0	40	C
696	210.0311	15-OCT-1998	winn	20	2	45	na	489.6	484.3	39.7	20	40	20	40	C
697	253.0128	08-DEC-1998	cont	40	2	45	na	707.2	702.0	39.8	0	40	0	40	C
698	029.0745	21-SEP-2004	lamp	20	2	72	na	147.0	116.2	41.2	40	60	40	60	C
699	052.0035	13-JUL-1985	saco	40	2	56	na	479.2	465.8	42.6	40	80	40	80	C
700	236.0374	25-MAY-2004	pemi	40	2	59	na	606.7	590.3	42.6	40	80	40	80	C

Characteristics for 1300 Verification Wells

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WRB: New Hampshire Geologic Survey well identification number

AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom

STI: Saturated Thickness Interval for the Study Area

OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

								Interpolated (ft msl)		Saturated Thickness (ft)					
						Depth (ft bgs) to					Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
701	252.0213	13-JUN-2003	mdct	40	2	75	na	1086.6	1054.7	43.1	40	80	40	80	C
702	233.0095	27-JUL-1986	saco	40	2	80	na	470.0	434.2	44.2	40	80	40	80	C
703	241.0756	17-MAY-2004	coch	20	2	69	na	538.0	513.2	44.2	40	60	40	60	C
704	139.0383	14-MAR-2002	nrpc	20	2	70	na	181.0	156.4	45.4	40	60	40	60	C
705	112.0326	27-MAR-2000	mdct	40	2	65	na	460.0	441.0	46.0	40	80	40	80	C
706	187.0425	07-OCT-1998	saco	40	2	55	na	422.0	413.1	46.1	40	80	40	80	C
707	241.0724	10-DEC-2003	coch	20	2	68	na	597.0	575.2	46.2	40	60	40	60	C
708	241.0882	11-AUG-2005	saco	40	2	100	na	640.0	586.2	46.2	40	80	40	80	C
709	121.0516	08-MAR-2002	cont	40	2	54	na	352.0	346.5	48.5	40	80	40	80	C
710	038.0249	02-DEC-1999	upmk	20	2	62	na	430.0	417.9	49.9	40	60	40	60	C
711	165.0194	27-FEB-2004	nrpc	20	2	65	na	203.9	190.0	51.1	40	60	40	60	C
712	088.0020	20-AUG-1985	saco	40	2	78	na	440.0	413.7	51.7	40	80	40	80	C
713	241.0484	18-NOV-1998	saco	40	2	60	na	591.2	584.0	52.8	40	80	40	80	C
714	232.0740	29-JUL-2004	lwct	40	2	58	na	465.9	461.0	53.1	40	80	40	80	C
715	020.0879	30-APR-1987	mdmk	20	2	78	na	191.0	166.8	53.8	40	60	40	60	C
716	118.0400	21-JUL-2005	pemi	40	2	60	na	478.9	472.9	54.0	40	80	40	80	C
717	007.0328	01-OCT-1990	nrpc	20	2	69	na	225.0	210.0	54.0	40	60	40	60	C
718	050.0149	07-MAR-2005	upct	40	2	75	na	1013.4	992.6	54.2	40	80	40	80	C
719	045.0731	14-JUN-2006	lwct	40	2	90	na	334.6	300.0	55.4	40	80	40	80	C
720	165.0081	20-JUL-1994	nrpc	20	2	72	na	178.8	162.4	55.6	40	60	40	60	C
721	003.0208	17-JUN-1999	pemi	40	2	58	na	619.0	617.3	56.3	40	80	40	80	C
722	063.1655	14-JUN-2001	lwmk	20	2	62	na	215.0	210.0	57.0	40	60	40	60	C
723	241.0740	21-JAN-2004	saco	40	2	95	na	600.0	562.0	57.0	40	80	40	80	C
724	236.0305	26-MAR-2002	pemi	40	2	96	na	597.9	559.4	57.5	40	80	40	80	C
725	241.0796	12-JUL-2004	saco	40	2	100	na	625.0	582.5	57.5	40	80	40	80	C
726	195.0376	23-AUG-2003	lwct	40	2	80	na	492.8	471.2	58.4	40	80	40	80	C
727	093.1088	23-JUN-2003	mdmk	20	2	84	na	315.0	290.5	59.5	40	60	40	60	C
728	233.0346	28-NOV-1998	saco	40	2	100	na	481.0	441.9	60.9	40	80	40	80	C
729	119.0703	16-OCT-1995	nrpc	20	2	80	na	208.1	189.5	61.4	60	80	60	80	C
730	007.1038	18-AUG-2003	nrpc	20	2	89	na	240.0	212.7	61.7	60	80	60	80	C
731	241.0703	06-OCT-2003	saco	40	2	80	na	577.0	559.0	62.0	40	80	40	80	C
732	031.0259	17-AUG-2004	pemi	40	2	100	na	482.0	446.4	64.4	40	80	40	80	C
733	232.0654	08-NOV-2001	lwct	40	2	79	na	482.3	468.2	64.9	40	80	40	80	C
734	241.0704	09-SEP-2003	saco	40	2	78	na	598.0	584.9	64.9	40	80	40	80	C
735	039.0096	10-JUN-2005	mdct	40	2	68	na	1552.0	1549.0	65.0	40	80	40	80	C
736	063.1688	17-APR-2002	lwmk	20	2	70	na	209.0	205.0	66.0	60	80	60	80	C
737	149.0354	28-AUG-1998	saco	40	2	70	na	491.9	489.1	67.2	40	80	40	80	C
738	148.0242	02-FEB-2005	lamp	20	2	87	na	84.5	65.0	67.5	60	80	60	80	C
739	027.1128	24-MAR-2003	upmk	20	2	70	na	200.0	198.8	68.8	60	80	60	80	C
740	139.0076	02-DEC-1988	nrpc	20	2	79	na	177.2	167.1	68.9	60	80	60	80	C
741	241.0897	29-OCT-2005	saco	40	2	90	na	628.0	608.4	70.4	40	80	40	80	C
742	015.1134	02-JUL-2004	coch	20	2	77	na	180.0	173.8	70.8	60	80	60	80	C
743	232.0727	25-NOV-2003	lwct	40	2	93	na	485.6	463.9	71.3	40	80	40	80	C
744	241.0824	17-NOV-2004	saco	40	2	76	na	588.0	584.0	72.0	40	80	40	80	C
745	051.0821	20-AUG-2002	upmk	20	2	97	na	317.0	292.4	72.4	60	80	60	80	C
746	086.0182	16-MAY-2002	mdct	40	2	95	na	980.0	959.4	74.4	40	80	40	80	C
747	241.0636	09-JAN-2002	saco	40	2	106	na	614.4	583.0	74.6	40	80	40	80	C
748	004.0207	08-MAY-2006	upmk	20	2	82	na	290.0	282.7	74.7	60	80	60	80	C
749	086.0224	15-JUL-2004	mdct	40	2	96	na	1015.7	995.2	75.5	40	80	40	80	C
750	172.0349	04-OCT-2003	pemi	40	2	125	na	528.2	479.0	75.8	40	80	40	80	C

Characteristics for 1300 Verification Wells

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Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Depth (ft bgs) to Bedrock	Depth (ft bgs) to Till	Interpolated (ft msl) Land Elev	Interpolated (ft msl) Water Table	Saturated Thickness (ft) Calc ST	Actual Class Min	Actual Class Max	Mapped Class Min	Mapped Class Max	OCU
751	067.0324	02-JUN-2003	coch	20	2	109	na	41.0	8.6	76.6	60	80	60	80	C
752	096.0209	12-JUL-2006	pemi	40	2	98	na	885.0	863.7	76.7	40	80	40	80	C
753	052.0646	02-MAR-2004	saco	40	2	115	na	528.3	492.9	79.6	40	80	40	80	C
754	075.0142	10-NOV-1998	saco	40	2	82	na	387.0	385.3	80.3	80	120	80	120	C
755	047.0231	23-SEP-2004	lwct	40	2	90	na	556.5	551.0	84.5	80	120	80	120	C
756	149.0504	29-MAY-2004	saco	40	2	90	na	495.6	491.5	85.9	80	120	80	120	C
757	052.0504	14-OCT-2000	saco	40	2	95	na	461.9	453.8	86.9	80	120	80	120	C
758	172.0372	26-JUN-2004	pemi	40	2	157	na	522.0	455.4	90.4	80	120	80	120	C
759	139.0159	20-APR-1993	nrpc	20	2	95	na	176.0	174.0	93.0	80	100	80	100	C
760	117.0180	20-DEC-2001	lwct	40	2	105	na	195.8	184.9	94.1	80	120	80	120	C
761	187.0613	27-JAN-2004	saco	40	2	128	na	442.0	411.6	97.6	80	120	80	120	C
762	232.0318	05-NOV-1998	lwct	40	2	105	na	557.8	550.5	97.7	80	120	80	120	C
763	232.0779	19-AUG-2005	lwct	40	2	105	na	492.1	489.2	102.1	80	120	80	120	C
764	117.0037	16-JAN-1989	lwct	40	2	130	na	258.9	233.8	104.9	80	120	80	120	C
765	202.0642	08-MAY-2003	lwct	40	2	127	na	1064.0	1044.9	107.9	80	120	80	120	C
766	134.0424	25-APR-2005	mdct	40	2	120	na	773.0	771.3	118.3	80	120	80	120	C
767	197.0150	26-MAY-1998	pemi	40	2	147	na	482.3	474.5	139.2	120	160	120	160	C
768	073.0052	26-SEP-2003	mdct	40	2	155	na	1227.6	1212.8	140.2	120	160	120	160	C
769	220.0082	15-SEP-2003	upct	40	2	150	na	979.0	971.0	142.0	120	160	120	160	C
770	187.0101	26-SEP-1986	saco	40	2	153	na	416.5	413.5	150.0	120	160	120	160	C
771	149.0515	15-JUL-2004	saco	40	2	183	na	485.0	459.0	157.0	120	160	120	160	C
772	033.0813	13-MAR-1998	nrpc	20	2	28	na	280.2	262.2	10.0	10	20	0	10	U
773	007.0285	17-OCT-1988	nrpc	20	2	15	na	262.0	257.0	10.0	10	20	0	10	U
774	033.0414	19-NOV-1991	nrpc	20	2	26	na	265.7	250.0	10.3	10	20	0	10	U
775	188.0657	20-JUL-1996	nrpc	20	2	12	na	219.0	217.4	10.4	10	20	0	10	U
776	033.0411	22-OCT-1991	nrpc	20	2	19	na	285.4	277.0	10.6	10	20	0	10	U
777	033.0673	08-AUG-1995	nrpc	20	2	48	na	347.4	310.0	10.6	10	20	0	10	U
778	188.1341	10-APR-2002	nrpc	20	2	30	na	174.3	155.0	10.7	10	20	0	10	U
779	007.0204	29-MAR-1988	nrpc	20	2	25	na	264.0	249.7	10.7	10	20	0	10	U
780	033.0224	10-NOV-1989	nrpc	20	2	35	na	388.5	364.6	11.1	10	20	0	10	U
781	119.0711	02-JAN-1996	nrpc	20	2	21	na	213.9	204.5	11.6	10	20	0	10	U
782	139.0198	12-JUL-1995	nrpc	20	2	35	na	215.0	192.0	12.0	10	20	0	10	U
783	159.0132	18-APR-1988	nrpc	20	2	16	na	255.0	251.0	12.0	10	20	0	10	U
784	033.0257	06-JUL-1990	nrpc	20	2	15	na	308.1	305.1	12.0	10	20	0	10	U
785	139.0189	28-JUN-1994	nrpc	20	2	50	na	250.0	212.5	12.5	10	20	0	10	U
786	159.0183	09-JUL-1989	nrpc	20	2	22	na	288.0	279.0	13.0	10	20	0	10	U
787	122.1078	24-JUL-2003	nrpc	20	2	21	na	204.1	196.6	13.5	10	20	0	10	U
788	159.0249	02-JUN-1991	nrpc	20	2	22	na	361.0	352.8	13.8	10	20	0	10	U
789	122.1110	08-JUL-2003	nrpc	20	2	23	na	198.0	189.0	14.0	10	20	0	10	U
790	139.0223	10-APR-1996	nrpc	20	2	42	na	199.0	171.7	14.7	10	20	0	10	U
791	139.0209	02-OCT-1995	nrpc	20	2	40	na	204.0	179.0	15.0	10	20	0	10	U
792	159.0494	22-APR-1997	nrpc	20	2	27	na	310.0	300.0	17.0	10	20	0	10	U
793	007.0361	16-JUN-1992	nrpc	20	2	19	na	270.0	269.0	18.0	10	20	0	10	U
794	033.0132	08-FEB-1988	nrpc	20	2	28	na	334.6	324.8	18.2	10	20	0	10	U
795	033.0507	27-AUG-1993	nrpc	20	2	40	na	285.4	264.0	18.6	10	20	0	10	U
796	119.1249	09-JUL-2004	nrpc	20	2	28	na	183.1	174.0	18.9	10	20	0	10	U
797	033.0809	27-JAN-1998	nrpc	20	2	30	na	311.0	301.0	20.0	20	40	0	10	U
798	143.0863	15-DEC-2005	upmk	20	2	40	na	365.0	345.0	20.0	20	40	0	20	U
799	188.1703	21-JUL-2006	nrpc	20	2	22	na	182.0	180.0	20.0	20	40	0	10	U
800	122.1056	07-JUN-2001	nrpc	20	2	45	na	233.9	209.3	20.4	20	40	0	10	U

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						Depth		Interpolated (ft msl)		Saturated Thickness (ft)					
						(ft bgs) to					Actual Class		Mapped Class		
		Date	USGS	(ft)				Land	Water	Calc					
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU
801	239.0612	24-OCT-2005	winn	20	2	29	na	660.0	651.4	20.4	20	40	0	20	U
802	188.0652	12-SEP-1996	nrpc	20	2	30	na	170.6	161.6	21.0	20	40	0	10	U
803	142.2304	06-JUL-2006	lwmk	20	2	30	na	232.0	223.0	21.0	20	40	0	20	U
804	164.1267	12-AUG-2002	winn	20	2	38	na	608.7	592.0	21.3	20	40	0	20	U
805	021.0694	08-JUL-2004	winn	20	2	40	na	606.3	587.7	21.4	20	40	0	20	U
806	015.1103	22-DEC-2003	lamp	20	2	23	na	166.5	165.0	21.5	20	40	0	20	U
807	006.1528	30-JAN-2006	winn	20	2	30	na	564.9	556.4	21.5	20	40	0	20	U
808	119.0697	20-NOV-1995	nrpc	20	2	45	na	223.4	200.0	21.6	20	40	0	10	U
809	029.0701	20-OCT-2003	lamp	20	2	27	na	139.5	135.0	22.5	20	40	0	20	U
810	159.0489	30-APR-1997	nrpc	20	2	26	na	268.4	265.0	22.6	20	40	0	10	U
811	067.0386	24-AUG-2005	coch	20	2	28	na	54.7	49.3	22.6	20	40	10	20	U
812	174.0506	22-DEC-2000	mdmk	20	2	30	na	1030.0	1022.9	22.9	20	40	0	20	U
813	015.0996	05-DEC-2002	coch	20	2	25	na	200.0	197.9	22.9	20	40	0	10	U
814	200.0716	12-NOV-1997	lamp	20	2	25	na	192.0	190.0	23.0	20	40	0	20	U
815	089.0775	02-APR-2002	lamp	20	2	30	na	172.0	165.0	23.0	20	40	0	20	U
816	006.1448	04-MAY-2005	winn	20	2	25	na	540.0	538.0	23.0	20	40	0	20	U
817	067.0398	03-OCT-2005	coch	20	2	32	na	32.5	23.8	23.3	20	40	10	20	U
818	119.0309	10-JUN-1988	nrpc	20	2	27	na	289.0	285.4	23.4	20	40	0	10	U
819	258.0557	06-AUG-2002	winn	20	2	35	na	640.0	628.7	23.7	20	40	0	20	U
820	007.0385	04-JUN-1993	nrpc	20	2	34	na	230.0	220.0	24.0	20	40	0	10	U
821	225.0954	23-JUL-2004	lamp	20	2	56	na	136.8	105.0	24.2	20	40	0	20	U
822	156.0291	22-APR-1989	nrpc	20	2	27	na	219.0	216.4	24.4	20	40	0	10	U
823	033.0475	07-OCT-1992	nrpc	20	2	25	na	297.0	296.5	24.5	20	40	10	20	U
824	156.0414	27-APR-1996	nrpc	20	2	37	na	230.0	218.0	25.0	20	40	0	10	U
825	159.0229	25-FEB-1991	nrpc	20	2	30	na	387.0	382.0	25.0	20	40	0	10	U
826	167.0975	13-AUG-2003	mdmk	20	2	30	na	465.0	460.0	25.0	20	40	0	20	U
827	029.0754	11-NOV-2004	lamp	20	2	30	na	136.0	131.5	25.5	20	40	0	20	U
828	171.0231	21-OCT-2002	lamp	20	2	38	na	115.0	103.0	26.0	20	40	0	20	U
829	254.0151	08-DEC-1995	nrpc	20	2	40	na	673.9	660.0	26.1	20	40	0	10	U
830	006.1307	07-JAN-2004	winn	20	2	28	na	538.6	537.0	26.4	20	40	0	20	U
831	029.0752	18-NOV-2004	lamp	20	2	40	na	114.0	100.5	26.5	20	40	0	20	U
832	188.1326	29-OCT-2001	nrpc	20	2	30	na	163.3	160.0	26.7	20	40	0	10	U
833	061.0762	30-NOV-1999	lamp	20	2	40	na	260.0	246.8	26.8	20	40	0	20	U
834	156.0271	10-NOV-1988	nrpc	20	2	39	na	210.0	198.0	27.0	20	40	10	20	U
835	078.0683	04-NOV-2005	lamp	20	2	50	na	176.0	153.0	27.0	20	40	0	20	U
836	139.0166	03-JUN-1992	nrpc	20	2	42	na	171.0	156.1	27.1	20	40	10	20	U
837	256.1680	23-MAR-2000	lwmk	20	2	35	na	192.7	184.9	27.2	20	40	0	20	U
838	089.0774	10-SEP-2002	lamp	20	2	28	na	139.0	138.4	27.4	20	40	0	20	U
839	159.0281	20-MAY-1993	nrpc	20	2	30	na	310.0	307.5	27.5	20	40	10	20	U
840	129.0793	02-JUL-2002	lwmk	20	2	30	na	121.4	119.0	27.6	20	40	0	20	U
841	254.0078	11-MAY-1988	nrpc	20	2	34	na	696.0	690.0	28.0	20	40	0	10	U
842	170.0431	18-MAR-1999	coch	20	2	30	na	522.0	520.0	28.0	20	40	0	20	U
843	188.0756	19-MAR-1997	nrpc	20	2	38	na	150.0	140.5	28.5	20	40	10	20	U
844	156.0572	16-JUL-2002	nrpc	20	2	56	na	192.0	164.9	28.9	20	40	10	20	U
845	033.1063	17-AUG-2004	nrpc	20	2	60	na	447.0	416.0	29.0	20	40	0	10	U
846	033.0669	25-OCT-1995	nrpc	20	2	50	na	292.0	271.5	29.5	20	40	10	20	U
847	078.0711	10-APR-2006	lamp	20	2	45	na	156.5	141.0	29.5	20	40	0	20	U
848	021.0681	18-SEP-2003	winn	20	2	50	na	660.0	640.0	30.0	20	40	0	20	U
849	200.1105	22-JAN-2004	lamp	20	2	32	na	199.0	197.4	30.4	20	40	0	20	U
850	143.0875	28-MAR-2006	upmk	20	2	37	na	353.7	347.2	30.5	20	40	0	20	U

Characteristics for 1300 Verification Wells

Table-Specific Acronyms

WRB: New Hampshire Geologic Survey well identification number

AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom

STI: Saturated Thickness Interval for the Study Area

OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

						Depth (ft bgs) to		Interpolated (ft msl)		Saturated Thickness (ft)					
											Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
851	083.0302	08-OCT-2002	coch	20	2	35	na	284.0	280.0	31.0	20	40	0	20	U
852	029.0781	21-SEP-2005	lamp	20	2	46	na	134.1	119.5	31.4	20	40	0	20	U
853	119.0480	05-OCT-1992	nrpc	20	2	47	na	204.7	189.3	31.6	20	40	10	20	U
854	171.0239	16-DEC-2002	lamp	20	2	54	na	123.0	100.6	31.6	20	40	0	20	U
855	083.0287	06-JUN-1999	coch	20	2	40	na	285.1	277.0	31.9	20	40	0	20	U
856	044.0522	11-AUG-1997	lamp	20	2	45	na	179.0	166.2	32.2	20	40	0	20	U
857	105.0233	13-APR-2005	lwmk	20	2	41	na	73.8	65.9	33.1	20	40	0	20	U
858	139.0219	19-DEC-1993	nrpc	20	2	50	na	178.0	161.4	33.4	20	40	0	10	U
859	139.0201	28-JUN-1995	nrpc	20	2	82	na	218.2	170.0	33.8	20	40	0	10	U
860	188.1550	23-DEC-2003	nrpc	20	2	50	na	144.4	128.3	33.9	20	40	10	20	U
861	159.0831	25-APR-2003	nrpc	20	2	52	na	301.0	283.0	34.0	20	40	0	10	U
862	204.0143	02-AUG-2006	coch	20	2	55	na	81.0	60.0	34.0	20	40	0	10	U
863	112.0350	28-APR-2005	mdct	40	2	38	na	760.0	756.5	34.5	20	40	0	20	U
864	017.0126	25-FEB-2002	mdct	40	2	65	na	686.4	656.1	34.7	20	40	0	20	U
865	089.0532	24-APR-1998	lamp	20	2	45	na	150.0	140.0	35.0	20	40	0	20	U
866	007.1152	11-AUG-2006	nrpc	20	2	38	na	235.0	232.0	35.0	20	40	0	10	U
867	033.0623	04-JAN-1995	nrpc	20	2	82	na	351.4	304.5	35.1	20	40	0	10	U
868	234.0186	02-AUG-2004	mdmk	20	2	38	na	1053.0	1050.8	35.8	20	40	0	20	U
869	119.1272	08-OCT-2004	nrpc	20	2	56	na	220.0	200.0	36.0	20	40	10	20	U
870	188.1646	23-MAY-2005	nrpc	20	2	38	na	133.0	131.0	36.0	20	40	10	20	U
871	167.1016	29-APR-2004	mdmk	20	2	48	na	367.6	355.7	36.1	20	40	0	20	U
872	188.1560	18-MAY-2004	nrpc	20	2	60	na	181.0	157.2	36.2	20	40	0	10	U
873	083.0451	17-NOV-2005	coch	20	2	40	na	315.4	311.7	36.3	20	40	0	20	U
874	188.0452	12-AUG-1993	nrpc	20	2	50	na	154.2	141.0	36.8	20	40	0	10	U
875	051.0790	17-JUN-2005	upmk	20	2	43	na	334.0	328.0	37.0	20	40	0	20	U
876	033.0471	26-OCT-1992	nrpc	20	2	48	na	250.0	239.2	37.2	20	40	10	20	U
877	234.0145	08-MAY-2001	mdmk	20	2	40	na	884.0	881.8	37.8	20	40	0	20	U
878	139.0092	17-JAN-1991	nrpc	20	2	50	na	185.0	173.1	38.1	20	40	10	20	U
879	156.0301	12-SEP-1989	nrpc	20	2	47	na	209.0	201.0	39.0	20	40	10	20	U
880	078.0548	12-APR-2002	lamp	20	2	70	na	133.0	102.0	39.0	20	40	0	20	U
881	007.0359	23-FEB-1992	nrpc	20	2	65	na	275.0	249.3	39.3	20	40	0	20	U
882	078.0712	18-APR-2006	lamp	20	2	57	na	136.0	118.5	39.5	20	40	0	20	U
883	188.0388	03-JUL-1991	nrpc	20	2	55	na	156.2	141.0	39.8	20	40	10	20	U
884	015.0992	16-APR-2003	coch	20	2	43	na	195.0	191.8	39.8	20	40	10	20	U
885	188.0398	13-AUG-1992	nrpc	20	2	49	na	153.9	144.9	40.0	40	60	0	10	U
886	183.0864	01-OCT-2003	lamp	20	2	45	na	231.0	226.0	40.0	40	60	0	20	U
887	154.0234	13-MAY-2005	mdmk	20	2	56	na	396.0	380.0	40.0	40	60	0	20	U
888	009.0198	25-SEP-2003	cont	40	2	50	na	819.0	809.2	40.2	40	80	0	40	U
889	142.2178	02-JUL-2003	lwmk	20	2	54	na	236.8	223.2	40.4	40	60	0	20	U
890	158.0244	04-NOV-2005	upct	40	2	58	na	1137.0	1120.0	41.0	40	80	0	40	U
891	161.0238	16-AUG-1995	coch	20	2	47	na	427.9	422.0	41.1	40	60	20	40	U
892	119.0412	19-JUN-1991	nrpc	20	2	60	na	192.6	173.9	41.3	40	60	10	20	U
893	244.0091	19-SEP-2005	pemi	40	2	53	na	769.9	758.7	41.8	40	80	0	40	U
894	191.0166	08-JUN-2006	mdct	40	2	45	na	578.0	574.9	41.9	40	80	0	40	U
895	006.1291	04-JUN-2001	winn	20	2	49	na	529.7	522.7	42.0	40	60	20	40	U
896	188.1349	15-JAN-2002	nrpc	20	2	50	na	150.9	143.0	42.1	40	60	10	20	U
897	091.0858	28-APR-2006	upmk	20	2	50	na	632.9	625.0	42.1	40	60	0	20	U
898	033.1085	14-DEC-2004	nrpc	20	2	60	na	265.7	248.0	42.3	40	60	10	20	U
899	252.0228	06-AUG-2004	mdct	40	2	45	na	1019.5	1017.0	42.5	40	80	0	40	U
900	089.0883	26-JUL-2004	lamp	20	2	57	na	143.5	129.0	42.5	40	60	20	40	U

Characteristics for 1300 Verification Wells

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						Depth		Interpolated		Saturated Thickness (ft)					
						(ft bgs) to		(ft msl)			Actual Class		Mapped Class		
		Date	USGS	(ft)				Land	Water	Calc					
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU
901	254.0147	06-SEP-1995	nrpc	20	2	50	na	490.1	482.8	42.7	40	60	20	40	U
902	143.0737	30-JUN-2003	upmk	20	2	69	na	391.0	365.0	43.0	40	60	0	20	U
903	032.0102	01-MAY-2004	coch	20	2	70	na	548.0	521.0	43.0	40	60	20	40	U
904	008.0278	18-JUN-2004	cont	40	2	60	na	649.0	632.0	43.0	40	80	0	40	U
905	189.0164	28-MAY-1998	upmk	20	2	67	na	300.0	276.1	43.1	40	60	20	40	U
906	256.0760	06-DEC-1993	lwmk	20	2	60	na	196.8	180.0	43.2	40	60	0	20	U
907	063.1653	06-SEP-2001	lwmk	20	2	50	na	212.0	205.3	43.3	40	60	0	20	U
908	092.0101	18-SEP-2003	lwct	40	2	54	na	857.8	847.4	43.6	40	80	0	40	U
909	133.0144	10-MAY-2005	lwct	40	2	45	na	327.4	326.0	43.6	40	80	0	40	U
910	143.0870	09-FEB-2006	upmk	20	2	55	na	378.0	366.6	43.6	40	60	0	20	U
911	062.0271	25-SEP-2003	cont	40	2	66	na	675.0	652.9	43.9	40	80	0	40	U
912	142.1839	14-DEC-1999	lwmk	20	2	60	na	237.0	221.0	44.0	40	60	0	20	U
913	147.0241	16-DEC-2003	nrpc	20	2	65	na	803.5	782.5	44.0	40	60	0	10	U
914	232.0684	23-AUG-2001	lwct	40	2	50	na	544.5	539.0	44.5	40	80	0	40	U
915	020.1508	06-NOV-1995	lwmk	20	2	49	na	225.0	220.5	44.5	40	60	20	40	U
916	033.1067	19-AUG-2004	nrpc	20	2	47	na	226.4	224.0	44.6	40	60	20	40	U
917	138.0154	07-MAY-2003	mdct	40	2	77	na	742.0	710.0	45.0	40	80	20	40	U
918	015.1170	27-OCT-2004	coch	20	2	47	na	299.1	297.3	45.2	40	60	0	10	U
919	051.0737	12-NOV-2004	cont	40	2	73	na	370.0	342.7	45.7	40	80	0	40	U
920	121.0515	01-AUG-2002	cont	40	2	54	na	423.0	415.0	46.0	40	80	0	40	U
921	026.0127	16-OCT-2002	upmk	20	2	57	na	422.0	411.0	46.0	40	60	0	20	U
922	136.0187	25-JUN-2003	lwct	40	2	48	na	1205.0	1203.0	46.0	40	80	0	40	U
923	232.0735	25-MAY-2004	lwct	40	2	48	na	607.0	605.2	46.2	40	80	0	40	U
924	033.0402	13-JUN-1991	nrpc	20	2	57	na	231.6	221.0	46.4	40	60	10	20	U
925	180.0250	28-SEP-2004	lwmk	20	2	67	na	68.9	48.3	46.4	40	60	0	20	U
926	058.0152	07-AUG-2003	cont	40	2	67	na	682.0	662.0	47.0	40	80	0	40	U
927	025.0285	12-JUL-2004	mdct	40	2	57	na	1016.1	1006.2	47.1	40	80	0	40	U
928	007.0218	09-JUN-1988	nrpc	20	2	55	na	272.7	264.8	47.1	40	60	0	10	U
929	075.0253	12-DEC-2005	saco	40	2	56	na	436.4	428.0	47.6	40	80	0	40	U
930	220.0072	16-JUL-2002	upct	40	2	55	na	916.9	910.0	48.1	40	80	0	40	U
931	135.0629	20-JUN-2003	lamp	20	2	110	na	191.9	130.0	48.1	40	60	20	40	U
932	047.0223	19-MAR-2004	lwct	40	2	55	na	534.2	527.5	48.3	40	80	0	40	U
933	188.1376	20-JUN-2003	nrpc	20	2	65	na	147.6	131.0	48.4	40	60	10	20	U
934	239.0610	01-NOV-2005	winn	20	2	50	na	573.0	571.4	48.4	40	60	20	40	U
935	203.0595	04-NOV-2003	coch	20	2	50	na	229.0	227.5	48.5	40	60	0	10	U
936	242.0317	20-OCT-2004	lwct	40	2	60	na	485.2	473.7	48.5	40	80	0	40	U
937	139.0081	15-AUG-1989	nrpc	20	2	70	na	175.0	153.6	48.6	40	60	10	20	U
938	118.0322	23-AUG-2002	pemi	40	2	98	na	539.0	490.2	49.2	40	80	0	40	U
939	214.0032	03-MAY-2000	lwmk	20	2	63	na	88.6	74.9	49.3	40	60	0	20	U
940	232.0655	10-DEC-2001	lwct	40	2	57	na	604.8	597.4	49.6	40	80	0	40	U
941	036.0476	29-DEC-2000	mdct	40	2	65	na	892.4	877.0	49.6	40	80	0	20	U
942	119.0676	02-OCT-1995	nrpc	20	2	80	na	219.5	189.5	50.0	40	60	10	20	U
943	063.1686	16-OCT-2002	lwmk	20	2	65	na	310.0	295.0	50.0	40	60	0	20	U
944	087.0181	22-OCT-2003	upmk	20	2	70	na	290.0	270.0	50.0	40	60	0	20	U
945	014.0547	23-MAY-2006	upmk	20	2	80	na	537.0	507.0	50.0	40	60	0	20	U
946	139.0208	13-NOV-1995	nrpc	20	2	65	na	182.0	167.4	50.4	40	60	0	10	U
947	170.0589	18-NOV-2005	winn	20	2	60	na	700.0	690.9	50.9	40	60	0	20	U
948	254.0277	20-MAR-2001	nrpc	20	2	80	na	760.0	731.0	51.0	40	60	0	10	U
949	007.0481	12-SEP-1994	nrpc	20	2	53	na	243.0	241.3	51.3	40	60	20	40	U
950	196.0710	13-SEP-2002	lwmk	20	2	55	na	113.2	110.0	51.8	40	60	0	20	U

Characteristics for 1300 Verification Wells

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Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Depth (ft bgs) to Bedrock	Depth (ft bgs) to Till	Interpolated (ft msl) Land Elev	Interpolated (ft msl) Water Table	Saturated Thickness (ft) Calc ST	Actual Class Min	Actual Class Max	Mapped Class Min	Mapped Class Max	OCU
951	256.1806	18-MAR-2004	lwmk	20	2	66	na	179.0	164.8	51.8	40	60	0	20	U
952	210.0538	15-JUL-2003	pemi	40	2	60	na	535.8	527.7	51.9	40	80	0	40	U
953	107.0146	23-AUG-2000	cont	40	2	80	na	755.0	727.0	52.0	40	80	0	40	U
954	087.0197	10-SEP-2004	pemi	40	2	80	na	416.8	388.8	52.0	40	80	0	40	U
955	258.0636	29-MAR-2004	winn	20	2	80	na	582.7	554.9	52.2	40	60	20	40	U
956	239.0522	07-MAY-2003	winn	20	2	78	na	564.7	539.0	52.3	40	60	20	40	U
957	224.0098	12-SEP-2003	upct	40	2	96	na	928.5	884.9	52.4	40	80	0	40	U
958	035.0381	02-JUL-2004	pemi	40	2	67	na	604.6	590.3	52.7	40	80	0	40	U
959	087.0143	19-MAR-2002	pemi	40	2	60	na	442.0	434.9	52.9	40	80	0	40	U
960	115.0088	03-OCT-2003	pemi	40	2	55	na	462.0	460.0	53.0	40	80	0	40	U
961	180.0237	22-APR-2003	lwmk	20	2	57	na	64.0	60.0	53.0	40	60	0	20	U
962	139.0085	20-FEB-1990	nrpc	20	2	117	na	228.5	164.7	53.2	40	60	10	20	U
963	224.0094	26-NOV-2003	upct	40	2	57	na	946.8	943.1	53.3	40	80	0	40	U
964	239.0483	19-APR-2002	winn	20	2	70	na	659.0	642.5	53.5	40	60	0	20	U
965	036.0671	19-JAN-2006	mdct	40	2	58	na	974.6	970.5	53.9	40	80	0	20	U
966	183.0520	12-OCT-1997	lamp	20	2	75	na	168.0	147.0	54.0	40	60	0	20	U
967	143.0799	10-MAR-2004	upmk	20	2	62	na	402.0	394.0	54.0	40	60	0	20	U
968	172.0311	10-DEC-2002	pemi	40	2	66	na	549.1	537.9	54.8	40	80	0	40	U
969	051.0406	12-NOV-1998	cont	40	2	65	na	348.0	338.0	55.0	40	80	0	40	U
970	177.0242	02-JUN-2003	lwct	40	2	60	na	792.0	787.0	55.0	40	80	0	40	U
971	005.0336	01-NOV-2005	lwct	40	2	58	na	453.4	450.8	55.4	40	80	0	40	U
972	119.0524	13-SEP-1993	nrpc	20	2	79	na	297.0	273.5	55.5	40	60	20	40	U
973	036.0583	12-JAN-2004	mdct	40	2	59	na	908.0	905.0	56.0	40	80	0	20	U
974	140.0353	20-AUG-2004	mdct	40	2	75	na	865.0	846.0	56.0	40	80	0	40	U
975	051.0725	25-JUN-2004	cont	40	2	60	na	344.0	340.0	56.0	40	80	0	40	U
976	174.0334	14-SEP-1998	mdmk	20	2	79	na	1053.1	1030.7	56.6	40	60	0	20	U
977	239.0105	16-SEP-1987	winn	20	2	60	na	563.3	560.0	56.7	40	60	0	20	U
978	107.0149	25-OCT-2000	cont	40	2	66	na	739.0	729.8	56.8	40	80	0	40	U
979	041.0273	14-APR-2005	lwct	40	2	75	na	315.0	296.9	56.9	40	80	0	40	U
980	256.1674	29-APR-2002	lwmk	20	2	65	na	185.0	177.0	57.0	40	60	20	40	U
981	154.0187	24-JUL-2003	mdmk	20	2	65	na	612.0	604.0	57.0	40	60	0	20	U
982	236.0376	28-MAY-2004	pemi	40	2	108	na	628.8	577.9	57.1	40	80	0	40	U
983	170.0443	26-JUN-2003	winn	20	2	70	na	661.6	648.9	57.3	40	60	0	20	U
984	090.0788	30-APR-2004	winn	20	2	105	na	732.6	685.5	57.9	40	60	0	20	U
985	119.1178	27-AUG-2003	nrpc	20	2	62	na	202.0	198.0	58.0	40	60	20	40	U
986	167.1015	21-MAY-2004	mdmk	20	2	68	na	550.0	540.0	58.0	40	60	20	40	U
987	256.1872	04-JAN-2005	lwmk	20	2	60	na	159.6	157.6	58.0	40	60	20	40	U
988	127.0360	20-NOV-2002	lwmk	20	2	60	na	139.2	137.3	58.1	40	60	0	20	U
989	232.0776	16-AUG-2005	lwct	40	2	76	na	477.4	459.5	58.1	40	80	0	40	U
990	005.0347	05-APR-2006	lwct	40	2	63	na	479.6	475.2	58.6	40	80	0	40	U
991	053.0268	15-OCT-2005	lwct	40	2	63	na	842.6	838.3	58.7	40	80	0	40	U
992	162.0122	15-FEB-2006	mdct	40	2	82	na	605.0	581.8	58.8	40	80	0	40	U
993	107.0125	08-MAY-1998	cont	40	2	78	na	726.2	707.1	58.9	40	80	0	40	U
994	033.0264	09-NOV-1990	nrpc	20	2	75	na	295.3	280.0	59.7	40	60	10	20	U
995	086.0191	24-SEP-2003	mdct	40	2	65	na	988.0	982.7	59.7	40	80	0	40	U
996	188.1523	16-DEC-2003	nrpc	20	2	80	na	173.5	153.3	59.8	40	60	0	10	U
997	088.0383	08-APR-2004	saco	40	2	84	na	441.0	416.9	59.9	40	80	0	40	U
998	119.0298	18-MAY-1988	nrpc	20	2	67	na	277.0	270.0	60.0	60	80	40	60	U
999	134.0415	28-JUN-2004	mdct	40	2	63	na	705.9	702.9	60.0	40	80	0	20	U
1000	052.0604	09-MAY-2003	saco	40	2	80	na	463.7	444.6	60.9	40	80	0	40	U

Characteristics for 1300 Verification Wells

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AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom

STI: Saturated Thickness Interval for the Study Area

OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

						Depth (ft bgs) to		Interpolated (ft msl)		Saturated Thickness (ft)					
											Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
1001	003.0276	19-MAY-2004	pemi	40	2	85	na	504.6	481.0	61.4	40	80	0	40	U
1002	241.0778	16-JUL-2004	saco	40	2	81	na	577.4	558.0	61.6	40	80	0	40	U
1003	159.0985	06-OCT-2005	nrpc	20	2	65	na	480.0	476.6	61.6	60	80	0	10	U
1004	256.1236	12-NOV-1999	lwmk	20	2	70	na	215.4	207.3	61.9	60	80	0	20	U
1005	031.0262	09-MAY-2005	pemi	40	2	80	na	488.1	470.0	61.9	40	80	0	40	U
1006	188.0461	06-MAY-1993	nrpc	20	2	70	na	144.4	136.9	62.5	60	80	20	40	U
1007	203.0587	20-AUG-2003	coch	20	2	86	na	142.1	118.6	62.5	60	80	40	60	U
1008	115.0102	19-AUG-2004	pemi	40	2	75	na	515.3	502.8	62.5	40	80	0	40	U
1009	172.0319	28-AUG-2002	pemi	40	2	70	na	516.5	509.3	62.8	40	80	0	40	U
1010	159.0453	17-DEC-1996	nrpc	20	2	77	na	302.0	288.0	63.0	60	80	0	10	U
1011	211.0574	10-FEB-1999	lamp	20	2	72	na	240.0	231.0	63.0	60	80	0	20	U
1012	092.0083	18-SEP-1998	lwct	40	2	86	na	743.5	721.0	63.5	40	80	0	40	U
1013	123.0173	07-AUG-2001	saco	40	2	80	na	778.0	761.5	63.5	40	80	0	40	U
1014	209.0205	06-OCT-2003	cont	40	2	89	na	585.0	560.0	64.0	40	80	0	40	U
1015	057.0181	18-OCT-2005	mdct	40	2	67	na	899.0	896.0	64.0	40	80	0	40	U
1016	119.1327	27-FEB-2006	nrpc	20	2	85	na	193.9	172.9	64.0	60	80	10	20	U
1017	230.0075	05-AUG-2002	lwct	40	2	68	na	567.6	564.3	64.7	40	80	0	40	U
1018	225.1029	24-JUL-2006	lamp	20	2	83	na	122.7	104.5	64.8	60	80	0	20	U
1019	052.0711	27-AUG-2005	saco	40	2	70	na	438.2	433.1	64.9	40	80	0	40	U
1020	035.0030	17-DEC-1986	pemi	40	2	105	na	640.0	600.0	65.0	40	80	0	40	U
1021	139.0211	06-FEB-1996	nrpc	20	2	85	na	190.0	171.0	66.0	60	80	40	60	U
1022	029.0777	09-SEP-2005	lamp	20	2	68	na	136.0	134.0	66.0	60	80	20	40	U
1023	188.0380	13-MAY-1991	nrpc	20	2	85	na	148.6	130.0	66.4	60	80	40	60	U
1024	159.0963	27-AUG-2005	nrpc	20	2	77	na	259.5	248.9	66.4	60	80	0	10	U
1025	187.0462	13-DEC-1999	saco	40	2	80	na	693.1	680.0	66.9	40	80	0	40	U
1026	020.2354	11-MAY-2001	mdmk	20	2	78	na	232.0	221.0	67.0	60	80	20	40	U
1027	248.0260	20-MAY-2003	cont	40	2	82	na	378.0	363.0	67.0	40	80	0	40	U
1028	149.0574	01-JUN-2006	saco	40	2	90	na	551.0	528.1	67.1	40	80	0	40	U
1029	086.0246	09-SEP-2005	mdct	40	2	116	na	1188.5	1140.0	67.5	40	80	0	40	U
1030	221.0136	30-JUL-2005	upct	40	2	112	na	1244.7	1200.6	67.9	40	80	0	40	U
1031	006.1498	16-NOV-2005	winn	20	2	70	na	538.9	537.2	68.3	60	80	20	40	U
1032	139.0388	16-APR-2003	nrpc	20	2	76	na	187.5	180.0	68.5	60	80	20	40	U
1033	188.0572	21-FEB-1994	nrpc	20	2	70	na	159.0	157.8	68.8	60	80	0	10	U
1034	026.0178	05-APR-2006	upmk	20	2	78	na	291.0	282.0	69.0	60	80	20	40	U
1035	121.0507	15-OCT-2001	cont	40	2	80	na	398.0	387.3	69.3	40	80	0	40	U
1036	025.0250	03-SEP-2002	mdct	40	2	71	na	1011.4	1009.7	69.3	40	80	0	40	U
1037	203.0103	26-OCT-2001	coch	20	2	90	na	225.0	205.2	70.2	60	80	40	60	U
1038	087.0242	10-APR-2006	upmk	20	2	104	na	364.9	331.6	70.7	60	80	0	20	U
1039	063.1862	04-OCT-2005	lwmk	20	2	87	na	278.0	262.0	71.0	60	80	0	20	U
1040	168.0508	13-JUL-2004	cont	40	2	78	na	738.0	731.3	71.3	40	80	0	40	U
1041	221.0142	17-NOV-2005	upct	40	2	76	na	1084.3	1080.0	71.7	40	80	0	40	U
1042	212.0026	21-SEP-1986	saco	40	2	84	na	617.9	606.0	72.1	40	80	0	40	U
1043	098.0201	26-JUL-2004	cont	40	2	86	na	691.0	678.0	73.0	40	80	0	40	U
1044	004.0180	01-SEP-1998	upmk	20	2	75	na	289.0	287.3	73.3	60	80	40	60	U
1045	159.0172	17-FEB-1989	nrpc	20	2	102	na	320.0	291.5	73.5	60	80	20	40	U
1046	035.0379	17-MAY-2004	pemi	40	2	89	na	669.3	654.1	73.8	40	80	0	40	U
1047	172.0393	12-AUG-2005	pemi	40	2	95	na	571.3	550.1	73.8	40	80	0	40	U
1048	015.1126	17-FEB-2004	coch	20	2	76	na	150.0	148.0	74.0	60	80	20	40	U
1049	138.0202	07-JUN-2004	mdct	40	2	130	na	795.4	740.0	74.6	40	80	0	20	U
1050	099.0456	25-MAY-2004	lwmk	20	2	105	na	93.0	62.7	74.7	60	80	20	40	U

Characteristics for 1300 Verification Wells

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								Interpolated (ft msl)		Saturated Thickness (ft)					
						Depth (ft bgs) to					Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
1051	121.0514	21-OCT-2002	cont	40	2	98	na	370.0	346.8	74.8	40	80	0	40	U
1052	232.0713	26-OCT-2002	lwct	40	2	80	na	556.2	551.0	74.8	40	80	0	40	U
1053	051.0689	05-MAY-2004	cont	40	2	80	na	355.0	350.0	75.0	40	80	0	40	U
1054	220.0084	10-AUG-2004	upct	40	2	76	na	958.4	957.4	75.0	40	80	0	40	U
1055	178.0696	11-JUL-2005	lwmk	20	2	90	na	132.0	117.0	75.0	60	80	40	60	U
1056	129.0854	13-DEC-2002	lwmk	20	2	84	na	128.0	120.0	76.0	60	80	20	40	U
1057	254.0317	03-FEB-2004	nrpc	20	2	116	na	600.0	560.0	76.0	60	80	0	10	U
1058	108.0461	12-JAN-2005	mdct	40	2	127	na	521.0	470.0	76.0	40	80	0	40	U
1059	159.0966	17-NOV-2005	nrpc	20	2	78	na	262.0	260.0	76.0	60	80	10	20	U
1060	256.0914	12-OCT-1995	lwmk	20	2	79	na	182.0	180.0	77.0	60	80	0	20	U
1061	165.0171	03-JUN-2003	nrpc	20	2	88	na	200.0	189.0	77.0	60	80	10	20	U
1062	203.0649	06-JUL-2004	coch	20	2	95	na	238.0	220.0	77.0	60	80	40	60	U
1063	214.0035	28-APR-2003	lwmk	20	2	100	na	79.5	56.7	77.2	60	80	0	20	U
1064	025.0325	19-OCT-2005	mdct	40	2	97	na	1063.0	1043.3	77.3	40	80	0	40	U
1065	016.0368	03-MAR-2005	saco	40	2	86	na	666.7	658.2	77.5	40	80	0	40	U
1066	030.0181	25-FEB-2002	pemi	40	2	111	na	530.0	496.8	77.8	40	80	0	40	U
1067	051.0776	04-APR-2005	upmk	20	2	79	na	329.0	327.8	77.8	60	80	0	20	U
1068	113.0197	23-APR-2004	pemi	40	2	85	na	607.1	600.0	77.9	40	80	0	40	U
1069	091.0652	21-JUN-2002	upmk	20	2	82	na	627.0	623.0	78.0	60	80	40	60	U
1070	038.0458	17-JUN-2006	upmk	20	2	110	na	375.0	343.0	78.0	60	80	20	40	U
1071	104.0920	01-OCT-2001	lwmk	20	2	90	na	249.0	238.0	79.0	60	80	0	20	U
1072	237.0223	10-MAY-2005	winn	20	2	87	na	489.5	482.0	79.5	60	80	0	20	U
1073	178.0695	12-JUL-2005	lwmk	20	2	90	na	121.4	111.0	79.6	60	80	20	40	U
1074	199.0115	05-OCT-2001	upct	40	2	87	na	1503.3	1496.0	79.7	40	80	0	40	U
1075	143.0681	07-DEC-2001	upmk	20	2	90	na	390.0	380.0	80.0	80	100	0	20	U
1076	105.0192	13-MAY-2003	lwmk	20	2	90	na	29.5	19.7	80.2	80	100	0	20	U
1077	237.0224	05-APR-2005	winn	20	2	100	na	505.0	485.4	80.4	80	100	60	80	U
1078	256.0742	25-MAR-1994	lwmk	20	2	94	na	173.0	160.0	81.0	80	100	40	60	U
1079	122.0506	09-APR-1992	nrpc	20	2	91	na	145.0	135.4	81.4	80	100	10	20	U
1080	086.0247	11-OCT-2005	mdct	40	2	95	na	1013.4	1000.0	81.6	80	120	0	40	U
1081	016.0354	29-OCT-2004	saco	40	2	85	na	599.1	595.8	81.7	80	120	40	80	U
1082	156.0357	21-APR-1993	nrpc	20	2	108	na	200.0	173.8	81.8	80	100	40	60	U
1083	117.0174	17-SEP-2001	lwct	40	2	87	na	188.5	183.5	82.0	80	120	40	80	U
1084	016.0344	08-MAR-2004	saco	40	2	130	na	540.0	492.6	82.6	80	120	40	80	U
1085	159.0246	09-JUL-1991	nrpc	20	2	119	na	312.0	276.5	83.5	80	100	40	60	U
1086	035.0456	15-SEP-2005	pemi	40	2	100	na	770.8	754.6	83.8	80	120	0	40	U
1087	233.0413	27-JUN-2002	saco	40	2	112	na	466.1	438.1	84.0	80	120	0	40	U
1088	149.0393	19-MAY-1999	saco	40	2	90	na	476.1	471.9	85.8	80	120	40	80	U
1089	039.0093	06-MAY-2005	mdct	40	2	89	na	1402.5	1400.0	86.5	80	120	0	40	U
1090	039.0107	24-JUL-2006	mdct	40	2	90	na	1332.2	1328.8	86.6	80	120	0	40	U
1091	252.0253	10-NOV-2005	mdct	40	2	120	na	1063.0	1030.1	87.1	80	120	40	80	U
1092	142.2287	31-OCT-2005	lwmk	20	2	105	na	236.0	219.0	88.0	80	100	0	20	U
1093	181.0069	11-MAY-2006	upct	40	2	108	na	882.1	863.0	88.9	80	120	40	80	U
1094	052.0647	05-MAR-2004	saco	40	2	100	na	500.0	489.0	89.0	80	120	40	80	U
1095	003.0305	28-JUN-2006	pemi	40	2	115	na	625.4	599.5	89.1	80	120	0	40	U
1096	257.0033	15-DEC-2000	cont	40	2	125	na	1048.2	1012.5	89.3	80	120	0	40	U
1097	241.0846	02-MAY-2005	saco	40	2	91	na	585.2	584.0	89.8	80	120	0	40	U
1098	187.0066	08-APR-1986	saco	40	2	115	na	510.0	485.0	90.0	80	120	40	80	U
1099	073.0065	26-MAY-2005	mdct	40	2	110	na	1080.0	1060.0	90.0	80	120	0	40	U
1100	187.0570	02-MAY-2003	saco	40	2	146	na	470.0	415.1	91.1	80	120	40	80	U

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						Depth (ft bgs) to		Interpolated (ft msl)		Saturated Thickness (ft)					
											Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
1101	191.0164	23-NOV-2005	mdct	40	2	115	na	553.5	530.0	91.5	80	120	0	40	U
1102	112.0303	02-SEP-2003	mdct	40	2	105	na	790.0	776.9	91.9	80	120	0	20	U
1103	210.0539	04-JUN-2003	winn	20	2	95	na	485.0	482.0	92.0	80	100	0	20	U
1104	224.0106	11-MAY-2006	upct	40	2	112	na	980.0	960.0	92.0	80	120	0	40	U
1105	051.0392	25-JUL-1998	upmk	20	2	130	na	297.5	260.0	92.5	80	100	20	40	U
1106	236.0388	19-AUG-2004	pemi	40	2	100	na	644.4	637.0	92.6	80	120	0	40	U
1107	164.1563	11-AUG-2005	winn	20	2	106	na	517.3	504.0	92.7	80	100	0	20	U
1108	149.0541	09-AUG-2005	saco	40	2	95	na	470.0	468.0	93.0	80	120	40	80	U
1109	188.0791	23-MAR-1998	nrpc	20	2	95	na	154.0	152.5	93.5	80	100	0	10	U
1110	036.0602	23-SEP-2004	mdct	40	2	108	na	998.3	984.0	93.7	80	120	0	20	U
1111	051.0592	11-JUL-2000	upmk	20	2	101	na	235.0	228.0	94.0	80	100	40	60	U
1112	002.0127	23-OCT-2003	saco	40	2	100	na	463.0	457.0	94.0	80	120	40	80	U
1113	232.0672	26-JUL-2002	lwct	40	2	96	na	492.1	490.5	94.4	80	120	40	80	U
1114	121.0512	01-JUL-2002	cont	40	2	118	na	375.0	352.0	95.0	80	120	40	80	U
1115	233.0543	10-APR-2006	saco	40	2	135	na	483.1	443.2	95.1	80	120	40	80	U
1116	045.0478	01-OCT-1998	lwct	40	2	115	na	384.8	365.3	95.5	80	120	40	80	U
1117	050.0167	15-MAY-2006	upct	40	2	125	na	1020.0	990.9	95.9	80	120	40	80	U
1118	172.0402	11-JAN-2006	pemi	40	2	119	na	523.0	500.0	96.0	80	120	40	80	U
1119	047.0144	09-NOV-1999	lwct	40	2	108	na	562.3	551.0	96.7	80	120	40	80	U
1120	052.0457	25-NOV-1998	saco	40	2	115	na	506.5	489.0	97.5	80	120	40	80	U
1121	197.0276	27-JUL-2005	pemi	40	2	145	na	520.0	473.1	98.1	80	120	0	40	U
1122	003.0277	21-MAR-2005	pemi	40	2	108	na	524.1	514.9	98.8	80	120	0	40	U
1123	232.0663	19-JUN-2002	lwct	40	2	106	na	490.0	482.9	98.9	80	120	40	80	U
1124	114.0514	05-APR-2006	cont	40	2	119	na	454.1	434.3	99.2	80	120	0	40	U
1125	014.0483	22-DEC-2003	upmk	20	2	106	na	538.0	531.4	99.4	80	100	0	20	U
1126	073.0040	11-DEC-2001	mdct	40	2	102	na	1248.0	1245.7	99.7	80	120	0	40	U
1127	021.0745	30-JUN-2005	winn	20	2	110	na	475.0	465.0	100.0	100	120	80	100	U
1128	008.0262	25-JAN-2002	cont	40	2	120	na	620.0	601.0	101.0	80	120	0	40	U
1129	134.0414	25-JUN-2004	mdct	40	2	112	na	768.0	757.3	101.3	80	120	40	80	U
1130	206.0247	12-MAY-2004	pemi	40	2	130	na	560.0	531.4	101.4	80	120	0	40	U
1131	016.0242	03-NOV-1998	saco	40	2	105	na	709.7	706.3	101.6	80	120	40	80	U
1132	108.0395	23-AUG-2001	mdct	40	2	130	na	500.0	472.0	102.0	80	120	0	40	U
1133	115.0090	01-OCT-2003	pemi	40	2	150	na	410.6	362.7	102.1	80	120	0	40	U
1134	254.0365	24-MAR-2006	nrpc	20	2	120	na	687.0	670.0	103.0	100	120	0	10	U
1135	159.0159	21-OCT-1988	nrpc	20	2	111	na	275.0	268.1	104.1	100	120	10	20	U
1136	146.0249	13-AUG-2002	mdct	40	2	117	na	398.7	387.5	105.8	80	120	20	40	U
1137	075.0201	24-APR-2003	saco	40	2	108	na	416.0	414.0	106.0	80	120	0	40	U
1138	118.0405	13-JAN-2005	pemi	40	2	110	na	583.7	580.0	106.3	80	120	0	40	U
1139	052.0533	05-MAR-2001	saco	40	2	140	na	473.0	440.0	107.0	80	120	0	40	U
1140	241.0881	02-AUG-2005	saco	40	2	120	na	570.0	558.0	108.0	80	120	40	80	U
1141	143.0852	28-JUL-2005	upmk	20	2	125	na	360.0	346.3	111.3	100	120	40	60	U
1142	112.0328	10-AUG-2004	mdct	40	2	132	na	743.6	723.3	111.7	80	120	40	80	U
1143	098.0206	15-SEP-2004	cont	40	2	155	na	841.0	798.0	112.0	80	120	0	40	U
1144	242.0298	19-MAY-2003	lwct	40	2	145	na	474.4	442.0	112.6	80	120	0	40	U
1145	020.2576	06-AUG-2005	mdmk	20	2	130	na	238.0	221.0	113.0	100	120	40	60	U
1146	004.0186	15-JAN-2002	upmk	20	2	120	na	303.0	296.8	113.8	100	120	40	60	U
1147	098.0228	28-DEC-2005	cont	40	2	130	na	858.0	842.0	114.0	80	120	40	80	U
1148	025.0313	16-MAY-2005	mdct	40	2	118	na	1160.0	1156.9	114.9	80	120	0	20	U
1149	086.0201	29-SEP-2003	mdct	40	2	118	na	942.0	939.5	115.5	80	120	0	40	U
1150	021.0768	07-OCT-2005	winn	20	2	120	na	486.0	482.0	116.0	100	120	60	80	U

	Characteristics for 1300 Verification Wells														
	Table-Specific Acronyms WRB: New Hampshire Geologic Survey well identification number AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom STI: Saturated Thickness Interval for the Study Area OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed														
								Interpolated		Saturated Thickness (ft)					
						Depth		(ft msl)			Actual		Mapped		
		Date	USGS	(ft)		(ft bgs) to		Land	Water	Calc	Class		Class		
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU
1151	253.0234	11-AUG-2003	cont	40	2	162	na	880.0	834.1	116.1	80	120	0	40	U
1152	236.0378	30-JUN-2004	pemi	40	2	126	na	767.5	760.0	118.5	80	120	0	40	U
1153	206.0214	13-MAY-2004	pemi	40	2	153	na	607.1	573.1	119.0	80	120	0	40	U
1154	091.0863	21-DEC-2005	upmk	20	2	145	na	650.0	625.0	120.0	120	140	100	120	U
1155	162.0115	22-JUN-2004	mdct	40	2	143	na	613.5	591.0	120.5	120	160	40	80	U
1156	256.1689	23-DEC-2002	lwmk	20	2	130	na	165.0	155.6	120.6	120	140	40	60	U
1157	161.0436	27-JUL-2004	coch	20	2	130	na	422.0	413.0	121.0	120	140	80	100	U
1158	255.0227	07-JUL-2004	lwct	40	2	126	na	447.0	442.9	121.9	120	160	0	40	U
1159	020.2497	22-MAR-2004	mdmk	20	2	126	na	215.0	211.0	122.0	120	140	20	40	U
1160	052.0745	06-JUN-2006	saco	40	2	129	na	410.0	403.6	122.6	120	160	80	120	U
1161	243.0437	09-MAY-2006	cont	40	2	138	na	411.0	397.0	124.0	120	160	0	40	U
1162	008.0298	07-APR-2005	cont	40	2	134	na	647.1	640.0	126.9	120	160	0	40	U
1163	036.0658	23-SEP-2005	mdct	40	2	130	na	807.0	804.0	127.0	120	160	40	80	U
1164	259.0109	17-MAY-2006	pemi	40	2	160	na	711.2	680.0	128.8	120	160	0	40	U
1165	021.0785	01-JUN-2006	winn	20	2	162	na	515.2	482.0	128.8	120	140	0	20	U
1166	112.0333	22-OCT-2004	mdct	40	2	140	na	760.7	750.6	129.9	120	160	40	80	U
1167	016.0343	04-MAR-2004	saco	40	2	140	na	580.0	572.0	132.0	120	160	0	40	U
1168	057.0180	14-OCT-2005	mdct	40	2	141	na	869.4	862.0	133.6	120	160	0	40	U
1169	212.0266	13-OCT-2001	saco	40	2	140	na	605.3	600.0	134.7	120	160	0	40	U
1170	186.0192	09-JUL-2004	mdct	40	2	162	na	420.0	393.1	135.1	120	160	0	40	U
1171	187.0131	16-JUL-1987	saco	40	2	162	na	435.1	408.3	135.2	120	160	40	80	U
1172	232.0625	26-SEP-2000	lwct	40	2	139	na	479.4	476.7	136.3	120	160	40	80	U
1173	002.0113	25-MAY-2002	saco	40	2	140	na	634.3	631.1	136.8	120	160	40	80	U
1174	086.0181	29-MAY-2002	mdct	40	2	150	na	1073.7	1066.0	142.3	120	160	40	80	U
1175	082.0218	07-JUN-1999	lamp	20	2	150	na	41.0	36.5	145.5	140	160	100	120	U
1176	232.0744	17-AUG-2004	lwct	40	2	153	na	488.8	481.3	145.5	120	160	40	80	U
1177	073.0049	03-JUL-2003	mdct	40	2	156	na	1274.7	1264.5	145.8	120	160	0	40	U
1178	008.0281	26-FEB-2004	cont	40	2	150	na	621.4	618.7	147.3	120	160	80	120	U
1179	051.0849	31-JUL-2006	upmk	20	2	157	na	362.0	355.2	150.2	140	160	20	40	U
1180	206.0210	13-MAY-2003	pemi	40	2	160	na	502.0	492.9	150.9	120	160	80	120	U
1181	112.0302	30-APR-2003	mdct	40	2	160	na	753.1	744.3	151.2	120	160	20	40	U
1182	177.0238	08-NOV-2002	lwct	40	2	160	na	879.9	872.4	152.5	120	160	40	80	U
1183	162.0104	05-DEC-2001	mdct	40	2	157	na	610.0	608.1	155.1	120	160	0	40	U
1184	052.0651	04-MAY-2004	saco	40	2	165	na	482.0	473.3	156.3	120	160	80	120	U
1185	138.0153	15-MAY-2003	mdct	40	2	182	na	744.1	720.0	157.9	120	160	40	80	U
1186	210.0567	13-SEP-2004	pemi	40	2	200	na	400.0	360.0	160.0	160	200	0	40	U
1187	206.0215	26-MAY-2004	pemi	40	2	175	na	513.8	499.6	160.8	160	200	0	40	U
1188	206.0206	03-MAR-2003	pemi	40	2	178	na	530.0	518.0	166.0	160	200	80	120	U
1189	035.0360	18-SEP-2003	pemi	40	2	180	na	604.4	592.5	168.1	160	200	80	120	U
1190	232.0677	03-FEB-2003	lwct	40	2	181	na	495.4	483.4	169.0	160	200	40	80	U
1191	241.0948	06-JUL-2006	saco	40	2	185	na	600.0	584.0	169.0	160	200	80	120	U
1192	193.0557	27-AUG-2004	upct	40	2	178	na	1578.1	1576.4	176.3	160	200	80	120	U
1193	206.0245	19-JAN-2006	pemi	40	2	178	na	497.6	496.6	177.0	160	200	80	120	U
1194	206.0222	09-NOV-2004	pemi	40	2	195	na	517.0	500.0	178.0	160	200	40	80	U
1195	112.0273	06-NOV-2001	mdct	40	2	185	na	419.4	414.4	180.0	160	200	0	40	U
1196	161.0378	26-NOV-2002	coch	20	2	191	na	421.0	413.0	183.0	180	200	120	140	U
1197	009.0242	19-AUG-2005	cont	40	2	200	na	642.0	630.0	188.0	160	200	0	40	U
1198	177.0282	21-APR-2005	lwct	40	2	198	na	795.2	787.4	190.2	160	200	0	40	U
1199	025.0296	14-OCT-2004	mdct	40	2	220	na	1322.1	1299.0	196.9	160	200	0	20	U
1200	035.0425	20-APR-2005	pemi	40	2	230	na	570.3	552.3	212.0	200	240	120	160	U

Characteristics for 1300 Verification Wells

Table-Specific Acronyms

WRB: New Hampshire Geologic Survey well identification number

AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom

STI: Saturated Thickness Interval for the Study Area

OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

								Interpolated		Saturated Thickness (ft)					
						Depth		(ft msl)			Actual		Mapped		
		Date	USGS	(ft)		(ft bgs) to		Land	Water	Calc	Class		Class		
Well	WRB	Completed	Study	STI	AGeo	Bedrock	Till	Elev	Table	ST	Min	Max	Min	Max	OCU
1201	107.0209	18-JAN-2006	nrpc	20	2	230	na	252.6	237.0	214.4	200	220	60	80	U
1202	002.0012	22-MAY-1989	saco	40	2	223	na	745.8	740.0	217.2	200	240	0	40	U
1203	149.0505	13-APR-2004	saco	40	2	235	na	480.0	467.0	222.0	200	240	120	160	U
1204	206.0232	18-MAY-2005	pemi	40	2	240	na	522.0	507.2	225.2	200	240	160	200	U
1205	098.0187	29-JUL-2003	cont	40	2	230	na	809.0	807.1	228.1	200	240	40	80	U
1206	186.0209	23-FEB-2006	mdct	40	2	245	na	424.7	416.3	236.6	200	240	120	160	U
1207	053.0169	18-JUN-1998	lwct	40	2	265	na	375.2	351.5	241.3	240	280	80	120	U
1208	116.0571	15-APR-2005	cont	40	2	250	na	770.0	764.0	244.0	240	280	0	40	U
1209	112.0377	27-JUL-2006	mdct	40	2	280	na	570.0	540.0	250.0	240	280	40	80	U
1210	119.0292	22-APR-1988	nrpc	20	3	28	8	211.6	182.0	-21.6	0	10	10	20	O
1211	041.0071	20-SEP-1988	lwct	40	3	26	10	315.0	286.8	-18.2	0	40	40	80	O
1212	006.1167	13-MAY-2002	winn	20	3	55	10	562.0	538.5	-13.5	0	20	20	40	O
1213	119.0475	02-SEP-1992	nrpc	20	3	35	21	208.0	190.0	3.0	0	10	10	20	O
1214	149.0516	06-JUL-2004	saco	40	3	150	30	534.2	510.9	6.7	0	40	40	80	O
1215	188.0344	22-MAY-1991	nrpc	20	3	20	10	135.0	134.4	9.4	0	10	10	20	O
1216	035.0301	07-JUN-2002	pemi	40	3	95	60	598.2	552.6	14.4	0	40	120	160	O
1217	232.0667	21-JAN-2002	lwct	40	3	96	25	465.9	456.9	16.0	0	40	80	120	O
1218	093.1014	02-AUG-2001	mdmk	20	3	60	40	303.0	289.2	26.2	20	40	40	60	O
1219	232.0743	11-JAN-2002	lwct	40	3	117	50	494.0	471.0	27.0	0	40	80	120	O
1220	149.0397	09-OCT-1999	saco	40	3	65	40	480.0	468.0	28.0	0	40	80	120	O
1221	008.0285	25-AUG-2004	pemi	40	3	177	42	656.4	648.0	33.6	0	40	40	80	O
1222	187.0540	08-FEB-2002	saco	40	3	127	80	460.0	415.0	35.0	0	40	40	80	O
1223	039.0073	17-SEP-2002	mdct	40	3	107	62	1481.6	1473.0	53.4	40	80	80	120	O
1224	203.0739	21-MAY-2005	coch	20	3	125	100	192.0	175.0	83.0	80	100	120	140	O
1225	206.0184	01-FEB-2002	pemi	40	3	248	220	525.0	505.2	200.2	200	240	240	280	O
1226	138.0141	21-JUN-2001	mdct	40	3	57	5	776.5	735.6	-35.9	0	20	0	20	C
1227	254.0140	01-DEC-1994	nrpc	20	3	90	15	560.0	520.0	-25.0	0	10	0	10	C
1228	145.0122	29-NOV-2001	mdct	40	3	26	6	794.8	767.2	-21.6	0	20	0	20	C
1229	224.0092	06-DEC-2002	upct	40	3	27	7	916.5	888.9	-20.6	0	40	0	40	C
1230	259.0099	16-JUL-2004	pemi	40	3	108	18	888.7	850.7	-20.0	0	40	0	40	C
1231	033.0532	21-OCT-1993	nrpc	20	3	40	20	454.0	422.0	-12.0	0	10	0	10	C
1232	021.0620	30-JUN-2003	winn	20	3	66	40	622.7	570.9	-11.8	0	20	0	20	C
1233	143.0659	03-MAY-1999	upmk	20	3	68	18	460.0	431.9	-10.1	0	20	0	20	C
1234	119.0513	14-JUN-1993	nrpc	20	3	24	10	288.0	269.0	-9.0	0	10	0	10	C
1235	165.0046	30-MAY-1991	nrpc	20	3	18	5	165.0	152.8	-7.2	0	10	0	10	C
1236	089.0772	07-MAR-2002	lamp	20	3	24	20	172.0	145.0	-7.0	0	20	0	20	C
1237	050.0156	20-MAY-2005	upct	40	3	35	8	1040.0	1026.3	-5.7	0	40	0	40	C
1238	006.1369	24-AUG-2004	winn	20	3	28	15	540.0	520.0	-5.0	0	20	0	20	C
1239	051.0574	18-APR-2002	cont	40	3	107	25	345.0	316.9	-3.1	0	40	0	40	C
1240	220.0076	19-MAR-2002	upct	40	3	68	15	973.4	959.5	1.1	0	40	0	40	C
1241	190.0197	04-OCT-2002	cont	40	3	150	7	800.0	795.0	2.0	0	40	0	40	C
1242	170.0423	08-NOV-2001	winn	20	3	23	10	545.1	537.2	2.1	0	20	0	20	C
1243	202.0652	22-DEC-2003	cont	40	3	47	22	1025.3	1007.0	3.7	0	40	0	40	C
1244	247.1400	06-JAN-2003	mdmk	20	3	45	20	522.0	506.6	4.6	0	20	0	20	C
1245	119.0636	07-OCT-1994	nrpc	20	3	42	25	206.7	187.0	5.3	0	10	0	10	C
1246	092.0119	03-JAN-2006	lwct	40	3	25	15	1035.7	1028.5	7.8	0	40	0	40	C
1247	234.0215	28-MAR-2006	mdmk	20	3	23	15	810.6	804.4	8.8	0	20	0	20	C
1248	039.0078	25-OCT-2003	mdct	40	3	115	30	1342.2	1322.6	10.4	0	40	0	40	C
1249	242.0337	18-MAY-2006	lwct	40	3	48	15	452.8	449.9	12.1	0	40	0	40	C
1250	143.0692	18-JUN-2002	upmk	20	3	70	20	396.0	389.2	13.2	0	20	0	20	C

Characteristics for 1300 Verification Wells

Table-Specific Acronyms

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AGeo: Aquifer Geology 1=100% Till 2=Bedrock Bottom 3=Till Bottom

STI: Saturated Thickness Interval for the Study Area

OCU: Classification Type O=Overclassed C= Correctly-Classed U=Underclassed

						Depth (ft bgs) to		Interpolated (ft msl)		Saturated Thickness (ft)					
											Actual Class		Mapped Class		
Well	WRB	Date Completed	USGS Study	(ft) STI	AGeo	Bedrock	Till	Land Elev	Water Table	Calc ST	Min	Max	Min	Max	OCU
1251	014.0174	12-OCT-1991	upmk	20	3	25	21	541.0	533.4	13.4	0	20	0	20	C
1252	247.1100	21-SEP-1998	mdmk	20	3	72	20	734.0	727.8	13.8	0	20	0	20	C
1253	126.0297	05-AUG-2004	lwct	40	3	46	20	530.2	524.0	13.8	0	40	0	40	C
1254	229.0477	08-JUL-2003	lwct	40	3	86	30	1133.3	1118.7	15.4	0	40	0	40	C
1255	039.0106	16-MAY-2006	mdct	40	3	74	35	1311.2	1291.6	15.4	0	40	0	40	C
1256	142.2254	06-MAY-2004	lwmk	20	3	60	23	239.0	234.3	18.3	0	20	0	20	C
1257	043.0040	10-SEP-1997	saco	40	3	39	28	488.0	478.4	18.4	0	40	0	40	C
1258	025.0331	26-MAY-2006	mdct	40	3	65	35	1191.6	1175.2	18.6	0	40	0	40	C
1259	133.0135	07-AUG-2003	lwct	40	3	28	20	429.0	427.9	18.9	0	40	0	40	C
1260	096.0125	13-FEB-2002	pemi	40	3	66	27	846.4	840.0	20.6	0	40	0	40	C
1261	121.0543	30-SEP-2003	cont	40	3	42	35	495.0	483.0	23.0	0	40	0	40	C
1262	243.0327	25-OCT-2001	cont	40	3	83	78	472.0	417.0	23.0	0	40	0	40	C
1263	102.0077	26-DEC-2002	pemi	40	3	43	30	665.7	660.0	24.3	0	40	0	40	C
1264	232.0725	23-OCT-2003	lwct	40	3	86	29	490.5	485.9	24.4	0	40	0	40	C
1265	159.0130	14-APR-1988	nrpc	20	3	42	35	250.0	240.0	25.0	20	40	20	40	C
1266	193.0622	04-MAY-2006	upct	40	3	78	30	1184.2	1179.6	25.4	0	40	0	40	C
1267	036.0478	25-JUL-2003	mdct	40	3	55	30	924.0	920.0	26.0	20	40	20	40	C
1268	232.0717	28-JUL-2003	lwct	40	3	64	35	501.6	493.4	26.8	0	40	0	40	C
1269	118.0319	08-MAY-2002	pemi	40	3	74	40	810.1	799.0	28.9	0	40	0	40	C
1270	052.0569	22-JAN-2003	saco	40	3	70	55	449.0	423.2	29.2	0	40	0	40	C
1271	188.0683	15-AUG-1997	nrpc	20	3	47	43	154.1	143.1	32.0	20	40	20	40	C
1272	124.0273	31-OCT-2003	cont	40	3	84	38	1043.0	1039.2	34.2	0	40	0	40	C
1273	058.0141	29-DEC-2001	pemi	40	3	66	46	803.6	795.4	37.8	0	40	0	40	C
1274	251.0186	19-JUN-2002	lwct	40	3	160	50	328.6	316.5	37.9	0	40	0	40	C
1275	251.0161	08-APR-1999	lwct	40	3	47	42	603.0	599.8	38.8	0	40	0	40	C
1276	220.0091	23-SEP-2005	upct	40	3	54	50	947.5	941.1	43.6	40	80	40	80	C
1277	007.1045	22-NOV-2002	nrpc	20	3	80	57	200.0	198.0	55.0	40	60	40	60	C
1278	092.0085	25-FEB-1999	lwct	40	3	106	75	728.3	720.5	67.2	40	80	40	80	C
1279	080.0066	20-NOV-2001	upct	40	3	128	100	1265.0	1245.8	80.8	80	120	80	120	C
1280	241.0544	06-OCT-1999	saco	40	3	165	140	670.0	620.0	90.0	80	120	80	120	C
1281	233.0415	02-AUG-2002	saco	40	3	299	140	482.0	439.5	97.5	80	120	80	120	C
1282	004.0132	07-APR-1998	upmk	20	3	135	39	320.0	303.9	22.9	20	40	0	20	U
1283	119.0899	11-AUG-1998	nrpc	20	3	95	60	370.6	335.5	24.9	20	40	10	20	U
1284	027.1146	27-FEB-2002	upmk	20	3	79	59	322.0	298.2	35.2	20	40	0	20	U
1285	204.0129	11-FEB-2004	coch	20	3	108	42	123.5	118.4	36.9	20	40	10	20	U
1286	203.0806	25-MAR-2006	coch	20	3	70	50	195.0	182.0	37.0	20	40	10	20	U
1287	087.0146	06-JUL-2001	pemi	40	3	117	72	413.4	382.0	40.6	40	80	0	40	U
1288	058.0162	20-OCT-2003	pemi	40	3	66	44	841.0	840.0	43.0	40	80	0	40	U
1289	114.0423	12-MAR-2002	cont	40	3	68	45	392.4	390.6	43.2	40	80	0	40	U
1290	232.0669	22-AUG-2002	lwct	40	3	76	45	564.0	563.1	44.1	40	80	0	40	U
1291	136.0190	15-JUL-2003	lwct	40	3	64	49	1217.0	1214.6	46.6	40	80	0	40	U
1292	131.0210	09-FEB-2005	upct	40	3	68	53	867.0	861.0	47.0	40	80	0	40	U
1293	107.0174	20-NOV-2002	cont	40	3	95	68	740.0	720.0	48.0	40	80	0	40	U
1294	188.0684	06-AUG-1997	nrpc	20	3	203	84	180.0	152.1	56.1	40	60	20	40	U
1295	093.1062	13-MAR-2002	mdmk	20	3	113	107	270.8	225.1	61.3	60	80	0	20	U
1296	243.0375	27-MAY-2003	cont	40	3	167	76	460.0	451.0	67.0	40	80	0	40	U
1297	165.0113	15-SEP-1998	nrpc	20	3	99	94	190.3	180.8	84.5	80	100	10	20	U
1298	098.0169	08-OCT-2002	cont	40	3	117	101	803.0	799.0	97.0	80	120	0	40	U
1299	008.0300	19-JUL-2005	cont	40	3	138	110	626.8	621.0	104.2	80	120	40	80	U
1300	140.0373	13-JUL-2005	mdct	40	3	206	178	866.8	850.0	161.2	160	200	0	40	U

APPENDIX H

1990 AND 2000 AQUIFER-SUBSET POPULATIONS BY TOWN

Upland + OSDA = 100% NH Population
OSDA<75 + OSDA75 = 100% OSDA Population
OSDA150 = subset of OSDA75 Population

	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	1	1	Acworth	721	55	37	17	14	786	49	32	17	14
1	1	1	Albany	380	183	40	143	102	473	207	53	155	104
1	1	1	Alexandria	947	250	172	78	49	1087	261	181	80	50
1	1	1	Allenstown	2663	1982	1850	132	33	2750	2083	1965	118	28
1	0	0	Alstead	1355	365	365	0	0	1556	386	386	0	0
1	1	1	Alton	2419	903	438	465	44	3573	978	543	435	46
1	1	1	Amherst	4927	4124	1340	2784	2559	5736	4997	1552	3445	3183
1	1	1	Andover	1065	812	256	556	308	1215	887	270	617	347
1	1	1	Antrim	1845	519	479	40	2	2002	449	410	39	2
1	1	1	Ashland	1344	571	465	106	28	1263	673	555	118	25
1	1	0	Atkinson	4864	310	301	9	0	5691	519	474	46	0
0	0	0	Atkinson & Gilmanton	0	0	0	0	0	12	0	0	0	0
1	1	0	Auburn	2899	1236	1219	18	0	3416	1325	1307	19	0
1	1	1	Barnstead	2622	528	523	4	2	3393	552	548	4	2
1	1	1	Barrington	4680	1528	1351	177	11	5856	1637	1437	201	9
1	1	1	Bartlett	1328	975	126	849	687	1700	1003	156	847	665
1	1	1	Bath	470	315	263	52	24	541	354	290	64	24
0	0	0	Beans Grant	0	0	0	0	0	0	0	0	0	0
0	0	0	Beans Purchase	0	0	0	0	0	4	0	0	0	0
1	1	1	Bedford	8074	4518	4346	172	54	11988	6287	6145	142	32
1	1	1	Belmont	2878	2893	2316	577	63	3275	3406	2657	749	70
1	1	1	Bennington	546	689	560	129	49	645	768	640	128	49
1	1	0	Benton	319	11	10	1	1	304	10	9	1	0
1	1	1	Berlin	11638	189	143	46	21	10160	178	139	39	20
1	1	1	Bethlehem	1834	216	174	42	24	1963	252	200	53	30
1	1	1	Boscawen	2116	1510	1476	35	16	2142	1582	1567	15	7
1	1	1	Bow	4596	908	737	171	101	6135	1011	844	166	95
1	1	1	Bradford	880	519	464	54	10	924	507	444	63	18
1	1	1	Brentwood	1233	1360	1317	43	12	1458	1742	1697	45	16

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OSDA150 = subset of OSDA75 Population

	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	1	1	Bridgewater	636	162	134	29	6	790	181	142	39	15
1	1	1	Bristol	1966	546	426	120	48	2420	591	455	136	59
1	1	0	Brookfield	377	140	121	19	0	462	141	122	19	0
1	1	1	Brookline	1303	1109	373	736	674	2575	1605	571	1034	938
0	0	0	Cambridge	3	0	0	0	0	10	2	2	1	0
1	1	1	Campton	1398	983	662	322	210	1762	961	580	381	284
1	1	1	Canaan	2211	857	605	252	23	2372	973	703	270	25
1	1	0	Candia	3203	351	340	11	0	3535	388	370	18	0
1	1	1	Canterbury	1364	343	331	12	6	1617	388	373	16	7
1	1	1	Carroll	229	300	176	124	68	297	367	196	171	102
1	1	0	Center Harbor	908	104	103	1	0	897	102	101	1	0
0	0	0	Chandlers Purchase	0	0	0	0	0	0	0	0	0	0
1	1	1	Charlestown	1311	3318	2468	851	481	1476	3271	2513	758	366
1	1	1	Chatham	154	110	79	31	12	168	90	71	19	5
1	0	0	Chester	2074	664	664	0	0	2817	1008	1008	0	0
1	1	1	Chesterfield	2728	384	287	97	95	3131	410	317	93	91
1	1	1	Chichester	1835	128	112	16	2	2104	144	131	13	1
1	1	1	Claremont	5178	8725	7781	944	484	5336	7815	6936	879	451
1	1	1	Clarksville	186	51	47	3	2	237	62	56	6	3
1	1	1	Colebrook	966	1481	778	703	525	1037	1283	696	587	429
1	1	1	Columbia	460	203	41	162	126	585	168	37	131	88
1	1	1	Concord	6728	29221	29021	200	59	8572	32035	31804	231	60
1	1	1	Conway	4139	3770	1906	1864	1283	4723	3847	1990	1857	1341
1	1	1	Cornish	1464	193	164	29	12	1417	240	183	57	14
0	0	0	Crawfords Purchase	0	0	0	0	0	0	0	0	0	0
1	1	1	Croydon	563	64	20	44	19	620	44	16	28	9
0	0	0	Cutts Grant	0	0	0	0	0	0	0	0	0	0
1	1	1	Dalton	531	271	130	141	14	605	308	185	123	16
1	1	1	Danbury	701	187	130	57	32	870	207	154	52	22

Upland + OSDA = 100% NH Population
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OSDA150 = subset of OSDA75 Population

	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	0	0	Danville	2196	324	324	0	0	3428	581	581	0	0
1	1	0	Deerfield	2691	423	421	2	0	3203	460	457	2	0
1	1	1	Deering	1184	526	140	386	45	1281	591	166	425	44
1	1	1	Derry	22230	7103	6154	949	322	25913	7886	6916	970	285
0	0	0	Dixs Grant	0	0	0	0	0	0	0	0	0	0
0	0	0	Dixville	39	8	8	0	0	63	9	8	1	0
1	1	0	Dorchester	352	40	34	6	0	321	31	26	4	0
1	1	1	Dover	3880	21156	17339	3818	944	4638	22243	18159	4084	1097
1	1	0	Dublin	1372	96	86	10	0	1351	116	106	10	0
1	1	1	Dummer	280	51	43	8	1	285	31	24	7	1
1	1	1	Dunbarton	1699	69	67	2	1	2141	93	90	3	1
1	1	0	Durham	11592	223	202	21	4	12399	262	240	22	4
1	0	0	East Kingston	1103	236	236	0	0	1523	239	239	0	0
1	1	1	Easton	140	83	54	29	13	156	100	66	35	15
1	1	1	Eaton	289	76	51	25	13	294	81	46	35	21
1	1	1	Effingham	485	470	242	228	49	602	702	375	327	76
1	0	0	Ellsworth	75	0	0	0	0	88	0	0	0	0
1	1	1	Enfield	3544	420	352	68	13	4095	511	412	99	27
1	1	1	Epping	3458	1699	1567	132	24	3699	1766	1637	129	23
1	1	1	Epsom	2624	991	852	140	55	2963	1078	916	162	60
1	1	1	Errol	161	129	93	37	7	138	159	112	47	10
0	0	0	Ervings Location	0	0	0	0	0	1	0	0	0	0
1	1	0	Exeter	11316	1153	1009	144	1	12564	1499	1332	168	1
1	1	1	Farmington	2827	2894	2346	548	154	3052	2713	2220	493	120
1	1	1	Fitzwilliam	1825	186	153	34	17	1947	193	158	35	18
1	1	0	Francestown	951	260	249	11	0	1203	271	257	14	0
1	1	1	Franconia	412	398	244	154	51	472	451	284	167	61
1	1	1	Franklin	2616	5690	5296	394	61	2615	5782	5389	393	55
1	1	1	Freedom	508	430	169	260	58	630	677	237	440	115

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	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	0	0	Fremont	1397	1185	1185	0	0	1963	1556	1556	0	0
1	1	1	Gilford	4118	1730	1101	629	80	4802	1976	1208	767	80
1	1	1	Gilmanton	2439	191	141	51	33	2865	223	164	59	32
1	0	0	Gilsum	617	128	128	0	0	663	114	113	0	0
1	1	1	Goffstown	9928	4720	4535	185	101	11590	5383	5150	233	133
1	1	1	Gorham	661	2502	1150	1352	376	615	2271	1053	1218	334
1	1	0	Goshen	616	127	126	1	0	610	132	131	1	0
1	1	1	Grafton	749	170	123	47	26	935	197	138	59	36
1	1	1	Grantham	1203	48	26	22	15	2095	73	42	31	21
1	1	1	Greenfield	968	573	298	274	77	1033	652	383	269	67
1	1	1	Greenland	1915	856	625	231	92	2288	918	653	265	100
0	0	0	Greens Grant	0	0	0	0	0	0	0	0	0	0
1	0	0	Greenville	2075	121	121	0	0	2068	126	126	0	0
1	1	0	Groton	267	51	44	7	0	395	63	54	9	0
0	0	0	Hadleys Purchase	0	0	0	0	0	0	0	0	0	0
0	0	1	Hales Location	1	5	0	5	4	52	14	2	12	9
1	1	0	Hampstead	5225	1598	1575	23	0	6393	1887	1860	26	0
1	1	1	Hampton	6972	5287	3183	2104	31	9140	5769	3595	2174	39
1	0	0	Hampton Falls	1463	46	46	0	0	1829	56	56	0	0
1	1	1	Hancock	1296	315	237	78	44	1379	367	270	97	56
1	1	1	Hanover	2800	6416	6135	281	91	5078	5777	5309	468	227
1	1	1	Harrisville	937	42	28	14	1	1024	48	36	12	1
1	1	1	Hart's Location	29	7	3	5	3	30	21	7	14	9
1	1	1	Haverhill	1265	2898	2424	474	35	1482	2931	2439	492	68
1	1	1	Hebron	309	86	34	52	46	368	94	37	57	51
1	1	1	Henniker	3280	870	556	314	184	3445	984	691	292	181
1	1	1	Hill	462	353	286	67	19	589	402	321	81	27
1	1	1	Hillsborough	3734	753	607	147	47	4140	777	621	155	40
1	1	1	Hinsdale	1252	2682	1582	1100	181	1326	2754	1573	1181	192

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	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	1	1	Holderness	1183	529	434	94	21	1371	591	476	115	35
1	1	1	Hollis	3347	2432	1074	1358	1177	4147	2952	1324	1628	1406
1	1	1	Hooksett	5771	3162	2321	841	258	8066	3741	2564	1177	305
1	1	1	Hopkinton	2712	2101	1795	306	132	3046	2365	1929	436	234
1	1	1	Hudson	8527	11037	6311	4726	3665	10993	11971	7093	4877	3684
1	1	1	Jackson	610	73	67	5	2	760	81	66	15	5
1	1	1	Jaffrey	3176	2200	1321	879	136	3438	2055	1226	828	122
1	0	0	Jefferson	857	107	107	0	0	883	123	122	0	0
1	1	1	Keene	5573	16867	12361	4506	946	5583	16974	12536	4438	929
1	1	0	Kensington	1267	362	357	5	0	1480	416	407	9	0
0	0	0	Kilkenny	0	0	0	0	0	0	0	0	0	0
1	1	1	Kingston	2318	3319	2743	575	183	2526	3420	2789	631	175
1	1	0	Laconia	10931	4700	4635	65	0	11688	4737	4679	58	0
1	1	1	Lancaster	1911	1613	1253	359	186	1636	1646	1321	325	169
1	0	0	Landaff	274	80	80	0	0	288	94	94	0	0
1	1	1	Langdon	400	180	177	3	3	419	167	165	2	2
1	1	1	Lebanon	7026	5151	4805	346	112	7209	5353	5024	329	95
1	1	1	Lee	2647	1080	1052	28	8	2961	1185	1159	25	7
1	1	1	Lempster	755	191	169	23	6	795	175	148	28	12
1	1	1	Lincoln	420	809	600	209	108	381	890	662	227	116
1	1	1	Lisbon	616	1043	1005	38	18	672	912	871	40	16
1	1	1	Litchfield	397	5132	3524	1608	1016	512	6917	5010	1907	1064
1	1	1	Littleton	4088	1723	1720	3	1	4254	1574	1570	4	1
1	1	1	Londonderry	15587	4369	3634	735	73	18825	4619	3845	774	91
1	1	1	Loudon	2761	1297	836	461	110	3181	1249	746	503	101
0	0	0	Low & Burbanks	0	0	0	0	0	0	0	0	0	0
1	1	0	Lyman	338	50	44	7	0	415	72	57	14	0
1	1	1	Lyme	1157	339	295	44	3	1267	412	358	54	4
1	1	1	Lyndeborough	1155	130	110	21	2	1417	149	126	23	2

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	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	1	1	Madbury	793	603	455	148	65	875	630	473	156	73
1	1	1	Madison	1071	614	151	463	264	1245	722	178	544	344
1	1	1	Manchester	39735	59501	44030	15471	8066	42361	64276	47563	16713	8714
1	1	1	Marlborough	1651	278	218	60	31	1792	219	174	46	24
1	1	0	Marlow	496	154	120	34	0	600	147	110	38	0
0	0	0	Martins Location	0	0	0	0	0	0	0	0	0	0
1	1	0	Mason	1052	170	166	4	0	961	194	191	3	0
1	1	1	Meredith	4211	736	573	163	3	5219	723	579	144	5
1	1	1	Merrimack	8781	13408	8758	4649	3176	10120	15029	9815	5214	3563
1	1	0	Middleton	1182	7	6	1	0	1439	9	7	2	1
1	1	1	Milan	1075	216	190	26	12	1113	210	184	26	12
1	1	1	Milford	6911	4863	2454	2409	1996	7863	5655	2950	2705	2209
0	0	0	Millsfield	18	3	2	1	0	22	0	0	0	0
1	1	1	Milton	2758	938	290	647	599	2909	1006	321	685	631
1	1	1	Monroe	423	323	211	111	49	434	325	235	90	36
1	1	0	Mont Vernon	1830	16	14	2	0	2069	16	14	2	0
1	1	0	Moultonborough	2315	645	622	24	0	3493	1004	971	33	0
1	1	1	Nashua	25062	54485	17532	36953	34004	28235	58249	18541	39708	36589
1	1	1	Nelson	501	35	32	3	2	581	54	50	4	2
1	1	1	New Boston	2319	888	718	170	54	3033	1101	871	230	61
1	0	0	New Castle	840	0	0	0	0	1010	0	0	0	0
1	1	1	New Durham	1524	444	378	66	17	1716	490	399	91	23
1	1	1	New Hampton	1196	400	321	79	32	1308	638	477	161	87
1	1	1	New Ipswich	3052	975	885	90	18	3270	1026	910	115	24
1	1	0	New London	3094	86	79	6	1	4008	102	96	6	1
1	1	1	Newbury	1217	134	79	55	26	1560	164	100	63	21
1	1	0	Newfields	648	245	244	1	0	1243	315	308	7	0
1	1	1	Newington	604	376	363	13	2	477	289	277	12	4
1	1	1	Newmarket	6549	609	575	34	15	7296	737	673	64	19

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	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	1	1	Newport	3319	2789	2399	390	223	3506	2760	2372	388	220
1	1	1	Newton	2235	1226	976	250	24	2604	1669	1366	304	37
1	1	1	North Hampton	2191	1447	1234	213	74	2688	1576	1304	272	95
1	1	1	Northfield	3005	1273	1252	21	11	3325	1219	1203	16	8
1	1	1	Northumberland	1288	1203	1003	200	15	1229	1208	992	215	40
1	0	0	Northwood	3051	72	72	0	0	3555	105	105	0	0
1	1	0	Nottingham	2550	392	385	7	0	3233	459	446	13	0
0	0	0	Odell	0	0	0	0	0	5	0	0	0	0
1	1	0	Orange	196	39	34	5	0	261	37	32	5	0
1	1	1	Orford	686	320	220	100	59	790	299	209	90	53
1	1	1	Ossipee	1612	1674	555	1119	609	1920	2259	675	1584	893
1	1	1	Pelham	5405	4000	2312	1688	1299	6449	4462	2619	1844	1403
1	1	1	Pembroke	3655	2858	2330	528	236	3832	3031	2426	605	196
1	1	1	Peterborough	3197	2048	1376	672	205	3464	2425	1545	880	333
1	0	0	Piermont	421	203	202	0	0	479	232	231	1	0
0	0	0	Pinkham's Grant	11	0	0	0	0	0	0	0	0	0
1	1	1	Pittsburg	752	146	84	62	42	738	126	80	45	31
1	0	0	Pittsfield	3688	45	45	0	0	3919	56	56	0	0
1	1	1	Plainfield	1599	458	420	38	20	1784	458	413	44	23
1	1	0	Plaistow	3407	3902	3423	479	0	3716	4025	3557	468	0
1	1	1	Plymouth	4534	1281	1076	205	24	4520	1374	1140	234	42
1	1	1	Portsmouth	19716	6187	5898	288	130	16222	4544	4358	186	73
1	1	0	Randolph	299	72	60	12	0	272	67	56	11	0
1	1	1	Raymond	5448	3263	3032	232	5	6179	3495	3302	193	5
1	1	1	Richmond	759	116	53	63	36	981	95	44	51	30
1	1	1	Rindge	4196	743	578	165	43	4288	1161	937	223	57
1	1	1	Rochester	9348	17248	11721	5527	3556	10697	17724	12082	5642	3610
1	1	0	Rollinsford	423	2210	1892	318	0	415	2226	1905	321	0
1	0	0	Roxbury	187	59	59	0	0	185	49	49	0	0

Upland + OSDA = 100% NH Population
OSDA<75 + OSDA75 = 100% OSDA Population
OSDA150 = subset of OSDA75 Population

	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	1	1	Rumney	753	693	442	251	177	764	716	442	274	200
1	1	1	Rye	3481	1158	1004	154	46	3924	1282	1142	140	46
1	1	1	Salem	17005	8734	7569	1165	3	18773	9323	7979	1344	4
1	1	1	Salisbury	977	72	61	11	2	1012	115	103	12	3
1	1	1	Sanbornton	1682	453	396	58	2	2013	573	498	75	3
1	1	1	Sandown	2815	1248	1229	20	5	3650	1497	1473	24	5
1	1	1	Sandwich	918	152	115	36	24	1123	170	121	48	34
0	0	0	Sargents Purchase	0	0	0	0	0	0	0	0	0	0
1	1	1	Seabrook	5492	1018	643	374	93	6521	1411	871	540	147
0	0	0	Second College	0	0	0	0	0	0	0	0	0	0
1	1	1	Sharon	255	75	69	6	3	307	83	76	7	3
1	1	1	Shelburne	221	216	69	147	113	172	207	79	127	95
1	1	1	Somersworth	6161	5106	4343	763	32	6286	5201	4418	783	40
1	0	0	South Hampton	677	88	87	1	0	770	105	104	1	0
1	1	1	Springfield	762	36	19	17	13	907	49	25	23	17
1	1	1	Stark	288	231	75	156	99	303	214	80	134	86
1	1	1	Stewartstown	806	241	230	12	6	782	230	207	23	14
1	0	0	Stoddard	618	4	4	0	0	921	8	8	0	0
1	1	0	Strafford	2698	214	190	24	0	3327	257	227	30	0
1	1	1	Stratford	553	372	207	165	130	547	393	192	202	158
1	1	1	Stratham	3984	991	967	24	2	5126	1239	1211	28	2
0	0	0	Success	0	0	0	0	0	2	0	0	0	0
1	1	1	Sugar Hill	445	21	14	7	3	542	22	17	5	2
1	0	0	Sullivan	692	15	15	0	0	740	6	6	0	0
1	1	0	Sunapee	2444	111	90	21	0	2945	103	89	14	0
1	1	1	Surry	514	170	153	17	6	533	160	144	17	8
1	1	1	Sutton	1135	328	302	26	6	1222	333	300	33	6
1	1	1	Swanzey	2855	3353	811	2542	1762	3291	3494	940	2554	1786
1	1	1	Tamworth	1112	1058	373	685	401	1316	1201	327	874	557

Upland + OSDA = 100% NH Population
OSDA<75 + OSDA75 = 100% OSDA Population
OSDA150 = subset of OSDA75 Population

	Model			Apportioned 1990 Population					Apportioned 2000 Population				
MCD	OSDA75L	OSDA150L	Town Name	Upland	OSDA	OSDA<75	OSDA75	OSDA150	Upland	OSDA	OSDA<75	OSDA75	OSDA150
1	0	0	Temple	924	249	249	0	0	982	300	300	0	0
0	0	0	Thompson & Meserve	0	0	0	0	0	0	0	0	0	0
1	1	1	Thornton	754	750	440	310	236	987	855	467	388	310
1	1	0	Tilton	2464	750	643	107	0	2587	871	764	106	0
1	0	0	Troy	1531	565	564	0	0	1469	491	491	0	0
1	1	1	Tuftonboro	1289	544	481	63	1	1528	607	544	63	2
1	1	1	Unity	1254	88	86	2	1	1473	58	56	2	1
0	0	0	Unorganized Territory	0	0	0	0	0	3	0	0	0	0
1	1	1	Wakefield	2294	765	369	396	229	2894	1357	556	801	490
1	1	1	Walpole	1700	1513	1148	366	268	2068	1531	1136	395	309
1	1	1	Warner	1350	876	506	370	167	1861	867	501	366	147
1	1	1	Warren	552	267	66	201	191	573	299	104	195	179
1	0	0	Washington	614	14	14	0	0	869	26	24	2	0
1	1	1	Waterville Valley	65	86	72	14	2	180	75	57	18	8
1	1	1	Weare	5206	987	820	167	8	6625	1153	933	220	5
1	1	1	Webster	1052	369	337	32	9	1214	383	346	37	10
1	1	1	Wentworth	398	233	166	67	39	549	250	183	68	37
0	0	0	Wentworths Location	37	16	12	4	2	25	19	14	5	3
1	1	1	Westmoreland	1347	250	229	21	7	1444	304	280	24	8
1	1	1	Whitefield	1147	787	756	31	4	1215	838	811	27	7
1	1	1	Wilmot	612	317	238	78	4	765	378	293	86	5
1	1	1	Wilton	1791	1325	1089	235	52	2273	1465	1210	255	51
1	1	1	Winchester	2206	1832	1274	559	400	2322	1822	1243	578	411
1	1	1	Windham	7441	1538	897	642	9	8991	1704	1064	640	11
1	1	0	Windsor	83	24	23	1	0	173	27	25	2	1
1	1	0	Wolfeboro	4316	491	454	37	0	5490	587	565	22	0
1	1	1	Woodstock	466	702	528	174	85	535	604	470	134	55

APPENDIX I

OSDA75 STATISTICS AND MODELED OSDA75 LOSSES BY TOWN FOR 2025

OSDA75 Statistics for 2000 and Modeled OSDA75 Losses for 2025					%Change: 2000 NH OSDA75P=			Scenario=	A 0%	B 19.1%	C 38.2%	D 100%
	0.0 mi^2 in Gray								%Lost > 90% in Gray			
	Apportion (mi^2)		Apport (mi^2) 2000		Modeled 2025 OSDA75L (mi^2)				%OSDA150 Lost -2025			
Town Name	OSDA	OSDA75	RSDA75	OSDA75L	A	B	C	D	A	B	C	D
Acworth	1.4782	0.1197	0.0232	0.0966	0.0966	0.1004	0.1022	0.1071	80.7	83.8	85.3	89.5
Albany	8.2841	4.2825	2.6203	1.6622	1.6622	1.7513	1.7969	1.9239	38.8	40.9	42.0	44.9
Alexandria	4.1698	1.2828	0.7258	0.5570	0.5570	0.5830	0.5983	0.6411	43.4	45.4	46.6	50.0
Allenstown	4.7449	0.4655	0.1751	0.2904	0.2904	0.3005	0.3076	0.3273	62.4	64.6	66.1	70.3
Alstead	1.2985	0.0000	0.0000	0.0000	MCD, Not Modeled							
Alton	6.6333	1.8756	1.0549	0.8206	0.8206	0.9007	0.9283	1.0054	43.8	48.0	49.5	53.6
Amherst	12.9012	8.3951	2.0442	6.3509	6.3509	6.5531	6.6773	7.0238	75.6	78.1	79.5	83.7
Andover	6.4717	3.4771	1.2091	2.2681	2.2681	2.3447	2.3916	2.5223	65.2	67.4	68.8	72.5
Antrim	3.5085	0.6730	0.3282	0.3448	0.3448	0.3522	0.3602	0.3825	51.2	52.3	53.5	56.8
Ashland	2.6454	0.7034	0.1157	0.5877	0.5877	0.5989	0.6088	0.6362	83.5	85.1	86.5	90.4
Atkinson	0.7393	0.0284	0.0008	0.0276	0.0276	0.0284	0.0284	0.0284	97.2	100.0	100.0	100.0
Atkinson & Gilmanton	2.0345	0.5287	0.4599	0.0688	Not MCD, Not Modeled							
Auburn	7.5153	0.6149	0.4147	0.2003	0.2003	0.2106	0.2173	0.2362	32.6	34.2	35.3	38.4
Barnstead	5.3319	0.0334	0.0000	0.0334	0.0334	0.0334	0.0334	0.0334	100.0	100.0	100.0	100.0
Barrington	8.4700	1.3016	0.6588	0.6427	0.6427	0.6794	0.6973	0.7473	49.4	52.2	53.6	57.4
Bartlett	8.5768	7.0320	1.6375	5.3945	5.3945	5.6053	5.6940	5.9414	76.7	79.7	81.0	84.5
Bath	8.0751	0.9778	0.4557	0.5221	0.5221	0.5371	0.5489	0.5818	53.4	54.9	56.1	59.5
Beans Grant	0.0020	0.0005	0.0000	0.0005	Not MCD, Not Modeled							
Beans Purchase	0.0000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Bedford	9.1277	0.2339	0.0395	0.1944	0.1944	0.2028	0.2070	0.2187	83.1	86.7	88.5	93.5
Belmont	11.0201	2.2775	0.8933	1.3842	1.3842	1.4631	1.4977	1.5943	60.8	64.2	65.8	70.0
Bennington	4.0817	1.1470	0.4228	0.7243	0.7243	0.7459	0.7608	0.8025	63.1	65.0	66.3	70.0
Benton	0.9335	0.0428	0.0205	0.0222	0.0222	0.0227	0.0232	0.0245	52.0	53.1	54.2	57.4
Berlin	3.3544	1.0914	0.4350	0.6564	0.6564	0.6603	0.6721	0.7048	60.1	60.5	61.6	64.6
Bethlehem	9.6111	1.7804	1.0267	0.7537	0.7537	0.7795	0.7982	0.8504	42.3	43.8	44.8	47.8
Boscawen	5.8272	0.1594	0.0425	0.1168	0.1168	0.1208	0.1230	0.1291	73.3	75.8	77.2	81.0
Bow	5.7477	1.4923	0.1394	1.3529	1.3529	1.4094	1.4293	1.4846	90.7	94.4	95.8	99.5
Bradford	3.8663	0.7387	0.2574	0.4813	0.4813	0.5022	0.5117	0.5383	65.2	68.0	69.3	72.9
Brentwood	5.5145	0.3952	0.1905	0.2047	0.2047	0.2174	0.2228	0.2381	51.8	55.0	56.4	60.2

OSDA75 Statistics for 2000 and Modeled OSDA75 Losses for 2025					%Change: 2000 NH OSDA75P=		Scenario=		A	B	C	D
									0%	19.1%	38.2%	100%
	0.0 mi² in Gray								%Lost > 90% in Gray			
	Apportion (mi²)		Apport (mi²) 2000		Modeled 2025 OSDA75L (mi²)				%OSDA150 Lost -2025			
Town Name	OSDA	OSDA75	RSDA75	OSDA75L	A	B	C	D	A	B	C	D
Bridgewater	2.5430	0.5070	0.1894	0.3176	0.3176	0.3277	0.3341	0.3521	62.6	64.6	65.9	69.4
Bristol	2.9688	0.7332	0.1865	0.5468	0.5468	0.5615	0.5719	0.6011	74.6	76.6	78.0	82.0
Brookfield	1.6722	0.1841	0.1140	0.0701	0.0701	0.0779	0.0805	0.0878	38.1	42.3	43.7	47.7
Brookline	6.1817	3.6009	1.5753	2.0256	2.0256	2.1545	2.2075	2.3553	56.3	59.8	61.3	65.4
Cambridge	7.6888	1.9905	1.7863	0.2042	Not MCD, Not Modeled							
Campton	6.3282	2.9169	0.8295	2.0875	2.0875	2.1457	2.1834	2.2886	71.6	73.6	74.9	78.5
Canaan	8.1797	1.8096	0.9044	0.9052	0.9052	0.9280	0.9519	1.0187	50.0	51.3	52.6	56.3
Candia	2.9054	0.0614	0.0196	0.0418	0.0418	0.0432	0.0442	0.0470	68.1	70.3	72.0	76.6
Canterbury	7.0912	0.3144	0.1479	0.1664	0.1664	0.1731	0.1769	0.1876	52.9	55.1	56.3	59.7
Carroll	10.4412	3.0550	1.1792	1.8758	1.8758	1.8963	1.9303	2.0253	61.4	62.1	63.2	66.3
Center Harbor	0.5335	0.0100	0.0015	0.0085	0.0085	0.0088	0.0090	0.0094	84.9	87.9	89.4	93.7
Chandlers Purchase	0.0000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Charlestown	9.4777	2.1809	0.6533	1.5276	1.5276	1.5815	1.6145	1.7065	70.0	72.5	74.0	78.2
Chatham	4.0567	1.5094	0.8396	0.6698	0.6698	0.7026	0.7169	0.7569	44.4	46.6	47.5	50.1
Chester	4.8224	0.0000	0.0000	0.0000	MCD, Not Modeled							
Chesterfield	2.1230	0.2822	0.0312	0.2510	0.2510	0.2578	0.2624	0.2750	89.0	91.4	93.0	97.4
Chichester	1.1432	0.1111	0.0126	0.0985	0.0985	0.1017	0.1033	0.1077	88.6	91.5	92.9	96.9
Claremont	9.4424	1.5106	0.2997	1.2109	1.2109	1.2255	1.2499	1.3181	80.2	81.1	82.7	87.3
Clarksville	1.6420	0.3012	0.1653	0.1359	0.1359	0.1370	0.1401	0.1487	45.1	45.5	46.5	49.4
Colebrook	5.5630	1.3377	0.3314	1.0063	1.0063	1.0139	1.0347	1.0925	75.2	75.8	77.3	81.7
Columbia	2.9935	1.5737	0.4935	1.0802	1.0802	1.0881	1.1071	1.1600	68.6	69.1	70.3	73.7
Concord	31.2152	2.0060	0.8230	1.1830	1.1830	1.2188	1.2445	1.3161	59.0	60.8	62.0	65.6
Conway	22.2434	9.3522	3.3818	5.9704	5.9704	6.1062	6.2286	6.5699	63.8	65.3	66.6	70.3
Cornish	2.6588	0.3431	0.1096	0.2336	0.2336	0.2434	0.2484	0.2624	68.1	70.9	72.4	76.5
Crawfords Purchase	0.1414	0.0030	0.0009	0.0021	Not MCD, Not Modeled							
Croydon	0.9096	0.3247	0.0519	0.2728	0.2728	0.2842	0.2885	0.3007	84.0	87.5	88.9	92.6
Cutts Grant	0.0000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Dalton	3.8916	1.7285	0.8159	0.9126	0.9126	0.9294	0.9498	1.0069	52.8	53.8	55.0	58.3
Danbury	4.6995	1.3434	0.5184	0.8250	0.8250	0.8513	0.8662	0.9079	61.4	63.4	64.5	67.6

OSDA75 Statistics for 2000 and Modeled OSDA75 Losses for 2025					%Change: 2000 NH OSDA75P= (Scenario=)				A 0%	B 19.1%	C 38.2%	D 100%
	0.0 mi^2 in Gray								%Lost > 90% in Gray			
	Apportion (mi^2)		Apport (mi^2) 2000		Modeled 2025 OSDA75L (mi^2)				%OSDA150 Lost -2025			
Town Name	OSDA	OSDA75	RSDA75	OSDA75L	A	B	C	D	A	B	C	D
Danville	2.2677	0.0000	0.0000	0.0000	MCD, Not Modeled							
Deerfield	4.8255	0.0311	0.0104	0.0207	0.0207	0.0216	0.0220	0.0232	66.6	69.4	70.8	74.7
Deering	4.0819	2.1544	1.0959	1.0585	1.0585	1.1080	1.1380	1.2217	49.1	51.4	52.8	56.7
Derry	5.0263	0.7596	0.0272	0.7324	0.7324	0.7469	0.7596	0.7596	96.4	98.3	100.0	100.0
Dixs Grant	0.4786	0.1244	0.1023	0.0221	Not MCD, Not Modeled							
Dixville	1.3326	0.2672	0.1572	0.1100	Not MCD, Not Modeled							
Dorchester	0.8081	0.1090	0.0515	0.0575	0.0575	0.0593	0.0606	0.0642	52.7	54.4	55.6	58.9
Dover	20.2108	3.8571	1.2304	2.6267	2.6267	2.6752	2.7415	2.9262	68.1	69.4	71.1	75.9
Dublin	1.4358	0.1405	0.0874	0.0531	0.0531	0.0556	0.0575	0.0626	37.8	39.6	40.9	44.6
Dummer	1.8541	0.3704	0.1905	0.1799	0.1799	0.1812	0.1850	0.1955	48.6	48.9	50.0	52.8
Dunbarton	1.7049	0.1385	0.0882	0.0503	0.0503	0.0534	0.0550	0.0593	36.3	38.6	39.7	42.8
Durham	1.1529	0.2058	0.1207	0.0851	0.0851	0.0892	0.0920	0.0999	41.3	43.3	44.7	48.5
East Kingston	1.0593	0.0000	0.0000	0.0000	MCD, Not Modeled							
Easton	3.4227	1.0302	0.6683	0.3619	0.3619	0.3826	0.3939	0.4257	35.1	37.1	38.2	41.3
Eaton	2.0615	0.6687	0.2591	0.4097	0.4097	0.4301	0.4383	0.4609	61.3	64.3	65.5	68.9
Effingham	15.7493	6.3171	4.2800	2.0371	2.0371	2.2152	2.2860	2.4833	32.2	35.1	36.2	39.3
Ellsworth	0.0000	0.0000	0.0000	0.0000	MCD, Not Modeled							
Enfield	2.7936	0.5119	0.1931	0.3188	0.3188	0.3298	0.3372	0.3580	62.3	64.4	65.9	69.9
Epping	3.8973	0.1753	0.0422	0.1332	0.1332	0.1374	0.1406	0.1496	75.9	78.4	80.2	85.3
Epsom	4.2380	0.6072	0.1388	0.4684	0.4684	0.4857	0.4950	0.5209	77.1	80.0	81.5	85.8
Errol	9.0857	1.9596	1.2592	0.7003	0.7003	0.7237	0.7435	0.7987	35.7	36.9	37.9	40.8
Ervings Location	0.0000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Exeter	2.8367	0.4961	0.2561	0.2400	0.2400	0.2487	0.2565	0.2783	48.4	50.1	51.7	56.1
Farmington	4.0003	1.1090	0.3104	0.7986	0.7986	0.8352	0.8532	0.9033	72.0	75.3	76.9	81.5
Fitzwilliam	2.6940	0.4692	0.2742	0.1950	0.1950	0.2033	0.2092	0.2257	41.6	43.3	44.6	48.1
Francestown	4.4109	0.1535	0.0781	0.0754	0.0754	0.0795	0.0816	0.0875	49.1	51.8	53.2	57.0
Franconia	4.5579	1.7209	0.8218	0.8991	0.8991	0.9297	0.9513	1.0116	52.2	54.0	55.3	58.8
Franklin	7.9789	1.3088	0.4759	0.8329	0.8329	0.8380	0.8571	0.9106	63.6	64.0	65.5	69.6
Freedom	9.2521	5.2253	2.1942	3.0311	3.0311	3.1917	3.2551	3.4318	58.0	61.1	62.3	65.7

OSDA75 Statistics for 2000 and Modeled OSDA75 Losses for 2025					%Change: 2000 NH OSDA75P=	Scenario=			A 0%	B 19.1%	C 38.2%	D 100%
	0.0 mi² in Gray								%Lost > 90% in Gray			
	Apportion (mi²)		Apport (mi²) 2000		Modeled 2025 OSDA75L (mi²)				%OSDA150 Lost -2025			
Town Name	OSDA	OSDA75	RSDA75	OSDA75L	A	B	C	D	A	B	C	D
Fremont	6.5313	0.0000	0.0000	0.0000	MCD, Not Modeled							
Gilford	5.6790	1.4671	0.2673	1.1998	1.1998	1.2549	1.2791	1.3468	81.8	85.5	87.2	91.8
Gilmanton	2.2824	0.4525	0.0664	0.3861	0.3861	0.4009	0.4073	0.4250	85.3	88.6	90.0	93.9
Gilsum	1.1238	0.0048	0.0026	0.0022	MCD, Not Modeled							
Goffstown	5.3517	0.7184	0.1503	0.5682	0.5682	0.5854	0.5966	0.6278	79.1	81.5	83.0	87.4
Gorham	4.9742	0.8889	0.0058	0.8832	0.8832	0.8879	0.8889	0.8889	99.3	99.9	100.0	100.0
Goshen	2.2843	0.0589	0.0067	0.0522	0.0522	0.0536	0.0542	0.0561	88.7	91.0	92.1	95.2
Grafton	2.7811	0.6330	0.1783	0.4547	0.4547	0.4667	0.4749	0.4977	71.8	73.7	75.0	78.6
Grantham	0.7631	0.3245	0.0527	0.2718	0.2718	0.2843	0.2888	0.3012	83.8	87.6	89.0	92.8
Greenfield	7.6565	2.3119	1.1493	1.1627	1.1627	1.2069	1.2365	1.3190	50.3	52.2	53.5	57.1
Greenland	2.7490	0.5194	0.0419	0.4776	0.4776	0.4939	0.5027	0.5194	91.9	95.1	96.8	100.0
Greens Grant	0.3000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Greenville	0.2609	0.0000	0.0000	0.0000	MCD, Not Modeled							
Groton	0.9442	0.1360	0.0375	0.0985	0.0985	0.1012	0.1029	0.1079	72.4	74.4	75.7	79.3
Hadleys Purchase	0.0000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Hales Location	0.5426	0.3797	0.2220	0.1577	Not MCD, Not Modeled							
Hampstead	2.3291	0.0232	0.0023	0.0209	0.0209	0.0217	0.0222	0.0232	90.1	93.4	95.5	100.0
Hampton	2.5193	0.9362	0.0847	0.8515	0.8515	0.8767	0.8959	0.9362	91.0	93.6	95.7	100.0
Hampton Falls	0.3041	0.0000	0.0000	0.0000	MCD, Not Modeled							
Hancock	3.8484	0.5630	0.1718	0.3912	0.3912	0.4014	0.4094	0.4317	69.5	71.3	72.7	76.7
Hanover	4.7960	0.6179	0.1542	0.4638	0.4638	0.4772	0.4881	0.5184	75.0	77.2	79.0	83.9
Harrisville	1.2728	0.5502	0.2902	0.2601	0.2601	0.2681	0.2739	0.2899	47.3	48.7	49.8	52.7
Hart's Location	2.4236	1.2642	0.4377	0.8265	0.8265	0.8204	0.8315	0.8626	65.4	64.9	65.8	68.2
Haverhill	13.9047	1.6645	0.4733	1.1912	1.1912	1.2227	1.2474	1.3161	71.6	73.5	74.9	79.1
Hebron	1.2250	0.5818	0.2077	0.3741	0.3741	0.3879	0.3955	0.4169	64.3	66.7	68.0	71.7
Henniker	6.1433	2.4901	1.2200	1.2701	1.2701	1.3287	1.3608	1.4502	51.0	53.4	54.6	58.2
Hill	1.7959	0.4511	0.1756	0.2755	0.2755	0.2872	0.2938	0.3121	61.1	63.7	65.1	69.2
Hillsborough	5.6983	1.1168	0.2997	0.8171	0.8171	0.8437	0.8588	0.9010	73.2	75.5	76.9	80.7
Hinsdale	7.2866	2.5939	1.2664	1.3276	1.3276	1.3798	1.4201	1.5326	51.2	53.2	54.7	59.1

OSDA75 Statistics for 2000 and Modeled OSDA75 Losses for 2025					Scenario= %Change: 2000 NH OSDA75P=				A 0%	B 19.1%	C 38.2%	D 100%
	0.0 mi² in Gray								%Lost > 90% in Gray			
	Apportion (mi²)		Apport (mi²) 2000		Modeled 2025 OSDA75L (mi²)				%OSDA150 Lost -2025			
Town Name	OSDA	OSDA75	RSDA75	OSDA75L	A	B	C	D	A	B	C	D
Holderness	3.5932	0.6588	0.1891	0.4697	0.4697	0.4811	0.4904	0.5163	71.3	73.0	74.4	78.4
Hollis	10.9472	5.8296	2.9457	2.8840	2.8840	3.0421	3.1251	3.3566	49.5	52.2	53.6	57.6
Hooksett	8.3499	2.8687	0.2995	2.5691	2.5691	2.6889	2.7339	2.8597	89.6	93.7	95.3	99.7
Hopkinton	15.2641	2.3802	1.0542	1.3259	1.3259	1.3784	1.4111	1.5021	55.7	57.9	59.3	63.1
Hudson	9.9940	2.8757	0.1878	2.6879	2.6879	2.7832	2.8378	2.8757	93.5	96.8	98.7	100.0
Jackson	1.7718	0.4022	0.2131	0.1891	0.1891	0.1992	0.2039	0.2170	47.0	49.5	50.7	53.9
Jaffrey	5.2123	1.5192	0.3521	1.1672	1.1672	1.1994	1.2242	1.2931	76.8	78.9	80.6	85.1
Jefferson	3.0526	0.1493	0.0227	0.1267	MCD, Not Modeled							
Keene	10.3016	4.1989	0.7975	3.4014	3.4014	3.4415	3.5130	3.7127	81.0	82.0	83.7	88.4
Kensington	2.2493	0.0334	0.0173	0.0161	0.0161	0.0172	0.0177	0.0193	48.2	51.4	53.1	57.8
Kilkenny	0.0000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Kingston	11.0632	2.2470	1.3515	0.8955	0.8955	0.9386	0.9713	1.0625	39.9	41.8	43.2	47.3
Laconia	2.4572	0.1907	0.0042	0.1865	0.1865	0.1865	0.1894	0.1907	97.8	97.8	99.3	100.0
Lancaster	7.3922	1.2117	0.6775	0.5342	0.5342	0.5408	0.5583	0.6072	44.1	44.6	46.1	50.1
Landaff	1.1071	0.0000	0.0000	0.0000	MCD, Not Modeled							
Langdon	2.8431	0.0166	0.0082	0.0083	0.0083	0.0089	0.0091	0.0098	50.3	53.5	55.0	59.3
Lebanon	6.6153	0.8445	0.0176	0.8269	0.8269	0.8326	0.8445	0.8445	97.9	98.6	100.0	100.0
Lee	4.3006	0.1223	0.0659	0.0564	0.0564	0.0599	0.0618	0.0671	46.1	49.0	50.5	54.9
Lempster	3.2296	0.2102	0.0483	0.1618	0.1618	0.1684	0.1715	0.1799	77.0	80.1	81.6	85.6
Lincoln	3.9954	0.8852	0.2630	0.6222	0.6222	0.6351	0.6481	0.6845	70.3	71.7	73.2	77.3
Lisbon	6.0362	0.9626	0.1277	0.8349	0.8349	0.8467	0.8575	0.8877	86.7	88.0	89.1	92.2
Litchfield	13.5641	3.7679	0.7923	2.9755	2.9755	3.1439	3.2046	3.3738	79.0	83.4	85.1	89.5
Littleton	4.4888	0.2013	0.0908	0.1105	0.1105	0.1131	0.1152	0.1212	54.9	56.2	57.2	60.2
Londonderry	10.4272	1.8829	0.5870	1.2959	1.2959	1.3428	1.3722	1.4540	68.8	71.3	72.9	77.2
Loudon	5.7607	2.1670	0.6455	1.5214	1.5214	1.5828	1.6139	1.7007	70.2	73.0	74.5	78.5
Low & Burbanks	0.0000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Lyman	1.4947	0.2476	0.0647	0.1829	0.1829	0.1883	0.1914	0.2001	73.9	76.1	77.3	80.8
Lyme	4.7116	0.5399	0.2053	0.3346	0.3346	0.3436	0.3507	0.3704	62.0	63.6	65.0	68.6
Lyndeborough	2.3059	0.4021	0.1612	0.2408	0.2408	0.2508	0.2558	0.2696	59.9	62.4	63.6	67.1

OSDA75 Statistics for 2000 and Modeled OSDA75 Losses for 2025					%Change: 2000 NH OSDA75P= (Scenario=)				A 0%	B 19.1%	C 38.2%	D 100%
	0.0 mi² in Gray								%Lost > 90% in Gray			
	Apportion (mi²)		Apport (mi²) 2000		Modeled 2025 OSDA75L (mi²)				%OSDA150 Lost -2025			
Town Name	OSDA	OSDA75	RSDA75	OSDA75L	A	B	C	D	A	B	C	D
Madbury	4.3967	1.0107	0.4570	0.5536	0.5536	0.5824	0.5964	0.6356	54.8	57.6	59.0	62.9
Madison	9.0359	6.1351	2.8470	3.2881	3.2881	3.4726	3.5470	3.7547	53.6	56.6	57.8	61.2
Manchester	18.4761	4.8018	0.3088	4.4930	4.4930	4.5581	4.6556	4.8018	93.6	94.9	97.0	100.0
Marlborough	0.5343	0.0431	0.0021	0.0410	0.0410	0.0419	0.0428	0.0431	95.1	97.3	99.3	100.0
Marlow	1.6060	0.1135	0.0167	0.0967	0.0967	0.0995	0.1014	0.1066	85.3	87.7	89.3	94.0
Martins Location	0.5428	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Mason	3.4564	0.0745	0.0200	0.0545	0.0545	0.0560	0.0569	0.0595	73.1	75.2	76.4	79.8
Meredith	2.5901	0.3726	0.0929	0.2797	0.2797	0.2930	0.2992	0.3163	75.1	78.6	80.3	84.9
Merrimack	17.8525	5.8035	0.8376	4.9659	4.9659	5.1390	5.2371	5.5105	85.6	88.6	90.2	95.0
Middleton	0.1590	0.0295	0.0135	0.0160	0.0160	0.0171	0.0175	0.0187	54.4	57.9	59.3	63.2
Milan	6.8533	1.2977	0.8627	0.4350	0.4350	0.4412	0.4539	0.4895	33.5	34.0	35.0	37.7
Milford	9.0554	4.7558	1.1243	3.6316	3.6316	3.7649	3.8405	4.0513	76.4	79.2	80.8	85.2
Millsfield	0.4027	0.0194	0.0073	0.0121	Not MCD, Not Modeled							
Milton	3.5419	1.0194	0.3216	0.6978	0.6978	0.7359	0.7535	0.8028	68.5	72.2	73.9	78.8
Monroe	4.0531	1.0412	0.2653	0.7759	0.7759	0.7955	0.8086	0.8451	74.5	76.4	77.7	81.2
Mont Vernon	0.4135	0.0595	0.0407	0.0188	0.0188	0.0201	0.0208	0.0228	31.6	33.7	34.9	38.3
Moultonborough	7.2951	0.2882	0.1129	0.1753	0.1753	0.1860	0.1900	0.2013	60.8	64.5	65.9	69.9
Nashua	21.0281	12.8491	1.5752	11.2739	11.2739	11.3884	11.6350	12.3230	87.7	88.6	90.6	95.9
Nelson	0.7394	0.1201	0.0744	0.0458	0.0458	0.0474	0.0488	0.0527	38.1	39.5	40.6	43.9
New Boston	9.4485	0.9558	0.3376	0.6181	0.6181	0.6526	0.6669	0.7069	64.7	68.3	69.8	74.0
New Castle	0.0000	0.0000	0.0000	0.0000	MCD, Not Modeled							
New Durham	5.0328	0.6356	0.2417	0.3939	0.3939	0.4257	0.4349	0.4604	62.0	67.0	68.4	72.4
New Hampton	5.6452	1.3454	0.2920	1.0534	1.0534	1.0929	1.1108	1.1607	78.3	81.2	82.6	86.3
New Ipswich	5.8510	0.8619	0.4984	0.3635	0.3635	0.3850	0.3968	0.4295	42.2	44.7	46.0	49.8
New London	1.2531	0.1982	0.0929	0.1053	0.1053	0.1094	0.1117	0.1180	53.1	55.2	56.3	59.5
Newbury	2.0623	0.6764	0.2872	0.3892	0.3892	0.4095	0.4184	0.4432	57.5	60.5	61.9	65.5
Newfields	0.7900	0.0616	0.0437	0.0179	0.0179	0.0192	0.0201	0.0225	29.1	31.1	32.6	36.6
Newington	3.2411	0.1882	0.0000	0.1882	0.1882	0.1882	0.1882	0.1882	100.0	100.0	100.0	100.0
Newmarket	1.0477	0.1798	0.0395	0.1403	0.1403	0.1444	0.1473	0.1556	78.0	80.3	81.9	86.5

OSDA75 Statistics for 2000 and Modeled OSDA75 Losses for 2025					Scenario= %Change: 2000 NH OSDA75P=				A 0%	B 19.1%	C 38.2%	D 100%
	0.0 mi^2 in Gray								%Lost > 90% in Gray			
	Apportion (mi^2)		Apport (mi^2) 2000		Modeled 2025 OSDA75L (mi^2)				%OSDA150 Lost -2025			
Town Name	OSDA	OSDA75	RSDA75	OSDA75L	A	B	C	D	A	B	C	D
Newport	6.1321	1.3102	0.2834	1.0269	1.0269	1.0462	1.0657	1.1199	78.4	79.9	81.3	85.5
Newton	4.0170	0.4710	0.1575	0.3135	0.3135	0.3255	0.3337	0.3566	66.6	69.1	70.8	75.7
North Hampton	3.1790	0.7572	0.1794	0.5778	0.5778	0.5953	0.6072	0.6404	76.3	78.6	80.2	84.6
Northfield	3.0896	0.2538	0.0365	0.2173	0.2173	0.2228	0.2260	0.2350	85.6	87.8	89.1	92.6
Northumberland	6.8451	2.1984	0.7845	1.4139	1.4139	1.4223	1.4491	1.5238	64.3	64.7	65.9	69.3
Northwood	0.4059	0.0003	0.0000	0.0003	MCD, Not Modeled							
Nottingham	3.2912	0.0111	0.0000	0.0111	0.0111	0.0111	0.0111	0.0111	100.0	100.0	100.0	100.0
Odell	0.0008	0.0002	0.0002	0.0000	Not MCD, Not Modeled							
Orange	1.0032	0.1408	0.0437	0.0970	0.0970	0.0992	0.1009	0.1055	68.9	70.5	71.7	75.0
Orford	5.0983	0.7414	0.1149	0.6266	0.6266	0.6399	0.6498	0.6774	84.5	86.3	87.6	91.4
Ossipee	24.5454	16.0393	8.4032	7.6360	7.6360	8.1121	8.3034	8.8371	47.6	50.6	51.8	55.1
Pelham	9.6175	3.6741	1.0989	2.5752	2.5752	2.8096	2.8703	3.0394	70.1	76.5	78.1	82.7
Pembroke	5.4191	2.2299	0.7911	1.4387	1.4387	1.4951	1.5276	1.6185	64.5	67.0	68.5	72.6
Peterborough	9.0865	2.0460	0.5909	1.4550	1.4550	1.4985	1.5304	1.6192	71.1	73.2	74.8	79.1
Piermont	3.6132	0.0366	0.0182	0.0183	MCD, Not Modeled							
Pinkham's Grant	0.0226	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Pittsburg	18.3796	5.1637	3.6373	1.5264	1.5264	1.5551	1.5980	1.7177	29.6	30.1	30.9	33.3
Pittsfield	0.3487	0.0000	0.0000	0.0000	MCD, Not Modeled							
Plainfield	3.2034	0.3126	0.0940	0.2186	0.2186	0.2254	0.2298	0.2421	69.9	72.1	73.5	77.4
Plaistow	5.1010	0.6419	0.1054	0.5365	0.5365	0.5510	0.5622	0.5936	83.6	85.8	87.6	92.5
Plymouth	6.1875	1.0124	0.2971	0.7154	0.7154	0.7374	0.7522	0.7934	70.7	72.8	74.3	78.4
Portsmouth	5.1207	0.7407	0.0148	0.7259	0.7259	0.7378	0.7407	0.7407	98.0	99.6	100.0	100.0
Randolph	1.1823	0.1062	0.0131	0.0931	0.0931	0.0955	0.0970	0.1011	87.7	89.9	91.3	95.2
Raymond	6.0224	0.2702	0.0807	0.1895	0.1895	0.1968	0.2016	0.2153	70.1	72.8	74.6	79.7
Richmond	1.0641	0.4734	0.2533	0.2202	0.2202	0.2310	0.2374	0.2551	46.5	48.8	50.1	53.9
Rindge	5.1548	1.0438	0.3653	0.6786	0.6786	0.7068	0.7220	0.7643	65.0	67.7	69.2	73.2
Rochester	17.6253	4.5263	1.1940	3.3323	3.3323	3.4545	3.5351	3.7597	73.6	76.3	78.1	83.1
Rollinsford	5.6500	0.8136	0.3226	0.4910	0.4910	0.5078	0.5207	0.5566	60.3	62.4	64.0	68.4
Roxbury	0.0973	0.0000	0.0000	0.0000	MCD, Not Modeled							

OSDA75 Statistics for 2000 and Modeled OSDA75 Losses for 2025					%Change: 2000 NH OSDA75P=		Scenario=		A 0%	B 19.1%	C 38.2%	D 100%
	0.0 mi² in Gray								%Lost > 90% in Gray			
	Apportion (mi²)		Apport (mi²) 2000		Modeled 2025 OSDA75L (mi²)				%OSDA150 Lost -2025			
Town Name	OSDA	OSDA75	RSDA75	OSDA75L	A	B	C	D	A	B	C	D
Rumney	6.3245	1.8863	0.6244	1.2619	1.2619	1.2956	1.3207	1.3905	66.9	68.7	70.0	73.7
Rye	2.6505	0.3100	0.0327	0.2774	0.2774	0.2823	0.2874	0.3018	89.5	91.1	92.7	97.3
Salem	8.0400	1.3046	0.2031	1.1015	1.1015	1.1265	1.1498	1.2149	84.4	86.3	88.1	93.1
Salisbury	6.1006	0.5047	0.2942	0.2105	0.2105	0.2222	0.2277	0.2429	41.7	44.0	45.1	48.1
Sanbornton	6.1367	0.9933	0.4852	0.5081	0.5081	0.5363	0.5488	0.5836	51.2	54.0	55.3	58.8
Sandown	3.7160	0.0408	0.0014	0.0393	0.0393	0.0408	0.0408	0.0408	96.5	100.0	100.0	100.0
Sandwich	7.2948	2.1691	1.3505	0.8186	0.8186	0.8636	0.8856	0.9469	37.7	39.8	40.8	43.7
Sargents Purchase	0.0000	0.0000	0.0000	0.0000	Not MCD, Not Modeled							
Seabrook	0.9755	0.3377	0.0752	0.2625	0.2625	0.2727	0.2795	0.2985	77.7	80.7	82.8	88.4
Second College	4.5713	1.1879	1.0273	0.1607	Not MCD, Not Modeled							
Sharon	3.6251	0.3813	0.2615	0.1198	0.1198	0.1229	0.1268	0.1377	31.4	32.2	33.3	36.1
Shelburne	5.6392	3.3651	1.2516	2.1135	2.1135	2.1265	2.1616	2.2594	62.8	63.2	64.2	67.1
Somersworth	6.5860	1.0413	0.2894	0.7519	0.7519	0.7671	0.7849	0.8347	72.2	73.7	75.4	80.2
South Hampton	0.7002	0.0013	0.0003	0.0010	MCD, Not Modeled							
Springfield	0.8621	0.2237	0.0877	0.1360	0.1360	0.1435	0.1466	0.1553	60.8	64.2	65.5	69.4
Stark	6.1909	3.2767	1.3075	1.9692	1.9692	1.9852	2.0198	2.1165	60.1	60.6	61.6	64.6
Stewartstown	3.3158	0.6241	0.3599	0.2641	0.2641	0.2662	0.2730	0.2922	42.3	42.7	43.8	46.8
Stoddard	0.6704	0.0248	0.0184	0.0064	MCD, Not Modeled							
Strafford	2.1514	0.1499	0.0678	0.0821	0.0821	0.0871	0.0894	0.0959	54.8	58.1	59.6	64.0
Stratford	6.1742	2.1359	0.8181	1.3178	1.3178	1.3305	1.3565	1.4290	61.7	62.3	63.5	66.9
Stratham	2.9143	0.0740	0.0090	0.0649	0.0649	0.0671	0.0684	0.0720	87.8	90.7	92.5	97.3
Success	2.6449	0.6873	0.6241	0.0632	Not MCD, Not Modeled							
Sugar Hill	0.4519	0.1422	0.0015	0.1407	0.1407	0.1422	0.1422	0.1422	98.9	100.0	100.0	100.0
Sullivan	0.1261	0.0000	0.0000	0.0000	MCD, Not Modeled							
Sunapee	0.6131	0.0616	0.0047	0.0568	0.0568	0.0591	0.0601	0.0616	92.3	96.1	97.7	100.0
Surry	2.1610	0.2195	0.1186	0.1008	0.1008	0.1041	0.1069	0.1149	45.9	47.4	48.7	52.3
Sutton	6.2595	0.8888	0.4407	0.4481	0.4481	0.4702	0.4803	0.5084	50.4	52.9	54.0	57.2
Swanzey	11.7095	8.0235	2.3711	5.6524	5.6524	5.8110	5.9249	6.2426	70.4	72.4	73.8	77.8
Tamworth	15.3105	8.3572	4.4844	3.8727	3.8727	4.0924	4.1945	4.4792	46.3	49.0	50.2	53.6

APPENDIX J

OSDA150 STATISTICS, 2000, AND MODELED OSDA150 LOSSES. 2025, BY TOWN

OSDA150 Statistics-2000 and Modeled Losses-2025 (*"Hale's Location is Not-MCD, populations were GIS estimated.)					Scenario= %Change 2000 NH OSDA150P =				A 0%	B 19.6%	C 39.2%	D 100%
	Apportion (mi^2)		0.0 mi^2 is in Gray Apportion (mi^2) 2000		Modeled 2025 OSDA150L (mi^2)				%Lost > 90% in Gray %OSDA150 Lost by 2025			
Town Name	OSDA	OSDA150	OSDA150L	RSDA150	A	B	C	D	A	B	C	D
Acworth	1.4782	0.0502	0.0479	0.0023	0.0479	0.0499	0.0502	0.0502	95.4	99.4	100.0	100.0
Albany	8.2841	2.1268	1.0932	1.0337	1.0932	1.1479	1.1687	1.2396	51.4	54.0	55.0	58.3
Alexandria	4.1698	0.7972	0.3205	0.4767	0.3205	0.3397	0.3479	0.3761	40.2	42.6	43.6	47.2
Allenstown	4.7449	0.1625	0.0994	0.0631	0.0994	0.1035	0.1055	0.1124	61.2	63.7	64.9	69.2
Alstead	1.2985	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Alton	6.6333	0.1683	0.1347	0.0336	0.1347	0.1434	0.1457	0.1535	80.1	85.2	86.6	91.2
Amherst	12.9012	7.6370	6.3939	1.2431	6.3939	6.6064	6.7017	7.0262	83.7	86.5	87.8	92.0
Andover	6.4717	1.5738	1.0750	0.4988	1.0750	1.1175	1.1365	1.2010	68.3	71.0	72.2	76.3
Antrim	3.5085	0.0765	0.0271	0.0494	0.0271	0.0281	0.0289	0.0315	35.4	36.8	37.7	41.1
Ashland	2.6454	0.3825	0.3325	0.0500	0.3325	0.3392	0.3432	0.3570	86.9	88.7	89.7	93.3
Atkinson	0.7393	0.0284	0.0284	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Atkinson & Gilmanton	2.0345	0.5287	0.2894	0.2393	Not-MCD, Not Modeled							
Auburn	7.5153	0.6149	0.6024	0.0125	MCD, in 75 GPM Model, but not 150 GPM							
Barnstead	5.3319	0.0136	0.0136	0.0000	0.0136	0.0136	0.0136	0.0136	100.0	100.0	100.0	100.0
Barrington	8.4700	0.1809	0.1301	0.0508	0.1301	0.1354	0.1373	0.1439	71.9	74.8	75.9	79.5
Bartlett	8.5768	5.5702	4.7897	0.7805	4.7897	4.9785	5.0386	5.2435	86.0	89.4	90.5	94.1
Bath	8.0751	0.3831	0.2514	0.1318	0.2514	0.2586	0.2627	0.2765	65.6	67.5	68.6	72.2
Beans Grant	0.0020	0.0005	0.0005	0.0000	Not-MCD, Not Modeled							
Beans Purchase	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Bedford	9.1277	0.0482	0.0472	0.0009	0.0472	0.0482	0.0482	0.0482	98.1	100.0	100.0	100.0
Belmont	11.0201	0.3619	0.2767	0.0853	0.2767	0.2904	0.2950	0.3105	76.4	80.2	81.5	85.8
Bennington	4.0817	0.5538	0.3869	0.1669	0.3869	0.3992	0.4052	0.4259	69.9	72.1	73.2	76.9
Benton	0.9335	0.0428	0.0342	0.0085	MCD, in 75 GPM Model, but not 150 GPM							
Berlin	3.3544	0.5967	0.3813	0.2154	0.3813	0.3850	0.3906	0.4096	63.9	64.5	65.5	68.6
Bethlehem	9.6111	0.9408	0.4713	0.4696	0.4713	0.4882	0.4971	0.5271	50.1	51.9	52.8	56.0
Boscawen	5.8272	0.0978	0.0749	0.0229	0.0749	0.0776	0.0787	0.0825	76.6	79.4	80.5	84.4
Bow	5.7477	0.9884	0.9594	0.0291	0.9594	0.9884	0.9884	0.9884	97.1	100.0	100.0	100.0
Bradford	3.8663	0.2736	0.2081	0.0655	0.2081	0.2168	0.2198	0.2300	76.1	79.2	80.3	84.1
Brentwood	5.5145	0.0955	0.0638	0.0316	0.0638	0.0676	0.0688	0.0730	66.9	70.8	72.1	76.5

OSDA150 Statistics-2000 and Modeled Losses-2025

(*"Hale's Location is Not-MCD, populations were GIS estimated.)

					Scenario=				A	B	C	D
					%Change 2000 NH OSDA150P =				0%	19.6%	39.2%	100%
			0.0 mi² is in Gray						%Lost > 90% in Gray			
	Apportion (mi²)		Apportion (mi²) 2000		Modeled 2025 OSDA150L (mi²)				%OSDA150 Lost by 2025			
Town Name	OSDA	OSDA150	OSDA150L	RSDA150	A	B	C	D	A	B	C	D
Bridgewater	2.5430	0.1645	0.1373	0.0272	0.1373	0.1414	0.1432	0.1497	83.5	85.9	87.1	91.0
Bristol	2.9688	0.3571	0.2869	0.0703	0.2869	0.2954	0.2997	0.3144	80.3	82.7	83.9	88.0
Brookfield	1.6722	0.1841	0.1841	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Brookline	6.1817	3.1667	2.0187	1.1480	2.0187	2.1452	2.1847	2.3190	63.7	67.7	69.0	73.2
Cambridge	7.6888	1.9905	1.0722	0.9184	Not-MCD, Not Modeled							
Campton	6.3282	2.3431	1.8547	0.4883	1.8547	1.9094	1.9350	2.0223	79.2	81.5	82.6	86.3
Canaan	8.1797	0.4215	0.2044	0.2171	0.2044	0.2106	0.2150	0.2299	48.5	50.0	51.0	54.5
Candia	2.9054	0.0614	0.0614	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Canterbury	7.0912	0.1427	0.0961	0.0466	0.0961	0.0997	0.1012	0.1064	67.4	69.9	70.9	74.6
Carroll	10.4412	1.3683	1.0950	0.2732	1.0950	1.1089	1.1229	1.1706	80.0	81.0	82.1	85.6
Center Harbor	0.5335	0.0100	0.0100	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Chandlers Purchase	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Charlestown	9.4777	0.6983	0.5791	0.1192	0.5791	0.6008	0.6106	0.6436	82.9	86.0	87.4	92.2
Chatham	4.0567	0.6920	0.4184	0.2737	0.4184	0.4349	0.4403	0.4588	60.5	62.8	63.6	66.3
Chester	4.8224	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Chesterfield	2.1230	0.2618	0.2535	0.0083	0.2535	0.2609	0.2618	0.2618	96.8	99.6	100.0	100.0
Chichester	1.1432	0.0192	0.0192	0.0000	0.0192	0.0192	0.0192	0.0192	100.0	100.0	100.0	100.0
Claremont	9.4424	0.7602	0.6800	0.0803	0.6800	0.6903	0.7008	0.7366	89.4	90.8	92.2	96.9
Clarksville	1.6420	0.1557	0.0800	0.0757	0.0800	0.0810	0.0824	0.0872	51.4	52.0	52.9	56.0
Colebrook	5.5630	0.8679	0.6645	0.2034	0.6645	0.6727	0.6843	0.7238	76.6	77.5	78.8	83.4
Columbia	2.9935	0.8313	0.6348	0.1965	0.6348	0.6417	0.6508	0.6816	76.4	77.2	78.3	82.0
Concord	31.2152	0.5658	0.4126	0.1532	0.4126	0.4249	0.4313	0.4529	72.9	75.1	76.2	80.0
Conway	22.2434	7.6108	5.3063	2.3045	5.3063	5.4405	5.5241	5.8089	69.7	71.5	72.6	76.3
Cornish	2.6588	0.1517	0.1082	0.0435	0.1082	0.1129	0.1146	0.1206	71.3	74.4	75.6	79.5
Crawfords Purchase	0.1414	0.0030	0.0027	0.0003	Not-MCD, Not Modeled							
Croydon	0.9096	0.1246	0.1048	0.0198	0.1048	0.1097	0.1111	0.1160	84.1	88.1	89.2	93.1
Cutts Grant	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Dalton	3.8916	0.4531	0.3123	0.1408	0.3123	0.3178	0.3222	0.3371	68.9	70.1	71.1	74.4
Danbury	4.6995	0.5186	0.4171	0.1015	0.4171	0.4295	0.4347	0.4525	80.4	82.8	83.8	87.2

OSDA150 Statistics-2000 and Modeled Losses-2025 (*"Hale's Location is Not-MCD, populations were GIS estimated.)					Scenario= %Change 2000 NH OSDA150P =				A 0%	B 19.6%	C 39.2%	D 100%
			0.0 mi^2 is in Gray						%Lost > 90% in Gray			
	Apportion (mi^2)		Apportion (mi^2) 2000		Modeled 2025 OSDA150L (mi^2)				%OSDA150 Lost by 2025			
Town Name	OSDA	OSDA150	OSDA150L	RSDA150	A	B	C	D	A	B	C	D
Danville	2.2677	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Deerfield	4.8255	0.0311	0.0311	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Deering	4.0819	0.2497	0.2006	0.0491	0.2006	0.2076	0.2107	0.2212	80.3	83.1	84.4	88.6
Derry	5.0263	0.2822	0.2793	0.0029	0.2793	0.2822	0.2822	0.2822	99.0	100.0	100.0	100.0
Dixs Grant	0.4786	0.1244	0.0723	0.0521	Not-MCD, Not Modeled							
Dixville	1.3326	0.2672	0.1959	0.0713	Not-MCD, Not Modeled							
Dorchester	0.8081	0.1090	0.1032	0.0058	MCD, in 75 GPM Model, but not 150 GPM							
Dover	20.2108	1.1100	0.9088	0.2013	0.9088	0.9275	0.9437	0.9992	81.9	83.6	85.0	90.0
Dublin	1.4358	0.1405	0.1405	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Dummer	1.8541	0.1594	0.0843	0.0751	0.0843	0.0852	0.0865	0.0909	52.9	53.5	54.3	57.1
Dunbarton	1.7049	0.0722	0.0320	0.0402	0.0320	0.0340	0.0347	0.0370	44.3	47.0	48.0	51.3
Durham	1.1529	0.0850	0.0157	0.0694	MCD, in 75 GPM Model, but not 150 GPM							
East Kingston	1.0593	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Easton	3.4227	0.5187	0.2102	0.3085	0.2102	0.2223	0.2273	0.2441	40.5	42.9	43.8	47.1
Eaton	2.0615	0.3567	0.2555	0.1012	0.2555	0.2683	0.2721	0.2852	71.6	75.2	76.3	79.9
Effingham	15.7493	1.1317	0.5562	0.5755	0.5562	0.5957	0.6076	0.6483	49.1	52.6	53.7	57.3
Ellsworth	0.0000	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Enfield	2.7936	0.1971	0.1285	0.0686	0.1285	0.1334	0.1358	0.1438	65.2	67.7	68.9	73.0
Epping	3.8973	0.0185	0.0184	0.0001	0.0184	0.0185	0.0185	0.0185	99.2	100.0	100.0	100.0
Epsom	4.2380	0.2964	0.2502	0.0462	0.2502	0.2596	0.2634	0.2761	84.4	87.6	88.9	93.2
Errol	9.0857	0.8471	0.2706	0.5764	0.2706	0.2823	0.2893	0.3129	32.0	33.3	34.2	36.9
Ervings Location	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Exeter	2.8367	0.0039	0.0039	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Farmington	4.0003	0.6226	0.4900	0.1326	0.4900	0.5109	0.5185	0.5446	78.7	82.1	83.3	87.5
Fitzwilliam	2.6940	0.2368	0.1101	0.1266	0.1101	0.1152	0.1178	0.1267	46.5	48.7	49.8	53.5
Francestown	4.4109	0.1535	0.1535	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Franconia	4.5579	1.0345	0.5317	0.5029	0.5317	0.5524	0.5629	0.5987	51.4	53.4	54.4	57.9
Franklin	7.9789	0.7099	0.4036	0.3063	0.4036	0.4080	0.4154	0.4406	56.9	57.5	58.5	62.1
Freedom	9.2521	1.9489	1.0619	0.8869	1.0619	1.1280	1.1478	1.2154	54.5	57.9	58.9	62.4

OSDA150 Statistics-2000 and Modeled Losses-2025

(*"Hale's Location is Not-MCD, populations were GIS estimated.)

					Scenario=				A	B	C	D
					%Change 2000 NH OSDA150P =				0%	19.6%	39.2%	100%
			0.0 mi² is in Gray						%Lost > 90% in Gray			
	Apportion (mi²)		Apportion (mi²) 2000		Modeled 2025 OSDA150L (mi²)				%OSDA150 Lost by 2025			
Town Name	OSDA	OSDA150	OSDA150L	RSDA150	A	B	C	D	A	B	C	D
Fremont	6.5313	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Gilford	5.6790	0.2204	0.2059	0.0144	0.2059	0.2152	0.2182	0.2204	93.5	97.6	99.0	100.0
Gilmanton	2.2824	0.2211	0.2114	0.0097	0.2114	0.2198	0.2211	0.2211	95.6	99.4	100.0	100.0
Gilsum	1.1238	0.0048	0.0048	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Goffstown	5.3517	0.4774	0.3944	0.0830	0.3944	0.4075	0.4137	0.4347	82.6	85.4	86.7	91.1
Gorham	4.9742	0.3046	0.3046	0.0000	0.3046	0.3046	0.3046	0.3046	100.0	100.0	100.0	100.0
Goshen	2.2843	0.0589	0.0589	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Grafton	2.7811	0.2717	0.2193	0.0524	0.2193	0.2258	0.2291	0.2400	80.7	83.1	84.3	88.3
Grantham	0.7631	0.2077	0.1914	0.0163	0.1914	0.2005	0.2030	0.2077	92.2	96.5	97.7	100.0
Greenfield	7.6565	1.0557	0.5575	0.4982	0.5575	0.5799	0.5908	0.6277	52.8	54.9	56.0	59.5
Greenland	2.7490	0.1948	0.1859	0.0089	0.1859	0.1930	0.1948	0.1948	95.5	99.1	100.0	100.0
Greens Grant	0.3000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Greenville	0.2609	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Groton	0.9442	0.1360	0.1360	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Hadleys Purchase	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
**Hales Location	0.5426	0.3797	0.1577	0.1184	0.1577	0.1746	0.1784	0.1914	41.5	46.0	47.0	50.4
Hampstead	2.3291	0.0232	0.0232	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Hampton	2.5193	0.0603	0.0401	0.0202	0.0401	0.0418	0.0427	0.0459	66.5	69.3	70.9	76.1
Hampton Falls	0.3041	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Hancock	3.8484	0.2799	0.2217	0.0583	0.2217	0.2280	0.2315	0.2434	79.2	81.5	82.7	87.0
Hanover	4.7960	0.3288	0.2710	0.0578	0.2710	0.2795	0.2843	0.3008	82.4	85.0	86.5	91.5
Harrisville	1.2728	0.0539	0.0302	0.0237	0.0302	0.0312	0.0317	0.0335	56.0	57.9	58.9	62.2
Hart's Location	2.4236	0.8118	0.6112	0.2006	0.6112	0.6087	0.6150	0.6366	75.3	75.0	75.8	78.4
Haverhill	13.9047	0.5304	0.4374	0.0930	0.4374	0.4485	0.4546	0.4754	82.5	84.5	85.7	89.6
Hebron	1.2250	0.4736	0.3603	0.1134	0.3603	0.3734	0.3788	0.3972	76.1	78.8	80.0	83.9
Henniker	6.1433	1.4827	0.9162	0.5665	0.9162	0.9572	0.9738	1.0303	61.8	64.6	65.7	69.5
Hill	1.7959	0.2249	0.1292	0.0957	0.1292	0.1356	0.1383	0.1473	57.4	60.3	61.5	65.5
Hillsborough	5.6983	0.4166	0.3561	0.0605	0.3561	0.3674	0.3721	0.3880	85.5	88.2	89.3	93.1
Hinsdale	7.2866	0.3016	0.2673	0.0343	0.2673	0.2753	0.2797	0.2946	88.6	91.3	92.7	97.7

OSDA150 Statistics-2000 and Modeled Losses-2025					Scenario=				A	B	C	D
(*"Hale's Location is Not-MCD, populations were GIS estimated.)					%Change 2000 NH OSDA150P =				0%	19.6%	39.2%	100%
			0.0 mi^2 is in Gray						%Lost > 90% in Gray			
	Apportion (mi^2)		Apportion (mi^2) 2000		Modeled 2025 OSDA150L (mi^2)				%OSDA150 Lost by 2025			
Town Name	OSDA	OSDA150	OSDA150L	RSDA150	A	B	C	D	A	B	C	D
Holderness	3.5932	0.1652	0.1651	0.0001	0.1651	0.1652	0.1652	0.1652	99.9	100.0	100.0	100.0
Hollis	10.9472	4.9687	2.7518	2.2169	2.7518	2.9057	2.9657	3.1699	55.4	58.5	59.7	63.8
Hooksett	8.3499	1.1069	1.0162	0.0907	1.0162	1.0655	1.0797	1.1069	91.8	96.3	97.5	100.0
Hopkinton	15.2641	0.7486	0.5564	0.1922	0.5564	0.5778	0.5874	0.6204	74.3	77.2	78.5	82.9
Hudson	9.9940	1.6782	1.6363	0.0419	1.6363	1.6782	1.6782	1.6782	97.5	100.0	100.0	100.0
Jackson	1.7718	0.1785	0.0808	0.0977	0.0808	0.0859	0.0876	0.0937	45.3	48.1	49.1	52.5
Jaffrey	5.2123	0.2704	0.2513	0.0191	0.2513	0.2582	0.2620	0.2704	92.9	95.5	96.9	100.0
Jefferson	3.0526	0.1493	0.1441	0.0052	MCD, in 75 GPM Model, but not 150 GPM							
Keene	10.3016	1.5922	1.2672	0.3250	1.2672	1.2873	1.3087	1.3816	79.6	80.9	82.2	86.8
Kensington	2.2493	0.0334	0.0334	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Kilkenny	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Kingston	11.0632	0.8105	0.2991	0.5114	0.2991	0.3174	0.3273	0.3609	36.9	39.2	40.4	44.5
Laconia	2.4572	0.1907	0.1907	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Lancaster	7.3922	0.5968	0.2903	0.3065	0.2903	0.2957	0.3032	0.3287	48.6	49.5	50.8	55.1
Landaff	1.1071	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Langdon	2.8431	0.0166	0.0112	0.0054	0.0112	0.0118	0.0120	0.0128	67.7	71.3	72.6	77.0
Lebanon	6.6153	0.3527	0.3527	0.0000	0.3527	0.3527	0.3527	0.3527	100.0	100.0	100.0	100.0
Lee	4.3006	0.0404	0.0203	0.0201	0.0203	0.0216	0.0221	0.0239	50.2	53.5	54.8	59.2
Lempster	3.2296	0.0778	0.0704	0.0073	0.0704	0.0733	0.0743	0.0777	90.6	94.3	95.6	99.9
Lincoln	3.9954	0.3620	0.3411	0.0209	0.3411	0.3480	0.3528	0.3620	94.2	96.1	97.5	100.0
Lisbon	6.0362	0.4060	0.3898	0.0161	0.3898	0.3962	0.4002	0.4060	96.0	97.6	98.6	100.0
Litchfield	13.5641	2.1199	1.8833	0.2366	1.8833	1.9880	2.0169	2.1155	88.8	93.8	95.1	99.8
Littleton	4.4888	0.0937	0.0547	0.0390	0.0547	0.0561	0.0570	0.0599	58.4	59.9	60.8	63.9
Londonderry	10.4272	0.1801	0.1437	0.0364	0.1437	0.1494	0.1520	0.1609	79.8	82.9	84.4	89.3
Loudon	5.7607	0.6054	0.4612	0.1442	0.4612	0.4804	0.4877	0.5126	76.2	79.4	80.6	84.7
Low & Burbanks	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Lyman	1.4947	0.2476	0.2476	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Lyme	4.7116	0.0906	0.0421	0.0485	0.0421	0.0438	0.0448	0.0480	46.5	48.3	49.4	52.9
Lyndeborough	2.3059	0.0818	0.0704	0.0114	0.0704	0.0726	0.0734	0.0761	86.1	88.7	89.7	93.1

OSDA150 Statistics-2000 and Modeled Losses-2025

(*"Hale's Location is Not-MCD, populations were GIS estimated.)

								Scenario=	A	B	C	D
					%Change 2000 NH OSDA150P =				0%	19.6%	39.2%	100%
			0.0 mi^2 is in Gray						%Lost > 90% in Gray			
	Apportion (mi^2)		Apportion (mi^2) 2000		Modeled 2025 OSDA150L (mi^2)				%OSDA150 Lost by 2025			
Town Name	OSDA	OSDA150	OSDA150L	RSDA150	A	B	C	D	A	B	C	D
Madbury	4.3967	0.4131	0.2879	0.1252	0.2879	0.3018	0.3069	0.3242	69.7	73.1	74.3	78.5
Madison	9.0359	4.1133	2.4215	1.6917	2.4215	2.5611	2.6040	2.7499	58.9	62.3	63.3	66.9
Manchester	18.4761	2.5047	2.3965	0.1082	2.3965	2.4418	2.4842	2.5047	95.7	97.5	99.2	100.0
Marlborough	0.5343	0.0225	0.0218	0.0006	0.0218	0.0224	0.0225	0.0225	97.2	99.8	100.0	100.0
Marlow	1.6060	0.1135	0.1135	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Martins Location	0.5428	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Mason	3.4564	0.0745	0.0745	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Meredith	2.5901	0.0515	0.0201	0.0315	0.0201	0.0218	0.0225	0.0246	38.9	42.4	43.6	47.7
Merrimack	17.8525	3.7766	3.4874	0.2892	3.4874	3.6169	3.6709	3.7766	92.3	95.8	97.2	100.0
Middleton	0.1590	0.0295	0.0295	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Milan	6.8533	0.6562	0.2347	0.4215	0.2347	0.2395	0.2452	0.2645	35.8	36.5	37.4	40.3
Milford	9.0554	4.0325	3.3181	0.7145	3.3181	3.4461	3.4995	3.6815	82.3	85.5	86.8	91.3
Millsfield	0.4027	0.0194	0.0165	0.0029	Not-MCD, Not Modeled							
Milton	3.5419	0.5950	0.5235	0.0716	0.5235	0.5500	0.5592	0.5907	88.0	92.4	94.0	99.3
Monroe	4.0531	0.4170	0.3332	0.0838	0.3332	0.3427	0.3473	0.3629	79.9	82.2	83.3	87.0
Mont Vernon	0.4135	0.0595	0.0595	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Moultonborough	7.2951	0.2882	0.2882	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Nashua	21.0281	11.4732	10.2510	1.2222	10.2510	10.4008	10.5827	11.2020	89.3	90.7	92.2	97.6
Nelson	0.7394	0.0627	0.0270	0.0356	0.0270	0.0281	0.0287	0.0309	43.1	44.8	45.8	49.3
New Boston	9.4485	0.2089	0.1363	0.0726	0.1363	0.1452	0.1481	0.1577	65.2	69.5	70.9	75.5
New Castle	0.0000	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
New Durham	5.0328	0.2258	0.1939	0.0320	0.1939	0.2059	0.2086	0.2178	85.8	91.2	92.4	96.4
New Hampton	5.6452	0.7172	0.6246	0.0927	0.6246	0.6488	0.6571	0.6852	87.1	90.5	91.6	95.5
New Ipswich	5.8510	0.2196	0.0844	0.1352	0.0844	0.0907	0.0933	0.1021	38.4	41.3	42.5	46.5
New London	1.2531	0.0101	0.0019	0.0082	MCD, in 75 GPM Model, but not 150 GPM							
Newbury	2.0623	0.2868	0.1676	0.1192	0.1676	0.1773	0.1805	0.1913	58.4	61.8	62.9	66.7
Newfields	0.7900	0.0616	0.0616	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Newington	3.2411	0.0383	0.0383	0.0000	0.0383	0.0383	0.0383	0.0383	100.0	100.0	100.0	100.0
Newmarket	1.0477	0.0579	0.0554	0.0025	0.0554	0.0570	0.0578	0.0579	95.6	98.3	99.7	100.0

OSDA150 Statistics-2000 and Modeled Losses-2025 (*"Hale's Location is Not-MCD, populations were GIS estimated.)					Scenario= %Change 2000 NH OSDA150P =				A 0%	B 19.6%	C 39.2%	D 100%
	Apportion (mi^2)		0.0 mi^2 is in Gray Apportion (mi^2) 2000		Modeled 2025 OSDA150L (mi^2)				%Lost > 90% in Gray %OSDA150 Lost by 2025			
Town Name	OSDA	OSDA150	OSDA150L	RSDA150	A	B	C	D	A	B	C	D
Newport	6.1321	0.7752	0.6669	0.1083	0.6669	0.6812	0.6909	0.7242	86.0	87.9	89.1	93.4
Newton	4.0170	0.0868	0.0850	0.0018	0.0850	0.0868	0.0868	0.0868	98.0	100.0	100.0	100.0
North Hampton	3.1790	0.3070	0.2367	0.0702	0.2367	0.2450	0.2491	0.2629	77.1	79.8	81.1	85.7
Northfield	3.0896	0.0165	0.0165	0.0000	0.0165	0.0165	0.0165	0.0165	100.0	100.0	100.0	100.0
Northumberland	6.8451	0.4697	0.3895	0.0802	0.3895	0.3928	0.3978	0.4150	82.9	83.6	84.7	88.3
Northwood	0.4059	0.0003	0.0003	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Nottingham	3.2912	0.0111	0.0111	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Odell	0.0008	0.0002	0.0001	0.0001	Not-MCD, Not Modeled							
Orange	1.0032	0.1408	0.1408	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Orford	5.0983	0.2891	0.2386	0.0505	0.2386	0.2453	0.2489	0.2610	82.5	84.9	86.1	90.3
Ossipee	24.5454	8.6800	5.1535	3.5265	5.1535	5.4506	5.5413	5.8505	59.4	62.8	63.8	67.4
Pelham	9.6175	2.6740	2.1166	0.5575	2.1166	2.3009	2.3382	2.4651	79.2	86.0	87.4	92.2
Pembroke	5.4191	0.8559	0.6098	0.2461	0.6098	0.6347	0.6453	0.6813	71.2	74.2	75.4	79.6
Peterborough	9.0865	0.9263	0.7651	0.1612	0.7651	0.7882	0.8002	0.8413	82.6	85.1	86.4	90.8
Piermont	3.6132	0.0366	0.0287	0.0078	MCD, in 75 GPM Model, but not 150 GPM							
Pinkham's Grant	0.0226	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Pittsburg	18.3796	3.0949	1.1476	1.9473	1.1476	1.1728	1.1963	1.2764	37.1	37.9	38.7	41.2
Pittsfield	0.3487	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Plainfield	3.2034	0.1630	0.1265	0.0366	0.1265	0.1307	0.1326	0.1394	77.6	80.1	81.4	85.5
Plaistow	5.1010	0.6419	0.6419	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Plymouth	6.1875	0.1419	0.1380	0.0039	0.1380	0.1419	0.1419	0.1419	97.3	100.0	100.0	100.0
Portsmouth	5.1207	0.4550	0.4527	0.0023	0.4527	0.4550	0.4550	0.4550	99.5	100.0	100.0	100.0
Randolph	1.1823	0.1062	0.1059	0.0003	MCD, in 75 GPM Model, but not 150 GPM							
Raymond	6.0224	0.0094	0.0082	0.0012	0.0082	0.0085	0.0087	0.0092	87.0	90.3	91.9	97.2
Richmond	1.0641	0.2374	0.1480	0.0894	0.1480	0.1546	0.1574	0.1670	62.3	65.1	66.3	70.4
Rindge	5.1548	0.4339	0.2815	0.1523	0.2815	0.2944	0.2995	0.3169	64.9	67.8	69.0	73.0
Rochester	17.6253	2.3227	1.9097	0.4130	1.9097	1.9850	2.0209	2.1432	82.2	85.5	87.0	92.3
Rollinsford	5.6500	0.8136	0.8136	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Roxbury	0.0973	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							

OSDA150 Statistics-2000 and Modeled Losses-2025							Scenario=		A	B	C	D
(*"Hale's Location is Not-MCD, populations were GIS estimated.)					%Change 2000 NH OSDA150P =				0%	19.6%	39.2%	100%
			0.0 mi^2 is in Gray						%Lost > 90% in Gray			
	Apportion (mi^2)		Apportion (mi^2) 2000		Modeled 2025 OSDA150L (mi^2)				%OSDA150 Lost by 2025			
Town Name	OSDA	OSDA150	OSDA150L	RSDA150	A	B	C	D	A	B	C	D
Rumney	6.3245	1.1397	0.8858	0.2539	0.8858	0.9111	0.9245	0.9700	77.7	79.9	81.1	85.1
Rye	2.6505	0.1102	0.1082	0.0020	0.1082	0.1102	0.1102	0.1102	98.2	100.0	100.0	100.0
Salem	8.0400	0.0126	0.0126	0.0000	0.0126	0.0126	0.0126	0.0126	100.0	100.0	100.0	100.0
Salisbury	6.1006	0.1660	0.0747	0.0913	0.0747	0.0791	0.0806	0.0858	45.0	47.6	48.6	51.7
Sanbornton	6.1367	0.2514	0.1221	0.1292	0.1221	0.1288	0.1310	0.1384	48.6	51.2	52.1	55.1
Sandown	3.7160	0.0111	0.0111	0.0000	0.0111	0.0111	0.0111	0.0111	100.0	100.0	100.0	100.0
Sandwich	7.2948	1.3897	0.6954	0.6942	0.6954	0.7299	0.7425	0.7854	50.0	52.5	53.4	56.5
Sargents Purchase	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Seabrook	0.9755	0.1106	0.0962	0.0143	0.0962	0.1001	0.1019	0.1082	87.0	90.5	92.2	97.8
Second College	4.5713	1.1879	0.6541	0.5338	Not-MCD, Not Modeled							
Sharon	3.6251	0.1877	0.0745	0.1132	0.0745	0.0765	0.0782	0.0838	39.7	40.8	41.7	44.7
Shelburne	5.6392	2.5742	1.7680	0.8062	1.7680	1.7846	1.8079	1.8875	68.7	69.3	70.2	73.3
Somersworth	6.5860	0.1085	0.0983	0.0103	0.0983	0.1002	0.1017	0.1068	90.5	92.3	93.7	98.4
South Hampton	0.7002	0.0013	0.0013	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Springfield	0.8621	0.1127	0.0806	0.0320	0.0806	0.0852	0.0866	0.0915	71.6	75.6	76.9	81.2
Stark	6.1909	2.1546	1.4520	0.7026	1.4520	1.4683	1.4883	1.5561	67.4	68.1	69.1	72.2
Stewartstown	3.3158	0.3923	0.1841	0.2081	0.1841	0.1865	0.1902	0.2031	46.9	47.5	48.5	51.8
Stoddard	0.6704	0.0248	0.0156	0.0093	MCD, in 75 GPM Model, but not 150 GPM							
Strafford	2.1514	0.1499	0.1499	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Stratford	6.1742	1.5534	1.0593	0.4941	1.0593	1.0733	1.0898	1.1459	68.2	69.1	70.2	73.8
Stratham	2.9143	0.0094	0.0092	0.0002	0.0092	0.0094	0.0094	0.0094	98.0	100.0	100.0	100.0
Success	2.6449	0.6873	0.3638	0.3235	Not-MCD, Not Modeled							
Sugar Hill	0.4519	0.0484	0.0484	0.0000	0.0484	0.0484	0.0484	0.0484	100.0	100.0	100.0	100.0
Sullivan	0.1261	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Sunapee	0.6131	0.0616	0.0616	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Surry	2.1610	0.0754	0.0352	0.0402	0.0352	0.0367	0.0376	0.0406	46.7	48.7	49.8	53.9
Sutton	6.2595	0.1991	0.1451	0.0540	0.1451	0.1509	0.1528	0.1596	72.9	75.8	76.8	80.2
Swanzey	11.7095	5.2871	4.0440	1.2431	4.0440	4.1696	4.2342	4.4541	76.5	78.9	80.1	84.2
Tamworth	15.3105	5.2208	2.8763	2.3445	2.8763	3.0350	3.0904	3.2791	55.1	58.1	59.2	62.8

OSDA150 Statistics-2000 and Modeled Losses-2025					Scenario=				A	B	C	D
(*"Hale's Location is Not-MCD, populations were GIS estimated.)					%Change 2000 NH OSDA150P =				0%	19.6%	39.2%	100%
			0.0 mi^2 is in Gray						%Lost > 90% in Gray			
	Apportion (mi^2)		Apportion (mi^2) 2000		Modeled 2025 OSDA150L (mi^2)				%OSDA150 Lost by 2025			
Town Name	**OSDA**	**OSDA150**	**OSDA150L**	**RSDA150**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Temple	3.2135	0.0000	0.0000	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Thompson & Meserve	0.0000	0.0000	0.0000	0.0000	Not-MCD, Not Modeled							
Thornton	8.5768	3.2370	2.3950	0.8420	2.3950	2.4695	2.5035	2.6193	74.0	76.3	77.3	80.9
Tilton	3.2479	0.9021	0.9021	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Troy	1.0683	0.0119	0.0119	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Tuftonboro	8.4743	0.0559	0.0229	0.0330	0.0229	0.0247	0.0252	0.0272	41.0	44.1	45.2	48.7
Unity	1.0814	0.0405	0.0376	0.0029	0.0376	0.0389	0.0393	0.0405	92.8	95.9	96.9	100.0
Unorganized Territory	0.5033	0.0053	0.0053	0.0000	Not-MCD, Not Modeled							
Wakefield	8.9241	2.8047	2.2711	0.5336	2.2711	2.3847	2.4175	2.5291	81.0	85.0	86.2	90.2
Walpole	7.8601	0.3975	0.2762	0.1213	0.2762	0.2866	0.2925	0.3126	69.5	72.1	73.6	78.6
Warner	6.5222	0.9770	0.7933	0.1837	0.7933	0.8278	0.8393	0.8785	81.2	84.7	85.9	89.9
Warren	2.5439	0.7468	0.6144	0.1324	0.6144	0.6323	0.6416	0.6732	82.3	84.7	85.9	90.1
Washington	0.6842	0.0526	0.0524	0.0003	MCD, in 75 GPM Model, but not 150 GPM							
Waterville Valley	2.5609	0.0490	0.0300	0.0190	0.0300	0.0312	0.0319	0.0340	61.2	63.7	65.0	69.4
Weare	7.9137	0.0603	0.0602	0.0000	0.0602	0.0603	0.0603	0.0603	99.9	100.0	100.0	100.0
Webster	6.8985	0.2589	0.1665	0.0924	0.1665	0.1739	0.1765	0.1855	64.3	67.2	68.2	71.7
Wentworth	3.9275	0.6450	0.4696	0.1754	0.4696	0.4843	0.4909	0.5136	72.8	75.1	76.1	79.6
Wentworths Location	1.7221	0.4471	0.3184	0.1287	Not-MCD, Not Modeled							
Westmoreland	3.3433	0.1037	0.0572	0.0465	0.0572	0.0595	0.0607	0.0647	55.1	57.4	58.5	62.4
Whitefield	4.8643	0.2794	0.2038	0.0755	0.2038	0.2056	0.2082	0.2170	73.0	73.6	74.5	77.7
Wilmot	2.9318	0.0518	0.0474	0.0043	0.0474	0.0491	0.0497	0.0518	91.6	94.7	95.9	100.0
Wilton	5.1023	0.5651	0.4570	0.1081	0.4570	0.4706	0.4768	0.4980	80.9	83.3	84.4	88.1
Winchester	8.3111	2.1063	1.3906	0.7156	1.3906	1.4343	1.4589	1.5424	66.0	68.1	69.3	73.2
Windham	3.4105	0.0263	0.0262	0.0000	0.0262	0.0263	0.0263	0.0263	99.9	100.0	100.0	100.0
Windsor	1.3670	0.2651	0.1578	0.1073	MCD, in 75 GPM Model, but not 150 GPM							
Wolfeboro	6.2675	0.1150	0.1150	0.0000	MCD, in 75 GPM Model, but not 150 GPM							
Woodstock	3.7876	1.0742	1.0009	0.0732	1.0009	1.0202	1.0309	1.0673	93.2	95.0	96.0	99.4