Appendix A. Mount Sunapee Base Area Well Yield Evaluation

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June 18, 1999

Mr. Richard Flanders, Jr.
Water Supply and Pollution Control Division
Department of Environmental Services
64 North Main Street
Concord, New Hampshire 03301

**RE: Mt. Sunapee Base Area Well Yield Evaluation
Newbury, New Hampshire**

Dear Mr. Flanders:

Pioneer Environmental Associates, LLC. (Pioneer) of Middlebury, Vermont has completed testing associated with the re-evaluation of the yield of the Mt. Sunapee Base Area Well at the ski area at Mt. Sunapee State Park located in Newbury, New Hampshire (see site location map, page 1 of Attachment). In accordance with the June 1997 Design Standards for Small Public Drinking Water Systems (Section Env-Ws 372.14), we performed a 48-hour constant discharge test for this well from May 18 through 20, 1999. In addition to the required pumping test, we have also completed a step-drawdown test at the well on May 17, 1999, and a recovery test following the end of the constant discharge test on May 20, 1999. These additional tasks were performed to provide additional data on the hydraulics of the well and the bedrock aquifer in which the well is completed to help characterize the source capacity of this well. We also collected water samples prior to the end of the 48-hour test for analysis for the constituents listed in Table 372-4 of Env-Ws 372.

In summary, the aquifer testing indicates that, at a minimum, the Mt. Sunapee Base Area Well has a source capacity of 109.6 gallons per minute (gpm), or 157,824 gallons per day (gpd), based on our capacity analysis. As specified in Section Env-Ws 372.11(b), a minimum total source capacity of 1½ times the design flow rate is required for public non-community water systems such as this. A source capacity of 109.6 gpm is adequate to serve a design flow rate of 73.1 gpm, or 105,216 gpd. This exceeds the currently permitted source capacity of 70 gpm which is sufficient to serve a design flow rate of 67,200 gpd. A detailed description of the testing program follows.

INTRODUCTION

The ski area at Mt. Sunapee State Park has historically been operated by the New Hampshire Department of Resources and Economic Development (DRED). However, as of the 1998-99 ski season, the ski area is operated by Okemo Mountain Resort, as Mount Sunapee Resort, through a lease agreement with the State of New Hampshire. Because of improvement plans being implemented at the resort, primarily the construction of the new Sunapee Base Lodge, a re-evaluation of well capacity was requested by the Department of Environmental Services. The water system is a transient non-community system as it serves a transient, rather than residential, population.

The Base Area Well is located near the base of the Duckling chairlift at the Mt. Sunapee Resort (Attachment, page 1). The well is used to meet the water needs of the base area of the resort's facilities. Details of the well are as follows:

- Date Drilled: February 1980
- Drilled By: Gallagher and Philbrick, Concord, NH
- Drilling Method: Pounder/Percussion
- Depth of Well: 244 feet
- Depth to Bedrock: 47 feet
- Casing Length: 63 feet
- Static Level: 10 feet

According to a sanitary survey performed on November 1, 1993 by Mr. Jack Mollica of the Department of Environmental Services Water Supply Engineering Bureau, the Base Area Well has a permitted source capacity of 70 gpm, sufficient to serve a design flow rate of 67,200 gpd. During a previous pumping test performed for this well on June 4-6, 1980, the water level in the well was slowly rising while being pumped at a rate of 70 gpm. This suggests that the capacity of the well is greater than the currently approved 70 gpm. Therefore, this most recent testing was performed to determine the source capacity of the well to a greater degree of accuracy.

WELL TESTING

Testing of the Base Area Well occurred from May 17-20, 1999 and consisted of the following:

- Step-Drawdown Test
- 48-Hour Constant Discharge Test
- Observation Well Monitoring at Shop Well
- Recovery Test
- Collection of Water Quality Samples

The production well data (step-drawdown test, constant discharge test, and recovery test) are presented on pages 2 through 21 of the Attachment. The results and evaluation of the water quantity testing are discussed below.

Step Drawdown Test

A step-drawdown test was performed at the well on May 17, 1999. The purpose of this test was to determine a safe pumping rate for the 48-hour pumping test. Additionally, the step-drawdown test data allows for the development of a head loss equation for the well to determine the components of drawdown in the well attributable to formation (aquifer) drawdown and turbulent (in-well) drawdown.

The step-drawdown test consisted of six 60-minute step performed at mean discharges ranging from 11.5 gpm to 181.2 gpm. At the end of the sixth step, the pump was allowed to run for an additional 38 minutes at which time the water level was 75.62 feet, representing a drawdown of 64.99 feet. Step-drawdown test data are included on pages 2 through 14 of the Attachment.

From the step-drawdown test data, a head loss equation has been derived for the Base Area Well. The head loss equation is as follows:

$$s_w\ (60\text{-}minute) = 0.199Q + 0.000784Q^2$$

where:

s_w = drawdown in production well at a pumping duration of 60 minutes (feet)
Q = pumping rate (gpm)

This equation can be used in conjunction with the 48-hour test constant discharge test data to determine the source capacity of the well. The step-drawdown test analysis is presented on pages 24 through 25 of the Attachment.

Constant Discharge and Recovery Tests

A 48-hour constant discharge test was performed at a mean discharge of 134.4 gpm from May 18-20, 1999 (Attachment, pages 15 through 19). At the conclusion of the 48-hour test, the production well water level was 115.21 feet below top of casing, representing a drawdown of 105.59 feet. A generally linear drawdown curve (on semi-logarithmic data plot) was maintained during the initial 1,000 minutes (16.7 hours) of the test at which time it appears that a discharging boundary within the bedrock aquifer was encountered. The discharging boundary resulted in the steepening of the drawdown curve, which remained linear on the semi-logarithmic data plot at the steeper slope for the remainder of the test (Attachment, page 17).

Section Env-Ws 372.14(a) indicates that the 48-hour pumping test shall demonstrate stabilized drawdown (less than one inch of drawdown in two hours) for at least the last 12-hours of the test. This criterion was not met during the final 12 hours of the test as the water level was declining at an average rate of approximately 1.9 feet every two hours during this time period. However, the test was shut off at 48 hours for two primary reasons:

1) The testing performed for this well exceeds the requirements of Env-Ws 372 as a step-drawdown test and recovery test were performed to provide additional data concerning the source capacity of the well.

2) This is the main water source for Mt. Sunapee Resort, and it had been disconnected since May 14, 1999 when the temporary test pump was installed to allow for the well testing. A large event (the Mt. Sunapee Bike Race) was scheduled for May 22, 1999 and the permanent pump needed to be reinstalled and the reservoir filled prior to this event to accommodate the anticipated demand.

The testing performed for the Base Area Well provides adequate data to characterize the yield of the well.

Following the constant discharge test, recovery measurements were made at the production well and the maintenance building observation well (Attachment, pages 20 through 23). At the conclusion of 257 minutes of recovery measurements, the water level in the production well was 45.8 feet (drawdown = 36.2 feet) representing a recovery of 66 percent. At this time, the process of removing the temporary test pump and reinstallation of the permanent pump needed to begin to ensure its timely completion.

<u>Observation Well Monitoring</u>

Water level measurements were collected during the testing procedures at the Mt. Sunapee Shop Well located approximately 1,500 feet northeast of the Base Area Well to determine if there were any interference effects between the two wells. Well details for the Shop Well are as follows:

- Date Drilled: May 1985
- Depth of Well: 360 feet
- Depth to Bedrock: 185 feet

- Casing Length: 200 feet
- Static Level: Overflowing (at time of drilling)
- Driller's Yield: 5 gpm

As can be noted on the data plot for the water level data collected at this well (Attachment, pages 22 through 23), the pumping of the Base Area Well does not affect the water level at the Shop Well.

Water Quality Sampling

Water quality samples were collected just prior to the end of the 48-hour constant discharge test to be analyzed for the constituents listed in Table 372-4 of Env-Ws 372. The pH was measured in the field to be 6.98, and the temperature of the discharge water was 9.1ºC. Complete analytical results are included on pages 29 through 30 of the Attachment. The concentrations of all analytes tested for are below the Environmental Protection Agency's Maximum Contaminant Levels. Total Coliform tested as being present; however, the water samples collected represent the raw water quality from the well, and not after treatment prior to distribution. In addition, *E. Coli* was absent in the sample.

CAPACITY ANALYSIS

Section Env-Ws 372.13(c) indicates that the permitted production volume shall not be greater than the source capacity based on a 24-hour period, as defined by the 48-hour constant discharge test. For the purposes of this analysis, the total available head (TAH) in the well is 105.6 feet, as this is the maximum drawdown obtained during the testing.

To determine the source capacity of this well at steady-state conditions, which is what is essentially required by Env-Ws 372 given the stabilization requirement for the pumping test, the capacity analysis for the Base Area Well was performed by modeling the noted discharging boundary using the method developed by Stallman (Ground-Water Hydraulics, 1972). The aquifer coefficients of transmissivity (T) and storativity (S) were calculated from data collected during the 48-hour constant discharge test and recovery test (Attachment, pages 17 through 21). The calculated values are summarized in Table 1.

Table 1: Calculated Aquifer Coefficients from Pumping Well Data		
Test	T (ft^2/day)	S (dimensionless)†
48-hr. pumping	215.26	6.41
48-hr. recovery	197.32	---

Table 1: Calculated Aquifer Coefficients from Pumping Well Data		
Test	T (ft^2/day)	S (dimensionless)†

† S value used in equations to predict long-term drawdown, does not reflect actual aquifer S value

To accurately model the aquifer behavior during pumping conditions, an aquifer T of 215.26 ft^2/day is used in the calculations to determine the source capacity of the well. As footnoted in Table 1, the calculated S values are not indicative of the actual storativity of the bedrock aquifer. However, the values can be used in the long-term capacity analysis equations to predict the drawdown in the pumping well over long periods of time. Essentially, the aquifer equations define the drawdown curve of the production well and, thus, can be used to predict the long-term drawdown.

The Stallman method is an analysis that models boundaries, either discharging or recharging, that are noted during aquifer tests. The boundary is modeled via a curve matching technique to determine the Stallman constant of proportionality (K). This is illustrated for the Base Area Well on page 18 of the Attachment. A K value of 10 was determined for the Base Area Well. This K value, and the values of T and S determined for the aquifer are used in the equations developed by Stallman to model the behavior of the aquifer under extended pumping conditions. The Stallman equations are presented on pages 27 and 28 of the Attachment.

The well capacity has been evaluated based on a seven day peak demand, to account for the one-week holiday periods during the winter season when the demand will be the greatest. Using the Stallman equations, the calculated source yield using a total available head of 105.9 feet is 109.6 gpm (157,824 gpd) for a continuous seven day pumping period. Therefore, in accordance with Section Env-Ws 372.11(b), a source capacity of 109.6 gpm is adequate to serve a design flow of 73.1 gpm, or 105,216 gpd. Equations used in the capacity analysis are included on page 27 of the Attachment, and calculations specific to the Base Area Well are included on page 28 of the Attachment.

This capacity analysis is very conservative (i.e., results in a low source capacity) because of the assumptions used in performing the analysis. These include:

- A total available head for the well based only on the tested portion of the well bore, ignoring the remaining well bore below this point (approximately 129 feet). In essence, the analysis uses only 45% of the projected total available head. This is extremely conservative given that the well was drilled using a pounder/percussion drilling methodology. The main water bearing fractures in wells of this type are usually at the bottom of the well bore, because additional percussion drilling becomes difficult after a substantial water bearing fracture zone is encountered.

- The continuous pumping for a seven day period at the source capacity, with no recovery or recharge events.
- The 1.5 reduction factor applied to the calculated source capacity to calculate the design flow able to be accommodated by the well.

Therefore, a permitted source capacity of 109.6 gpm is requested for this well. The actual source capacity is likely significantly greater than the requested capacity given the conservative assumptions used in the analysis. The aquifer characteristics noted during the 48-hour constant discharge test indicate that the source capacity may equal or exceed the constant discharge pumping rate of 134.4 gpm.

SANITARY PROTECTIVE AREA

A sanitary protective area has been designated for the Mt. Sunapee Base Area Well in accordance with Section Env-Ws 372.13. In this case, given the requested permitted source capacity of 157,824 gpd, the sanitary protective area is comprised of the area of land encompassed by a circle around the well with a 400-foot radius. This land is entirely included within Mt. Sunapee State Park land and the lease area.

The bottom termini of two chairlifts (Duckling double and North Peak triple) and the Lower Mountain Base Lodge exist within the sanitary protective area. According to Mt. Sunapee Resort personnel, there is no storage of petroleum products or hazardous materials within this area. A large expanse of lawn exists between the well and the North Peak triple chairlift to the west. Given this area's location within the sanitary protective area, no chemical soil fertilization will occur on this lawn area. No wastewater disposal systems are located within the sanitary protective area.

Please call with any questions or comments you may have during your review of this report. I hope to hear from you soon.

Sincerely,

Eric R. Hanson
Senior Hydrogeologist

cc: Tim Drew
Jay Gamble

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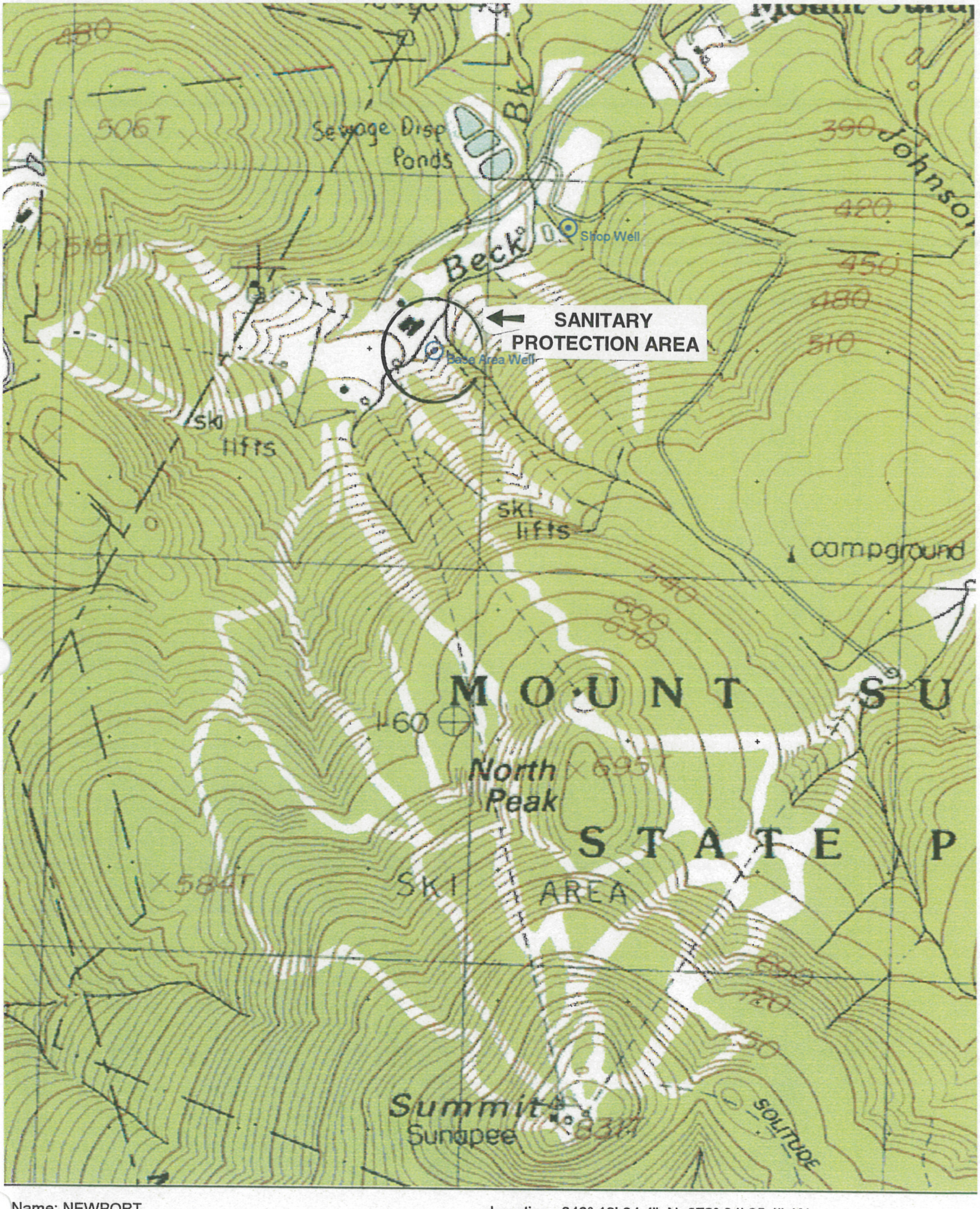

Name: NEWPORT
Date: 6/4/99
Scale: 1 inch equals 1000 feet

Location: 043° 19' 34.4" N 072° 04' 35.1" W
Caption: Mount Sunapee Resort
Base Area Well Location Map
Newbury, New Hampshire

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10 SEYMOUR STREET
P.O. BOX 304

Appendix B. Wastewater Facilities Evaluation Report

HTA
Consulting Engineers
184 South Winooski Avenue • Burlington • VT 05401 • 802 860 1331 • Fax 802 860 6499 • www.hoyletanner.com

March 12, 2003

Mr. Jay Gamble, General Manager
Mount Sunapee Ski Resort
P.O. Box 2021
Route 103
Newbury, New Hampshire 03255

RE: Wastewater Facilities Evaluation Report

Dear Mr. Gamble

The following letter report constitutes our evaluation of the existing wastewater treatment facilities at the Mount Sunapee Ski Area and its capacity to adequately handle the projected increase in skier visits for the future.

1.0 PROJECT DESCRIPTION

In the summer of 1998, the Mount Sunapee Ski Area was leased to a private ski industry firm, Okemo Mountain Resort. Under the new management, the ski area has incorporated many upgrades to the ski area and to the wastewater treatment system. Based on previous engineering recommendations, they have installed a v-notch weir and ultrasonic meter in the distribution box to measure and record influent lagoon flows. This has allowed for accurate records of flow data during the past five years. Drainage around the lagoons has been improved to reduce the amount of surface run-off that enters the lagoons each year during the spring. This has been accomplished by construction of a berm around the up gradient side of the lagoon and providing a drainage swale to direct run-off from the forested slope around the lagoons. Also, the ski area has made many other improvements to the wastewater systems such as replacing leaky manhole covers with water-tight covers, disconnecting sump pumps from the collection system, and also locating and correcting sources of extraneous inflow and/or infiltration. These changes have improved the operating conditions of the wastewater treatment system considerably since previous evaluations.

Hoyle, Tanner & Associates, Inc. (HTA) has been retained to complete an evaluation of the wastewater treatment and disposal system to determine if the system is capable of handling an increase in skier volumes. Our evaluation includes the review and analysis of the past five years of operating data, including monthly average wastewater influent data, spray application data, skier visits and other data associated with the wastewater facilities. One goal of this study is to evaluate the impact that the various improvements made at the ski area have had on the operations of the wastewater treatment facilities.

Our evaluations include analysis of the lagoons and spray areas. The lagoon evaluation included analysis of meteorological impacts, free board levels and other design factors. Our evaluation focused on the conditions for the last five years. Projected future trends have been evaluated for expected skier visit levels of 275,000, 300,000 and 325,000. The existing wastewater facilities were analyzed to determine their ability to satisfy these anticipated needs. HTA has also reviewed groundwater monitoring reports, and evaluated the overall operation condition of the lagoons and spray areas.

2.0 SKI AREA ATTENDANCE

Ski area attendance is defined as the number of ski tickets sold, ski season pass visits, and employees attending the park during the ski season. Attendance was determined for ski seasons 1998/1999 thru 2001/2002 based on actual recorded data. The current season, 2002/2003, represents accurate data from the ski season opening in November 2002 thru February 2003, and projected data from February 2003 through the end of the season based on historical data. The following table shows the attendance for the past five seasons:

Table 2-1
Annual Ski Season Attendance

	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003*
Ticketed Skier Visits	109,803	131,511	195,237	159,646	194,990
Season Pass Visits	55,516	58,150	62,599	70,542	66,571
Employees	17,200	23,095	30,375	25,625	28,025
Total	**182,519**	**212,756**	**288,211**	**255,813**	**289,586**

*The season 2002/2003 represents actual data (Nov. thru Feb.) and projected data through the end of the season which is based on historical data.

Skier Attendance

Historical records of skier attendance during the ski season are maintained through both the sale of daily lift tickets and season passes. The daily sale of lift tickets was used to determine the daily skier visits at the ski area, and then totalized for the annual skier visits for each of the last five ski seasons. Figures for season pass visits are estimated based on the number of season passes sold and total skier visits. The table above summarizes attendance for the past five ski seasons.

Employees

Employee figures were obtained from the ski area's payroll records. The amount of skiers varies from year to year and also with the length of the ski season. As attendance increases, so have the employee numbers. Earlier seasons used original figures of 125-225 employees.

3.0 EXISTING WASTEWATER FLOWS

Wastewater inputs to the ski area's treatment and disposal facilities come from several sources, including skiers, summer visitors, and employees. There are also sources that are directly influenced by the local weather conditions, such as infiltration and inflow into the sewage collection system as well as direct precipitation into the lagoons.

Ski-Season Wastewater Flows

To correlate wastewater flows to the attendance at the mountain, wastewater flows to the lagoons during the last five ski seasons were analyzed. Influent flows to the lagoons are measured and recorded by a v-notch weir and ultrasonic meter located in the distribution box. Daily wastewater flows were totalized for each of the past five ski seasons and correlated with the ski season attendance for each ski season to determine a per person wastewater flow rate.

A summary of the total influent wastewater flows per season, the total number of attendance per season, and the corresponding wastewater flow rate in gallons per person are presented in the following table:

Table 3-1
Ski Season Wastewater Data

Ski Season Year	Wastewater Influent (gallons) [1]	Attendance	Wastewater Flowrates (gal/person)
1998-1999	970,417	182,519	5.32
1999-2000	856,522	212,756	4.03
2000-2001	1,010,728	288,211	3.51
2001-2002	765,739	255,813	2.99
2002-2003 [2]	651,973	194,598	3.35

Notes:
[1] Wastewater Influent is the total gallons during the ski season year based on the opening and closing dates of each ski season.
[2] Ski season 2002-2003 data is not complete.

From the last five years of operating data, one can see that the corresponding wastewater flow rate per person has decreased. This is very likely due in part to the implementation of several flow saving measures, such as low flow fixtures, improvements to the collection system, and other improvements aimed at reducing wastewater flows. Based on the available data, Hoyle, Tanner and Associates, Inc.

feels that a 4 gallon per person wastewater flow rate for estimating future ski season wastewater flows is reasonable.

Off-Season Wastewater Flows

For the above wastewater correlation, we did not include summer visitors, summer-time employees, nor summer wastewater flows. However, wastewater flows into the lagoons that occur during the remainder of the year, or "off-season," need to be considered when evaluating the total capacity of the lagoons. For the purpose of determining the off-season wastewater flows into the lagoons, we subtracted the total ski season wastewater flows from the total annual wastewater flows for each of the last five years. The resulting off-season flows are summarized in the following table:

Table 3-2
Off-Seasonal Wastewater Data

Season Year[1]	Annual Wastewater Influent (gallons)	Ski-Season Wastewater Influent (gallons)[2]	Off-Season Wastewater Influent (gallons)
1998-1999	1,494,670	970,417	524,253
1999-2000	1,226,590	856,522	370,068
2000-2001	1,261,832	1,010,728	251,104
2001-2002	1,048,150	765,739	282,411
2002-2003[3]	N/A	651,973	N/A

Notes:
1. The season year is from November thru October.
2. Ski-Season Wastewater Influent is the total gallons during the ski season year based on the opening and closing dates of each ski season.
3. Season 2002-2003 data is not complete.

Infiltration/Inflow

Total inputs into the storage lagoons include inflow and infiltration (I/I) into the sewer collection system. Inflow is defined as extraneous water that enters into a sewer collection system from sources that are directly connected, such as sump pumps, catch basins, manhole covers, and other direct inlets. Infiltration is defined as extraneous water that enters into the sewer system from the ground through sources such as defective pipes, pipe joints, connections and manhole walls. Infiltration is directly influenced by groundwater levels.

In our analysis, I/I is included as a part of the total influent flow measured and summarized in Table 3-1. We have seen from previous studies, that while the system does not appear to have excessive I/I, the collection system does experience a steady nighttime flow, which can be associated with infiltration and/or inflow. For the purpose of our evaluation, I/I is considered as part of the total wastewater influent amounts on both an annual basis and ski season basis, and is therefore accounted for in the per person wastewater flow rate correlation.

Meteorological Inputs

The meteorological inputs have been examined a number of ways. In our 1999 *Wastewater Lagoon and Spray Irrigation System Phase II Report*, an empirical analysis of using the Thornthwaite method to calculate the evaporation losses from the lagoons and run-of areas was used. This previous report estimated a net total of 2.4 million gallons per year could be expected from meteorological factors.

Another method for estimating the meteorological inputs is to look at historical operating data. The difference between the annual wastewater sprayed (effluent) in the irrigation field and the annual wastewater that flows into the lagoons (influent) can be considered as net annual meteorological inputs to the lagoons. This accounts for precipitation, evaporation losses, and direct run-off into the lagoons. The following table shows the annual meteorological inputs for the seasons of 1998/99 thru 2001/02:

Table 3-3
Meteorological Inputs into Lagoon

Season Year[1]	Annual Influent (gallons)	Annual Effluent (Spray) (gallons)	Meteorological Inputs (gallons)
1998-1999	1,494,670	2,896,971	1,402,301
1999-2000	1,226,590	3,587,830	2,361,240
2000-2001	1,261,832	3,894,900	2,633,068
2001-2002	1,048,150	2,534,200	1,486,050
Average	**1,257,811**	**3,228,475**	**1,970,665**

[1]The season year is from November thru October.

By examining the last four years of operating data, one can seen that the two methodologies result in similar estimates of meteorological input into the lagoons. The 2000/2001 season was an unusually very wet year, whereas, 2001-2002 season was a very dry year. Previously recommended improvements have been made to reduce the runoff that flows into the lagoons from the adjacent hillside. These improvements, together with the historical average of less than 2.0 million gallons, lead us to recommend an allowance of 2.4 million gallons for future meteorological inputs.

Lagoon Capacity

In our *Wastewater Lagoon and Spray Irrigation System Phase II Report, 1999*, the active storage capacity of the lagoons had been estimated to be approximately 5.48 million gallons. This was based on the past operating conditions of maintaining 1' of freeboard and a 1' minimum operating depth. Operator reports have shown that no sludge accumulation occurs in Lagoon #3 nor in Lagoon #2, and little if any in Lagoon #1. Taking this into consideration, it is acceptable to conclude that the active storage space is approximately 5.48 million gallons.

Water level measurements in the lagoons were analyzed for the past four operating years to determine the reasonable operating capacity of the lagoons. Historically, the maximum depths seen in the lagoons occur just before spraying starts. The ski area spray season begins on May 1 which makes this a critical time, and represents the maximum water level depth in the lagoons per year. The maximum water level measured over the past four years occurred on April 27, 2000. This was 65.5 inches, which correlates to a lagoon freeboard of approximately 2.5 feet. This is within the operating parameters of the lagoons.

Groundwater Monitoring Data

Groundwater data from monitoring wells installed down gradient of the lagoon were reviewed and show that there appears to be no evidence of groundwater degradation in the vicinity of the lagoon or spray area.

Spray Season Capacity

The Ski Area is permitted to spray 250,000 gallons per week of lagoon effluent on its spray disposal fields, which consists of approximately 5 acres. Spray application is permitted from May to October or until leaf drop. Spraying is also limited during this period and is not allowed during rain events or when ground water levels are high. Theoretically, there are approximately 24 weeks of available spray season. However, wet weather and high groundwater conditions reduce this by as much as 25 to 30 percent. Based on historical spray data, we would estimate that the annual capacity of the spray area is between 4.2 and 4.5 million gallons per season.

4.0 FUTURE CONDITIONS

This section of the report will focus on projecting wastewater flows for future conditions. Future wastewater flows will be based on projected future trends for expected skier visit levels during the ski season, employee figures, off-season wastewater flows, and meteorological inputs into the lagoons.

Future Skier Attendance

Projections were made for the following three levels of skier visits:

Current:	275,000 skiers
Future:	300,000 skiers
Future:	325,000 skiers

It is assumed that these expected levels of skier attendance include season pass holders.

Future Ski Season Employee Attendance

Employee attendance during the ski season must be included in the wastewater flow projection as well. The average employee attendance per ski season from seasons 00-01 thru 01-02 used in this report was approximately 28,000 employees. The current 2002/2003 season was not included in this average, since the season is not completed. This amount of employees will be added to the projected number of skiers for total ski season attendance figures.

Projected Ski Season Wastewater Flows

To project ski season wastewater flows, we applied a wastewater flow estimate of 4 gallon per person to the total ski season attendance for the different targeted skier visit levels. The resulting ski season wastewater flows are shown in Table 4-1.

Projected Off-Season Wastewater Flows

For the purpose of determining projected off-season wastewater flows, we assumed that current attendance levels and wastewater flows generated during the summer months are going to remain fairly consistent from year to year. Taking the average of these flows from the past three years results in a projected off-season wastewater flow of approximately 300,000 gallons. The past three years are more representative of the actual conditions seen at the treatment facility due to system improvements made after the 1998/1999 season.

Projected Meteorological Inputs

A future projected meteorological input amount of 2,400,000 gallons was used for each targeted skier visit level.

Total Projected Wastewater Flows

The following table shows the total amount of projected wastewater flows for each of the targeted skier visit levels:

Table 4-1 Projected Wastewater Flows			
Skier Visits	**275,000**	**300,000**	**325,000**
Ski Season Employees	28,000	28,000	28,000
Total Ski Season Attendance	303,000	328,000	353,000
Ski Season Wastewater Flows @ 4 gal/person (gallons)	1,212,000	1,312,000	1,412,000
Off-Season Wastewater Flows (gallons)	300,000	300,000	300,000
Meteorological Inputs (gallons)	2,400,000	2,400,000	2,400,000
Total Wastewater Flows (gallons)	**3,912,000**	**4,012,000**	**4,112,000**

5.0 ABILITY OF EXISTING WASTEWATER FACILITIES TO MEET FUTURE NEEDS

The existing wastewater treatment system was evaluated to determine its ability to satisfy the projected capacity needs for the projected skier visits.

As discussed previously, review of the lagoon capacity indicates a total usable volume of 5.48 million gallons. In addition, the last several years of operating data indicate that ski seasons ended with an average freeboard condition at the lagoons of approximately 2.5 feet. Therefore, the projected flows should be able to be accommodated in the lagoons. While the capacity requirement of the lagoons is very weather dependent, it appears that there will be adequate storage capacity for the projected wastewater flows associated with the targeted levels of skier visits.

The Ski Area is permitted to spray 250,000 gallons per week of lagoon effluent on its spray disposal fields, which consists of approximately 5 acres. Spray application is permitted from May to October or until leaf drop. Spraying is however, restricted and is not allowed when groundwater levels are high and is further limited by precipitation. Earlier in this report we estimated that the spray area will have an effective spray capacity of between 4.2 and 4.5 million gallons depending on the weather and groundwater conditions.

6.0 CONCLUSIONS

The future projections of skier visits will result in an increase in wastewater flows to the Mount Sunapee Ski Resort's wastewater treatment facilities. Based on the operating data of the past five years, an estimate of 4 gallons per person is appropriate for projecting wastewater flows. The total capacity requirements also include other flow inputs, some of which are very weather dependent. The available data of actual operating conditions support the estimates of future wastewater storage and disposal capacity needs for the future projection levels.

Both the storage and disposal requirements of the Mount Sunapee Ski Resort's wastewater treatment facilities are greatly influenced by the weather. Based on our flow projections, it appears that the existing system will be adequate to handle the increase in capacity associated with the future projected skier visits. While our flow projections take into account meteorological inputs, there is no way of guaranteeing the weather conditions for upcoming years. There is a significant margin of safety in the available storage volume of the lagoons and a smaller, but adequate, margin of safety in the available spray area.

We appreciate the opportunity to provide you with this evaluation. If you have any questions or comments on this report please don't hesitate to call.

Very truly yours,

HOYLE, TANNER & ASSOCIATES, INC.

Eugene J. Forbes, P.E.
Vice President

Appendix C. Wetland and Surface Water Delineation Study Reports

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CONSULTING SCIENTISTS

MEMORANDUM

To: Jay Gamble
From: Sean W. Donohue
Subject: Wetland and Surface Water Delineation Dodd Johnson Parcel Goshen, New Hampshire
Date: April 19, 2004

Introduction

Pioneer Environmental Associates, LLC. (Pioneer) has completed field delineation of wetlands and surface water features on approximately 15 acres of the subject property (see site location map on page 1 of the Attachment), in the vicinity of the proposed chairlift base station at the request of Mount Sunapee Resort. Field investigation was conducted by Sean Donohue, Wetland Scientist of Pioneer, on September 9, September 10, and October 1, 2003. Wetland determinations were made using the criteria outlined in the United States Army Corps of Engineers (Corps) Wetlands Delineation Manual (Corps 1987). The purpose of the investigation was to identify wetlands and surface water features within the designated portion of the property that are subject to federal and state regulation, for project planning purposes.

Previously, on November 1, 2001 Shelley Gustafson, Senior Wetland Scientist of Pioneer, conducted a preliminary wetland walkover on the entire 130 acre parcel owned by Dodd Johnson (see cover letter, memorandum, and attachment dated January 25, 2002 summarizing this investigation on pages 2 through 9 of the Attachment). Wetlands delineated by Pioneer in 2003 are primarily associated with the stream identified as "Perennial Stream 1" in the above-referenced memorandum.

The subject property is located in the town of Goshen, New Hampshire, on the east side of Brook Road. To the north, east, and south the property is bordered by forested land. To the west the property is bordered by forested land and private residences located along Brook Road. Delineated wetland and surface water features are shown on the map on page 10 of the Attachment.

Site Description

The property is currently managed as a woodlot, and a network of skidder trails and logging roads are present on the site. The site has been heavily logged, and saplings common to the uplands on the site include *Quercus rubra* (northern red oak), *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple), and *Betula papyrifera* (paper birch). Other saplings that are also present in the upland vegetation communities include *Prunus virginiana* (chokecherry), *Fraxinus americana* (white ash), and *Acer pennsylvanicum* (striped maple). Larger *Pinus strobus* (white pine) and *Tsuga canadensis* (eastern hemlock) are occasionally present in the sparse overstory, and inclusions of hemlock dominated stands that have not been logged as heavily are also present. The various wetland communities present on the site are described in the relevant sections below.

Site topography is substantial, with a steady increase in elevation from west to east. Elevation of the project area ranges from approximately 430 feet above sea level at the west end of the property and 570 feet above sea level at the eastern edge of the site, based on United States Geological Survey topographic mapping. The project area lies at the western foot of Mount Sunapee, and is located within the watershed of the ## River.

Soils on the site are primarily composed of ablation and basal glacial till, and generally have textures of sandy loam to loamy sand. The National Resources Conservation Service (NRCS) Soil Survey of Sullivan County, New Hampshire shows soils on the property to be mapped as Mondadnock (well-drained), Monadnock-Hermon association (well-drained to somewhat excessively drained), Marlow (well-drained), and Lyme-Moosilauke loams (somewhat poorly drained to poorly drained) series soils. Field investigation has verified that hydric soil inclusions are present along the riparian corridor within the area of investigation.

National Wetland Inventory (NWI) mapping of the project area shows a wetland complex located at the western edge of the project area (see site location map on page 1 of the Attachment). This complex is identified as a scrub-shrub/forested wetland feature on the NWI mapping, which is consistent with the observed characteristics of the portion of the wetland that was delineated.

Fourteen wetlands were identified within the area of investigation, and were flagged using pink wetland delineation tape and labeled with the year, wetland number, and flag number (i.e., 2003-1-1). The top of bank of one perennial stream was also flagged. Wetland and top of bank flagging was located by Pioneer using sub-meter Global Positioning System (GPS) and transferred onto the wetland delineation map. The wetlands and surface water features identified in the project area are summarized in Table 1 and discussed in detail below.

Table 1: Summary of Wetland and Surface Water Features

Feature Identification	Jurisdictional Classification	Description
2003-1	Corps/ NHDES	Riparian Fringe Wetland
2003-2	Corps/ NHDES	Forested Riparian Wetland
2003-3	Corps/ NHDES	Forested Riparian Wetland
2003-4	Corps/ NHDES	Riparian Fringe Wetland
2003-5	Corps/ NHDES	Riparian Seepage Wetland
2003-6	Corps/ NHDES	Forested Riparian Wetland
2003-7	Corps/ NHDES	Scrub-Shrub/ Forested Wetland
2003-8	Corps/ NHDES	Emergent/ Scrub-Shrub Wetland
2003-9	Corps/ NHDES	Riparian Fringe Wetland
2003-10	Corps/ NHDES	Disturbed Riparian Wetland
2003-11	Corps/ NHDES	Constructed Riparian Wetland Ditch
2003-12	Corps/ NHDES	Forested Riparian Wetland

Table 1: Summary of Wetland and Surface Water Features		
Feature Identification	Jurisdictional Classification	Description
2003-13	Corps/ NHDES	Riparian Fringe Wetland
2003-14	Corps/ NHDES	Disturbed Forested Riparian Wetland
TB-1	Corps/ NHDES	Perennial Stream

Riparian Wetlands

As indicated in Table 1, twelve riparian wetlands were delineated along the corridor of Stream TB-1. The vegetation communities of these features have been influenced by the previous logging activity on the property, and most exhibit early successional vegetation. All of these wetlands are small in size and occupy riparian terraces, areas of groundwater seepage along the streambank, or the ordinary high water (OHW) of Stream TB-1. Logging disturbance history in the features is variable, ranging from none to evidence of excavation associated with construction of logging trails. Most of the wetlands exhibit some indication of recent logging activity. Some wetland features are located along the fringe of the channel of Stream TB-1 and are dominated by herbaceous growth, while others are forested features along the riparian corridor of Stream TB-1.

Herbs and shrubs typical of these wetlands include *Onoclea sensibilis* (sensitive fern), *Spirea latifolia* (meadowsweet), *Carex crinita* (fringed sedge), and *Impatiens capensis* (jewelweed). Asters and goldenrods are also common in these wetlands and include *Aster novae-angilae* (New England aster), *Solidago canadensis* (Canada goldenrod), *Solidago gramnifolia* (grass leaved goldenrod), and *Solidago rugosa* (rough-stemmed goldenrod). *Osmunda cinnamomea* (cinnamon fern), *Thelypteris thelypteroides* (marsh fern), *Carex lurida* (shallow sedge), *Spirea tomentosa* (steeplebush), *Scirpus cyperinus* (woolgrass), and *Rubus allegheniensis* (blackberry) are other herbs and shrubs that are present in some of these wetland features, but not as common.

Betula alleghaniensis (yellow birch) and *Acer rubrum* (red maple) saplings are very common to these riparian wetlands. Striped maple, hemlock, and other saplings more typical of the uplands on the site are present but less prevalent. Presence of woody vegetation varies between wetlands and is primarily a function of the extent of previous logging activity and successional phase. As with adjacent uplands, large overstory trees are less common. Some features are almost entirely devoid of woody vegetation while others have a dense sapling layer. In certain upland areas with non-hydric soils, hydrophytes that also function as aggressive post-disturbance colonizers are present in the species composition. Photographs 1, 2, and 3 on pages 11 and 12 of the Attachment depict selected riparian wetlands and adjacent uplands on the property.

The soils along the riparian corridor tend to exhibit horizons and profile development that have been influenced by depositional processes associated with Stream TB-1. Soil profiles often exhibit a sandy loam A horizon underlain by a horizon of sandy parent material. In wetland areas the A horizon exhibits a dark color (black or dark brown), and the underlying horizon exhibits a gray color, often with redoximorphic features. Soils in upland portions of the riparian corridor lack dark A horizons and/or are not underlain by horizons exhibiting redoximorphic features that suggest soil saturation within one foot of the surface for significant durations during the growing season. At the location of skidder roads and stream crossings, the upper part of the soil profile has been significantly altered, and constructed drainage ditches are evident in some areas.

At the time of field investigation, wetland hydrology in these riparian wetland features was evidenced by active groundwater seepage, soil saturation within one foot of the surface, and/or drainage patterns within the wetland boundary.

The Highway Methodology of the United States Army Corps of Engineers (Highway Methodology) for wetland evaluation identifies 13 different ecological, social, and economic functions provided by wetlands, which can be utilized as a framework for conducting wetland functional assessments. As summarized in Table 2, the riparian wetlands that have been delineated on the property may contribute to the following wetland functions and values within the landscape:

- floodflow alteration
- groundwater discharge and recharge
- retention of sediment and pollutants
- nutrient removal
- sediment/streambank stabilization

In addition, smaller species of wildlife may utilize the riparian corridor in which these features are located as a protected travel corridor.

Table 2: Matrix Summary of Wetland Functions					
Wetland Unit	**Groundwater Discharge/ Recharge**	**Sediment/ Toxicant/ Pathogen Retention**	**Nutrient Removal**	**Floodflow Alteration**	**Sediment/ Streambank Stabilization**
2003-1					
2003-2	*	*	*	*	*
2003-3	*	*	*	*	*
2003-4	*	*	*	*	*
2003-5	*		*		
2003-6	*	*	*	*	*
2003-9	*		*		
2003-10	*	*	*	*	
2003-11					
2003-12	*	*	*	*	*
2003-13	*		*		*
2003-14	*	*	*	*	*
* = Function associated with a given wetland					

<u>Scrub-Shrub/ Forested Wetland Complex</u>

Wetland 2003-7 consists of a scrub-shrub/forested wetland complex that is identified on NWI mapping. Stream TB-1 also drains into and runs through Wetland 2003-7. *Salix sp.* (willow), *Alnus rugosa* (speckled alder), goldenrods, asters, meadowsweet, *Populus tremuloides* (quaking aspen), and sedges are common to the portion of the wetland that was delineated. Red maple and white ash with shallow root systems are also present.

Along the periphery of the wetlands sensitive fern, cinnamon fern, and *Osmunda regalis* (royal fern) are also present. Adjacent upland communities are typical of the site.

Wetland soil profiles along the delineated boundary tend to exhibit a brown, fine sandy loam A horizon that is friable, and depleted B horizons or B horizons with depletions grading into a depleted matrix color within 20 inches of the surface. However, other areas of the wetland have a dark, thick A horizon underlain by a sandy horizon with a gray color and redoximorphic concentrations and depletions.

Data plots from Wetland 2003-7 and adjacent uplands are included on pages 13 to 16 of the Attachment. In addition, Photographs 4 and 5 on pages 12 and 17 of the Attachment depict these wetland and upland data plots.

Based on functions listed in the Highway Methodology, Wetland 2003-7 has the potential to contribute to the following wetland functions and values:

- floodflow alteration
- groundwater recharge/discharge
- retention of sediment, nutrients and pollutants
- production export (for wildlife)
- sediment/streambank stabilization
- wildlife habitat
- aesthetics

Scrub-Shrub/ Emergent Wetlands

Wetland 2003-8 is a scrub-shrub/emergent wetland located on the north side of the existing unpaved access road. Wetland 2003-7 and Wetland 2003-8 appear to have been contiguous prior to construction of the road, and still share a hydrologic connection via a 12 inch diameter metal culvert.

Meadowsweet, fringed sedge, jewelweed, New England aster, goldenrods, sensitive fern, and speckled alder are common to Wetland 2003-8. Adjacent uplands are typical of the site.

The soil profile is composed of a dark olive-gray A horizon with pieces of undecomposed organic material and oxidized rhizospheres, that is underlain by a depleted B horizon within 12 inches of the surface. The soil texture is fine sandy loam that is friable in the A horizon and firm in the B horizon. Free water was observed at two inches below grade at the time of field investigation. Although a significant amount of surface and subsurface water movement appears to occur in Wetland 2003-8, a stream with a defined channel is not present in the delineated portion of the wetland. The wetland boundary extends beyond the delineated area.

A small constructed ditch on the north edge of the existing access road drains into and is contiguous to Wetland 2003-8. The ditch contains hydric soils, and vegetation within the ditch is similar to Wetland 2003-8. The average width of the ditch is three feet.

Based on the functions listed in the Highway Methodology the delineated portion of Wetland 2003-8 may contribute to the following wetland functions and values:

- floodflow alteration
- groundwater recharge/discharge
- retention of sediment, nutrients and pollutants
- production export (for wildlife)
- wildlife habitat

Streams

The top of bank of a perennial stream identified as TB-1 was delineated on the property. The stream channel consists of sand, gravel, and small stones and exhibits an average OHW of 9 feet. However, the OHW width was observed to range from 6 to 15 feet. In a few areas where the stream channel widens and becomes less deep, small sedge dominated wetlands are confined within the defined stream channel and OHW, and were, therefore, not delineated. At other locations "overflow" channels and upland islands situated where the stream channel temporarily splits are included within the delineated top of bank. Water flow was present at the time of field investigation. The channel is incised in some areas, and the bank is also undercut in a few locations. The bank topography ranges from short, steep gullies to flat stream terraces. Vegetation along the TB-1 corridor is consistent with the previously described upland and wetland communities. Photograph 6 on page 17 of the Attachment depicts the channel of Stream TB-1 at the location of Wetland 2003-3.

Conclusions and Recommendations

All delineated wetlands and surface waters on the property fall under the jurisdiction of the New Hampshire Department of Environmental Services (NHDES) and the Corps. With regard to wetlands and surface water permitting, avoidance and minimization of impacts to the extent practicable for any proposed project will be required in the project permitting process.

As stated in the introduction to this memorandum, Pioneer's 2003 wetland investigation was limited to an area of approximately 15 acres in the vicinity of the proposed chair lift base station. Pioneer recommends that the remainder of the project area be comprehensively surveyed for wetlands in the growing season of 2004. Delineation of all jurisdictional wetland boundaries and surface waters in these areas would be required during regulatory review of any proposed project.

However, using the mapping and findings of Pioneer's 2003 wetland delineations in conjunction with Pioneer's 2001 site walkover would provide sufficient information for preliminary project planning purposes, and for initiation of avoidance and minimization of wetland impacts.

REFERENCE

Corps 1987. Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. 1987.

Highway Methodology Workbook 1987. U.S. Army Corps of Engineers. 1987. "The Highway Methodology Workbook – Integrating Corps Section 404 Permit Requirements with Highway Planning and Engineering and NEPA EIS Process."

F:\PROJECT\03075 Sunapee Wetlands 2003\delineation memo.doc

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CONSULTING SCIENTISTS

MEMORANDUM

To: Sunapee/Additional Parcel File
From: Shelley E. Gustafson
Subject: Wetlands and Streams Reconnaissance
Date: January 25, 2002

In November of 2001, Shelley E. Gustafson of Pioneer Environmental Associates, LLC. (Pioneer) conducted a site reconnaissance for wetlands and streams on three separate parcels located near the Mount Sunapee Resort in Goshen, New Hampshire (see site location map on page 1 of Attachment). The largest of the three properties is a 130-acre parcel currently owned by Dodd Johnson and surveyed on November 1, 2001. The remaining two properties are 35.5 acres and 9 acres, owned by Lamb and Dodd Johnson, respectively. These parcels were surveyed on November 12, 2001. All three parcels are situated between the Mount Sunapee Resort area and Brook Road.

Dodd Johnson Parcel – 130 Acres

The 130-acre parcel owned by Dodd Johnson can be accessed from Brook Road via an existing logging road. The parcel as a whole has been heavily impacted by recent logging efforts evidenced by the predominance of young, regenerating forest and myriad cleared, access roads. In general, the vegetation throughout the parcel is indicative of upland communities. The most common sapling species found throughout these young woods include *Betula papyrifera* (paper birch), *Fagus grandifolia* (American beech), *Acer saccharum* (sugar maple) and *Quercus rubra* (red oak). Larger individuals of *Tsuga canadensis* (hemlock) and *Pinus strobus* (white pine) are also found sparsely throughout the canopy.

Three distinct surface water features were identified during the course of the site walkover. First, a perennial stream bisects the property from an east to west direction (see "Perennial Stream 1" on Dodd Johnson Parcel map, page 2 of Attachment). Patches of riparian wetland can be found along its stream course, dominated by hydrophtyic vegetation species including *Carex sp.* (sedge) and *Spiraea sp.* (steeplebush). However, much of its course is bordered by upland, with hemlock in the canopy and upland ferns dominating the herbaceous understory. The stream also contains sections of eroded banks, most likely the result of heavy logging activities nearby. If this parcel were to be developed, Pioneer recommends maintaining a substantial buffer area of at least 100 feet around the stream to avoid impacting wetland areas and further degradation of the stream course.

The second surface water feature is associated with another perennial stream located along the northwest edge of the property (see "Perennial Stream 2" on Dodd Johnson Parcel map, page 2 of Attachment). This stream is contained within a steep ravine that would likely be avoided during development activities. Nonetheless, Pioneer recommends maintaining a 100-foot buffer around this feature as well.

The third feature corresponds to the first perennial stream's course after it bears to the south and follows along the southwest edge of the property. At this location, the stream is interconnected with an extensive wetland complex (see "Wetland/Stream Complex on Dodd Johnson Parcel map, page 2 of Attachment). The boundary of this stream/wetland complex is abruptly marked by a steep change in slope, the upland edge of which is characterized by white pine and hemlock in the canopy. Abundant wildlife sign was noted throughout the forest along the wetland boundary. Pioneer also recommends 100 feet of buffer along this boundary so that wildlife corridor activity can be maintained and protected.

Lamb Parcel

The Lamb parcel is located just north of the 130-acre Dodd Johnson parcel. Although evidence of recent logging was not as obvious in this parcel, the forest was relatively young and contained abundant paper birch in the understory, indicating recent disturbance. Additional common tree species found within this parcel included hemlock and white pine in the canopy with beech and red oak common in the understory. Forest composition was generally indicative of upland conditions within this parcel.

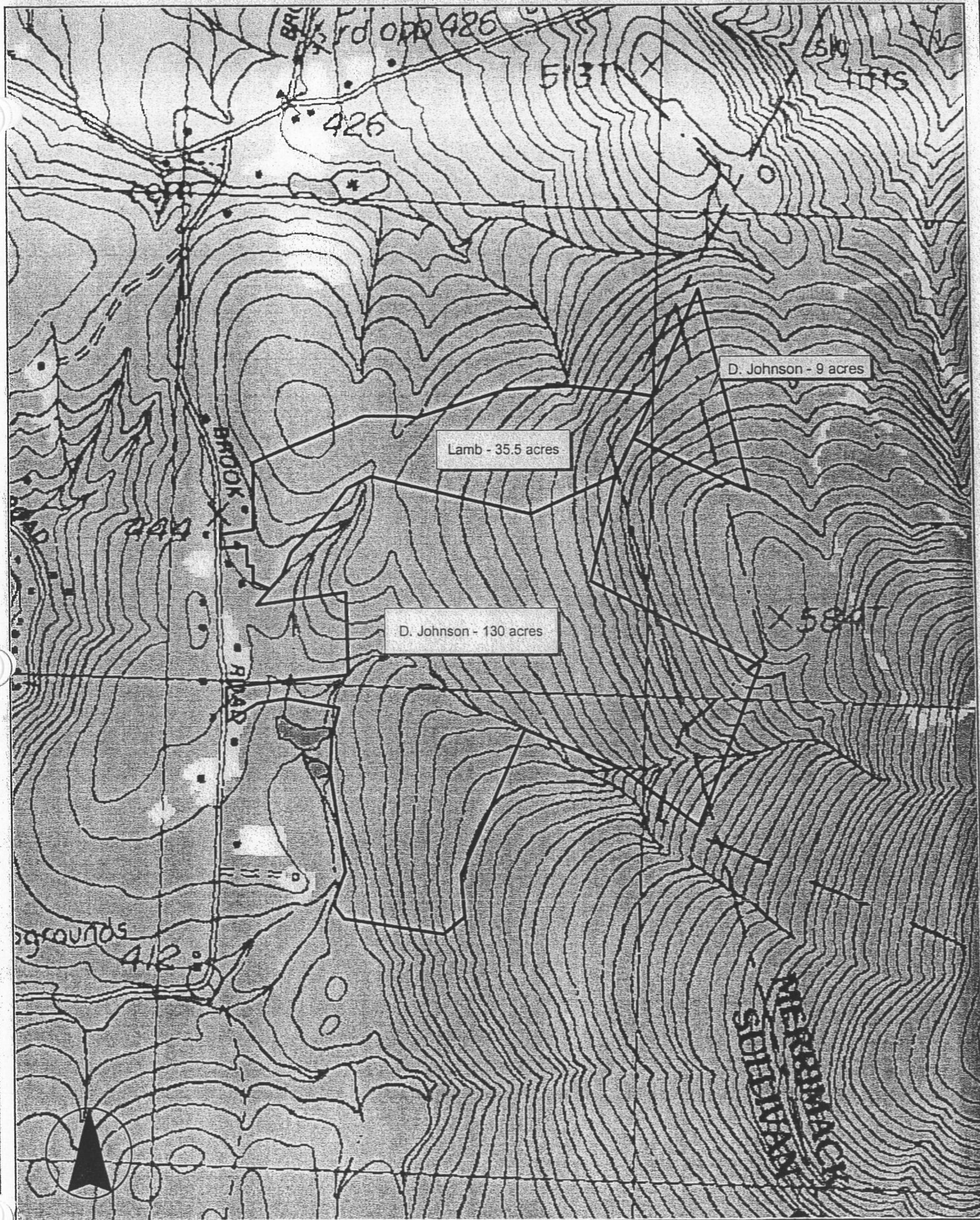
One basin-like wetland was located in the middle section of the parcel, near the saddle depicted on the USGS topographic quad (see "Wetland 1" on Lamb Parcel map, page 3 of Attachment). This roughly 4,000 square foot area was dominated by sedge, steeplebush, *Juncus sp.* (rush), and paper birch. Although no surface water was present on the day of the site walkover, this feature was characteristic of a vernal pool during the dry season. Care should be taken to avoid impact to this feature and the adjacent upland forest.

Additional surface water features located on site include two intermittent stream channels that lead to the north and beyond the property limits (see "Intermittent Stream 1 and 2" on Lamb Parcel map, page 3 of Attachment). Neither channel was flowing on the day of the delineation. Pioneer recommends maintaining a 50-foot buffer around both of these streams.

Dodd Johnson Parcel – 9 Acres

The 9-acre Dodd Johnson parcel is located to the east of the Lamb parcel and 1,660 feet above sea level. Steep slopes and exposed bedrock are predominant landscape features on this parcel. *Picea rubens* (red spruce) and *Abies balsamea* (balsam fir) dominate the canopy. No distinct surface water features were identified on the day of the site walkover.

ATTACHMENT



Property Boundaries

12/05/01

Source: USGS Topogr. Quad and Town of Goshen Tax Mapping

Mt. Sunapee Resort/Additional Parcel Investigation
Site Location Map
Goshen, New Hampshire

900 0 900 1800 Feet

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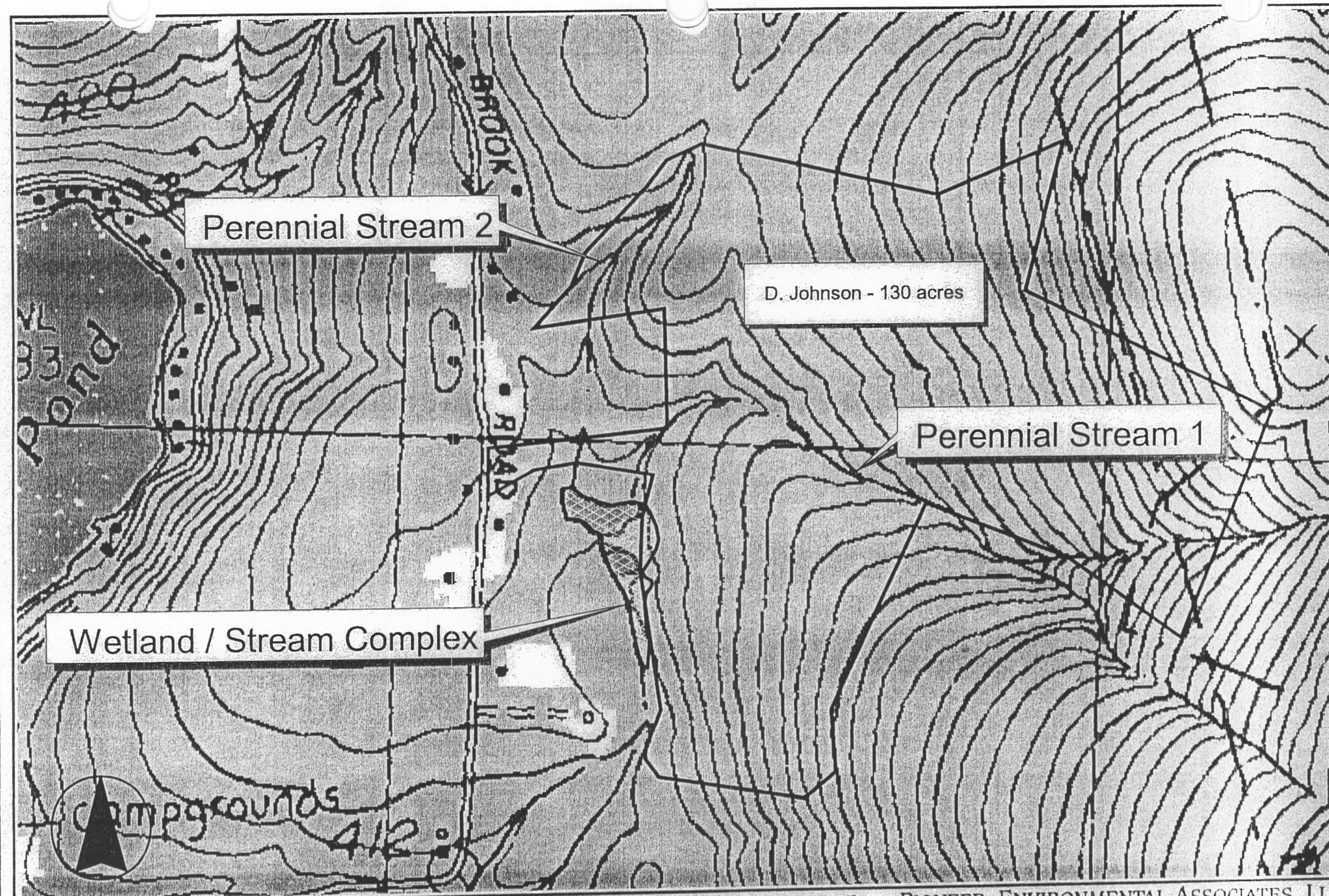

Legend

D. Johnson Property Boundary
Wetland complex.shp

January 9, 2002

Source: USGS Topogr. Quad and Town of Goshen Tax Mapping

Mt. Sunapee Resort / Dodd Johnson Parcel

Wetlands and Surface Water Features

Goshen, New Hampshire

2000 0 2000 4000 Feet

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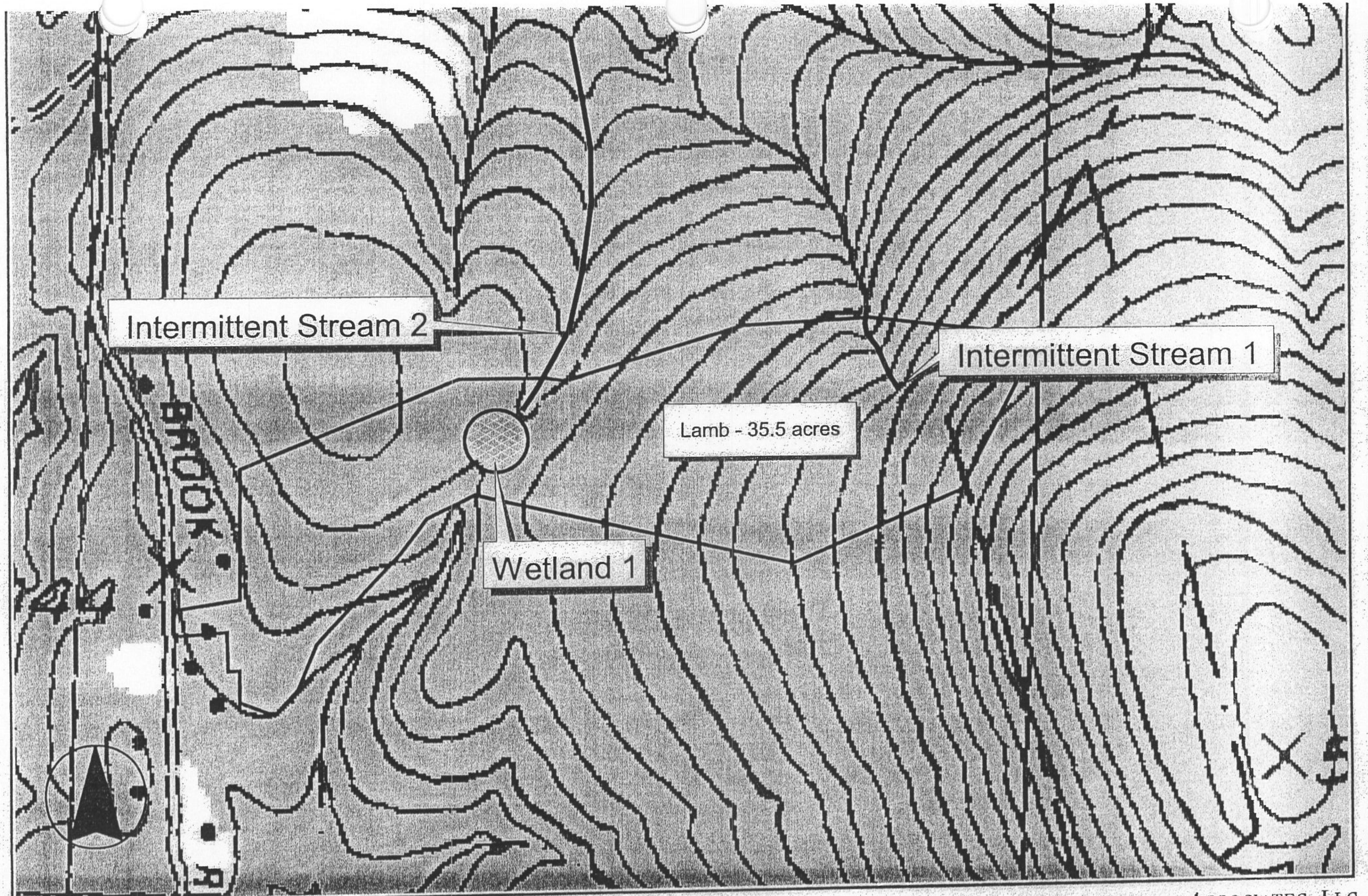

Legend

Wetland 1
Lamb Property Boundary

January 9, 2002

Source: USGS Topogr. Quad and Town of Goshen Tax Mapping

Mt. Sunapee Resort / Lamb Parcel

Wetlands and Surface Water Features

Goshen, New Hampshire

1500 0 1500 3000 Feet

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CONSULTING SCIENTISTS

Appendix D. Mount Sunapee West Bowl Expansion Snowmelt Drainage and Watershed Analysis

C I V I L E N G I N E E R S • L A N D S U R V E Y O R S

Bruno Associates

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MEMORANDUM

To: Jay Gamble

From: Nicole Kesselring, PE NSK

Re: Mount Sunapee Resort West Bowl Expansion
Snowmelt Drainage and Watershed Analysis

Date: 5/27/04

In response to our meeting on May 3, 2004, regarding the above mentioned project, our office has performed a hydrologic study to examine the potential impact snowmaking operations could have on The Gunnison Brook, Lake Gunnison and Rand Pond.

During that meeting you conveyed the concerns of some Goshen Citizens regarding:

- Potential impact to the water quality and quantity of Lake Gunnison, also known as the Goshen Ocean,
- Potential impact to the water quality and quantity of Rand Pond, and
- The potential for flooding and washout along Brook Road.

As part of this study, we performed a field visit to each of the water bodies, and examining all culverts and bridges on the Gunnison Brook along Brook Rd. Further information was gathered through the use of USGS Maps, the FEMA Flood Insurance Study for Newport, NH (none is currently available for Goshen), FEMA Flood Insurance Maps for Goshen, and a phone conversation with Alan Hanscom of the NH DOT.

We feel that the following study will provide information which will demonstrate that the work proposed by Mt. Sunapee in the West Bowl Area will not adversely impact the Gunnison Brook Watershed.

Per our conversation, you stated that Mt. Sunapee proposes to make snow on 75 Ac of proposed trails in the West Bowl. 2 ½ feet of snow is typically made over each Ac, at a volume of 180,000 gallons per ac-ft of snow. This means that the entire volume of water proposed for snowmaking in this area will be approximately 33.75 million gallons of water.

The West Bowl area lies on the western slope of Mt. Sunapee within the Gunnison Brook Watershed. This watershed is comprised of 4,500 Ac to the point where the Gunnison Brook crosses under Rt. 10. The West Bowl area drains to an unnamed tributary on the eastern side of Brook Rd., which then discharges into the Gunnison Brook near the 90° corner in Brook Rd.(Merrill's corner). From this point the Gunnison Brook follows

Brook Rd. its entire length, and crosses Rt. 10 prior to discharging into the South Branch of the Sugar River. See Exhibit 1.

Lake Gunnison: Lake Gunnison, also know as the Goshen Ocean, lies within the Sugar River Watershed area, on Blood Brook. The Blood Brook was dammed in this part of the valley to create the lake. Although Gunnison Brook and Lake Gunnison both lie within the Sugar River Watershed, Lake Gunnison is fed by Blood Brook, and is not hydraulically connected to Gunnison Brook. Chandler Hill and other mountain peaks create a drainage divide between the Gunnison Brook and Blood Brook, separating these two watersheds. Waters from these two brooks meet in Goshen, across Rt. 10 from Brook Rd., where the South Branch of the Sugar River begins.

Due to the hydraulic separation of the lake from Gunnison Brook, there is no potential for the lakes water level or water quality to be affected by snowmelt from the proposed trails within Mt. Sunapee Resort's West Bowl Area.

Rand Pond: Rand Pond lies within the Gunnison Brook Watershed. The pond's watershed area is approximately 270 Ac, and does not receive any runoff from the Mt. Sunapee West Bowl area. Rand Pond is fed by numerous tributaries, and it outflows drain into the Gunnison Brook. Due to the fact that the pond is located hydraulically upgradient of the Gunnison Brook, its inflows and water quality will not in any way be affected by snowmaking in the West Bowl area.

Bridges and Culverts along Brook Rd.: To assess the potential impact that snowmaking melt waters could have on the Gunnison Brook watershed a number of factors were examined.

First the snowmelt water quantity in relation to storm runoff from the entire watershed was examined. Based on The FEMA Flood Insurance Study for Newport, since none is available for Goshen, a discharge per square mile of watershed was calculated. This discharge was then applied to the Gunnison Brook Watershed area which is comprised of 7 Ac to arrive at stream flows for Gunnison Brook. These flows can be viewed in Table 1.

Table 1: Watershed Flow Data

S. Branch Sugar River @ Coon Brook Rd.				Gunnison Brook Watershed	
Storm Event (yr)	Stream Flow (cfs) *	Drainage Area (sq. miles)	Discharge per sq. mi (cfs)	Drainage Area (sq. miles)	Stream Flow (cfs) *
10	1,290	26.5	49	7	341
50	1,860	26.5	70	7	491
100	2,120	26.5	80	7	560

(Please note that due to the fact that peak flows for Gunnison Brook Watershed were calculated based on a much larger drainage area, that for a portion of the South Branch of the Sugar River, the actual peak flows out of the Gunnison Brook Watershed is most likely greater than the numbers represented in the table.)

Once the storm event streamflow for Gunnison Brook Watershed was calculated, we determined what percentage of total flow the snowmelt water from the West Bowl area will be. Snowmelt occurs at the end of the ski season as daily temperatures slowly rise. In any given year, snow can usually be seen left on the mountain in excess of 4 weeks after the mountain has closed. Taking into considering that when the mountain closes, melt has most likely already been occurring for up to 4 weeks, it would be reasonable assumed that snowmelt off the mountain actually occurs over an 8 week period of time. To be conservative, our calculations used a 7 day and 30 day melt period to determine what percentage of streamflow these quantities would represent. A 7 day melt time is unrealistic, but it puts into perspective the flow quantities we are dealing with.

As can be seen in Table 2, if melt were to occur over 7 days, snowmelt runoff would represent 2.2% of streamflow for a 10 year storm event and 1.3% of streamflow for a 100 year storm event. Similarly, runoff from a 30 day melt period would represent 0.5% to 0.3 % for a 10 and 100 year storm, respectively. As these calculations show, the snowmelt runoff, will represent such a small quantity of total flow, that it should not create an adverse impact.

Table 2: Snowmelt runoff as a % of Streamflow

Gunnison Brook Watershed		Snowmelt runoff as % of Streamflow	
Storm Event (yr)	Stream Flow (cfs) *	7 day melt (7.46cfs) (%)	30 day melt (1.74 cfs) (%)
10	341	2.2	0.5
50	491	1.5	0.4
100	560	1.3	0.3

Bridges and culverts along Brook Road were examined as part of this study. Our site visit revealed 4 driveway and class 4 road bridges, 2 culvert crossings, and 3 bridge crossings for Brook Rd. As Brook Rd. is a state road, bridges on this road are designed to the flood of record or the 50 year storm event, which ever is greater. All the bridges viewed appeared to be in good condition, with adequate clearance to pass large storm events. The two culverts under Cross Rd. appear to each be 68" diameter steel culverts, and appear to be in good condition. A single 60" culvert under a farm road, just east of the Province Rd./Brook Rd. intersection was severely clogged with branches and debris, thereby decreasing its capacity. The area in which this culvert is located is shown as flood plain on the FEMA Flood Maps, so it is likely, that flooding occurs in this area in the spring time. It did not appear that the crossing is used for more than access to fields on the other side of the brook.

Alan Hanscom of the NH DOT was also contacted to determine if he was aware of any problems in this area. He stated that from time to time road shoulder maintenance is necessary due to washout out from some larger storm events, where the brook comes very close to the road. He was unaware of any bridge issues along Gunnison Brook.

Storm event runoff from the proposed trails is expected to be negligible in terms of the overall watershed area, since no impervious area will be created, and the infiltration characteristics of the land will remain substantially the same.

In summary, Lake Gunnison and Rand Pond will be completely unaffected by any increase in snowmelt from the West Bowl area because they are hydraulically disconnected. The increase in flow that will be realized by the Gunnison Brook during spring melt is a very small percentage of its storm event flow and is unlikely to create a noticeable impact at any bridges or culvert crossings. Based on the above discussion, it is my professional opinion that there will not be any adverse impact from the increase in snowmelt created by the proposed West Bowl area.

M:\03jobs\03022\03022-EX1.dwg, 5/27/2004 1:29:18 PM, JWK

EX-1	MOUNT SUNAPEE WATERSHED AREA MAP	BRUNO ASSOCIATES INC. P.C. ENGINEERS, PLANNERS, SURVEYORS PO BOX 387, THE MILL BUILDING WOODSTOCK, VERMONT 05091 PHONE: (802) 457-3550 FAX: (802) 457-4853	GUNNISON BROOK WATERSHED AREA MAP FOR MOUNT SUNAPEE RESORT IN GOSHEN & SUNAPEE NEW HAMPSHIRE	NO.	REVISIONS	DATE

DATE: 5/27/04

PROJECT: 03022

West Bowl Area Fact Sheet

Gunnison Brook Watershed Area = 4,500 Ac

Gunnison Brook has it headwaters at the top of Mt. Sunapee, and follows Brook Road down to Rt. 10. Shortly after it crosses under Rt. 10 it converges with the South Branch of the Sugar River.

Snowmelt in West Bowl Area
Proposed snowmaking trail area = 75 Ac

Trail area = 1.67 % of Watershed

Snow making snow quantity= 180,000 gal/ac-ft

snow making snow depth = 2.5 ft

Total snowmaking snow quantity = 33,750,000 gal = 4,512,032 cf

Hypothetically, If entire snowmaking quantity melted over: 7 days

runoff to Gunnison Brook would be: 7.46 cfs

Hypothetically, If entire snowmaking quantity melted over: 30 days

runoff to Gunnison Brook would be: 1.74 cfs

In reality snow on mountain melts over a period of 4 - 6 weeks after Mt. Sunapee has closed. (runoff from melt begins prior to the mountain closing)

Gunnison Brook Watershed			Snowmelt runoff as % of Streamflow	
Storm Event (yr)	Drainage Area (sq. miles)	Stream Flow (cfs) *	7 day melt (7.46cfs) (%)	30 day melt (1.74 cfs) (%)
10	7	341	2.2	0.5
50	7	491	1.5	0.4
100	7	560	1.3	0.3

FEMA, Flood Insurance Study, Newport, NH

S. Branch Sugar River @ Coon Brook Rd.				Gunnison Brook Watershed	
Storm Event (yr)	Stream Flow (cfs) *	Drainage Area (sq. miles)	Discharge per sq. mi	Drainage Area (sq. miles)	Stream Flow (cfs) *
10	1,290	26.5	49	7	341
50	1,860	26.5	70	7	491
100	2,120	26.5	80	7	560

United States Department of Agriculture
NRCS Natural Resources Conservation Service

New Hampshi

New Hampshire County Rainfall Frequency Data

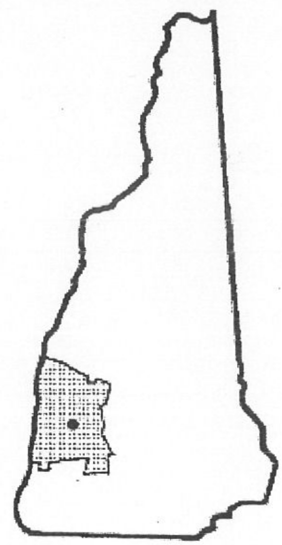
County or Area Rainfall Amounts in Inches by Frequency

County or Area	1 Year Inches	2 Years Inches	5 Years Inches	10 Years Inches	25 Years Inches	50 Years Inches	100 Years Inches
Belknap	2.4	2.8	3.7	4.1	5.0	5.5	6.1
Carroll - South	2.5	2.9	3.8	4.3	5.2	5.5	6.2
Carroll - North	3.0	3.3	4.3	5.0	5.7	6.2	6.6
Cheshire	2.4	2.8	3.7	4.2	5.0	5.6	6.3
Coos - South	3.0	3.5	4.1	4.8	5.6	6.2	6.8
Coos - North	2.4	3.0	3.5	4.2	4.9	5.3	6.1
Grafton	2.4	2.7	3.6	4.2	4.9	5.2	5.9
Hillsborough	2.5	2.9	3.8	4.3	5.1	5.7	6.3
Merrimack	2.4	2.8	3.7	4.2	5.0	5.6	6.2
Rockingham	2.5	3.0	3.8	4.3	5.2	5.7	6.4
Strafford	2.5	3.0	3.8	4.3	5.1	5.6	6.3
Sullivan	2.3	2.7	3.6	4.1	4.8	5.3	6.0

FLOOD INSURANCE STUDY

TOWN OF NEWPORT, NEW HAMPSHIRE

SULLIVAN COUNTY



APRIL 17, 1985

Federal Emergency Management Agency

COMMUNITY NUMBER - 330161

In the updated study, discharge-frequency relationships for the Sugar River were obtained from a hydrologic model of the Sugar River Basin using the HEC-1 Flood Hydrograph Package (Reference 4). This model did not include the area draining toward Lake Sunapee. It was determined that, with the high storage capacity of the lake, this area will not have a significant effect on the flooding downstream of the lake. To account for the lake dam outflows, 100 cubic feet per second (cfs) were added to HEC-1 discharges. This value was obtained from an integration of the curve of the average lake dam outflows for the past 20 years.

The discharges for the North Branch Sugar River and the South Branch Sugar River were determined using regional analyses of USGS gages in New Hampshire (Reference 5).

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SUGAR RIVER					
Downstream of confluence of North Branch Sugar River	204.1[1]	7,252	10,417	13,028	18,200
At Belknap Avenue	121.7[1]	4,054	5,414	6,793	9,700
At State Route 10	76.0[1]	1,720	2,387	3,053	4,600
NORTH BRANCH SUGAR RIVER					
At Old Cornish Turnpike	80.8	2,070	2,980	3,410	4,390
SOUTH BRANCH SUGAR RIVER					
At Elm Street	45.7	1,810	2,610	2,980	3,840
At Coon Brook Road	26.5	1,290	1,860	2,120	2,730

[1]Includes area draining toward Lake Sunapee

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Sugar River (continued)								
AT	56,893[1]	85	798	3.8	846.9	846.9	847.2	0.3
AU	56,957[1]	59	639	4.8	847.4	847.4	847.7	0.3
AV	57,352[1]	111	415	7.4	847.8	847.8	848.1	0.3
AW	58,057[1]	212	957	3.2	851.8	851.8	852.6	0.8
North Branch Sugar River								
A	122[2]	80	304	11.2	773.3	765.8[3]	765.8	0.0
B	190[2]	80	646	5.3	773.3	768.0[3]	768.0	0.0
C	4,080[2]	135	759	4.5	773.3	772.5[3]	772.7	0.2
D	8,662[2]	130	989	3.4	776.1	776.1	777.1	1.0
E	9,552[2]	37	428	8.0	776.8	776.8	777.6	0.8
F	9,604[2]	56	631	5.4	777.4	777.4	778.1	0.7
G	10,134[2]	75	779	4.4	777.9	777.9	778.6	0.7
South Branch Sugar River								
A	242[2]	84	403	7.4	788.3	783.7[3]	784.0	0.3
B	309[2]	60	374	8.0	788.3	784.5[3]	784.5	0.0
C	5,754[2]	228	1,213	2.5	794.9	794.9	795.8	0.9
D	11,682[2]	138	449	6.6	803.1	803.1	803.4	0.3
E	11,751[2]	150	650	4.6	803.5	803.5	804.0	0.5

[1]Feet above corporate limits
[2]Feet above confluence with Sugar River
[3]Elevation computed without consideration of backwater from Sugar River

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NEWPORT, NH
(SULLIVAN CO.)

FLOODWAY DATA

SUGAR RIVER-NORTH BRANCH SUGAR RIVER-SOUTH BRANCH SUGAR RIVER

TABLE 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
South Branch Sugar River (continued)								
F	12,351	75	339	8.8	805.1	805.1	805.2	0.1
G	13,351	85	396	7.5	810.8	810.8	811.0	0.2
H	14,351	126	584	4.6	819.7	819.7	819.8	0.1
I	15,086	36	209	12.8	851.0	851.0	851.4	0.4
J	18,474	40	340	7.9	877.0	877.0	877.8	0.8
K	19,174	48	275	9.7	880.2	880.2	881.0	0.8
L	20,819	67	308	8.7	893.9	893.9	894.6	0.7
M	23,831	49	313	6.8	913.0	913.0	913.3	0.3
N	27,561	45	240	8.8	920.6	920.6	921.5	0.9
O	27,626	60	273	7.8	922.0	922.0	922.0	0.0
P	29,311	56	452	4.7	928.6	928.6	929.5	0.9

[1] Feet above confluence with Sugar River

TABLE 2

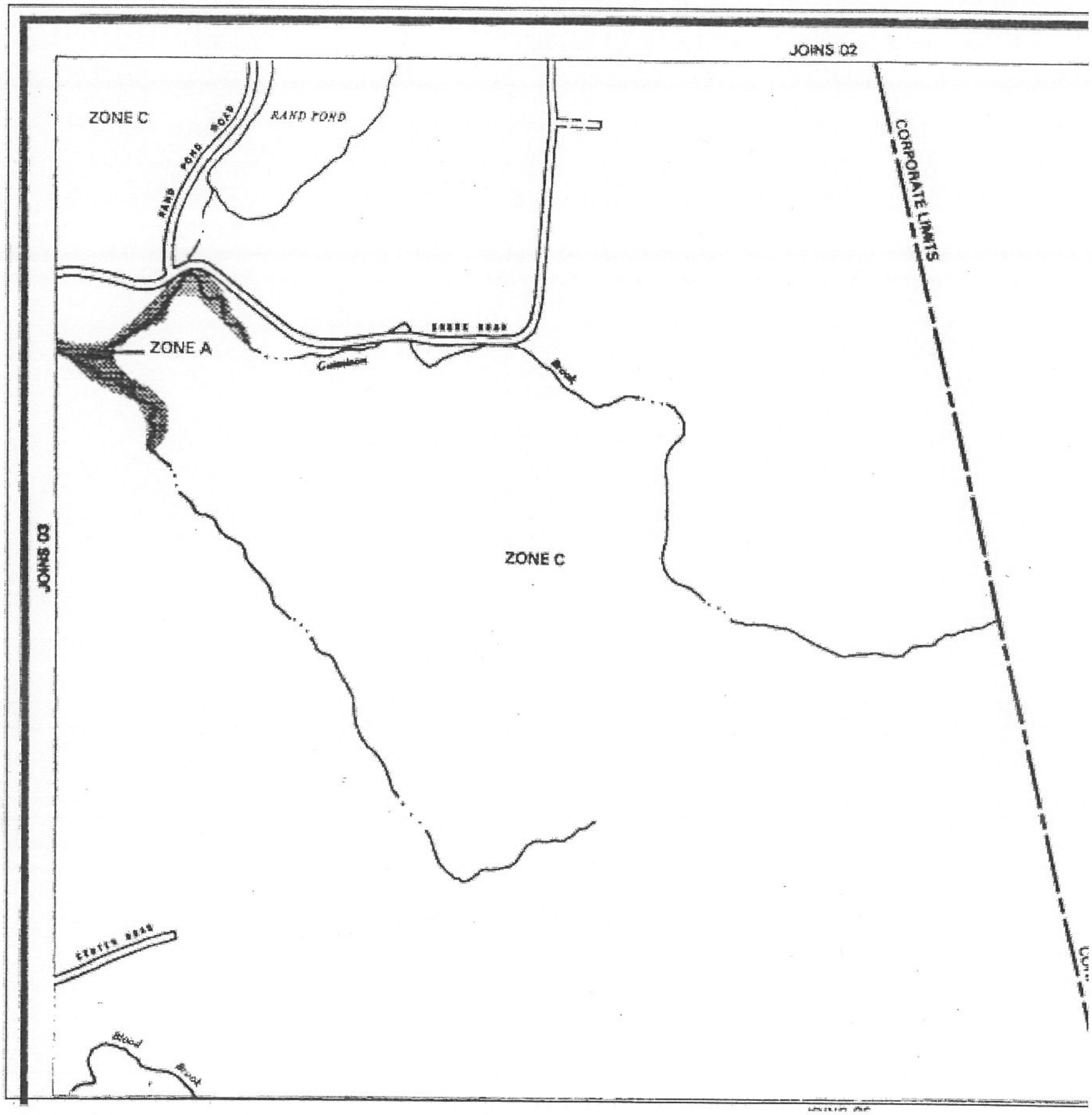
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF NEWPORT, NH

(SULLIVAN CO.)

FLOODWAY DATA

SOUTH BRANCH SUGAR RIVER


JOINS 02
ZONE C
RAND POND ROAD
RAND POND
CORPORATE LIMITS
ZONE A
Brook
ZONE C
JOINS 03

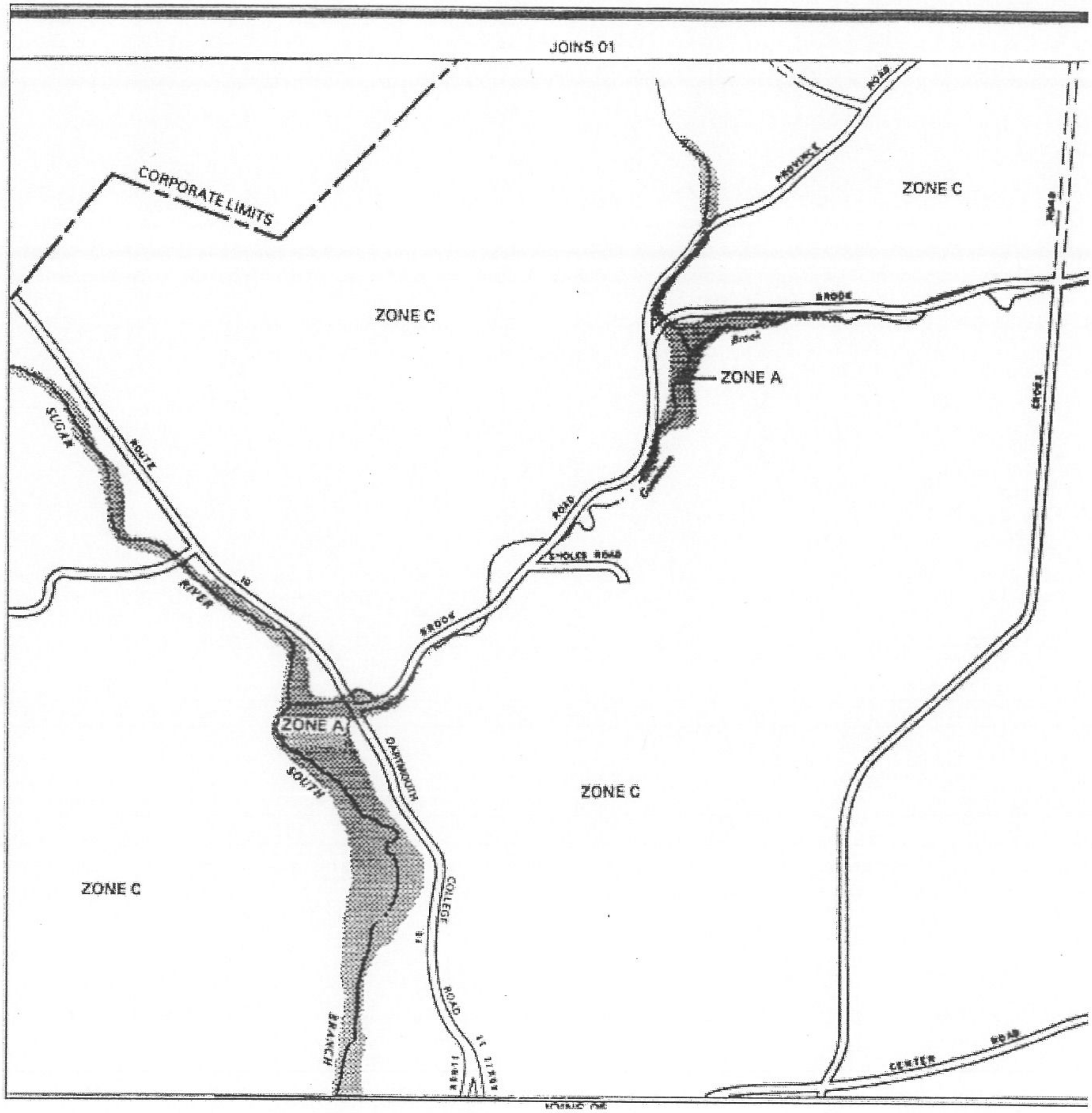

JOINS 01
CORPORATE LIMITS
ZONE C
ZONE C
ZONE A
ZONE A
ZONE C
ZONE C
SUGAR
RIVER
SOUTH
BRANCH
ROUTE
10
DARTMOUTH
COLLEGE
ROAD
BROOK
ROAD
PROVINCE
ROAD
BROOK
Brook
CROSS
ROAD
CENTER
ROAD

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH			Pct
MaB, MaC, MaD----- Marlow	0-8	3-10	1.00-1.30	0.6-2.0	0.10-0.23	3.6-6.0	0.24	3	2-8
	8-24	3-10	1.30-1.60	0.6-2.0	0.06-0.20	3.6-6.0	0.32		
	24-60	3-10	1.60-2.05	0.06-0.6	0.05-0.12	3.6-6.0	0.20		
MbB, MbC, MbD, MbE------------- Marlow	0-4	3-10	1.00-1.30	0.6-2.0	0.10-0.23	3.6-6.0	0.20	3	---
	4-24	3-10	1.30-1.60	0.6-2.0	0.06-0.20	3.6-6.0	0.32		
	24-60	3-10	1.60-2.05	0.06-0.6	0.05-0.12	3.6-6.0	0.20		
McB, McC, McD----- Monadnock	0-8	1-8	0.80-1.20	0.6-2.0	0.15-0.21	3.6-6.0	0.28	3	3-8
	8-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
MfB, MfC, MfD----- Monadnock	0-2	1-8	0.80-1.20	0.6-2.0	0.14-0.20	3.6-6.0	0.24	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
MrC*, MrD*, MrE*:									
Monadnock--------	0-2	1-8	0.80-1.20	0.6-2.0	0.10-0.18	3.6-6.0	0.24	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
Hermon-----------	0-3	2-6	0.95-1.20	6.0-20	0.07-0.20	3.6-5.5	0.10	3	---
	3-17	2-7	1.00-1.30	6.0-20	0.05-0.17	3.6-6.0	0.10		
	17-60	1-4	1.50-1.70	6.0-20	0.03-0.10	5.1-6.0	0.10		
MuD*:									
Monadnock--------	0-2	1-8	0.80-1.20	0.6-2.0	0.14-0.20	3.6-6.0	0.20	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
Hermon-----------	0-3	2-6	0.95-1.20	6.0-20	0.07-0.20	3.6-5.5	0.10	3	---
	3-17	2-7	1.00-1.30	6.0-20	0.05-0.17	3.6-6.0	0.10		
	17-60	1-4	1.50-1.70	6.0-20	0.03-0.10	5.1-6.0	0.10		
MvB*, MvC*, MvD*:									
Monadnock--------	0-2	1-8	0.80-1.20	0.6-2.0	0.14-0.20	3.6-6.0	0.24	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
Lyman------------	0-2	2-10	0.75-1.20	2.0-6.0	0.13-0.24	3.6-6.0	0.20	2	---
	2-15	2-10	0.90-1.40	2.0-6.0	0.08-0.28	3.6-6.0	0.32		
	15	---	---	---	---	---	----		
MwB*, MwC*, MwD*:									
Monadnock--------	0-2	1-8	0.80-1.20	0.6-2.0	0.14-0.20	3.6-6.0	0.24	3	---
	2-36	1-8	0.80-1.30	0.6-2.0	0.09-0.17	3.6-6.0	0.28		
	36-60	1-5	1.30-1.60	2.0-6.0	0.04-0.08	3.6-6.0	0.17		
Lyman------------	0-2	2-10	0.75-1.20	2.0-6.0	0.13-0.24	3.6-6.0	0.20	2	---
	2-15	2-10	0.90-1.40	2.0-6.0	0.08-0.28	3.6-6.0	0.32		
	15	---	---	---	---	---	----		
Rock outcrop.									
Na---------------- Naumburg	0-7	1-5	1.20-1.50	2.0-6.0	0.05-0.09	3.6-5.5	0.17	5	3-7
	7-33	1-5	1.20-1.50	6.0-20	0.06-0.08	3.6-5.5	0.17		
	33-60	1-5	1.45-1.65	6.0-20	0.04-0.06	4.5-6.5	0.17		
NnA--------------- Ninigret	0-9	3-7	1.00-1.25	2.0-6.0	0.13-0.25	4.5-6.0	0.28	3	2-8
	9-26	3-7	1.35-1.60	2.0-6.0	0.06-0.18	4.5-6.0	0.32		
	26-60	0-2	1.45-1.70	6.0-20	0.01-0.13	4.5-6.0	0.10		
Of---------------- Ondawa	0-10	1-9	1.15-1.40	2.0-6.0	0.12-0.26	4.5-6.5	0.24	5	3-7
	10-36	1-9	1.15-1.45	2.0-6.0	0.12-0.22	4.5-6.5	0.37		
	36-60	0-3	1.30-1.50	2.0-20	0.04-0.13	4.5-6.5	0.20		

See footnote at end of table.

GRANITEHIGHWAYS.COM

MAIN
HOME
NEW
RAIL
BRIDGE DATABASE
PHOTO SEARCH
LINKS
ABOUT
MAINE

Place Name: Goshen (Town of)

NBI Structure Number: **009800850011700**
Longitude: **-72° 08' 51"**, Latitude: **43° 18' 5"**

Show me a Map on the U.S. Census Service Tiger Map Server

Facility Carried: **BROOK ROAD**
Feature Intersected: **GUNNISON BROOK**
Location: **.05 MI NE OF JCT NH 10**

Year Built: **1940**, Reconstructed: **1998**

Owned and maintained by: **State Highway Agency**

Functional Classification: **Rural Minor Collector**
Service On Bridge: **Highway**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **8.9 m**
Bridge Roadway Width: **8.9 m**
Operating Rating: **56. Metric Tons**
Number of Spans in Main Unit: **1 Span**
Material Design: **Concrete**
Design Construction: **Slab**

Deck Condition: **Good Condition**
Superstructure Condition: **Good Condition**
Substructure Condition: **Good Condition**
Scour: **Foundations determined to be stable for assessed scour conditions**

Bridge Railing: **Meets currently acceptable standards.**
Inspection Date: **May, 2000**

Structural Evaluation: **Better than present minimum criteria**
Water Adequacy Evaluation: **Superior to present desirable criteria**

Average Daily Traffic: **200**
Year of Average Daily Traffic: **1984**
Sufficiency Rating: **97. %**

Return to National Bridge Inventory Database query form.

GRANITEHIGHWAYS.COM NBI

Place Name: Goshen (Town of)

NBI Structure Number: **009800870012000**
Longitude: **-72° 08' 39"**, Latitude: **43° 18' 14"**

Show me a Map on the U.S. Census Service Tiger Map Server

Bridge Photos and Road Photos and Train Pictures For Sale Online

Facility Carried: **BROOK ROAD**
Feature Intersected: **GUNNISON BROOK**
Location: **.32 MI NE OF JCT NH 10**

Year Built: **1940**

Owned and maintained by: **State Highway Agency**

Functional Classification: **Rural Minor Collector**
Service On Bridge: **Highway**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **9.8 m**
Bridge Roadway Width: **8.6 m**
Operating Rating: **25. Metric Tons**
Number of Spans in Main Unit: **1 Span**
Material Design: **Steel**
Design Construction: **Stringer/Multi-beam or Girder**

Deck Condition: **Good Condition**
Superstructure Condition: **Good Condition**
Substructure Condition: **Good Condition**
Scour: **Foundations determined to be stable for assessed scour conditions**
Bridge Railing: **Does not meet currently acceptable standards.**
Inspection Date: **May, 2000**

Structural Evaluation: **Somewhat better than minimum adequacy to tolerate being left in place as is**
Water Adequacy Evaluation: **Equal to present minimum criteria**

Average Daily Traffic: **200**
Year of Average Daily Traffic: **1984**
Sufficiency Rating: **74. %**

Return to National Bridge Inventory Database query form.

GH GRANITEHIGHWAYS.COM NBI

Bridge Photos and Road Photos and Train Pictures For Sale Online

Place Name: Goshen (Town of)

NBI Structure Number: **009800900012300**
Longitude: **-72° 08' 30"**, Latitude: **43° 18' 20"**

Show me a Map on the U.S. Census Service Tiger Map Server

Facility Carried: **BROOK ROAD**
Feature Intersected: **GUNNISON BROOK**
Location: **.47 MI N E OF JCT NH 10**

Year Built: **1945**

Owned and maintained by: **State Highway Agency**

Functional Classification: **Rural Minor Collector**
Service On Bridge: **Highway**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **7 m**
Bridge Roadway Width: **8 m**
Operating Rating: **48. Metric Tons**
Number of Spans in Main Unit: **1 Span**
Material Design: **Concrete**
Design Construction: **Slab**

Deck Condition: **Good Condition**
Superstructure Condition: **Good Condition**
Substructure Condition: **Good Condition**
Scour: **Foundations determined to be stable for assessed scour conditions**

Bridge Railing: **Meets currently acceptable standards.**
Inspection Date: **May, 2000**

Structural Evaluation: **Better than present minimum criteria**
Water Adequacy Evaluation: **Equal to present desirable criteria**

Average Daily Traffic: **200**
Year of Average Daily Traffic: **1984**
Sufficiency Rating: **95. %**

Return to National Bridge Inventory Database query form.

GH GRANITEHIGHWAYS.COM NBI

EMAIL
HOME
NEW
RAIL
BRIDGE DATABASE
PHOTO SEARCH
LINKS
ABOUT
MAINE

Place Name: Goshen (Town of)

NBI Structure Number: **009801050012900**
Longitude: **-72° 07' 32"**, Latitude: **43° 18' 45"**

Show me a Map on the U.S. Census Service Tiger Map Server

Facility Carried: **CROSS ROAD**
Feature Intersected: **GUNNISON BROOK**
Location: **TOWN RD**

Year Built: **1940**

Owned and maintained by: **City or Municipal Highway Agency**

Functional Classification: **Rural Local**
Service On Bridge: **Highway**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **4.3 m**
Operating Rating: **9.1 Metric Tons**
Number of Spans in Main Unit: **2 Spans**
Material Design: **Aluminum, Wrought Iron or Cast Iron**
Design Construction: **Culvert (includes frame culverts)**

Scour: **Foundations determined to be stable for assessed scour conditions**
Bridge Railing: **Does not meet currently acceptable standards.**
Inspection Date: **November, 2000**

Structural Evaluation: **Basically intolerable requiring high priority of corrrective action**

Water Adequacy Evaluation: **Equal to present minimum criteria**

Average Daily Traffic: **110**
Year of Average Daily Traffic: **1987**
Sufficiency Rating: **40. %**

Return to National Bridge Inventory Database query form.

GIL GRANITEHIGHWAYS.COM NBI

MAIL
HOME
NEW
RAIL
BRIDGE DATABASE
PHOTO SEARCH
LINKS
ABOUT
MAINE

Place Name: Goshen (Town of)

NBI Structure Number: 009800810011700
Longitude: -72° 08' 55", Latitude: 43° 18' 5"

Show me a Map on the U.S. Census Service Tiger Map Server

10

Facility Carried: **NH 10**
Feature Intersected: **GUNNISON BROOK**
Location: **1.78 MI N LEMPSTER TL**

Year Built: **1975**

Owned and maintained by: **State Highway Agency**

Functional Classification: **Rural Major Collector**
Service On Bridge: **Highway-pedestrian**
Service Under Bridge: **Waterway**
Lanes On Structure: **2**

Structure Length: **7.6 m**
Bridge Roadway Width: **9.8 m**
Operating Rating: **61. Metric Tons**
Number of Spans in Main Unit: **1 Span**
Material Design: **Concrete**
Design Construction: **Frame (except frame culverts)**

Deck Condition: **Good Condition**
Superstructure Condition: **Good Condition**
Substructure Condition: **Good Condition**
Scour: **Foundations determined to be stable for assessed scour conditions**

Bridge Railing: **Does not meet currently acceptable standards.**
Inspection Date: **July, 1999**

Structural Evaluation: **Better than present minimum criteria**
Water Adequacy Evaluation: **Superior to present desirable criteria**

Average Daily Traffic: **2600**
Year of Average Daily Traffic: **1993**
Sufficiency Rating: **91. %**

Return to National Bridge Inventory Database query form.

Water Resources

Data Category: Site Information | Geographic Area: New Hampshire | go

A scheduled power outage will affect access to **NWISWeb historical data**, updates for WaterWatch maps, and ftp services for water.usgs.gov. The outage could begin as early as Friday, May 21, 2004 at 10:30 pm EDT, and may continue as late as Monday May 24, 2004, 12:00 pm EDT. We are sorry for any inconvenience this may cause.

The following NWISWeb services will be affected:

- Discrete data **will not** be available during this time period (Water Quality Information, Ground-water levels, peaks, historical streamflow)
- Daily Streamflow Conditions maps **will not** be up-to-date.
- However, Real-time data **will** be available at http://waterdata.usgs.gov/nwis

Site Map for New Hampshire

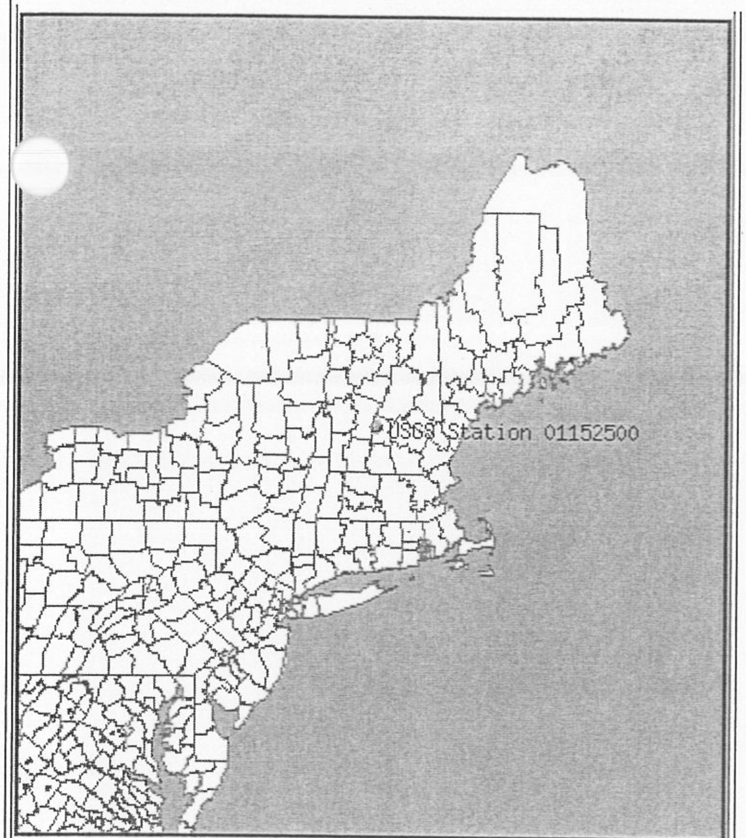
View real-time groundwater levels in Warner, NH. here

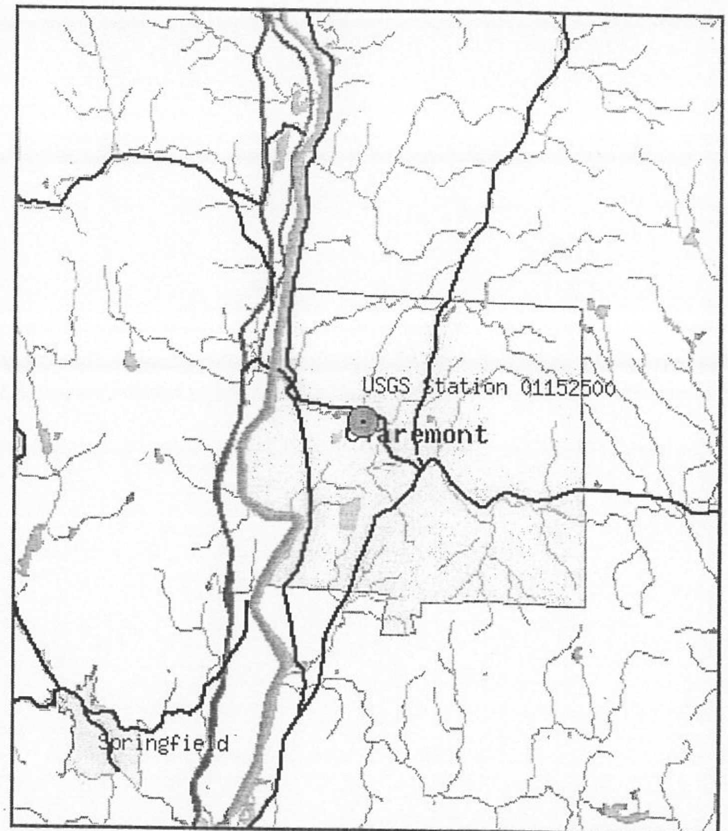
USGS 01152500 SUGAR RIVER AT WEST CLAREMONT, NH

Available data for this site Station site map | GO

Sullivan County, New Hampshire
Hydrologic Unit Code 01080104
Latitude 43°23'15", Longitude 72°21'45" NAD27
Drainage area 269.00 square miles
Gage datum 358.78 feet above sea level NGVD29

Location of the site in New Hampshire.	Site map.





ZOOM IN 2X, 4X, 6X, 8X, or ZOOM OUT 2X, 4X. 6X. 8X.

Maps are generated by US Census Bureau TIGER Mapping Service.

Questions about data gs-w-nh_NWISWeb_Data_Inquiries@usgs.gov
Feedback on this websitegs-w-nh_NWISWeb_Maintainer@usgs.gov

Top
Explanation of terms

NWIS Site Inventory for New Hampshire: Site Map
http://waterdata.usgs.gov/nh/nwis/nwismap?

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USGS Water Resources of New Hampshire
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Appendix E. Traffic Impact and Site Access Study

TRAFFIC IMPACT AND SITE ACCESS STUDY

MOUNT SUNAPEE WEST BOWL EXPANSION

Newbury, New Hampshire
Goshen, New Hampshire
Sunapee, New Hampshire

June 2004

Prepared for
Mount Sunapee Resort

Stephen G. Pernaw
& Company

Stephen G. Pernaw & Company

47 Hall Street, Suite 3 • Concord, NH 03301
tel: (603) 228-5750 • fax: (603) 228-5886 • sgp@lr.net

Transportation: Engineering • Planning • Design

TRAFFIC IMPACT AND SITE ACCESS STUDY
MOUNT SUNAPEE - WEST BOWL EXPANSION
NEWBURY, GOSHEN and SUNAPEE, NEW HAMPSHIRE
JUNE 3, 2004

I. INTRODUCTION

The Mount Sunapee Resort is located on NH Route 103 (NH103) at the Mount Sunapee Traffic Circle in Newbury, New Hampshire. Access to the mountain is provided via one access road that extends in a southerly direction from the traffic circle. The existing ski facility has a comfortable carrying capacity (CCC) of approximately 5,220 skiers per day. Several previously planned on-mountain improvements and enhancements will bring the CCC up to approximately 5,650 skiers per day soon. Recognizing that existing skier demand exceeds the skier capacity on certain peak days, and that skier demand will increase in the years to come, the West Bowl Expansion project is intended to better serve the public by increasing the CCC by approximately 1,200 skiers per day, bringing the total to 6,850 skiers per day.

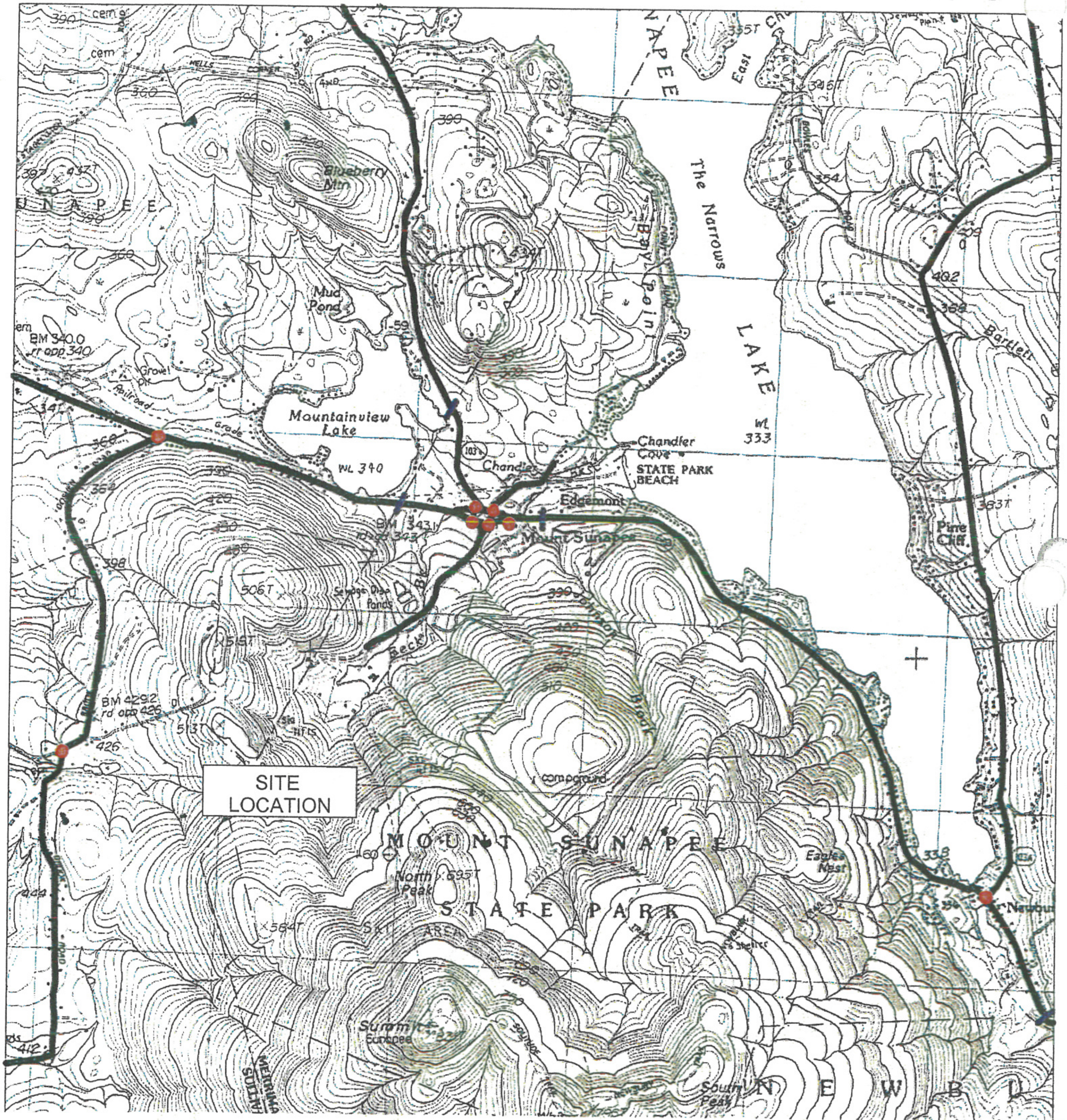
II. PROPOSED DEVELOPMENT

The West Bowl Expansion project involves a new ski lift and additional skiing terrain on the west side of the mountain. The expansion project includes the construction of 175 to 250 condominium units that will be located on private property that abuts the state lands. The condominium units will be comprised of hotel style units, two-story attached townhouses, and single-family detached dwellings, and many will be offered for sale on a "quarter share" basis.

Access to the West Bowl base lodge parking area, and the recreational homes is proposed via a new driveway on Brook Road in Goshen, New Hampshire. The proposed intersection is located approximately 2.1 miles south of the NH103/Brook Road intersection (in Sunapee, New Hampshire), and approximately 3.25 miles north of the NH10/Brook Road intersection (in Goshen, New Hampshire), and will intersect the east side of the roadway. The location of the subject site with respect to the area roadway network is shown on Figure 1.

In addition to traffic increases from local skiers, non-local day skiers, overnighters, and new residences, the expansion project will also result in approximately 108 additional employees on a typical weekend day. These additional employees will be affiliated with the skiing and the mountain, and others will be involved with the condominium/housing function. To put these statistics into perspective, Mount Sunapee reports that they currently utilize approximately 435-450 employees on a typical winter weekend.

Preliminary timetables indicate that project implementation would involve several years, and it is assumed for the purposes of this report that completion could occur by 2010. Accordingly, the traffic projections and analyses contained herein utilize 2010 as the base year, and 2020 as the ten-year planning horizon.



/ = AUTOMATIC TRAFFIC RECORDER LOCATION
● = INTERSECTION TURNING MOVEMENT COUNT LOCATION

78601

Figure 1

Site Location

Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

III. ACCESSIBILITY

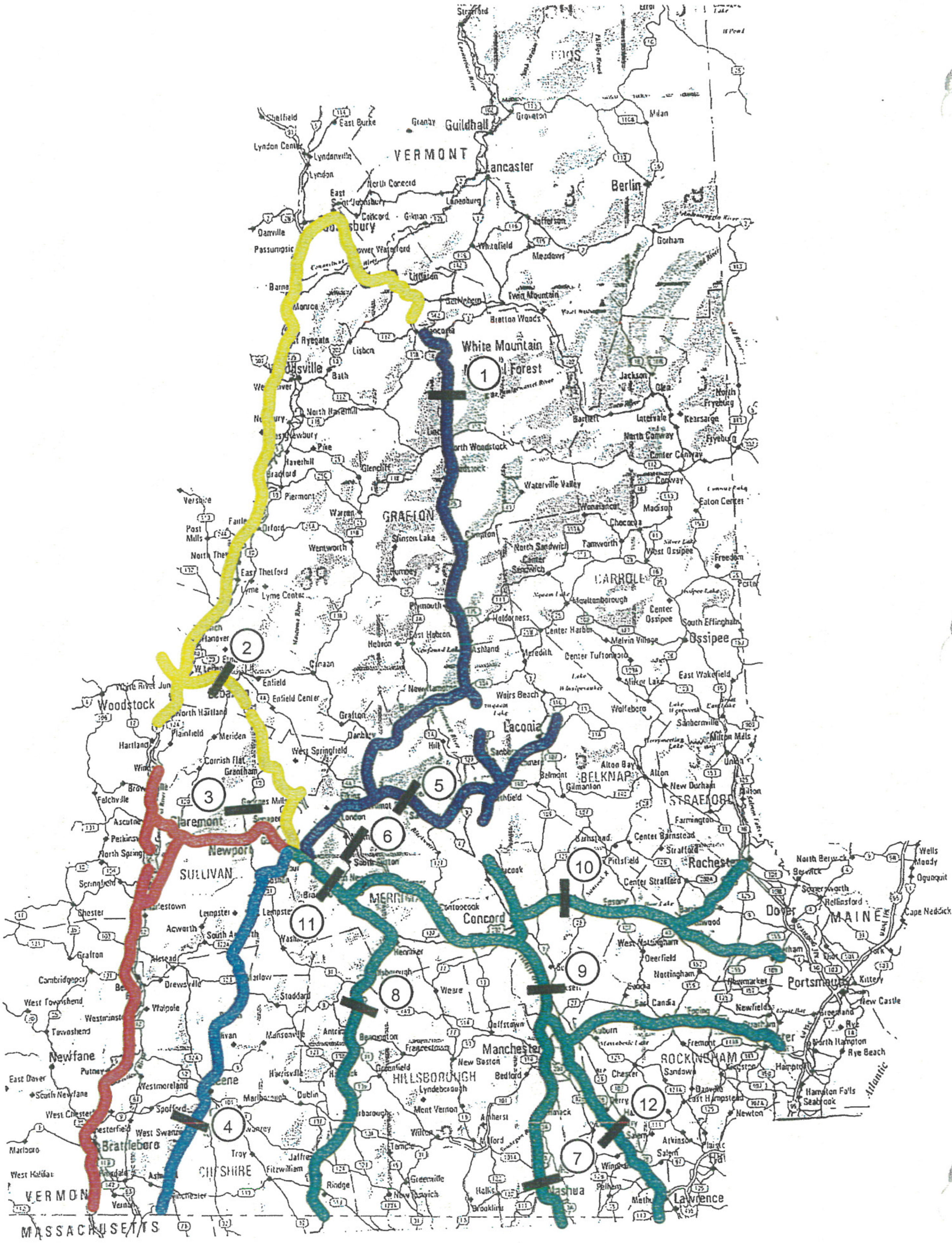
A. STATEWIDE – Mount Sunapee on NH103 is easily reached from Interstate Route 89 (I-89) via Exit 9 (and NH103) for northbound vehicles from Concord, Manchester, Nashua, and eastern Massachusetts, and via Exit 12-A (and NH11 to NH103-B) for southbound vehicles. From I-91 in central Vermont, most skiers take Exit 8 and travel east on NH103 through Claremont and Newport to reach the ski area. New Hampshire Routes 103-A and 103-B provide access between NH103 and I-89. Skiers from the southwest portion of the state utilize NH Route 10 (NH10) and Brook Road to reach NH103 and the traffic circle.

With the new point of access to the ski area and a new base lodge on Brook Road, those that currently utilize Brook Road to reach the mountain, will no longer need to travel to NH103 and enter the ski area via the traffic circle. Similarly, skiers arriving from points west via NH103 will have a choice between parking at the main mountain (via the traffic circle) or the new lodge (via Brook Road). Providing a secondary means of access to the ski area via the West Bowl area will reduce the number of existing vehicle-trips that utilize the traffic circle.

The diagram and table on Figure 2 show the primary access routes to Mount Sunapee from a statewide perspective and a summary of available traffic count data at several "checkpoints" throughout the State. In all cases, traffic demand on these principal access routes is lower during January and February (winter ski months) than during the peak summer months. With few exceptions, January and February travel is also below "average month" conditions (Annual Average Daily Traffic).

B. REGIONAL - The diagram and tables on Figure 3 show how the primary access routes to Mount Sunapee form four "gateways" that converge at the traffic circle, and several statistics from several nearby New Hampshire Department of Transportation (NHDOT) traffic recorder stations. The closest permanent traffic recorder station to the Mount Sunapee Ski Resort was located on NH103 in Newbury (east of Andrews Brook). This station was not so permanent in that the NHDOT discontinued its use in the spring of 2002. Nevertheless, from several years of historical data it is evident that traffic demand has been steadily increasing over the last decade (annual growth rate = 2.2%), and that the winter month travel is comparable to summer month travel due to the count station's proximity to the ski area.

The daily variations graph confirms that peak travel demand occurs on weekends. The hourly data suggests that on peak weekends, there are two separate and distinct peak hour periods. The morning peak hour period typically occurred from 8:00 to 9:00 AM and strongly reflects the ARRIVAL period for skiers. The afternoon peak hour period occurred from 4:00 to 5:00 PM and corresponds to the peak DEPARTURE period for the ski area. It is important to note that the hourly traffic demand falls off considerably before and after these periods. This means that periods with traffic congestion are of relatively short duration.



VERMONT
MAINE
MASSACHUSETTS
White Mountain
Forest
GRAFTON
CARROLL
BELKNAP
STRAFFORD
MERRIMACK
SULLIVAN
CHESHIRE
HILLSBOROUGH
ROCKINGHAM
Guildhall
Lancaster
Berlin
Gorham
Littleton
Bethlehem
Woodsville
Lisbon
Haverhill
Piermont
Orford
Lyme
Hanover
Lebanon
Enfield
Canaan
Plymouth
Ashland
Laconia
Meredith
Wolfeboro
Ossipee
Conway
North Conway
Jackson
Tamworth
Claremont
Newport
Grantham
Woodstock
Brattleboro
Keene
Walpole
Jaffrey
Fitzwilliam
Rindge
Concord
Henniker
Manchester
Bedford
Nashua
Milford
Derry
Salem
Lawrence
Rochester
Dover
Portsmouth
Exeter
Hampton
Kittery
Atlantic
1
2
3
4
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1. I-93 Lincoln (North of Exit 33)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	7643	8991	9833
Peak Month	13888	12817	13701
Winter Month	7606	8112	8926

2. I-89 NH - VT State Line

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	39959	34883	32337
Peak Month	44549	39894	36873
Winter Month	36412	30972	27920

3. NH 10 Newport (1 Mi. S. of Croydon T/L)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	4122	3303	2698
Peak Month	4488	3861	3068
Winter Month	3776	2711	2320

4. NH 10 Swanzey (S. of Base Hill Road)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	11592	11009	8688
Peak Month	12425	12160	9647
Winter Month	10512	9464	7214

5. US 4 & NH 11 Andover (West of Junction)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	5423	5734	4688
Peak Month	6121	6346	6177
Winter Month	4831	5439	4179

6. I-89 Sutton - Warner Town Line

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	7643	8991	9833
Peak Month	13888	12817	13701
Winter Month	7606	8112	8926

7. US 3 Nashua (Exit 5 -6 FEETurnpike)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	7643	8991	9833
Peak Month	13888	12817	13701
Winter Month	7606	8112	8926

8. US 202 Antrim (South of Rest Area)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	5285	4660	3870
Peak Month	5851	5323	4656
Winter Month	4760	3828	2960

9. I-93 Hooksett (Toll Booth - Exit 11)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	67927	62273	63593
Peak Month	79705	78073	79668
Winter Month	63006	54593	55391

10. US 4 Chichester (East of Chichester Road)

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	18224	16929	14814
Peak Month	21094	21324	18945
Winter Month	16185	13607	11298

11. NH 103 (East of Andrews Brook Bridge)*

	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	4357	5187	4787
Peak Month	5328	6971	6377
Winter Month	4338	5514	6081

12. I-93 Windham (Derry Town Line)

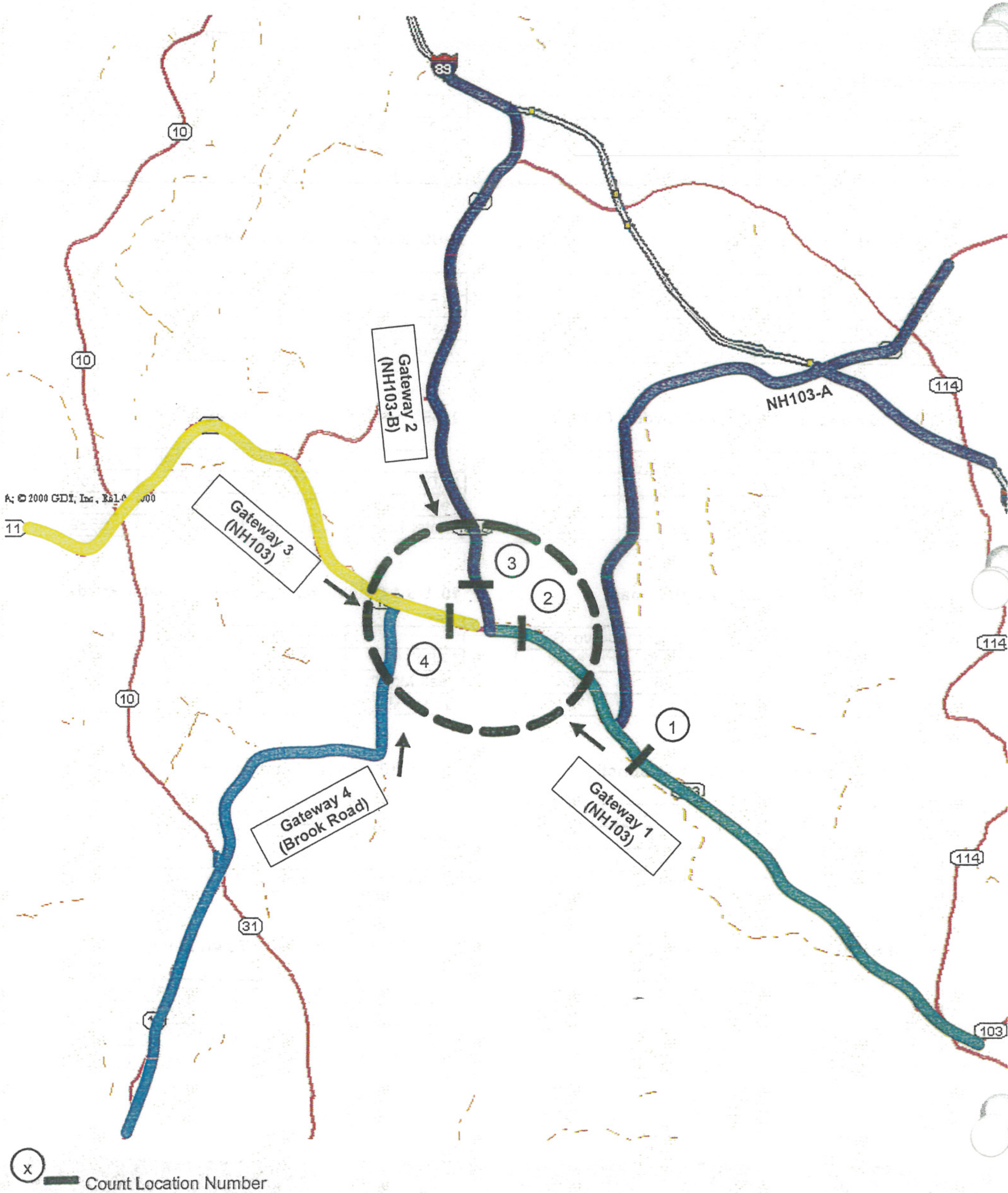
	Avg. W'day	Avg. Sat.	Avg. Sun.
AADT	67927	62273	63593
Peak Month	79705	78073	79668
Winter Month	63006	54593	55391

AADT - Annual Average Daily Traffic Volume
Peak Month = July or August
Winter Month = January or February
* 2001 Data (latest available)

Figure 2

Statewide Access Routes - 2003 Traffic Volumes

Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

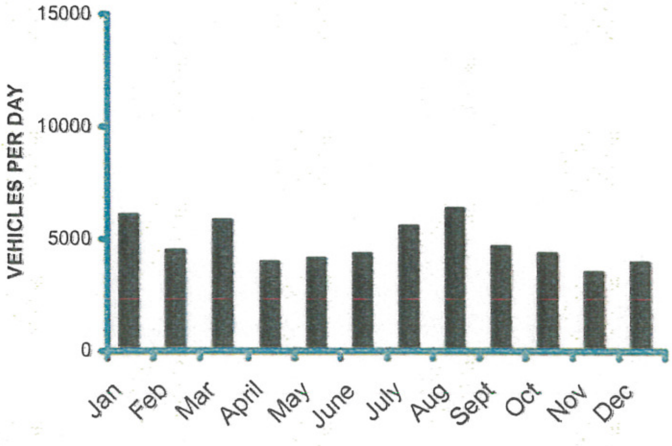


89
10
10
10
10
11
31
114
114
114
103
NH103-A
Gateway 2 (NH103-B)
Gateway 3 (NH103)
Gateway 4 (Brook Road)
Gateway 1 (NH103)
1
2
3
4
x
Count Location Number

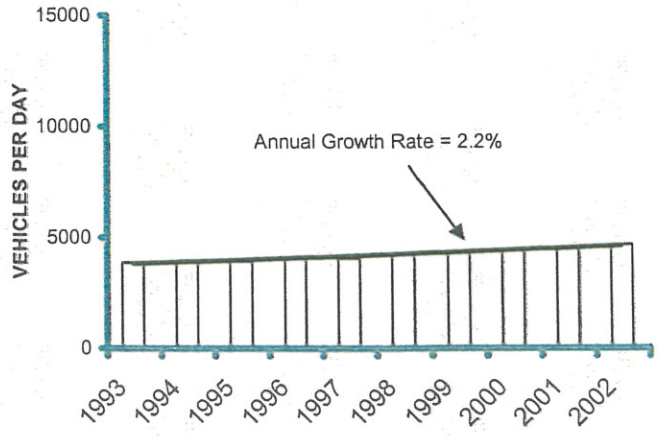
LOCATION 1: NH ROUTE 103 (East of Andrews Brook Bridge)

(NHDOT Permanent Recorder Location - 02321001)

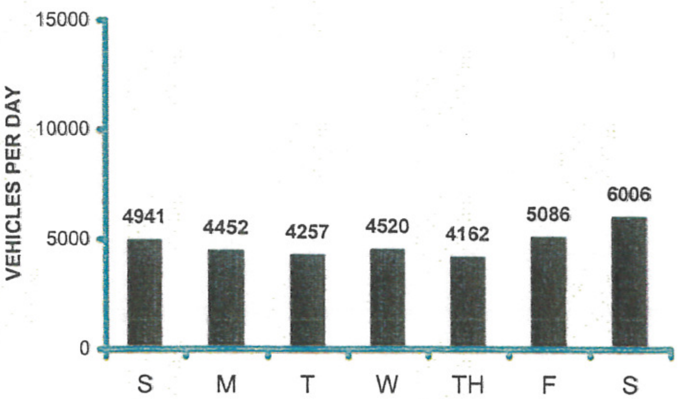
MONTHLY TRAFFIC VARIATIONS (2001)



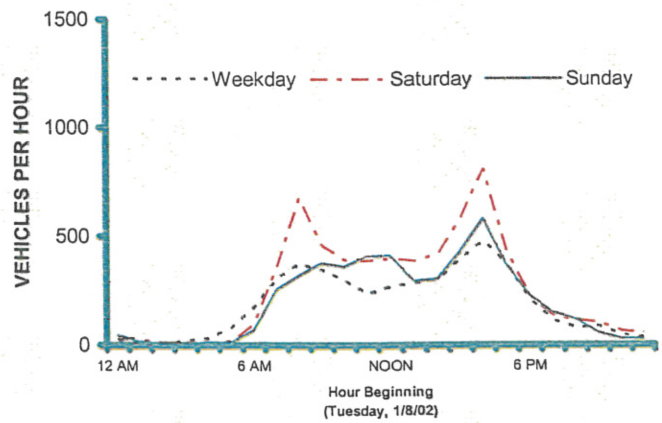
YEARLY TRAFFIC VARIATIONS



AVERAGE DAILY TRAFFIC VARIATIONS (January, 2002)

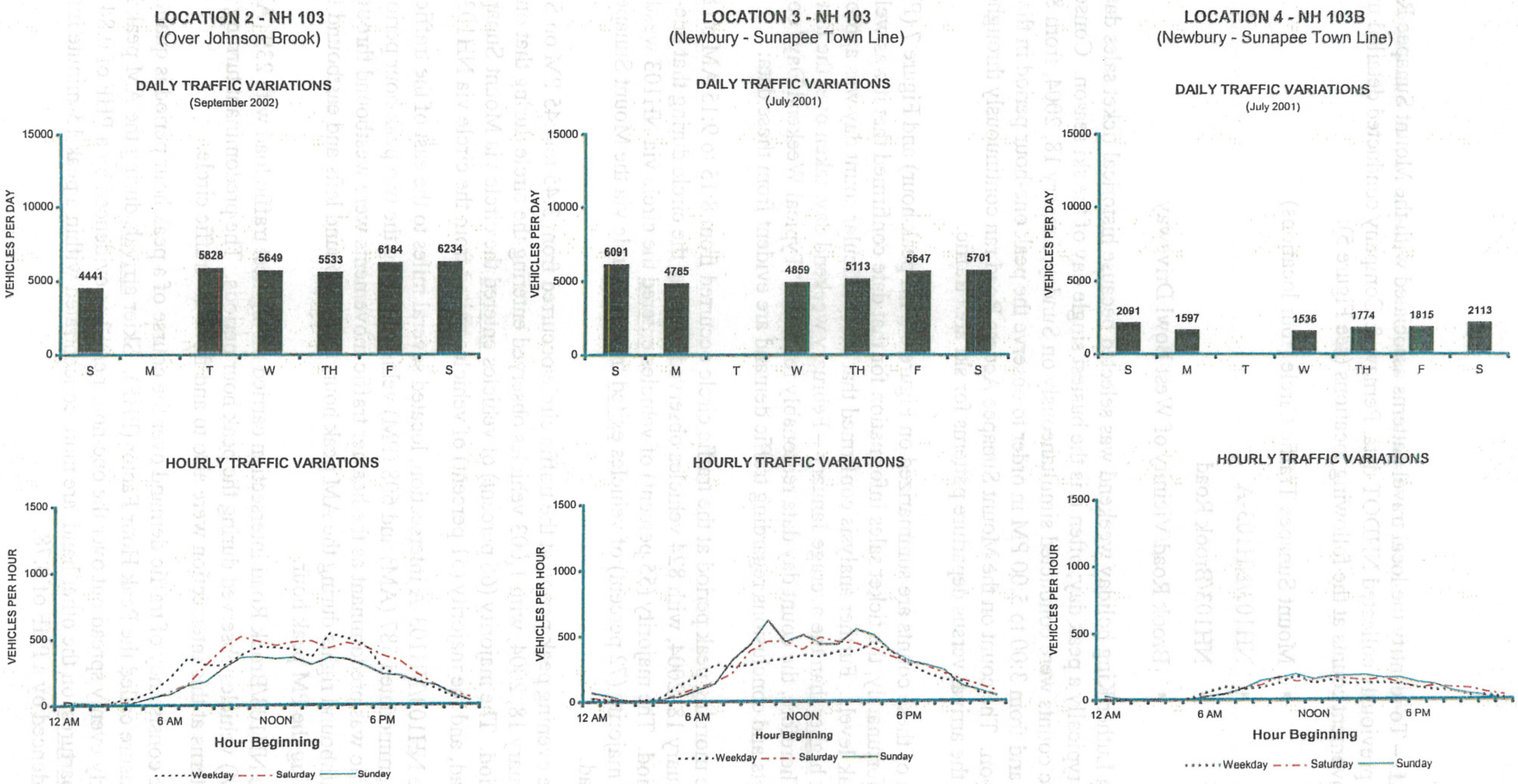


HOURLY TRAFFIC VARIATIONS



1) NHDOT Permanent Recorder Station 02321001 was discontinued in Spring of 2002

The graphs on Figure 4 depict the results from the latest NHDOT traffic recorder counts on the three major legs of the traffic circle. These data are several years old and reflect summer (July and September) traffic demand. Nevertheless, this data illustrates that the peak hour volumes on the two NH103 stations ranged from 500 to 600 vehicles per hour (vph), and the NH103-B station exhibits the lowest volumes, which are on the order of 200 vph.



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* Data not available

Figure 4

Short-Term Recorder Stations - Temporal Variations

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

C. LOCAL – To identify the local travel patterns associated with the Mount Sunapee Resort, and update the previously collected NHDOT data, Pernaw & Company conducted detailed intersection turning movement counts at the following locations (see Figure 5):

- Mount Sunapee Traffic Circle (four locations)
- NH103/NH103-A
- NH103/Brook Road
- Brook Road/Vicinity of West Bowl Driveway

The Martin Luther King holiday weekend was selected because historical ticket sales data confirms that this is typically a peak day; often it is the busiest single day of the ski season. Consequently, these traffic counts were conducted simultaneously on Sunday, January 18, 2004, from 8:00 to 11:00 AM and from 3:00 to 5:00 PM in order to observe the peak one-hour period in the morning and afternoon. The count on the Mount Sunapee Access Road ran continuously throughout the day to tabulate the arrival versus departure patterns for ski area traffic.

The results of these counts are summarized on Figure 6 (AM peak hour) and Figure 7 (PM peak hour). Unfortunately, the ticket sales information for that date confirmed that it was well below historic peak levels. Further analysis confirmed that that particular count day was approximately ten percent higher than the average January – February weekend day, taken over the last four ski seasons. Therefore, the count day data reasonably reflects a "Typical Weekend Day" condition. Several facts and conclusions regarding traffic demand are evident from these data:

- The morning peak period at the traffic circle occurred from 8:15 to 9:15 AM on Sunday, January 18, 2004, with 824 vehicles observed entering the circle during that one-hour period. The majority (55 percent) of vehicles entered the circle via NH103 westbound, and the majority (72 percent) of vehicles exited from the circle via the Mount Sunapee Access Road.
- The evening peak period at the traffic circle occurred from 3:45 to 4:45 PM on Sunday, January 18, 2004, with 1,003 vehicles observed entering the circle during that one-hour period. The majority (66 percent) of vehicles entered the circle via Mount Sunapee Access Road, and the majority (51 percent) of vehicles exited from the circle via NH103 eastbound.
- The NH103/NH103-A intersection, located several miles to the east of the traffic circle, accommodated 587 (AM) and 608 (PM) vehicles during the two peak hour periods. Skier traffic was predominant as the heavier traffic movements were westbound through and southbound rights during the AM peak hour, and eastbound lefts and eastbound throughs during the PM peak hour.
- The NH103/Brook Road intersection carried the lightest traffic load with 239 (AM) and 376 (PM) vehicles observed during the peak hour periods. The predominant turning movement patterns at this intersection were also to and from the traffic circle.
- The consistency of traffic demand over the course of a peak hour period is quantified by a measure called the Peak Hour Factor (PHF). Skier arrivals during the AM peak hour were fairly evenly spread out over the one-hour period as evidenced by a PHF of 0.84. Skier departures, on the other hand, are more concentrated within a peak 15-minute interval as evidenced by a PHF of 0.78.

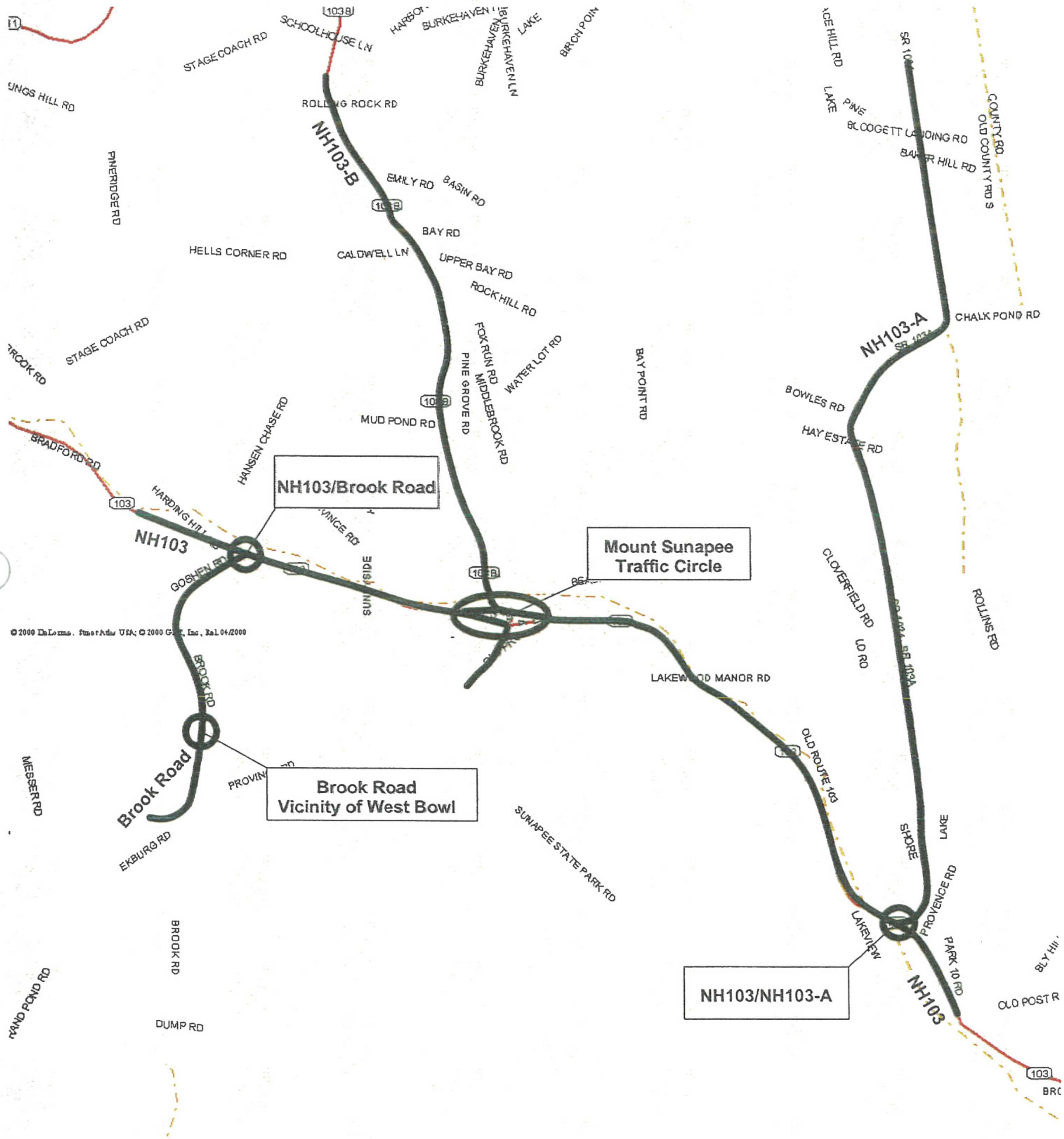

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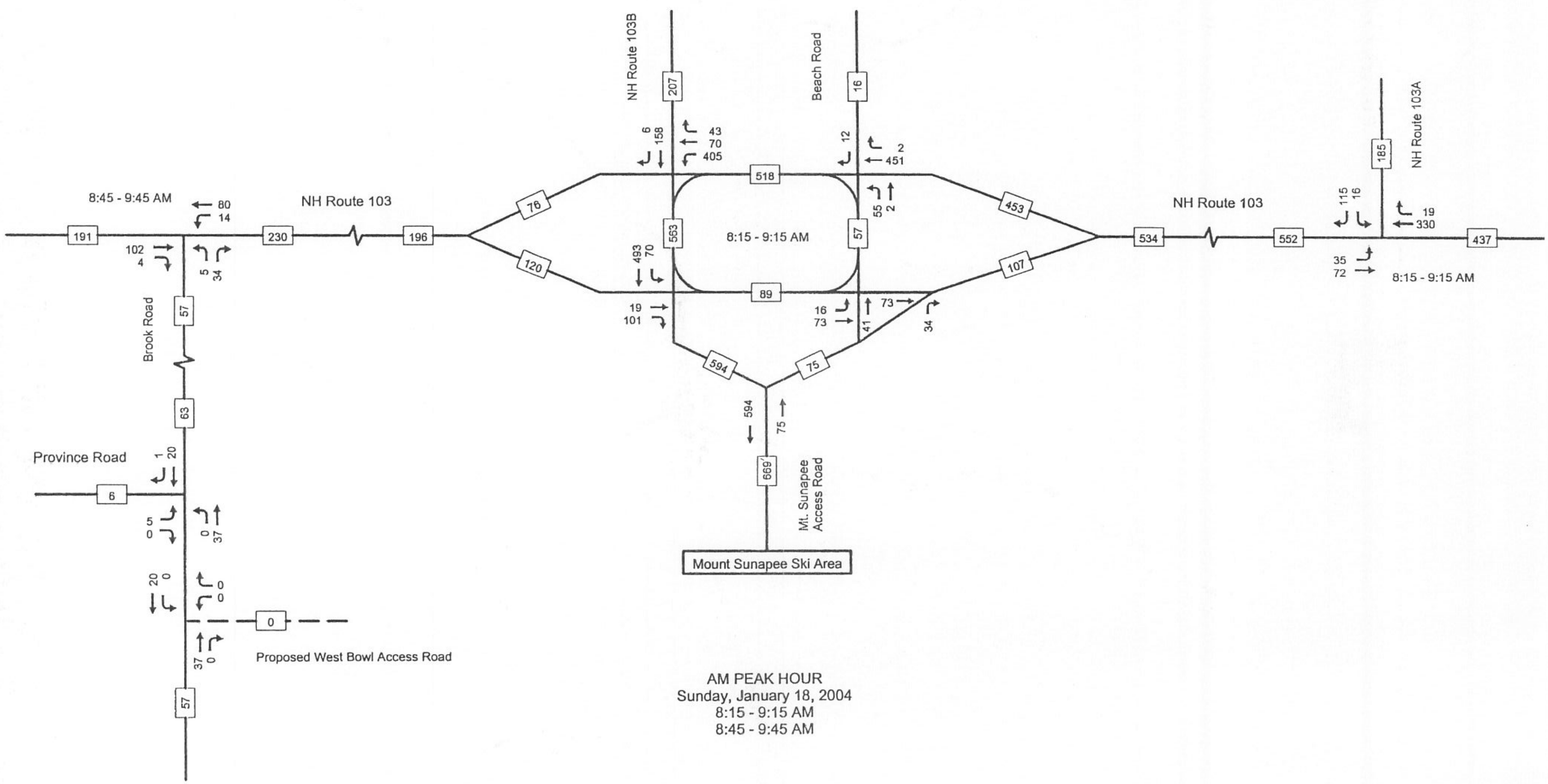
Figure 5

Local Access Routes (with Intersection Turning Movement Count Locations)

Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

Pernaw & Company



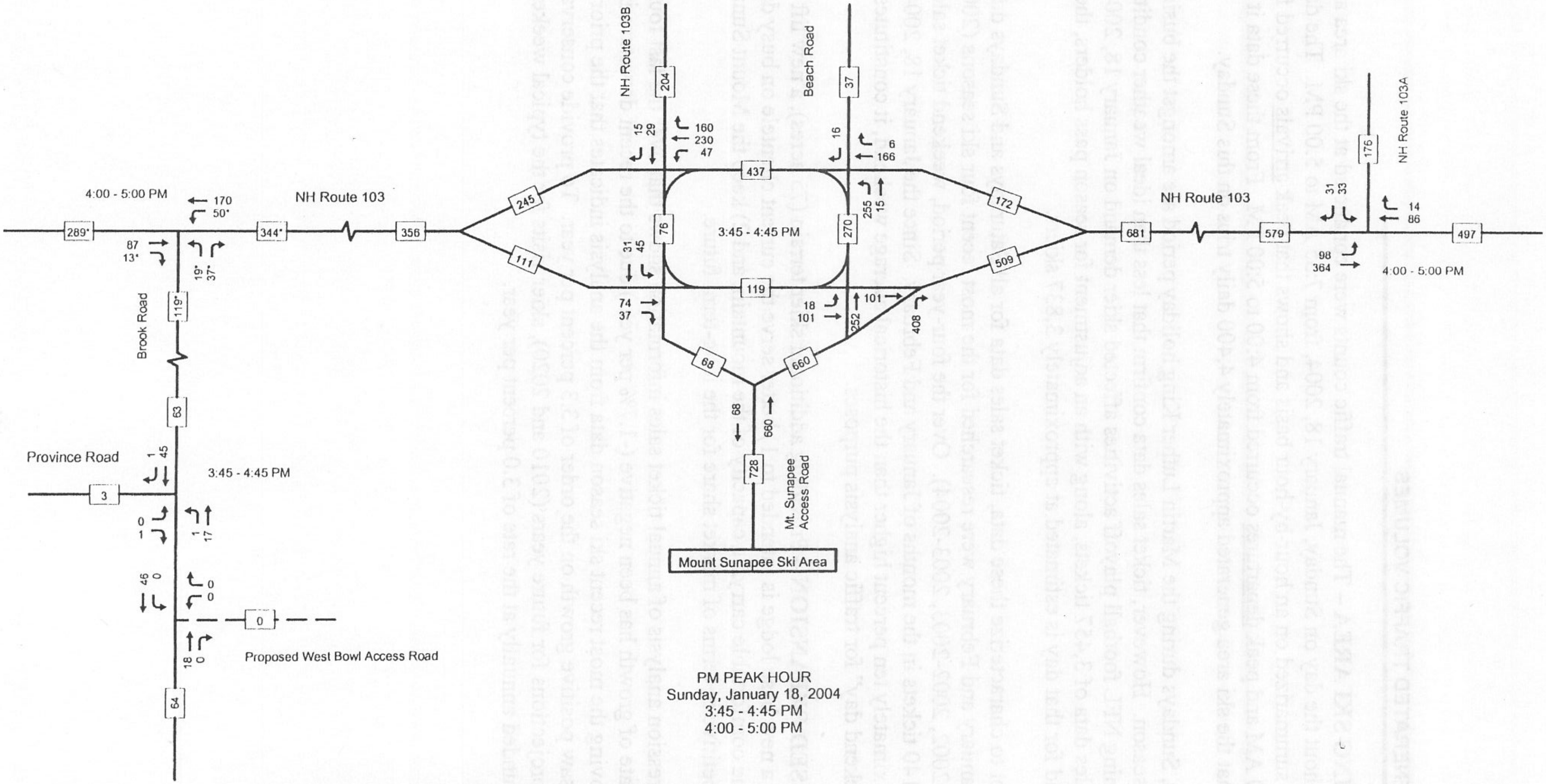
AM PEAK HOUR
Sunday, January 18, 2004
8:15 - 9:15 AM
8:45 - 9:45 AM

78601

Figure 6

2004 Existing Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed S... Expansion, Newbury, New Hampshire



* Atypical volumes due to special event (political campaign) at nearby establishment

78601

Figure 7

2004 Existing Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

A. EXISTING SKI AREA – The manual traffic counts were conducted at the ski area access road throughout the day on Sunday, January 18, 2004, from 7:35 AM to 5:00 PM. The data in Table 1 are summarized on an hour-by-hour basis and shows that peak arrivals occurred from 8:00 to 9:00 AM and peak departures occurred from 4:00 to 5:00 PM. From these data it is estimated that the ski area generated approximately 4,400 daily trips on this Sunday.

Historically, Sundays during the Martin Luther King holiday period are amongst the busiest ski days of the season. However, ticket sales data confirm that less than ideal weather conditions and the evening NFL football playoff activities affected skier demand on January 18, 2004. Based on sales data of 3,457 tickets, along with an adjustment for season pass holders, the total skier demand for that day is estimated at approximately 3,837 skiers.

In an attempt to characterize these data, ticket sales data for all Saturdays and Sundays during the months of January and February were researched for the most recent four ski seasons (2000-2001, 2001-2002, 2002-2003, 2003-2004). Over the four-year period, weekend ticket sales averaged 3,140 tickets in the months of January and February. Since the January 18, 2004, count day is approximately ten percent higher than the historical average weekend, it constitutes a "typical weekend day" for traffic analysis purposes.

B. PROPOSED EXPANSION – Providing additional skier terrain (75 acres), a new lift facility, and a new base lodge is intended to 1) better serve the current clientele on busy days by increasing the comfortable carrying capacity of the mountain, and 2) keep the Mount Sunapee Resort competitive in terms of market share for the long-term future.

A linear regression analysis of annual ticket sales information shows that over the last four year period, the rate of growth has been negative (-1.7% per year) due to the recent downturn in 2003-2004. Removing the most recent ski season data from the analysis indicates that the prior three year period saw positive growth on the order of 3.3 percent per year. To provide conservatively high traffic projections for future years (2010 and 2020), skier visits for the typical weekend case were compounded annually at the rate of 3.0 percent per year.

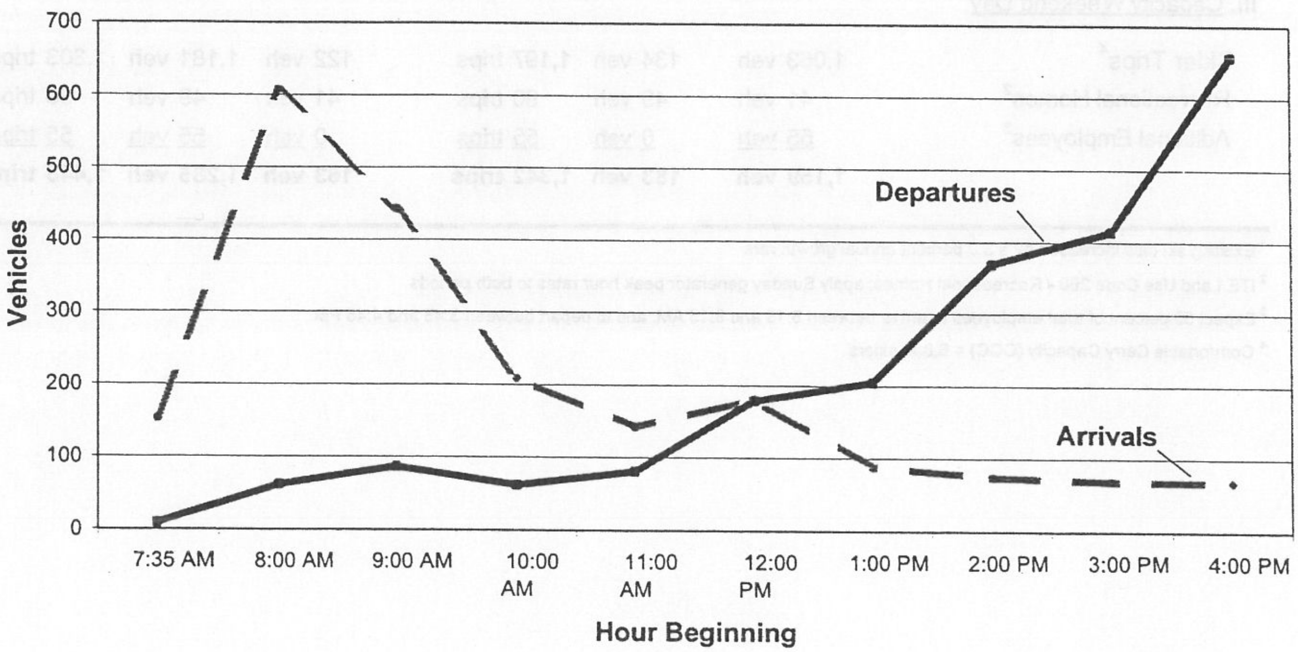
Table 1

Mount Sunapee Ski Area
Existing Site Generated Traffic Volumes

Sunday, January 18, 2004 (Martin Luther King Weekend)

	In		Out		Total	
7:35 - 8:00 AM*	218 veh	(10%)	14 veh	(1%)	232 trips	(5%)
8:00 - 9:00 AM	**607 veh**	**(29%)**	**62 veh**	**(3%)**	**669 trips**	**(16%)**
9:00 - 10:00 AM	443 veh	(21%)	87 veh	(4%)	530 trips	(13%)
10:00 - 11:00 AM	209 veh	(10%)	62 veh	(3%)	271 trips	(6%)
11:00 AM - 12:00 PM	142 veh	(7%)	81 veh	(4%)	223 trips	(5%)
12:00 - 1:00 PM	181 veh	(9%)	179 veh	(8%)	360 trips	(9%)
1:00 - 2:00 PM	88 veh	(4%)	205 veh	(10%)	293 trips	(7%)
2:00 - 3:00 PM	75 veh	(4%)	369 veh	(17%)	444 trips	(11%)
3:00 - 4:00 PM	69 veh	(3%)	414 veh	(19%)	483 trips	(11%)
4:00 - 5:00 PM	**68 veh**	**(3%)**	**657 veh**	**(31%)**	**725 trips**	**(17%)**
Sunday Total	2100 veh	(100%)	2130 veh	(100%)	4230 trips	(100%)

* Not a full hour



In addition to skiers, the West Bowl Expansion project will also generate traffic from the recreational homes (up to 250 condominium units), and additional employees (108 persons). Table 2 and Table 3 summarize the results of the trip generation analysis for the entire Mount Sunapee Resort.

Table 2 **Trip Generation Derivation**

	AM Peak Hour			PM Peak Hour		
	In	Out	Total	In	Out	Total
I. 2010 Typical Weekend Day						
Skier Trips[1]	707 veh	89 veh	796 trips	81 veh	785 veh	866 trips
Recreational Homes[2]	41 veh	49 veh	90 trips	41 veh	49 veh	90 trips
Aditional Employees[3]	55 veh	0 veh	55 trips	0 veh	55 veh	55 trips
	803 veh	**138 veh**	**941 trips**	**122 veh**	**889 veh**	**1,011 trips**
II. 2020 Typical Weekend Day						
Skier Trips[1]	956 veh	121 veh	1,077 trips	109 veh	1,063 veh	1,172 trips
Recreational Homes[2]	41 veh	49 veh	90 trips	41 veh	49 veh	90 trips
Aditional Employees[3]	55 veh	0 veh	55 trips	0 veh	55 veh	55 trips
	1,052 veh	**170 veh**	**1,222 trips**	**150 veh**	**1,167 veh**	**1,317 trips**
III. Capacity Weekend Day						
Skier Trips[4]	1,063 veh	134 veh	1,197 trips	122 veh	1,181 veh	1,303 trips
Recreational Homes[2]	41 veh	49 veh	90 trips	41 veh	49 veh	90 trips
Aditional Employees[3]	55 veh	0 veh	55 trips	0 veh	55 veh	55 trips
	1,159 veh	**183 veh**	**1,342 trips**	**163 veh**	**1,285 veh**	**1,448 trips**

[1] Existing ski trips increased by a 3.0 percent annual growth rate

[2] ITE Land Use Code 260 - Recreational Homes; apply Sunday generator peak hour rates to both periods

[3] Expect 50 percent of total employees to arrive between 8:15 and 9:15 AM, and to depart between 3:45 and 4:45 PM

[4] Comfortable Carry Capacity (CCC) = 6,850 skiers

C. TRIP DISTRIBUTION – Identifying the various travel routes that are used by skiers is an important consideration in preparing the future traffic projections for the West Bowl Expansion project. The annual "Guest Research Summary" reports prepared for the resort have consistently shown that approximately 65 percent of the visitors have trip origins from the following counties in southeast New Hampshire and eastern Massachusetts: Merrimack, Rockingham, Hillsborough, Essex, Middlesex, Suffolk, Norfolk, and Plymouth counties. The following travel patterns were derived from intersection turning movement count data and corroborate the finding from guest research information.

Gateway	Percentage
1. NH103 (east)	46%
2. NH103-A (north)	16%
3. NH103-B (north)	21%
4. NH103 (west)	12%
5. Brook Road (south)	5%
Total	100%

The distribution of vehicle trips associated with the future additional employees and the recreational homes are expected to be similar. It should be noted that the small percentage that utilizes Brook Road for access will likely utilize the West Bowl parking lot rather then continue up to NH103 and the traffic circle. Similarly, those traveling to/from points west on NH103 will likely use both points of access to the mountain. Such trip diversions to the new facility will translate into trip reductions on NH103 and the traffic circle, whereas the additional skiers, employees, and residents translate into traffic increases. The net changes to peak period traffic flows are presented in a later section.

C. TRIP DISTRIBUTION – Identifying the various travel routes that are used by skiers is an important consideration in preparing the future traffic projections for the West Bowl Expansion project. The annual "Guest Research Summary" reports prepared for the resort have consistently shown that approximately 65 percent of the visitors have trip origins from the following counties in southeast New Hampshire and eastern Massachusetts: Merrimack, Rockingham, Hillsborough, Essex, Middlesex, Suffolk, Norfolk, and Plymouth counties. The following travel patterns were derived from intersection turning movement count data and corroborate the finding from guest research information.

Gateway	Percentage
1. NH103 (east)	46%
2. NH103-A (north)	16%
3. NH103-B (north)	21%
4. NH103 (west)	12%
5. Brook Road (south)	5%
Total	100%

The distribution of vehicle trips associated with the future additional employees and the recreational homes are expected to be similar. It should be noted that the small percentage that utilizes Brook Road for access will likely utilize the West Bowl parking lot rather then continue up to NH103 and the traffic circle. Similarly, those traveling to/from points west on NH103 will likely use both points of access to the mountain. Such trip diversions to the new facility will translate into trip reductions on NH103 and the traffic circle, whereas the additional skiers, employees, and residents translate into traffic increases. The net changes to peak period traffic flows are presented in a later section.

D. FUTURE TRAFFIC PROJECTIONS – Since full buildout of the West Bowl expansion project may occur by 2010, this year was selected as the base year for this study. Consistent with standard practice for conducting traffic impact studies in New Hampshire, a ten-year planning horizon (2020) was selected for analysis purposes.

These projections were prepared for the "Typical Weekend Day" case and for a "Capacity Weekend Day" for both the peak arrival period (AM) and the peak departure period (PM). The following table identifies the various cases and the corresponding traffic projection figures.

	2010 Base Year		2020 Horizon Year	
	Typical Weekend	Capacity Weekend	Typical Weekend	Capacity Weekend
AM Peak Hour (Arrival Period)	Figure 8	Figure 10	Figure 12	Figure 14
PM Peak Hour (Departure Period)	Figure 9	Figure 11	Figure 13	Figure 15

These traffic projections are all inclusive in that they reflect skier vehicles, service vehicles, shuttles, employee trips, and are predicated on full occupancy of all quarter-share units. For analysis purposes, the subsequent traffic projections are based on the upper limit of 250 condominium units.

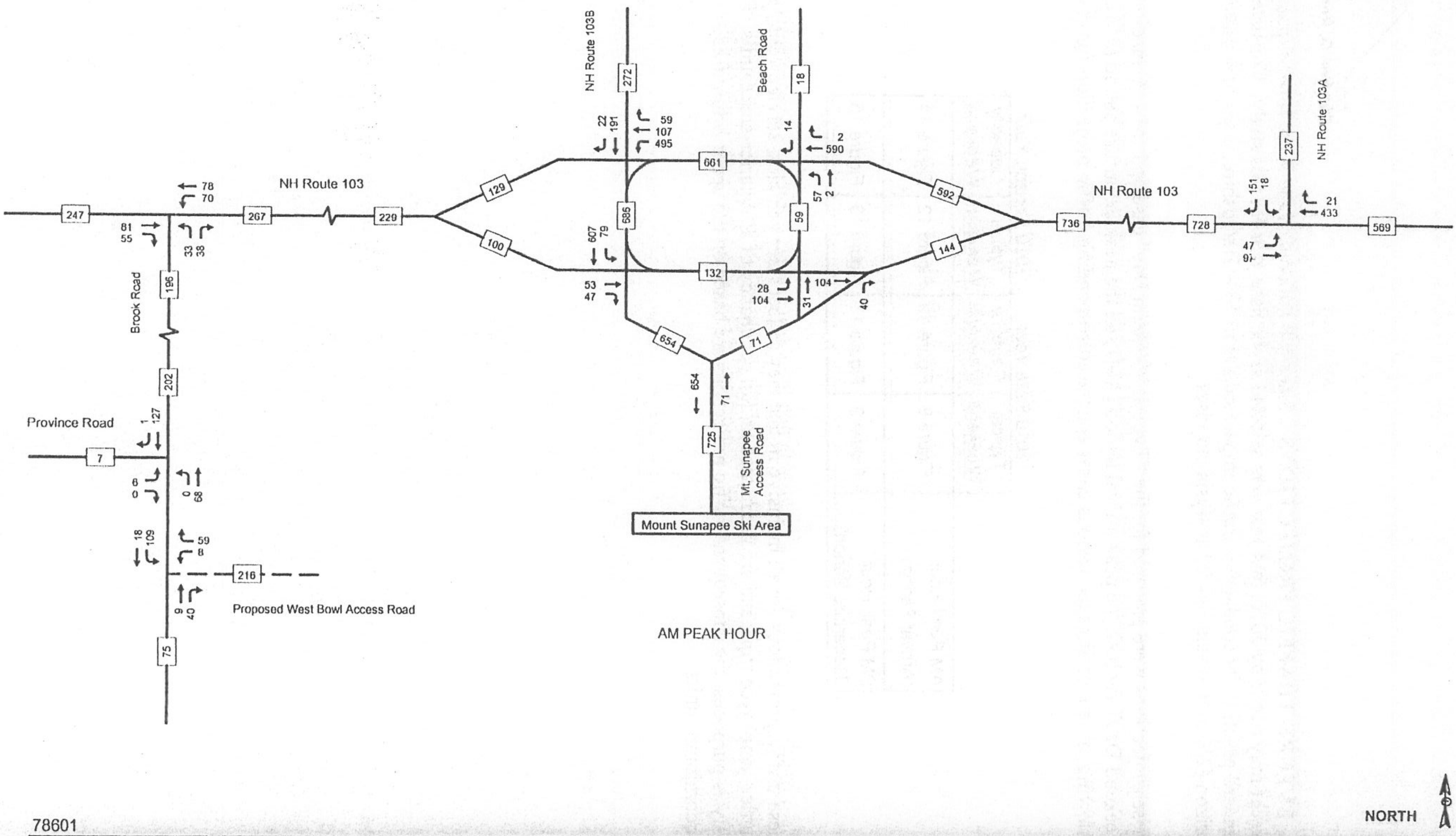


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Figure 8

2010 Typical Weekend Day Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

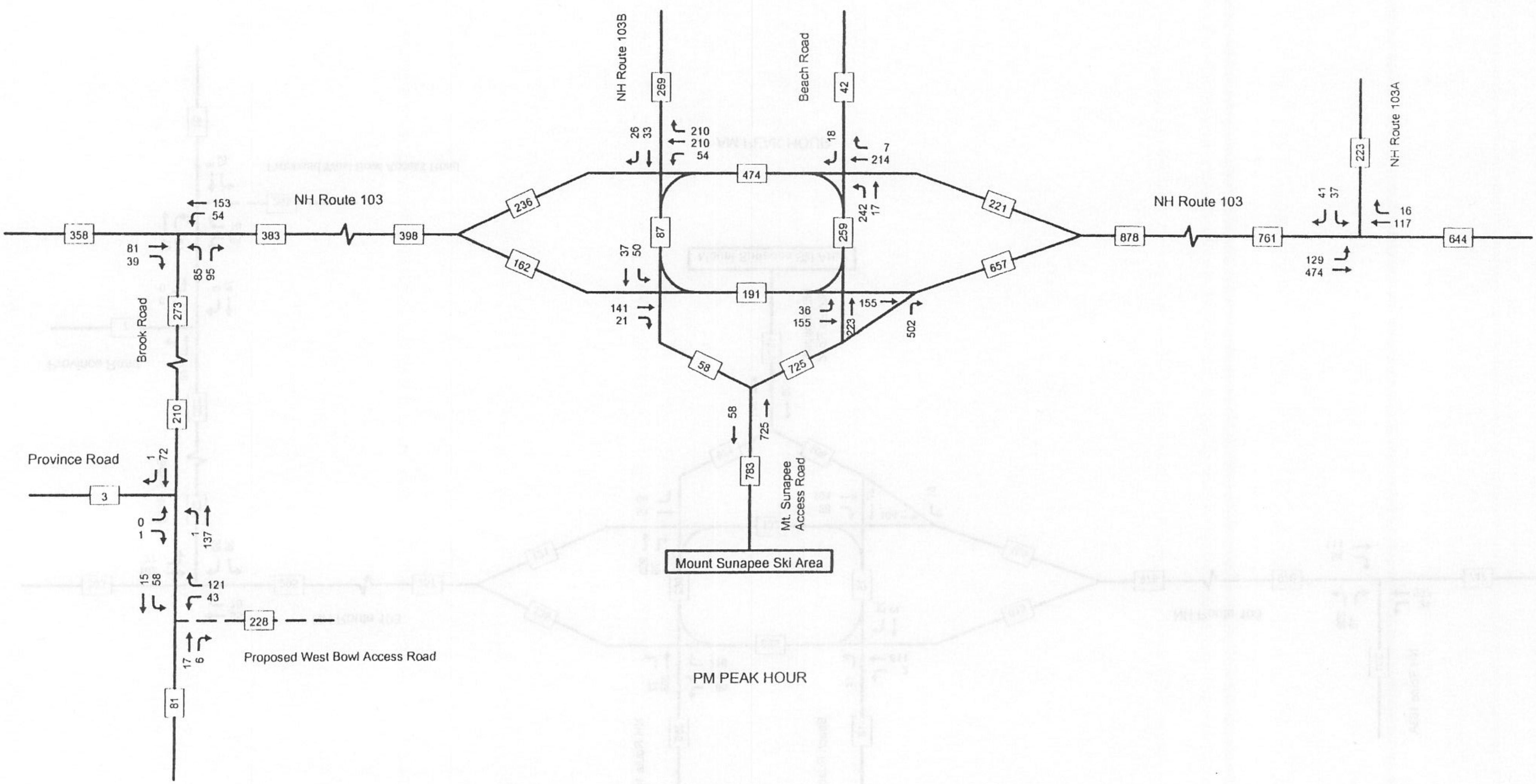

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Figure 9

2010 Typical Weekend Day Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

NORTH

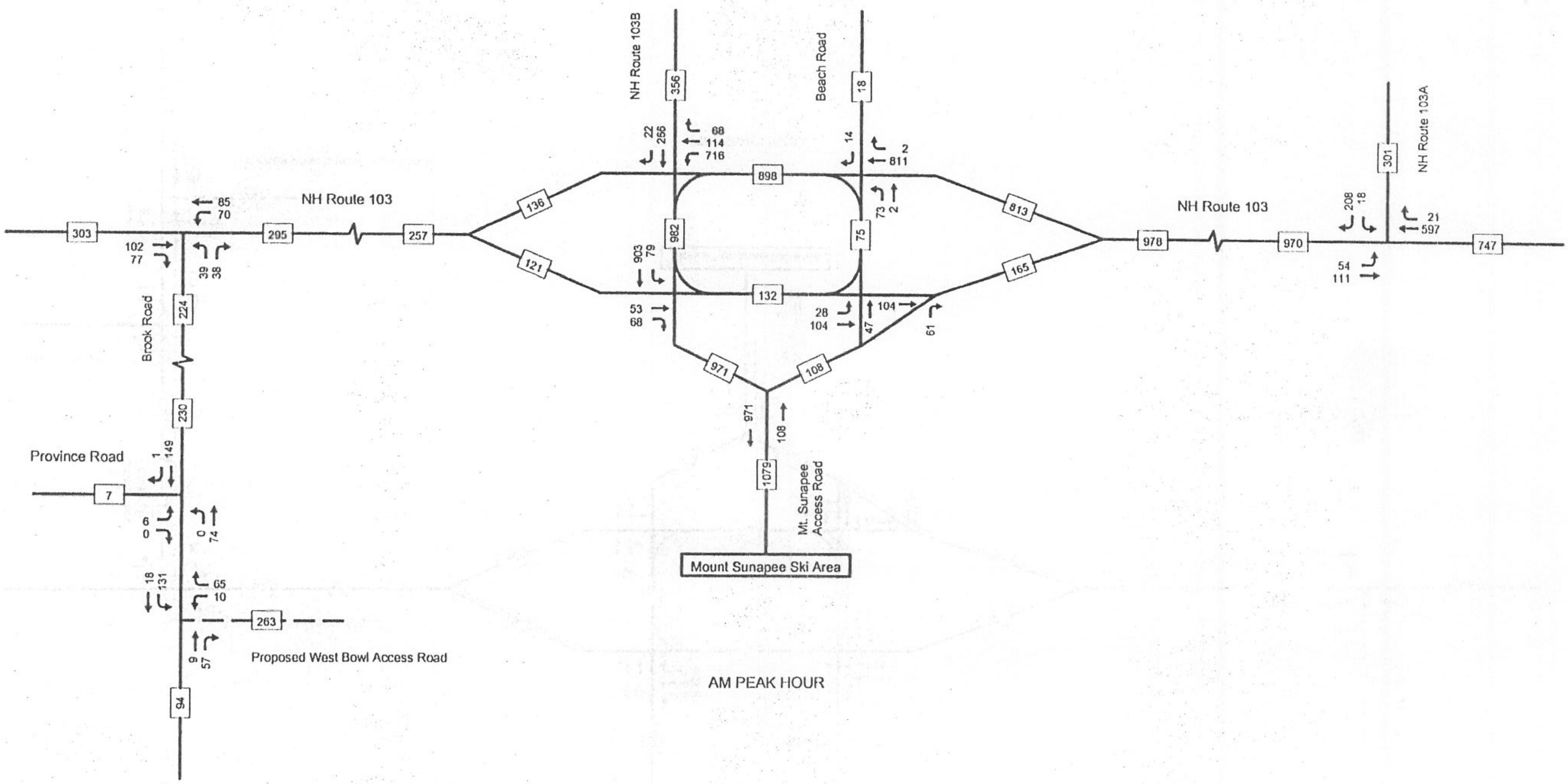

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Figure 10

2010 Capacity Day Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

Pernaw & Company

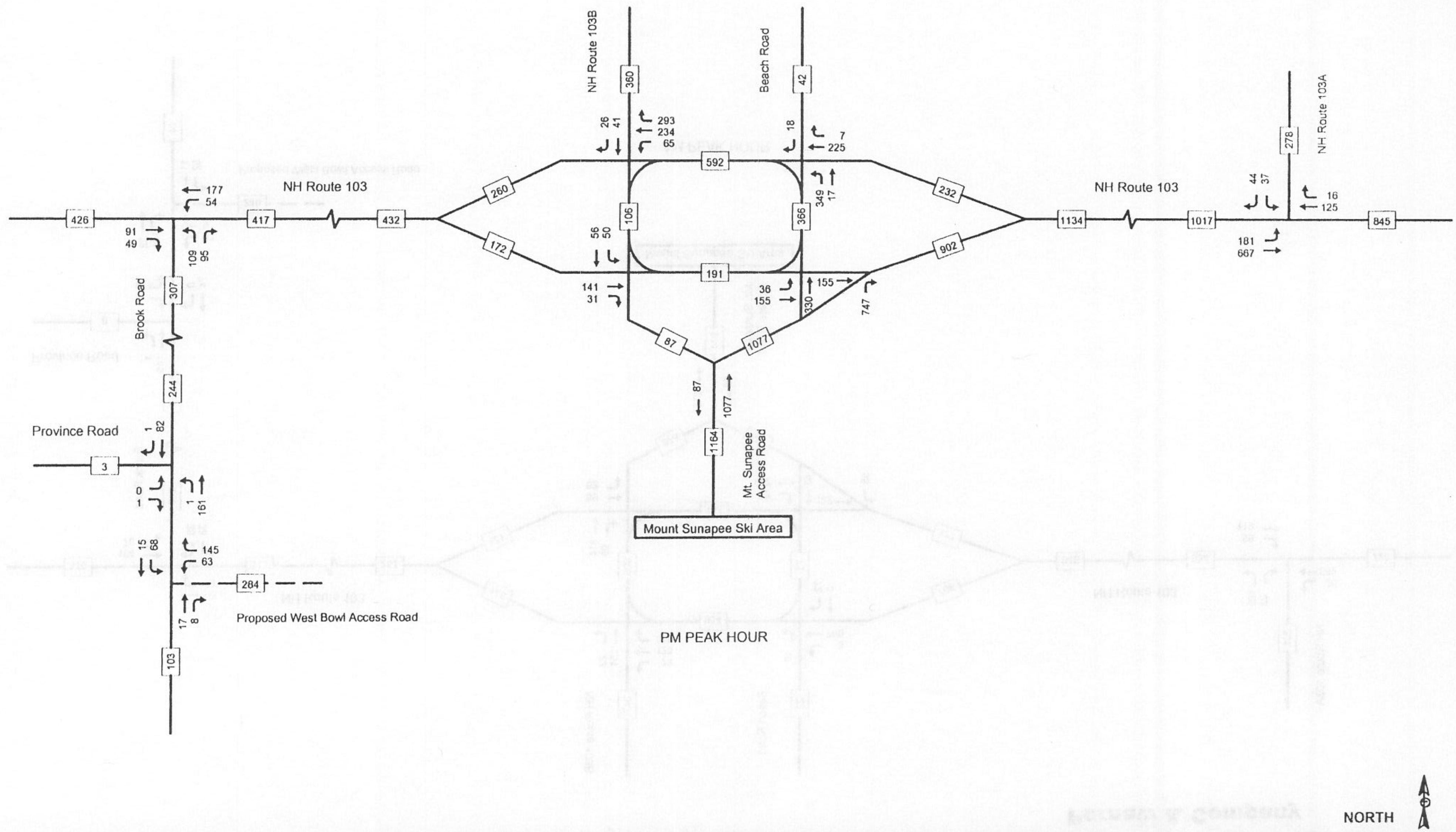

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Figure 11

2010 Capacity Day Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

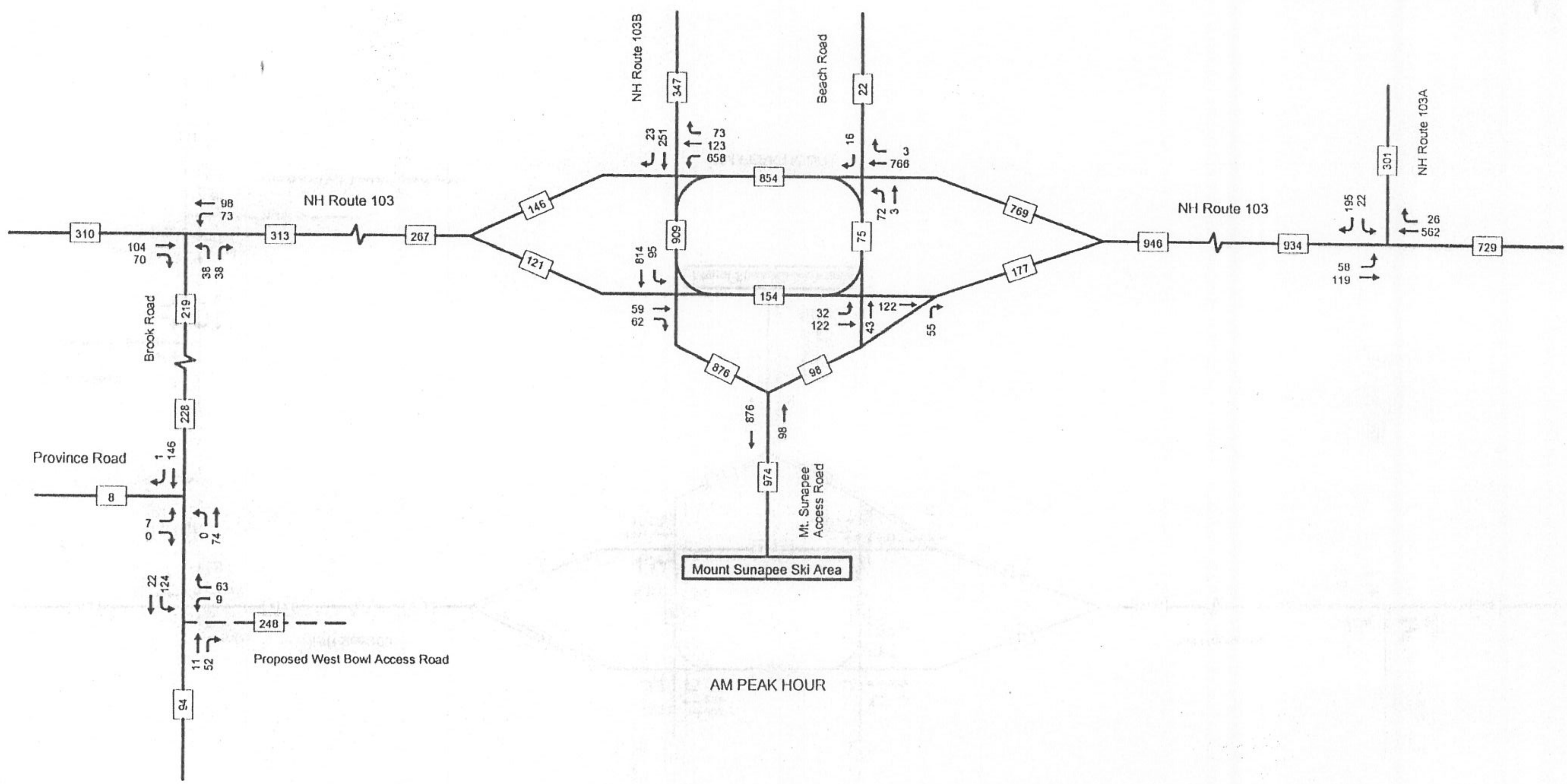

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Figure 12

2020 Typical Weekend Day Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed S[illegible]rea Expansion, Newbury, New Hampshire

Pernaw & Company

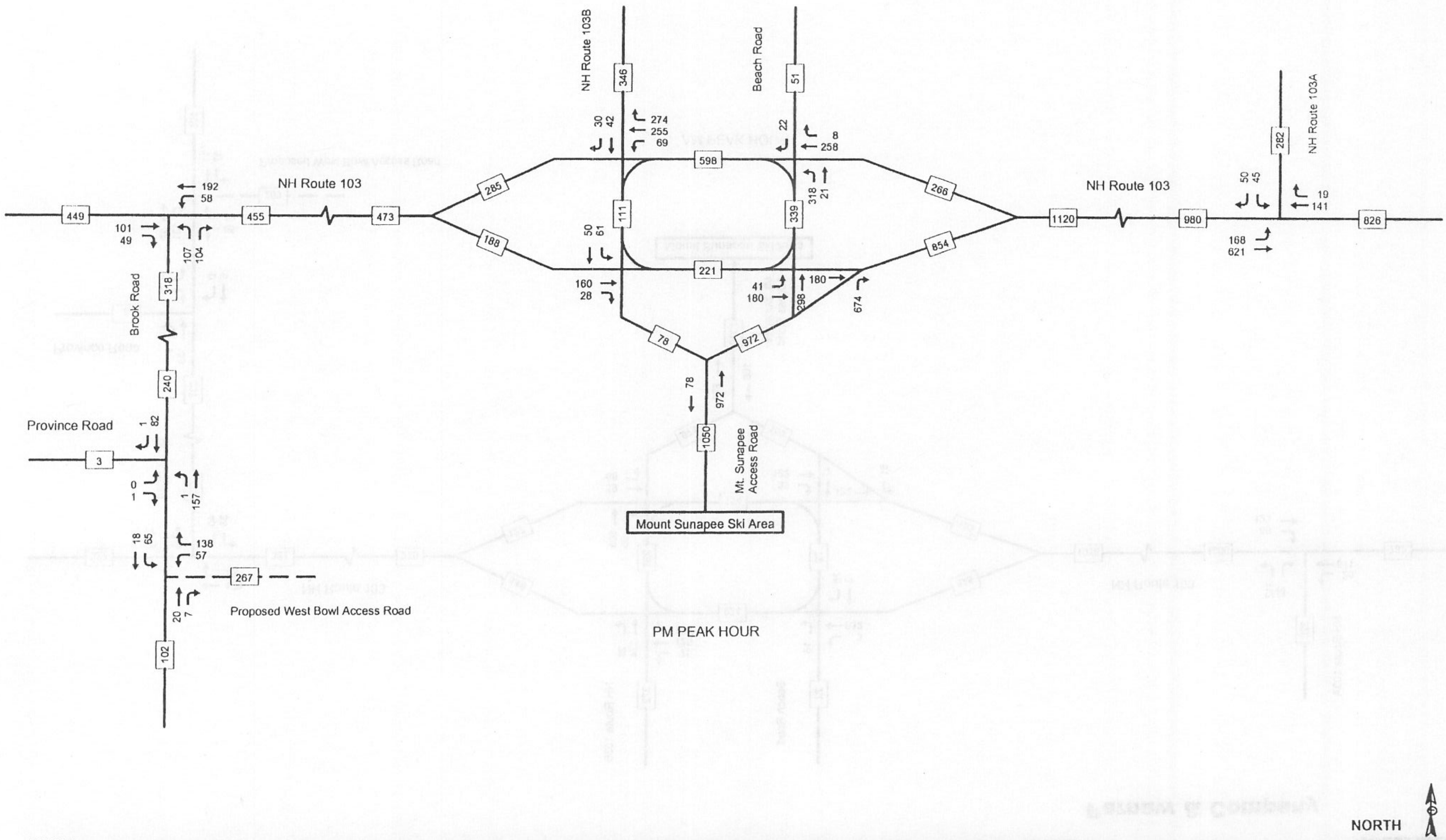

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Figure 13

2020 Typical Weekend Day Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

Pernaw & Company

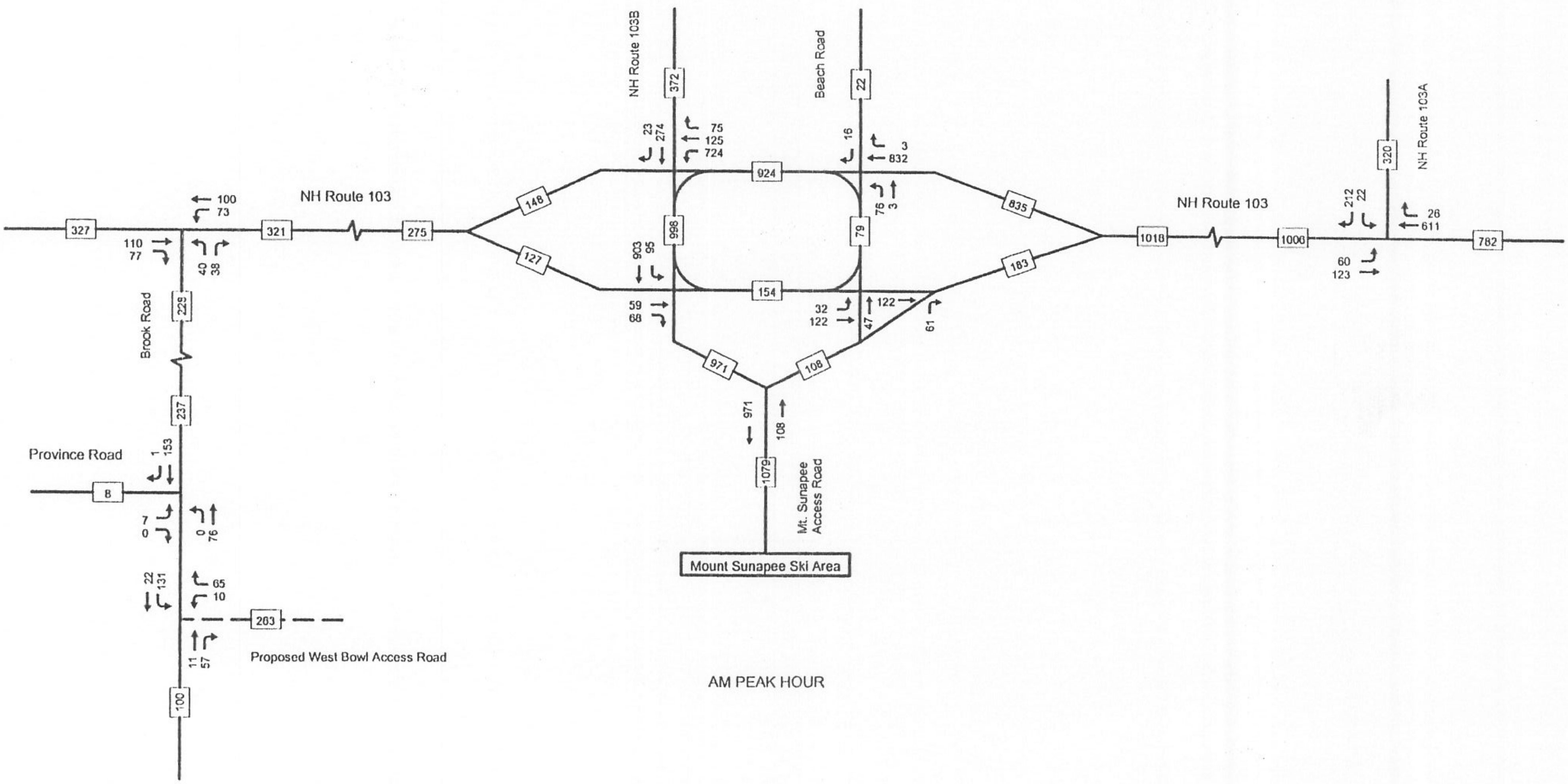

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Figure 14

2020 Capacity Day Traffic Volumes - AM Peak Hour

Traffic Impact & Site Access Study, Proposed S[...] Area Expansion, Newbury, New Hampshire

Pernaw & Company

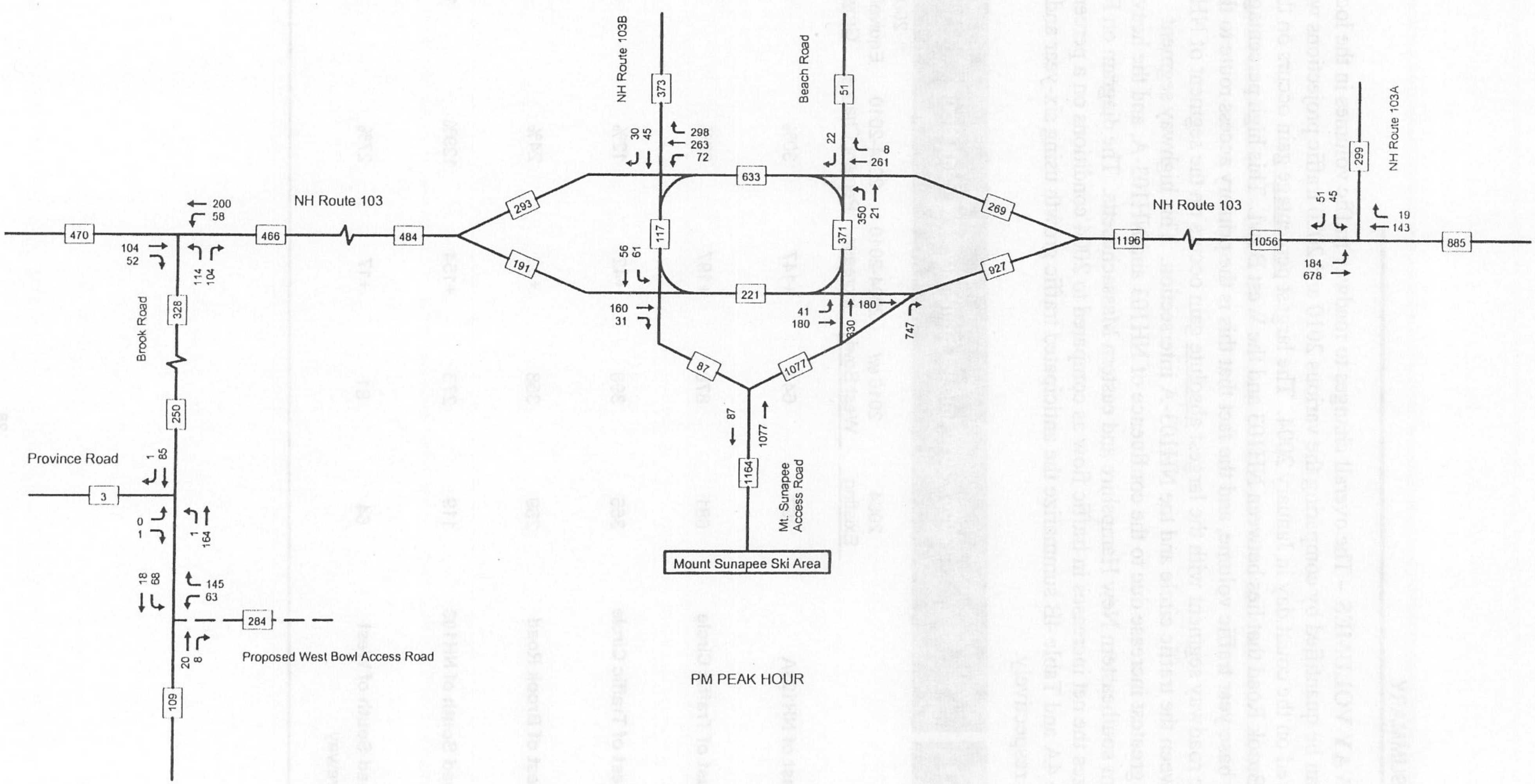

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Figure 15

2020 Capacity Day Traffic Volumes - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

V. IMPACT SUMMARY

A. ROADWAY VOLUMES – The overall changes to roadway traffic volumes in the local study area can be quantified by comparing the various 2010 and 2020 traffic projections with those observed on the count day in January 2004. The largest percentage gain occurs on the segment of Brook Road that lies between NH103 and the West Bowl. This high percentage is due to a low base year traffic volume, and the fact that this is the primary access route to the new facility. The roadway segment with the largest absolute gain occurs on the segment of NH103 that lies between the traffic circle and the NH103-A intersection. This highway segment receives the greatest increase due to the confluence of NH103 and NH103-A, and the heavy draw of skiers from southeastern New Hampshire and eastern Massachusetts. The diagram on Figure 16 summarizes the net increases in traffic flow as compared to 2004 conditions on a percentage basis. Table 4A and Table 4B summarize the anticipated traffic growth using six-year and ten-year periods respectively.

Table 4A — **2004 - 2010 Impact Summary - PM Peak Hour**

Checkpoint	2004 Existing	2010 w/ West Bowl	2004-2010 Increase	2004-2010 Percent Change	2004-2010 Equivalent Annual Growth Rate
1. NH103 East of NH103A	497	644	+147	30%	4%
2. NH103 East of Traffic Circle	681	878	+197	29%	4%
3. NH103 West of Traffic Circle	356	398	+42	12%	2%
4, NH103 West of Brook Road	289	358	+69	24%	4%
5. Brook Road South of NH103	119	273	+154	129%	15%
6. Brook Road South of West Bowl Driveway	64	81	+17	27%	4%

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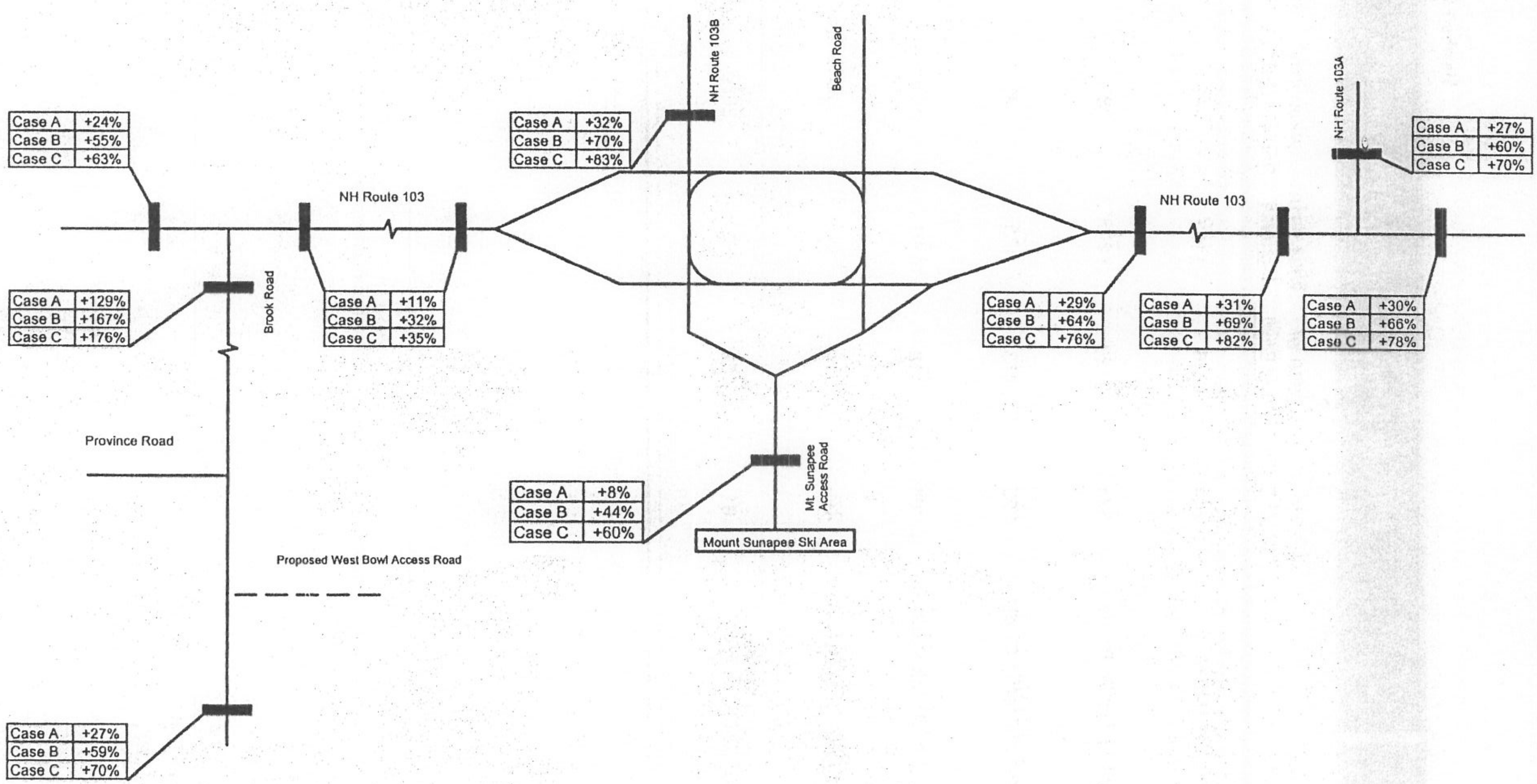
Table 4B — 2010 - 2020 Impact Summary - PM Peak Hour

Checkpoint	2010 w/ West Bowl	2020 w/ West Bowl	2004-2010 Increase	2004-2010 Percent Change	2004-2010 Equivalent Annual Growth Rate
1. NH103 East of NH103A	644	826	+182	28%	3%
2. NH103 East of Traffic Circle	878	1120	+242	28%	3%
3. NH103 West of Traffic Circle	398	473	+75	19%	2%
4, NH103 West of Brook Road	358	449	+91	25%	2%
5. Brook Road South of NH103	273	318	+45	16%	2%
6. Brook Road South of West Bowl Driveway	81	102	+21	26%	2%



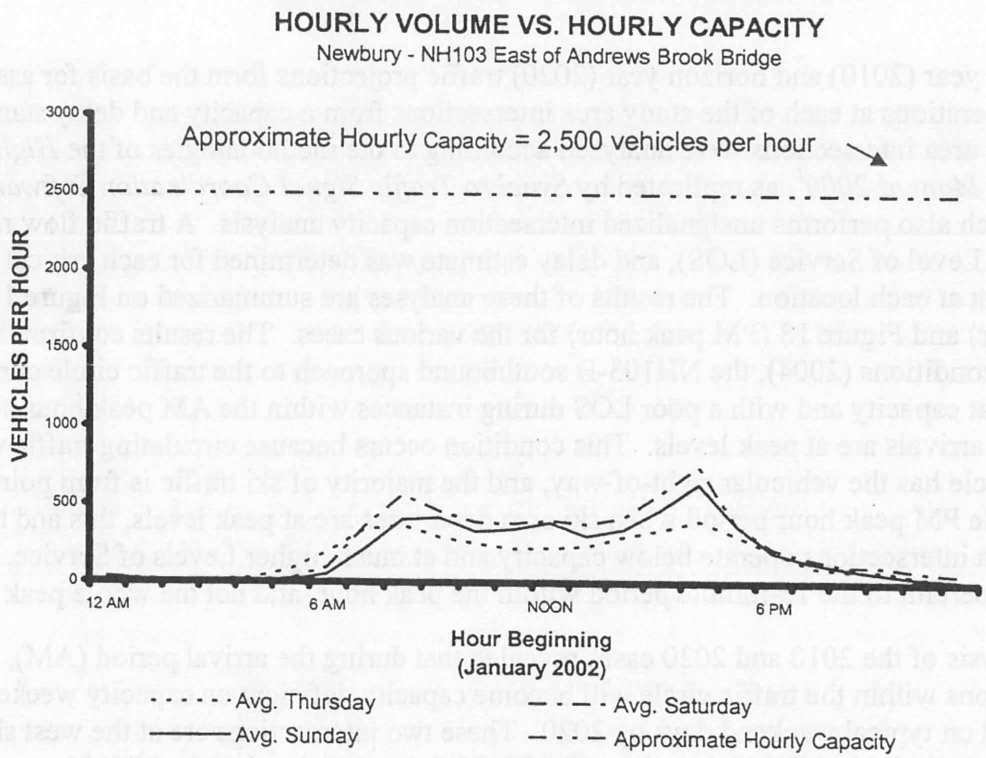
Case A - 2004 Count Day versus 2010 Typical Weekend Day
Case B - 2004 Count Day versus 2020 Typical Weekend Day
Case C - 2004 Count Day versus 2020 Capacity Weekend Day

Fig[illegible] 16 **Traffic Volume Increases (2004 vs. Future Years) - PM Peak Hour Case**

Traffic Impact & Site Access Study, Proposed Ski [illegible]ansion, Newbury, New Hampshire

B. ROADWAY CAPACITY – The term "roadway capacity" in this case refers to the maximum sustained hourly flow rate at which vehicles can reasonably be expected to traverse a uniform two-lane section under a set of roadway and traffic conditions. The capacity of a two-lane highway is 1,700 passenger cars per hour in each direction, with a maximum of 3,200 for travel in both directions. Taking into account that NH103 follows a rolling terrain (is not level) and that it accommodates a mix of passenger cars and trucks, the hourly capacity is conservatively estimated at approximately 2,500 vph (total both directions).

The future traffic projections for 2020 on Figure 15 indicate that the two-way traffic volume on NH103 is less than 1,200 vph during worst-case conditions. Accordingly, this two-lane section of NH103 exhibits ample capacity to accommodate the future traffic volumes during the ski season. There is no need to widen NH103 to a four-lane highway as a result of future growth at Mount Sunapee. The following diagram compares the hourly traffic volumes on NH103 at the permanent recorder station (east of Andrews Brook Bridge) with the approximate capacity of the highway. This graph shows that roadway capacity is not a constraint.



C. INTERSECTION CAPACITY – In addition to roadway capacity, intersections themselves have separate capacities and in some cases they can affect the flow of traffic on a particular roadway segment. Capacity and Level of Service (LOS) calculations pertaining to unsignalized intersections with STOP and YIELD sign control address the quality of service for those vehicles turning into and out of intersecting side streets. The availability of adequate gaps in the traffic stream on the major street actually controls the potential capacity for vehicle movements to and from the intersecting side streets and driveways. Levels of Service are simply letter grades (A-F) that categorize the vehicle delays associated with specific turning maneuvers. Table 5 describes the criteria used in this analysis.

Table 5	Level-of-Service Criteria for Unsignalized Intersections
Level of Service	Control Delay (seconds/vehicle)
A	≤ 10.0
B	> 10.0 and ≤ 15.0
C	> 15.0 and ≤ 25.0
D	> 25.0 and ≤ 35.0
E	> 35.0 and ≤ 50.0
F	> 50.0

Source: Transportation Research Board, Highway Capacity Manual 2000.

The base year (2010) and horizon year (2020) traffic projections form the basis for assessing traffic operations at each of the study area intersections from a capacity and delay standpoint. All study area intersections were analyzed according to the methodologies of the *Highway Capacity Manual 2000*[1], as replicated by *Synchro Traffic Signal Coordination Software (Version 6.0)*, which also performs unsignalized intersection capacity analysis. A traffic flow rate, capacity, Level of Service (LOS), and delay estimate was determined for each critical traffic movement at each location. The results of these analyses are summarized on Figure 17 (AM peak hour) and Figure 18 (PM peak hour) for the various cases. The results confirm that under existing conditions (2004), the NH103-B southbound approach to the traffic circle currently operates at capacity and with a poor LOS during instances within the AM peak hour period, when ski arrivals are at peak levels. This condition occurs because circulating traffic within the traffic circle has the vehicular right-of-way, and the majority of ski traffic is from points east. During the PM peak hour period when ski area departures are at peak levels, this and the other study area intersections operate below capacity and at much higher Levels of Service. These analyses pertain to the 15-minute period within the peak hour, and not the whole peak hour.

The analysis of the 2010 and 2020 cases revealed that during the arrival period (AM), two intersections within the traffic circle will become capacity deficient on capacity weekend days in 2010, and on typical weekend days by 2020. These two intersections are at the west side of the circle and include the NH103 (westbound)/NH103-B intersection and the NH103 (EB)/Circulating Ramp intersection. Analysis of the departure period (PM) indicates that the Mount Sunapee Access Road "slip ramp" to NH103 (eastbound) will experience congestion by 2020 on capacity days only. The remaining study area intersections will operate below capacity through the horizon year 2020, with the expanded ski area in full operation, and all quarter-share condominium units fully occupied.

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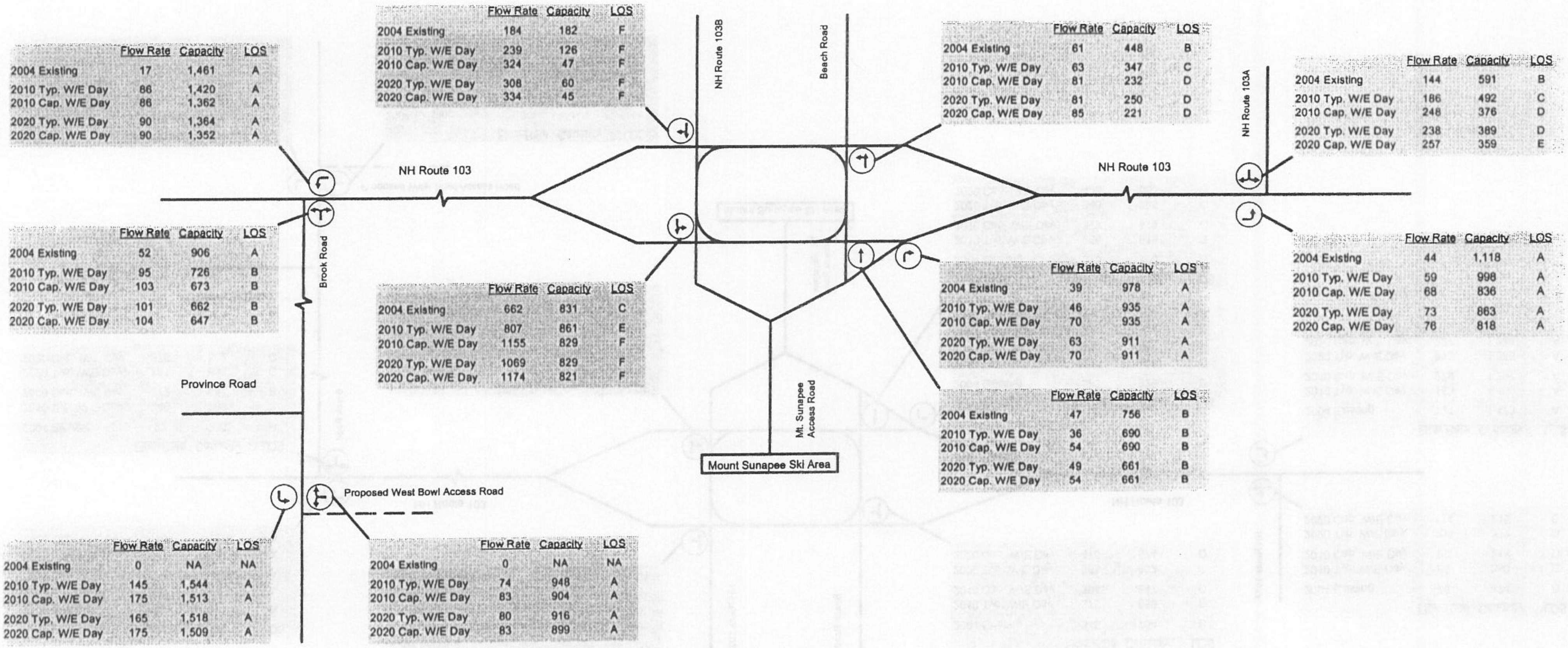
[1] Transportation Research Board, *Highway Capacity Manual* (Washington, D.C., 2000).



	Flow Rate	Capacity	LOS
2004 Existing	17	1,461	A
2010 Typ. W/E Day	86	1,420	A
2010 Cap. W/E Day	86	1,362	A
2020 Typ. W/E Day	90	1,364	A
2020 Cap. W/E Day	90	1,352	A

	Flow Rate	Capacity	LOS
2004 Existing	52	906	A
2010 Typ. W/E Day	95	726	B
2010 Cap. W/E Day	103	673	B
2020 Typ. W/E Day	101	662	B
2020 Cap. W/E Day	104	647	B

	Flow Rate	Capacity	LOS
2004 Existing	0	NA	NA
2010 Typ. W/E Day	145	1,544	A
2010 Cap. W/E Day	175	1,513	A
2020 Typ. W/E Day	165	1,518	A
2020 Cap. W/E Day	175	1,509	A

	Flow Rate	Capacity	LOS
2004 Existing	184	182	F
2010 Typ. W/E Day	239	126	F
2010 Cap. W/E Day	324	47	F
2020 Typ. W/E Day	308	60	F
2020 Cap. W/E Day	334	45	F

	Flow Rate	Capacity	LOS
2004 Existing	662	831	C
2010 Typ. W/E Day	807	861	E
2010 Cap. W/E Day	1155	829	F
2020 Typ. W/E Day	1069	829	F
2020 Cap. W/E Day	1174	821	F

	Flow Rate	Capacity	LOS
2004 Existing	0	NA	NA
2010 Typ. W/E Day	74	948	A
2010 Cap. W/E Day	83	904	A
2020 Typ. W/E Day	80	916	A
2020 Cap. W/E Day	83	899	A

	Flow Rate	Capacity	LOS
2004 Existing	61	448	B
2010 Typ. W/E Day	63	347	C
2010 Cap. W/E Day	81	232	D
2020 Typ. W/E Day	81	250	D
2020 Cap. W/E Day	85	221	D

	Flow Rate	Capacity	LOS
2004 Existing	39	978	A
2010 Typ. W/E Day	46	935	A
2010 Cap. W/E Day	70	935	A
2020 Typ. W/E Day	63	911	A
2020 Cap. W/E Day	70	911	A

	Flow Rate	Capacity	LOS
2004 Existing	47	756	B
2010 Typ. W/E Day	36	690	B
2010 Cap. W/E Day	54	690	B
2020 Typ. W/E Day	49	661	B
2020 Cap. W/E Day	54	661	B

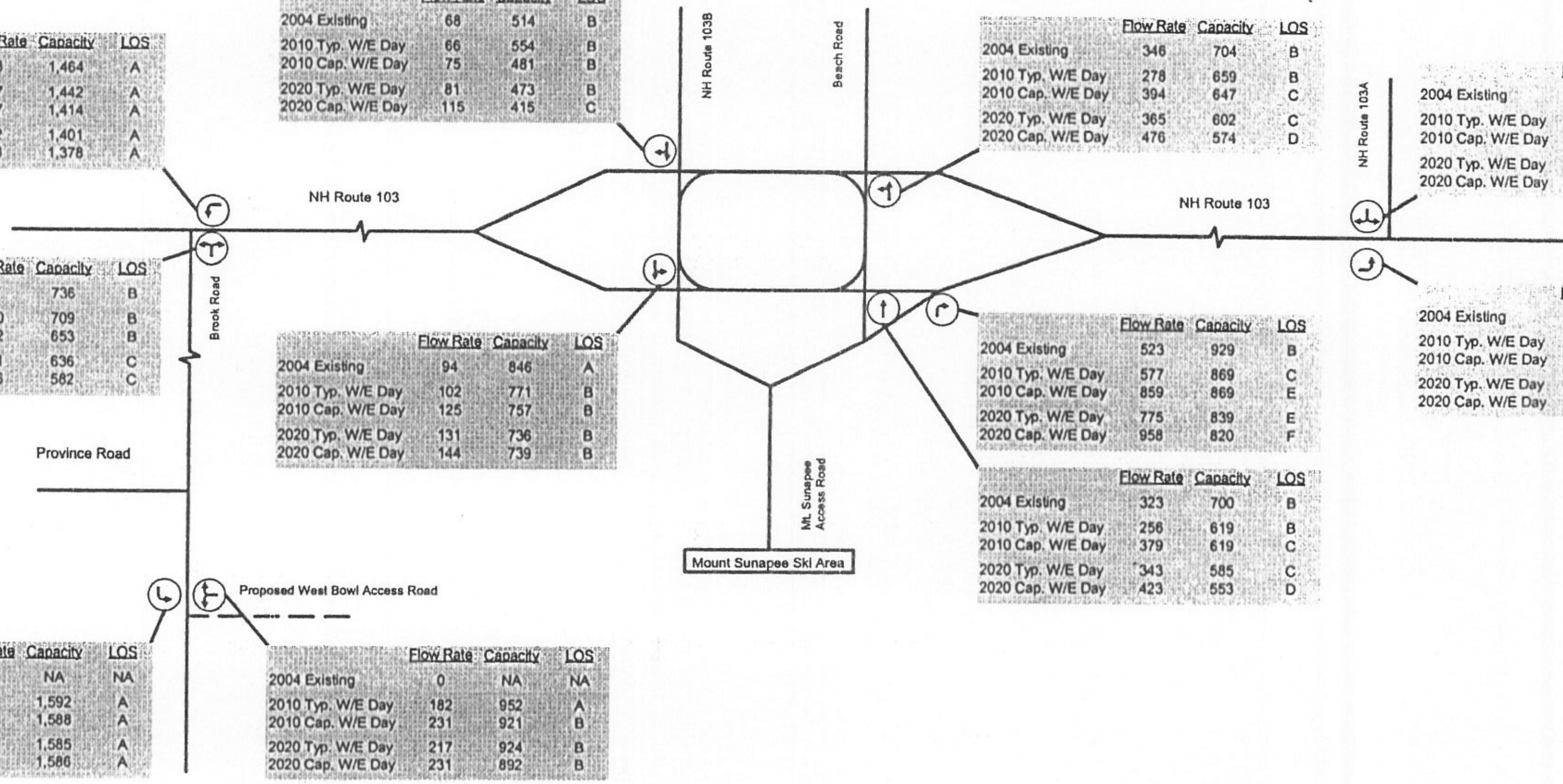
	Flow Rate	Capacity	LOS
2004 Existing	144	591	B
2010 Typ. W/E Day	186	492	C
2010 Cap. W/E Day	248	376	D
2020 Typ. W/E Day	238	389	D
2020 Cap. W/E Day	257	359	E

	Flow Rate	Capacity	LOS
2004 Existing	44	1,118	A
2010 Typ. W/E Day	59	998	A
2010 Cap. W/E Day	68	836	A
2020 Typ. W/E Day	73	863	A
2020 Cap. W/E Day	76	818	A

Figure 17

Stop & Yield Controlled Intersection Capacity Analysis Summary - AM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire



	Flow Rate	Capacity	LOS
2004 Existing	68	1,464	A
2010 Typ. W/E Day	67	1,442	A
2010 Cap. W/E Day	67	1,414	A
2020 Typ. W/E Day	72	1,401	A
2020 Cap. W/E Day	78	1,378	A

	Flow Rate	Capacity	LOS
2004 Existing	97	736	B
2010 Typ. W/E Day	240	709	B
2010 Cap. W/E Day	272	653	B
2020 Typ. W/E Day	281	636	C
2020 Cap. W/E Day	376	582	C

	Flow Rate	Capacity	LOS
2004 Existing	68	514	B
2010 Typ. W/E Day	66	554	B
2010 Cap. W/E Day	75	481	B
2020 Typ. W/E Day	81	473	B
2020 Cap. W/E Day	115	415	C

	Flow Rate	Capacity	LOS
2004 Existing	94	846	A
2010 Typ. W/E Day	102	771	B
2010 Cap. W/E Day	125	757	B
2020 Typ. W/E Day	131	736	B
2020 Cap. W/E Day	144	739	B

	Flow Rate	Capacity	LOS
2004 Existing	346	704	B
2010 Typ. W/E Day	278	659	B
2010 Cap. W/E Day	394	647	C
2020 Typ. W/E Day	365	602	C
2020 Cap. W/E Day	476	574	D

	Flow Rate	Capacity	LOS
2004 Existing	523	929	B
2010 Typ. W/E Day	577	869	C
2010 Cap. W/E Day	859	869	E
2020 Typ. W/E Day	775	839	E
2020 Cap. W/E Day	958	820	F

	Flow Rate	Capacity	LOS
2004 Existing	323	700	B
2010 Typ. W/E Day	256	619	B
2010 Cap. W/E Day	379	619	C
2020 Typ. W/E Day	343	585	C
2020 Cap. W/E Day	423	553	D

	Flow Rate	Capacity	LOS
2004 Existing	76	474	B
2010 Typ. W/E Day	86	350	C
2010 Cap. W/E Day	89	219	D
2020 Typ. W/E Day	104	233	D
2020 Cap. W/E Day	114	215	E

	Flow Rate	Capacity	LOS
2004 Existing	121	1,473	A
2010 Typ. W/E Day	163	1,409	A
2010 Cap. W/E Day	229	1,397	A
2020 Typ. W/E Day	213	1,369	A
2020 Cap. W/E Day	227	1,384	A

	Flow Rate	Capacity	LOS
2004 Existing	0	NA	NA
2010 Typ. W/E Day	77	1,592	A
2010 Cap. W/E Day	91	1,588	A
2020 Typ. W/E Day	87	1,585	A
2020 Cap. W/E Day	110	1,586	A

	Flow Rate	Capacity	LOS
2004 Existing	0	NA	NA
2010 Typ. W/E Day	182	952	A
2010 Cap. W/E Day	231	921	B
2020 Typ. W/E Day	217	924	B
2020 Cap. W/E Day	231	892	B

Figure 18

Stop & Yield Controlled Intersection Capacity Analysis Summary - PM Peak Hour

Traffic Impact & Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

To improve traffic operations at these temporary bottleneck locations, the following off-site mitigation is recommended.

- Widen the north side of the traffic circle between NH103-B and the Beach Access Road intersection to provide two westbound travel lanes; one shared lane for through movements (on NH103 westbound) and right-turns (onto NH103-B), and the other an exclusive lane for circulating traffic that is destined for the ski area.
- During the peak ARRIVAL period on weekends only, utilize police officer control from 8:15 to 9:15 AM at two locations within the traffic circle. The vehicular right-of-way needs to be controlled at the NH103 (westbound)/NH103-B intersection and the adjacent NH103 (eastbound)/Circulating Ramp intersection in order for approaching vehicles to traverse the traffic circle efficiently.
- During the peak DEPARTURE period on weekends only, utilize police officer control from 3:45 to 4:45 PM at one location within the traffic circle. Controlling the vehicular right-of-way at the NH103 (eastbound)/Access Road intersection will indirectly create adequate gaps in the traffic stream for skiers exiting onto NH103 (eastbound) via the nearby "slip ramp."

Use of police office control may delay the need for the physical modifications to the traffic circle; however, these should be completed prior to the horizon year 2020. The use of temporary police office control is expected to be needed on capacity days only in 2010, and on typical weekend days by 2020. Coordination between the Mount Sunapee Resort and the Newbury Police Department would ensure that police details are not used on weekend days with below normal skier demand (due to weather or other conditions).

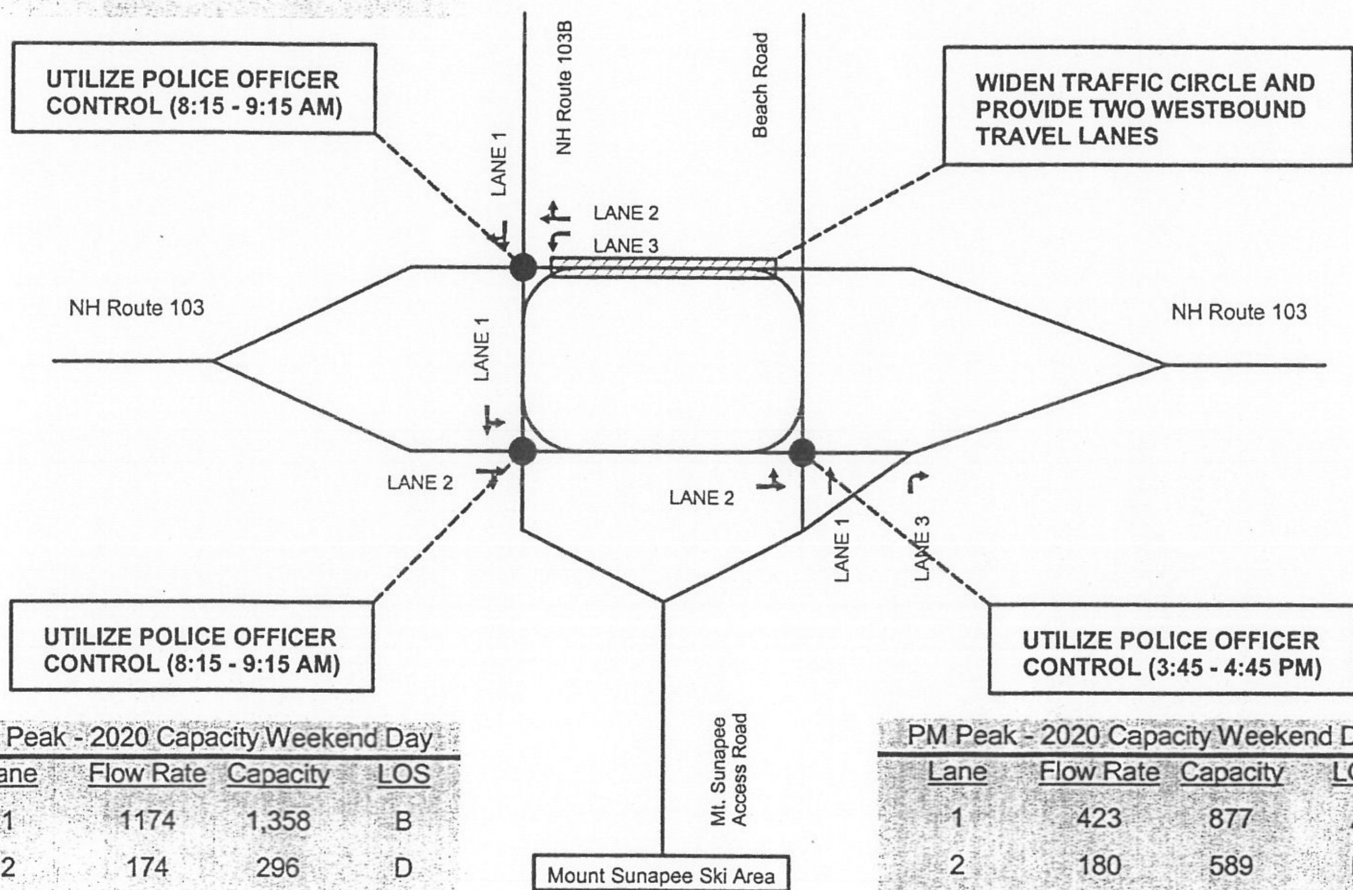
Analysis of these intersections with the recommended traffic mitigation in place is summarized on Figure 19. With police officer control, traffic operations will be similar to traffic signal control. The following table summarizes the criteria used in this type of analysis. The analysis demonstrates that all traffic movements will operate below capacity and at reasonable Levels of Service on capacity weekend days through the horizon year 2020, with the West Bowl expansion project in full operation.

Table 6 — **Level-of-Service Criteria for Signalized Intersections (Police Officer Control)**

Level of Service	Control Delay (seconds/vehicle)
A	< 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤ 35.0
D	> 35.0 and ≤ 55.0
E	> 55.0 and ≤ 80.0
F	> 80.0

Source: Transportation Research Board, Highway Capacity Manual 2000.

AM Peak - 2020 Capacity Weekend Day			
Lane	Flow Rate	Capacity	LOS
1	334	466	D
2	222	1,166	A
3	804	1,174	B



AM Peak - 2020 Capacity Weekend Day			
Lane	Flow Rate	Capacity	LOS
1	1174	1,358	B
2	174	296	D

PM Peak - 2020 Capacity Weekend Day			
Lane	Flow Rate	Capacity	LOS
1	423	877	A
2	180	589	B
3	958	969	C

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Figure 19

Intersection Capacity Analysis Summary With Mitigation

Traffic Impact and Site Access Study, Proposed Ski Area Expansion, Newbury, New Hampshire

D. OTHER STREETS AND DRIVEWAYS – NH103 is punctuated with many residential driveways, commercial driveways, and local street intersections that operate in an uncontrolled fashion. The section of NH103 that extends between the traffic circle and the NH103-A intersection will receive the greatest increase due to the West Bowl expansion project for reasons stated earlier. For example, during the PM peak hour, the two-way traffic volume on this section of highway is expected to increase from 681 vehicles in 2004, to 878 vehicles in 2010, with the West Bowl in full operation. A generic intersection analysis, that is applicable to any intersecting street or driveway, shows that the increased delays for other vehicles (non-skiers) using these streets and driveways is nominal.

GENERALIZED DRIVEWAY DELAYS ON NH103 - PM Peak Hour Period

	2004 Existing	2010 w/West Bowl	Increased Control Delay
Typical Left-Turn Delay (from minor street)	14.4 sec	17.7 sec	+3.3 sec/veh
Typical Right-Turn Delay (from minor street)	11.8 sec	13.4 sec	+1.6 sec/veh
Typical Left-Turn Arrival Delay (to minor street from NH103)	0.1 sec	0.1 sec	neg

In all cases there is triple digit capacity for each of the critical turning movements at these other streets and driveways on NH103. It should be noted that the increase in delay is not a result of the West Bowl expansion project alone, but is also affected by normal background traffic growth by non-skiers.

E. BROOK ROAD – The width and condition of Brook Road is varied over its entire length between NH103 in Sunapee and NH10 in Goshen. The post development traffic projections for 2020 show that the section north of the West Bowl parking lot will accommodate a total of 250-330 vehicles during peak periods. The section immediately south of the West Bowl complex will accommodate approximately 110 vehicles on a peak hour basis.

Based on these anticipated traffic loads, and a design speed of 35 miles per hour, the minimum suggested pavement width for Brook Road is 24 feet (between NH103 and West Bowl), and 22 feet to the south of West Bowl. In all cases, graded shoulders are considered to be desirable.

Brook Road is a State maintained facility. Accordingly, a driveway permit from the NHDOT, District 2 will be required to construct the proposed driveway on Brook Road for the West Bowl area. Analysis of the traffic projections contained herein demonstrates that a single shared approach lane is sufficient on each leg of the Brook Road/West Bowl driveway intersection. Intersection sight distances at the proposed driveway will need to be evaluated at the driveway permit stage.

F. TECHNICAL APPENDIX – A separate technical appendix includes traffic data, growth rate calculations, and capacity analyses that were performed in the course of this study.

VI. SUMMARY OF FINDINGS AND CONCLUSIONS

The Mount Sunapee Ski Resort in Newbury, New Hampshire currently offers 62 slopes and trails on 230 skiable acres that are serviced by ten ski lifts. Vehicular access to the mountain is provided by a single access road that intersects NH Route 103 at the Mount Sunapee traffic circle. The West Bowl expansion project includes adding approximately 75 acres of terrain that is skiable from the main summit, a new lift facility, a new base lodge, and 175 to 250 quarter-share condominium units. These improvements will increase the comfortable carrying capacity of the ski area to approximately 6,850 skiers, and is intended to better serve existing skier demand and maintain market share for the long-term future. Vehicular access to the new West Bowl facility is proposed via a two-way driveway that will intersect the east side of Brook Road in Goshen, at a point approximately 2.1 miles south of NH103 in Sunapee, New Hampshire.

The traffic counts that were collected at the traffic circle on Sunday, January 18, 2004 (Martin Luther King holiday weekend) revealed that the ski area generated 669 vehicle-trips (594 in, 75 out) during the peak ARRIVAL period from 8:15 to 9:15 AM, and 728 vehicle-trips (68 in, 660 out) during the peak DEPARTURE period from 3:45 to 4:45 PM. Due to weather and other conditions, this particular count is representative of a typical weekend day.

Future traffic projections were prepared for 2010 (base year = project completion) and 2020 (horizon year) for the entire study area, and reflect both typical weekend day and capacity weekend day conditions. By 2020, the Mount Sunapee Resort is expected to generate a total of 1,222 (AM) and 1,317 (PM) peak hour trips on a typical weekend day with the condominium units completely occupied. Under this scenario, the West Bowl driveway will accommodate approximately 248 (AM) and 267 (PM) trips. This translates into approximately 20 percent of the total trips utilizing the new access point on Brook Road, and the remaining 80 percent utilizing the existing access road at the traffic circle.

An intersection capacity and Level of Service analysis of all study area intersections using the 2020 traffic projections revealed that traffic operations and capacity deficiencies will occur at two locations within the traffic circle during the arrival period, and at one location during the departure period. To mitigate these situations, a combination of roadway widening along a portion of the traffic circle is necessary, along with police officer control from 8:15 to 9:15 AM (two persons) and 3:45 to 4:45 PM (one person) on typical winter weekends. For the base year case (2010), the need for police officer control will likely be limited to capacity weekend days only. In terms of roadway capacity, the two lane section of NH103 was found to be appropriate, and it will operate well below capacity on winter weekend days through 2020 and beyond, with the West Bowl Expansion project in full operation.

At the multitude of intersecting streets and driveways along the NH103 corridor (east of Mount Sunapee), the net increase in through traffic (due to ski area expansion and normal background growth) will result in longer delays for those using these various points of access during peak arrival and departure periods. Analysis of a generic case shows that increase in such delays will be limited, and on the order of an additional 2-4 seconds of delay per side-street vehicle, when comparing 2004 existing conditions with 2010 (full expansion). In the case of Brook Road, capacity conditions do not govern; however, the minimum roadway width should be 24 feet on the section between NH103 and the West Bowl driveway, and 22 feet south of the driveway, based on the anticipated traffic volumes and a thirty-five mile per hour design speed.

With implementation of the basic measures and recommendations contained herein, vehicular access to and from the Mount Sunapee Resort as proposed, will be reasonably safe and efficient from a traffic engineering and operations standpoint. Both the recommended modifications to the traffic circle and the proposed driveway on Brook Road will require the review and approval of the New Hampshire Department of Transportation – District 2 through the Driveway Permit system.

STATE OF NEW HAMPSHIRE – STEPHEN G. PERNAW No. 5234 LICENSED – PROFESSIONAL ENGINEER

6/7/04

Appendix F. Preliminary Wildlife and Habitat Assessment, Mount Sunapee West Bowl Expansion

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Preliminary Wildlife and Wildlife Habitat Assessment
Mount Sunapee Resort -- West Bowl Expansion

General

Field work to determine the presence of wildlife and the potential for significant habitats was undertaken on 4 and 13 May 2004. In both instances, investigations began at the summit, the first day concentrating on the area proposed for the ski lift, the second day concentrating on areas to the south and west. On both occasions, observations were made during a 'wander search', with objectives to note any wildlife or wildlife sign, and to characterize the vegetative cover and potential wildlife habitat.

On 4 May, snow cover from a storm the night before extended from the summit to about 750 meters elevation. The day was cool but with increasing sunshine and light wind. The second day, 13 May, was warm and sunny with light wind. Between the two dates, the season had advanced significantly, with development of leaves and spring flora much more evident by 13 May.

Land Use

There is little evidence of past human activity on the upper slopes, with the exception of the hiking trail. Although apparently undisturbed for many years, the number of large trees is small. At ca. 600 meter elevation, a few scattered yellow birch (Betula alleghaniensis) measuring as much as 87 cm. diameter (34.25 inches) were noted, but most trees are of modest height and diameter. The coniferous forest on a rocky shoulder near the state park boundary contains a few large red spruce (Picea rubens) but such trees are uncommon on the project site.

Uniformity of cover type found at higher elevations is missing below ca. 550 meters where recent cutting has taken place, and evidence of old logging roads and fencelines is found. The southern edge of the study area is bounded by a stone wall, indicating that one side or both was once cleared land. Clearings have grown to brush (primarily brambles, pin cherry and aspen), and the general aspect is of a diverse but broken canopy. The base area is a combination of broken woodlots, old field association and remnant orchards typical of once-settled farmland.

Old growth, as described in Neid, et al. (2003) was not observed on the study area. Isolated large trees were exceptionally uncommon, as noted above. The forest cover above 550 meters was generally uniform in height and apparent age, with a sparse shrub understory. There are few downed logs or dead snags in this forest, indicating a relatively even-aged forest that has developed since logging occurred prior to 1924.

Vegetative Cover

From summit to base, the dominant forest changes in distinct bands from coniferous growth at the summit, northern hardwoods between ca 780 and 480 meters elevation, and mixed growth below 480 meters. The summit forest is primarily spruce-fir (*Picea rubens* and *Abies balsamea*) with numerous birches (*Betula papyrifera*). The northern hardwood community includes beech (*Fagus grandifolia*), paper birch (*Betula papyrifera*), yellow birch (*B. alleghaniensis*) and black cherry (*Prunus serotina*), with sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), hophornbeam (*Ostrya virginiana*) and aspen (*Populus tremuloides*) increasingly common at lower elevations. Below 510 meters, stands of hemlock (*Tsuga canadensis*) and scattered red oak (*Quercus rubra*) appear, and in the vicinity of the proposed base facilities, white pine (*Pinus Strobus*) is common.

The high elevation coniferous woods has an understory of small trees of overstory species along with hobblebush (*Viburnum alnifolium*) mountain maple (*Acer spicatum*), red maple (*Acer rubrum*) and mountain ash (*Sorbus americana*) and a mossy ground cover which includes wood sorrel (*Oxalis montana*), Canada mayflower (*Maianthemum canadensis*), blue-bead lily (*Clintonia borealis*), wild sarsaparilla (*Aralia nudicaulis*) and goldthread (*Coptis groenlandica*).

The northern hardwood forest is open, with little in the way of saplings or understory shrubs except for striped maple (*Acer pensylvanicum*) and scattered hobblebush. Typical spring flowers such as Canada mayflower, false Solomon's-seal (*Smilacina racemosa*), Indian-cucumber (*Medeola virginiana*), purple trillium (*Trillium erectum*), painted trillium (*T. undluatum*), twisted-stalk (*Streptopus roseus*), bellwort (*Uvularia sessilifolia*) and yellow violet (*Viola rotundifolia*) occur sporadically in these woods, with blue-bead lily becoming uncommon at lower elevations. Ferns (*Osmunda claytoniana, O. regalis, O. cinnamomea, Thelypteris noveboracensis* and *Polystichum acrostichoides*) occur in the hardwood forests, as do clubmosses (*Huperzia lucidula, Diphasiastrum digitatum, Lycopodium obscurum* and *L. annotinum*).

The lower section of northern hardwood forest has been logged in the past, and regeneration includes sprouts and saplings of the trees listed above, along with shadbush (*Amelanchier* spp.) and pin cherry (*Prunus pensylvanica*). Hayscented fern (*Dennstaedtia punctilobula*) and bracken (*Pteridium aquilinum*) are common in logged forests and clearings.

Lower elevation forests contain a greater diversity of species. All the higher-elevation species are present, with the addition sweet birch (*Betula lenta*), apple (*Malus pumila*), cottonwood (*Populus deltoides*) and basswood (*Tilia americana*). Several shrub species absent on upper slopes are common at lower elevations, including meadowsweet (*Spiraea latifolia*), steeplebush (*S. tomentosa*), brambles (*Rubus idaeus*, R. *alleghaniensis* and *R. occidentalis*), willows (*Salix* spp.), choke cherry (*Prunus virginiana*) and hawthorn (*Crataegus* sp.). Weedy non-native species are common at the base.

One species listed on the New Hampshire Natural Heritage Bureau proposed list of Endangered, Threatened, Watch, Extirpated and Intermediate Plant Species was noted during field work. A single butternut tree (*Juglans cinerea*) occurs on the north side of the existing access road off Brook Road. The area appears to have been an old house site, and there are likely to be additional butternuts nearby. Butternut is of concern because of the threat posed by canker dieback (*Melanconis juglandis*), a widespread fungus disease that weakens and then kills the tree. The tree noted at Brook Road can likely be avoided and therefore not be affected by the project.

Wildlife Observations

The greatest concentration of wildlife sign was observed in the area where logging operations have recently taken place. While occasional evidence of moose (primarily scat) was noted as high on the mountain as 700 meters, such sign is abundant in the upper area of the cut. In addition, there are localize areas of concentrated bark stripping (mostly on red and striped maple) and browsing on maples, ash, aspen and elm. Evidence of deer was sporadic, consisting of widely scattered pellet groups and occasional browsing.

Pine and hemlock stands at lower elevations were investigated specifically to determine whether there was evidence of use by overwintering deer. The stands tend to be small and fragmented, and the overstory does not appear to be dense enough to prevent deep snows from accumulating or to shield the interior from winter winds. Hemlock foliage, within reach of deer, remained unbrowsed. No deer sign was noted in these stands.

No trees scarred by bears were noted during field work, and potential denning sites appear to be limited to areas with ledges and tumbled stone at higher elevations. Such an area was observed on a small spruce-covered promontory at ca. 700 meters near the southern edge of the project area. Talus-like rocks on the west side of this area could provide shelter for hibernating bears, although no indication of such use was seen (Photo 1). This area is south of the southernmost proposed ski trail, and would not be affected by the project as I understand it.

Bird life at Mount Sunapee is typical of deep forest environments at this latitude. Because field work was conducted in early to mid-May, much of the spring migration had not occurred, however, and most birds observed were resident species (hairy and downy woodpeckers (*Picoides villosus* and *P. pubescens*), chickadees (*Parus atricapillus*), blue jays (*Cyanocitta cristata*), ruffed grouse (*Bonasa umbellus*). Ovenbirds (*Seiurus aurocapillus*) are common in the northern hardwood forests. The extensive hardwood forests can be expected to provide habitat for numerous migratory and resident species.

Two partial twig nests were noted in tops of beech trees near the hiking trail at ca. 660 meters (Photo 2). There was no evidence of recent use (fresh twigs, feathers or droppings near the nests, so it was assumed that they were built last year. Being incomplete, the nests were not identifiable as to species. The fact that there were two nests, in trees that did not stand appreciably above the general canopy, would tend to eliminate raptors as the builders, and I conclude that they were most likely built by great blue herons (*Ardea herodias*).

Miscellaneous observations included evidence of porcupine (*Erethizon dorsatum*) in a small hovel beside a tote road, and a red-bellied snake (*Storeria occipitomaculata*) at ca. 480 meter elevation.

Summary

With the exception of a few scattered large trees, the area appears to have a history of timber operations: prior to 1924 on state park lands, and within the past 20 years on remaining properties. No areas answering to the description of old growth forests as used in Neid, et al. (2003) were observed.

One plant species of concern to the New Hampshire Natural Heritage Bureau was noted next to Brook Road. A single butternut tree occurs at an old house site north of the existing access road, but it appears to be far enough from the road not to be affected by improvements that might take place on the existing footprint. Before work is done, the tree (and any others nearby) should be flagged and a suitable protective buffer established.

The most significant wildlife observation was the two twig nests, possibly built by great blue herons, in tree tops at ca. 660 meters near the Summit Hiking Trail. Neither nest appeared to be finished or under active construction, but their presence indicates potential use of these woods for nesting by such birds. If the nests were active, a large buffer zone would be recommended within which no human activity should take place. Here, however, the birds who built these nests were acclimated to an active hiking trail lies a few yards away.

Wildlife on this parcel is typical of large wooded tracts in the state. Moose are the most obvious large animal, and the species is having impacts on woody plant succession where there is concentrated activity. A broad zone at ca. 540 meters (the upper edge of areas that have seen logging operations) is heavily used by moose, and ash, maples, elms, yellow birches and hophornbeams are especially affected by browsing. Bark stripping on striped maple and red maple is locally common.

Deer sign is light across most of the site, with pellet groups and evidence of browsing uncommon. Areas used by deer as overwintering habitat was not observed on the project area. Pine and hemlock stands occur at the lowest elevations, but they are fragmented and have relatively open canopies. In most instances where hemlocks, a favored browse species, occurs, foliage at heights available to deer showed only sporadic evidence of browsing.

Conclusions

The principal impact of the proposed ski trail development on wildlife will be the fragmentation of a relatively uniform forest. Certain deep-woods species of birds may be affected, depending on the width of the trails, but the number of species is likely to be increased as extensive "edge" habitat is created on both sides of all trails. In addition, the trails themselves will offer openland habitat that is currently not available.

Edge habitat will also provide ample browse for deer and moose, and both species can be expected to increase in numbers. There should be minimal impact on other species of resident mammals.

Literature Cited

Neid, S.L., D.D. Sperduto and K.F. Crowley. 2003. Natural Heritage Inventory of the East Bowl at Mount Sunapee State Park. A report submitted to the State of New Hampshire by the New Hampshire Natural Heritage Bureau. DRED Division of Forests & Lands and the Nature Conservancy. Concord.

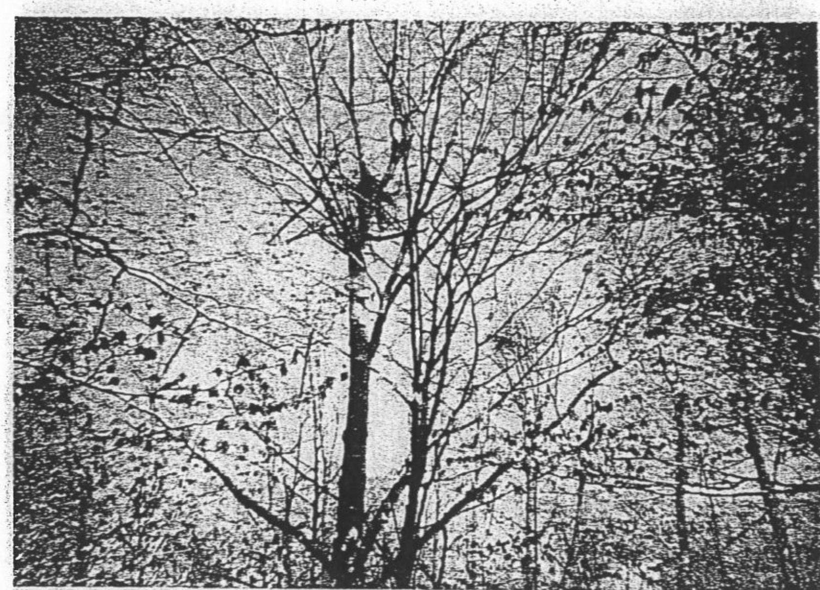

Photo 1. Partial twig nests in beech trees, near Summit Hiking Trail at ca. 660 meters.

Isolated rock at ca. 675 meters, midway between proposed lift line and park boundary. With the exception of a rocky promontory at ca. 700 meters near the southern edge of the project area, such rock was rare, but could offer denning sites for black bear.

Characteristic Plant Species
Mount Sunapee West Bowl Expansion

TREES		
Eastern white pine	*Pinus strobus*	Scattered mid-slope, in stands at base
Eastern hemlock	*Tsuga canadensis*	Scattered mid-slope and below, occasionally in small stands
Balsam fir	*Abies balsamea*	Co-dominant at higher elevations
Red spruce	*Picea rubens*	Co-dominant at higher elevations, scattered individuals at mid-slope
Trembling aspen	*Populus tremuloides*	Minor component at lower elevations
Bigtooth aspen	*Populus grandidentata*	Scattered
Butternut	*Juglans cinerea*	One tree near Goshen Road entrance
Hophornbeam	*Ostrya virginiana*	Minor component at lower elevations
Black birch	*Betula lenta*	Uncommon
Yellow birch	*Betula alleghaniensis*	Co-dominant in mid to upper level deciduous woods
Paper birch	*Betula papyrifera*	Co-dominant at high elevations, common at mid-slope
Gray birch	*Betula populifolia*	Lower elevations
Beech	*Fagus grandifolia*	Common, often dominant, component of northern hardwood stands
Red oak	*Quercus rubra*	Minor component in NHW stands
American elm	*Ulmus americana*	Minor component, lower elevations
Mountain ash	*Sorbus americana*	Common at higher elevations
Shadbush	*Amelanchier* sp.	Occasional
Black cherry	*Prunus serotina*	Common species, lower mid-slopes and above
Hawthorn	*Crataegus* sp.	Uncommon; lower elevations
Apple	*Malus pumila*	Lower elevations (old farm sites)
Striped maple	*Acer pensylvanicum*	Common species lower mid-slopes and above
Sugar maple	*Acer saccharum*	Common below conifer belt
Red maple	*Acer rubrum*	Common
Basswood	*Tilia americana*	Uncommon, below mid-slope
White ash	*Fraxinus americana*	Common on bottom 2/3 of mountain
SHRUBS		
Willows	*Salix* spp.	Occasional, along watercourses
Beaked hazelnut	*Corylus cornuta*	Common mid-slope and below
Currant	*Ribes* sp.	Occasional
Meadowsweet	*Spiraea latifolia*	Frequent, mid-slope and below
Steeplebush	*Spiraea tomentosa*	Uncommon, lower slopes
Shadbush	*Amelanchier* sp.	Occasional, lower 2/3 of mountain
Blackberry	*Rubus alleghaniensis*	Frequent
Black raspberry	*Rubus occidentalis*	Lower elevations
Raspberry	*Rubus idaeus*	Lower elevations
Dewberry	*Rubus hispidus*	Lower elevations
Choke cherry	*Prunus virginiana*	Near base
Pin cherry	*Prunus pensylvanica*	Common from mid-slope & below

Mountain maple	*Acer spicatum*	Common understory tree
Low sweet blueberry	*Vaccinium angustifolium*	Clearings at lower elevations
Elderberry	*Sambucus* sp.	Scattered
Hobblebush	*Viburnum alnifolium*	Abundant at higher elevations
Mtn fly honeysuckle	*Diervilla lonicera*	Occasional
HERBACEOUS		
Shining clubmoss	*Huperzia lucidula*	Common at higher elevations
Ground-cedar	*Diphasiastrum digitatum*	Occasional at lower elevations
Princess-pine	*Lycopodium obscurum*	Occasional at lower elevations
Bristly clubmoss	*Lycopodium annotinum*	Occasional
Long beech-fern	*Phegopteris conectilis*	Occasional
Cinnamon fern	*Osmunda cinnamomea*	Common
Interrupted fern	*Osmunda Claytoniana*	Common
Hay-scented fern	*Dennstaedtia punctilobula*	Common in cutover areas
Sensitive fern	*Onoclea sensibilis*	Common at lower elevations
Bracken	*Pteridium aquilinum*	Common in clearings & edges
Canada mayflower	*Maianthemum canadense*	Common
False hellebore	*Veratrum viride*	Occasional in wet sites
Blue-bead lily	*Clintonia borealis*	Common, esp. at upper elevations
Purple trillium	*Trillium erectum*	Occasional
Painted trillium	*Trillium undulatum*	Uncommon
Indian-cucumber	*Medeola virginiana*	Common
Twisted-stalk	*Streptopus roseus*	Occasional in hardwood forests
Bellwort	*Uvularia sessilifolia*	Common
False Solomon's seal	*Smilacina racemosa*	Common
Goldthread	*Coptis groenlandica*	Common
Buttercup	*Ranunculus acris*	Common at lower elevations
Partridgeberry	*Mitchella repens*	Occasional
Blue-eyed grass	*Sisyrinchium montanum*	Occasional
Starflower	*Trientalis borealis*	Common
Mountain sorrel	*Oxalis montana*	Common at higher elevations
Sarsaparilla	*Aralia nudicaulis*	Common
Cinquefoil	*Potentilla simplex*	Common at lower elevations
Strawberry	*Fragaria virginiana*	Common at lower elevations
Yellow violet	*Viola rotundifolia*	Common at higher elevations
White violet	*Viola blanda*	Occasional, damp openings
Blue violet	*Viola* sp.	Occasional
St. John's-wort	*Hypericum perfoliatum*	Occasional
Beechdrops	*Epifagus virginiana*	Occasional under *Fagus*
Bunchberry	*Cornus canadensis*	Occasional
Indian-pipe	*Monotropa uniflora*	Occasional
Speedwell	*Veronica officinalis*	Disturbed areas at lower elevations
Rough goldenrod	*Solidago rugosa*	Common at lower elevations
Ox-eye daisy	*Chrysanthemum leucanthemum*	Common, lower elevations

Appendix G. NH Natural Heritage Bureau Mount Sunapee State Forest Assessment Report (2004) and Addendum (2015)

New Hampshire Natural Heritage Bureau
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visit our web site at www.dred.state.nh.us/forlands/formgt/nhiweb

Evaluation of proposed ski lease area expansion on Mt. Sunapee – 11/23/2004

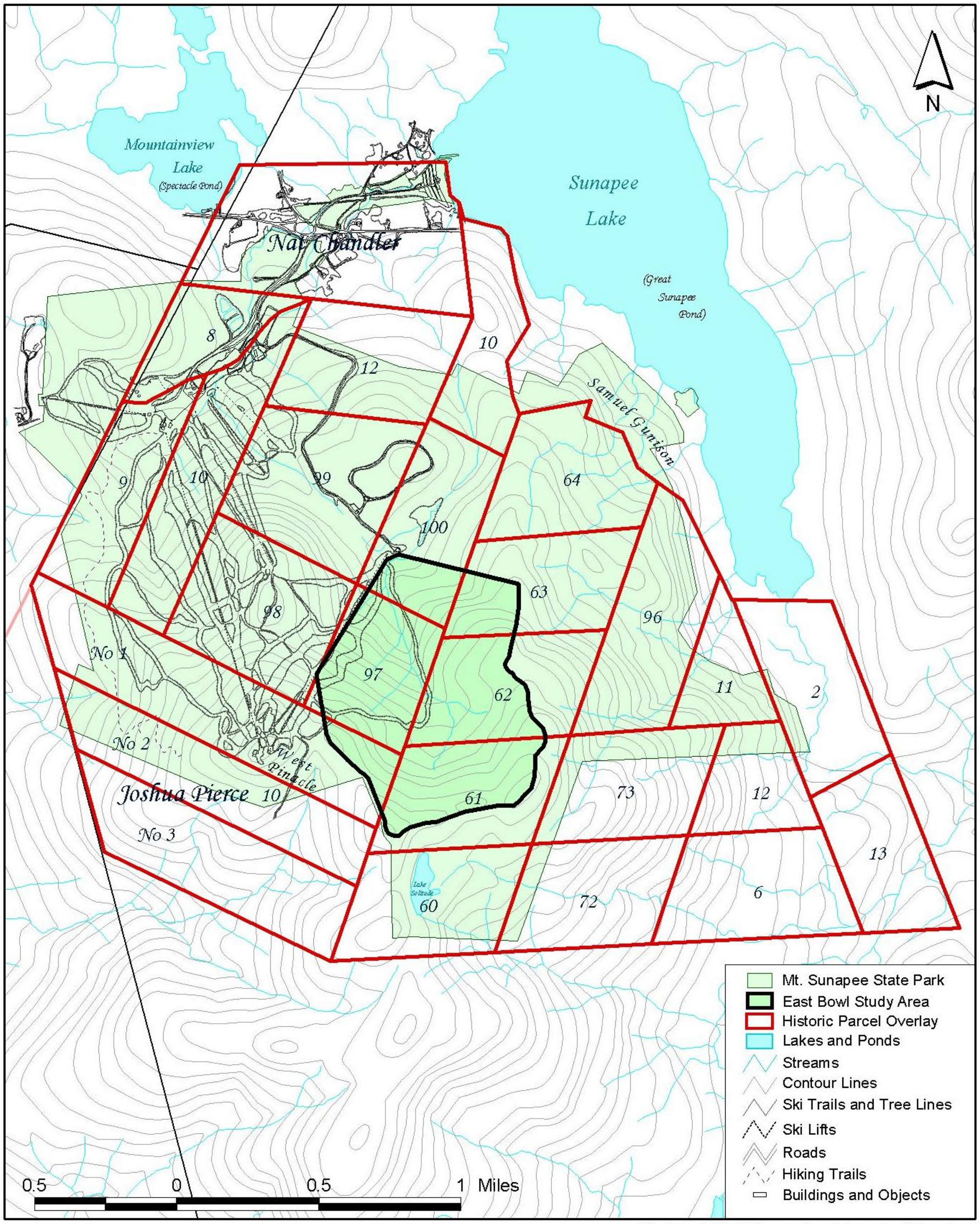
On September 13, 2004 staff from NH Natural Heritage Bureau (NH Heritage) and a volunteer (Chris Kane) conducted a field survey of the newly proposed ski lease area expansion (hereafter proposed expansion) within the current boundaries of Mt. Sunapee State Park. Two areas were assessed: the ~175 acres proposed for addition to the existing Ski Lease area (the so called "west bowl"), and a patch of forest within the current lease area between the Upper Ridge and Beck Brook trails that would also be impacted by the proposed expansion (i.e., the northern section of the "New Ridge Trail"). This patch of forest within the current lease area had been identified in Natural Heritage's 1999 Sunapee Lease Area report as containing possible patches of old growth spruce forest (see report description of "Polygon 3"), warranting its inclusion in the survey. A second reason for surveying Polygon 3 was that it provided contextual relevance for interpreting the land use history of the broader area.

During the field survey, vegetation data was gathered at 38 observation points and intervening areas, including species composition (trees and understory plants), tree diameters, type and extent of natural communities, site history information, and the extraction of more than 30 tree cores. Tree cores were subsequently mounted and sanded, tree rings counted and patterns interpreted (ages are given as ring counts at breast height). These data were considered in the context of information included in two previous reports on NH Heritage surveys of other portions of Mt. Sunapee State Park. The results of the survey are below:

FOREST HISTORY:

The lower portion of the proposed expansion area corresponds largely to lot 9, and the upper portion to lots 1 and 2 of Great Lot 10 (see Figure 8 from the Natural Heritage East Bowl Study, below). Polygon 3 within the lease area coincides with lot 1 and perhaps the extreme western corner of lot 98.

There is considerable historical evidence that much of the lower slopes of the mountain has a history of agricultural use (mostly haying and pasturing), timber harvesting, or both. There is no direct evidence of extensive harvesting at the higher elevations 100 to 200 years ago in the historical record. Deed records from 1836 refer to "considerable growth of timber" [that is] "rough…and hard to get off" for lot 98; there is evidence of pasturing and homesteads on the western portions of lots 1 and 2 but not at the higher elevations. In addition, Herbert Welsh's descriptions (ca. 1907) of the upper slopes of the mountain indicated that both spruce and hardwoods were still standing here in their "primeval condition". In 1907-1908, Emerson Paper



Scale = 1:32,000 contour interval = 20 meters

Figure 8. Digitized lot boundaries based on Willey (1809; Figure 7).

NH Natural Heritage Bureau

(Figure 8 from former report)

Co. took ownership of lots 1 – 3 of Great Lot 10, and in 1908 released the standing hardwood timber rights to the Draper Company on these lots (retaining the softwood rights). Also in 1908, Emerson released all timber rights on the eastern portion (only) of lot 98, thus retaining rights to timber on western portion. In 1911, many of the surrounding lots and timber rights were acquired by the Forest Society from Emerson and/or Draper (61, 62, 97, 98, with softwood rights retained by Emerson on lot 98) and from International Paper (58, 59, 60, and lots 4 & 5 of Great Lot 10). Thus, during the period from 1911 to 1924 Emerson had the softwood rights on lots 1 and 2, and Draper had the hardwood rights. In 1924, these lots and "…all of the remaining rights and privileges conveyed to the Draper Company…" were transferred to the Forest Society.

CURRENT FOREST CONDITION:

The field survey was corroborative with the historical evidence summarized above. The lower elevations (< 1800 ft.) of the study area consist of moderately young to maturing forests (all < 130 years), much of which was formerly pastured, and almost certainly cut throughout. These areas included an extensive successional stand of red spruce and hardwoods (old pasture); other areas were typified by *hemlock - beech - oak - pine forest*, *hemlock - spruce - northern hardwood forest*, and *sugar maple – beech – yellow birch forest*.

Above 1800 ft, four areas, or polygons, were identified as having potential ecological significance, which are described here as Polygons A, B, C, and D (see map, below).

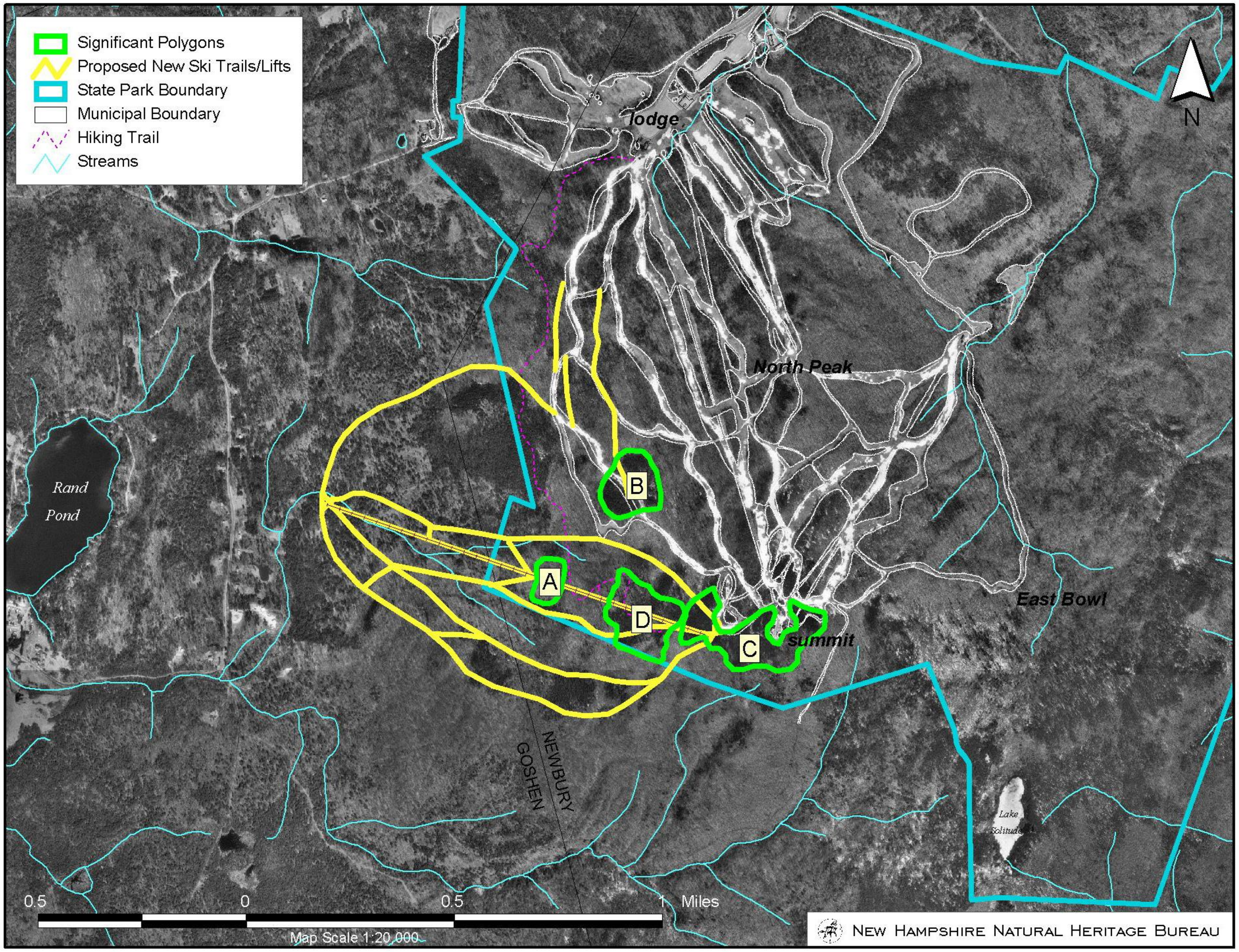
<u>Polygon A</u>

Below the hiking trail above about 1800 ft., there is a mature 4-acre stand of *northern hardwood - spruce - fir forest*. This stand has large, mature *Acer saccharum* (sugar maple), *Fagus grandifolia* (American beech), and *Picea rubens* (red spruce). The large hardwoods cored here were 103, 137, 141, and 188 years of age. One cored spruce in this area was 303 years old, and stump counts of blown-down (dead) spruce were in the vicinity of 130, 150, and 200+ years of age. This area may have been logged for hardwoods by Draper sometime from 1911-1924 during which time most or all of the current 100-140 year old hardwoods here would have been young and not particularly desirable (the oldest hardwood would have been about 14" DBH). Draper did not have softwood rights, but if Emerson had been to this site during this time period for softwoods, they almost certainly would have taken the spruce as it was common practice at the time to take spruce greater than 7 inches for pulp (the spruce would have been 50 – 200+ years old). The surrounding areas are younger and appear to have been cutover and/or hard-hit by the 1938 hurricane; there is no apparent reason why the hardwoods in this part of lot 1 and 2 would have been passed over while the surrounding areas were cut. Thus, we conclude that the forest in Polygon A is likely to have been harvested for hardwoods sometime between 1911-1924 and, as a maturing forest with few older trees, is of local but not statewide significance.

<u>Polygon B</u>

Polygon B consists of an 11-acre patch of spruce forest within Polygon 3 of the Ski Lease area. The forest of Polygon B is dominated by moderate to large sized red spruce, with most of the ages of cored trees between 89 to 142 years (89, 100, 110, 115, 121, and 142). One tree was 242 years old. There was little dead and downed wood typical of most old growth forests. The forest structure, the age structure, and the fact that some of the trees showed a period of release ca. 91-92 ybp is consistent with the idea that Emerson probably cut this forest over for mature spruce around 1912 during which time they had the spruce rights on the lots involved. As with Polygon A, this forest is not considered to be of statewide significance.

Areas of Potential Ecological Significance in the Proposed Mt. Sunapee Ski Lease Expansion Area



Polygon C

Located on the upper slopes of the proposed expansion area, Polygon C consists of a moderately young 21-acre patch of *high-elevation spruce - fir forest***,** which probably regenerated from heavy hurricane blowdown. This assessment is consistent with reports that only the ridgelines of Mt. Sunapee were severely impacted by the 1938 Hurricane. Although this forest does not contain old trees, Polygon C is considered to be ecologically significant in a statewide context as it is one of only a few known examples of *high-elevation spruce - fir forest* south of the White Mountains. However, given that this polygon is small, isolated, and in very close proximity to existing ski trails, it is of lesser significance when compared to other statewide significant examples in the White Mountains.

Polygon D

To the north of younger hardwoods, and west (downslope) of the *high-elevation spruce - fir forest* (Polygon C), is a mature, possibly old-growth patch of *northern hardwood - spruce - fir forest*. This forest was spared from severe impact from the 1938 hurricane, although the hardwoods may have been impacted. Most of the hardwoods are of moderate size, with scattered large, stag-headed yellow birch that were mostly rotten at the core and difficult to age (see photos, attached). Large red spruce are common in this forest, ranging in age from 129 to more than 200 years (6 of 8 cored spruce trees exceeded 170 years). It is unlikely that the spruce in this forest would have been passed over by Emerson Company if this part of lots 1 and 2 were harvested for spruce in the early part of the 1900s (when they retained softwood rights). Had this stand been harvested, the age and stand structure would have been closer to that exhibited in Polygon B.

Although this polygon's size (16 acres) is small compared to other old growth *northern hardwood - spruce - fir forest*s in the state, and ski trails and roads to the north are fragmenting features, Polygon D is considered of statewide significance for the following reasons: 1) the condition is good to very good in that it appears to have never been logged (indicators of this are the forest history, the considerable dead and downed woody debris, and the old trees); 2) even small patches of old examples of this natural community type (*northern hardwood - spruce - fir forest)* are rare in throughout central and southern NH; 3) it is part of a larger mosaic of mature and old growth patches of exemplary forest on Mt. Sunapee; and 4) it is contiguous with and forms the northern extent of the large, un-fragmented forest block to the south (the Sunapee-Pillsbury Highlands).

Images of Polygon D, 2004

coring a red spruce

yellow birch

“stag-headed” yellow birch

landscape

New Hampshire Natural Heritage Bureau
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To: Jeffrey J. Rose, Commissioner

Via: Brad Simpkins, Director, Division of Forests & Lands

From: Sabrina Stanwood, Administrator

Date: January 26, 2015

Subject: Addendum to 2004 report on Mt. Sunapee State Park

In November 2014, staff from the Natural Heritage Bureau (NHB) conducted preliminary assessments at Mt. Sunapee State Park (MSSP) and reevaluated the condition of the forest in portions of the West Bowl of Mt. Sunapee that was first surveyed in 2004. In addition, NHB was requested by Mount Sunapee Resort to gather information on land adjacent to MSSP. The following is an addendum to the 2004 NHB report.

According to the Native Plant Protection Act (RSA 217-A:7), state agencies are required to work together to protect New Hampshire's native plants and exemplary natural communities. It states that "All state agencies, consistent with their authority and responsibilities, shall assist and cooperate with the commissioner to carry out the purposes of this chapter. To the extent possible actions funded or carried out by state agencies shall not jeopardize the continued existence of any protected plant species or exemplary natural community."

In 2003 and 2004, several areas in Mt. Sunapee State Park were documented as components of an exemplary natural community system. The approach that NHB applied in all of the surveys was to analyze the forest community and/or system types for the criteria that determine whether their exemplary: size, condition, and landscape context. RSA 217-A:3 defines exemplary natural communities as a viable occurrence of a rare natural community type or a high quality example of a more common natural community type as designated by the Natural Heritage Bureau based on community size, ecological condition, and landscape context.

Highlights of the 2003 NHB Survey/Report:

In 2003, eastern portions of the Mt. Sunapee State Park were surveyed, and research conducted on the history and the land management of the area. NHB staff delineated the study areas on MSSP into sections described as polygons. The 2003 study in the East Bowl utilized numeric polygons (e.g. Polygon 23), the 2004 West Bowl studied labeled the polygons with letters (e.g. Polygon D).

Historical documentation from this period describes remnant patches of "primeval forest", particularly in the areas of the South Peak, the North Peak, and the East Bowl. In New Hampshire, primeval or primary forest (i.e., old growth) is rare, and a majority of the known acreage occurs within and north of the White Mountains. Old growth forests are a result of time and natural ecological processes. They result from a lack of or at least very minimal anthropogenic disturbance. Old growth areas harbor a wealth of biological diversity and legacies that do not occur in managed forests. The continued presence of old growth in the East Bowl was strongly supported by NHB's assessment in 2003. The forest in the East Bowl of Mount Sunapee is ecologically significant and was designated as exemplary by NHB as one of the best remaining examples in the state. Containing higher elevation communities (northern hardwoods and northern hardwood-spruce-fir), it is the only exemplary site for this combination of forest types in southern New Hampshire. The East Bowl contains a substantial area that is in old growth condition, which is also very rare, especially for southern New Hampshire.

To date, the old growth stands on Mount Sunapee are the only old growth forest remnants known to NHB in Merrimack County.

In 2003, NHB recommended the East Bowl of Mt. Sunapee, as well as north-facing slopes to the west and northwest of the East Bowl receive special conservation status as a formally designated Natural Area due to the age of cored trees, condition, rarity, and its role in a larger mosaic of contiguous forest that forms the northern extent of the large, un-fragmented forest block to the south. Following the 2004 survey of western sections of Mt. Sunapee State Park, areas south and west of the summit were added to the existing exemplary ***northern hardwood - conifer forest system***.

Highlights of the 2004 NHB Survey/Report:

Mt. Sunapee State Park is located at the northern end of a 30,000-acre continuously forested area in southwest New Hampshire called the Pillsbury Sunapee Highlands Corridor. This block of contiguous forest is one of the three largest contiguous forests in southwest New Hampshire that are not bisected or fragmented by roads. The Pillsbury-Sunapee Highland Corridor has rivers that flow into two federally designated watersheds: the Connecticut River (Sugar and Upper Ashuelot rivers) and the Merrimack River (Beards Brook and Warner rivers).

In 2004, NHB first surveyed the West Bowl portion of MSSP, an area on the western slope of the mountain that had been previously identified as part of an expansion of the Mt. Sunapee Resort. The purpose of the survey was to assess the condition of the forest in the West Bowl, particularly in relation to the forest of the East Bowl, which had been identified as mature forest having old-growth characteristics in a 2003 survey.

The areas identified in 2004 that are relevant to the current proposed expansion were originally labeled “Polygon A” and “Polygon D”. Polygon A is a patch of four acres of ***sugar maple - beech - yellow birch forest*** around 1800’ elevation with numerous large trees, most of which are between 100 and 200 years old. Because of its relatively small size, and presumed history of timber management, Polygon A was considered locally significant, but not an exemplary natural community at a statewide scale.

Higher on the slope, and west of the summit, is Polygon D, a 16-acre patch of ***northern hardwood - spruce - fir forest***. This area was identified as mature, with possible old-growth characteristics. Several cored red spruce (*Picea rubens*) trees were found to be over 170 years old (6 of 8 cored trees exceeded 170 years). The dominance of spruce suggests that this area has never been logged since red spruce was historically selectively logged on Mt. Sunapee, leaving the hardwoods behind. Polygon D was considered statewide significant due to:

1) The condition is good to very good in that it appears to never have been logged;
2) Small patches of old examples of this natural community type (***northern hardwood - spruce - fir forest***) are rare;
3) Polygon D is part of a larger mosaic of mature and old growth patches of exemplary forest on Mt. Sunapee (East Bowl); and
4) It is contiguous and forms the northern extent of the large, unfragmented forest block to the south (Sunapee-Pillsbury Highlands).

Based on these factors, and on the polygon's contiguity with other significant forest patches, Polygon D was recorded in the NHB database as part of the exemplary ***northern hardwood - conifer forest system*** that had been identified in the East Bowl.

2014 NHB Surveys:
Revisits to Polygons A and D confirmed the original assessment of the forest condition. Polygon A was characterized by large hardwoods, particularly sugar maple (*Acer saccharum*) and yellow birch (*Betula alleghaniensis*) with diameters in the 25" range. A ring count of a sugar maple coring determined that it was 156 years old. There were eight other hardwoods in this area around the same size diameter at breast height (dbh) as the cored sugar maple. The hardwood forest between Polygons A and D was characterized by trees that did not appear to be as large or old (generally 12-18" diameter) as those in Polygon A, but was generally mature and in good condition.

Polygon D was generally dominated by red spruce, with scattered hardwoods, primarily yellow birch. Conditions within Polygon D were not uniform, with patches large spruce and birch stems interspersed with smaller trees. Red spruce in the 22-30" diameter range were unevenly distributed, and ages for two individuals based on trees cores were approximately 120 years old. More trees were cored in this polygon in 2004, and six of eight of those showed ring counts exceeding 170 years old.

Adjacent to MSSP is property owned by the Mount Sunapee Resort. The Resort property includes most of the land west of the state park, as well as a relatively narrow (roughly 1,500' wide) strip of land south of MSSP. The proposed ski resort expansion would impact approximately half of this southern strip, as well as portions of the lower slope areas to the west. There is extensive forestland protected through a conservation easement held by DRED south of the narrow strip of land.

The 2014 NHB surveys assessed the condition of this adjacent parcel, focusing primarily on the southern strip. The larger western portion of the property is on lower slopes (mostly below 1,500' elevation), and there were indications of extensive recent forest management, with evident skid trails, cut stumps, and a generally younger age structure. The southern parcel of land is at higher elevation that rises from roughly 1,500' to nearly 2,500', just south of the summit of Mt. Sunapee. The terrain is mostly west- and south-facing slopes, with a few first-order streams.

The forest across most of the southern strip is dominated by northern hardwood species, primarily yellow birch, sugar maple, and American beech (*Fagus grandifolia*). In areas with particularly steep or rocky terrain there are patches that are dominated by red spruce. For the most part, the forest condition in this southern strip was similar to that of the West Bowl downslope of Polygon D with mostly mature hardwoods, but with some evidence of past management. In general, the condition was good, but not exemplary because it lacked old growth characteristics and showed obvious signs of past management activities.

However, in the northeastern corner of the southern strip of Resort property is an area with larger trees that stand out from the surrounding forest. This area, approximately 10 acres, was characterized by a mix of hardwoods and red spruce, with numerous trees having larger (20-35") diameters. Tree cores revealed trees in the 120-year old range, similar to those in Polygon D. Unlike Polygon D, there were at least two old cut stumps observed within this area, indicating that at least a portion of this stand had experienced timber management.

Due to the condition of this stand, this section may be worthy of inclusion in the exemplary ***northern hardwood - conifer forest system*** on MSSP. At this location in the far eastern end of the southern strip, the private property is separated from the state park by another area of state-owned land that is a part of the Pillsbury-Sunapee Highlands Corridor. This corridor has never been surveyed by NHB, but could have forest of similar quality that would provide a direct connection to the exemplary forest on MSSP.

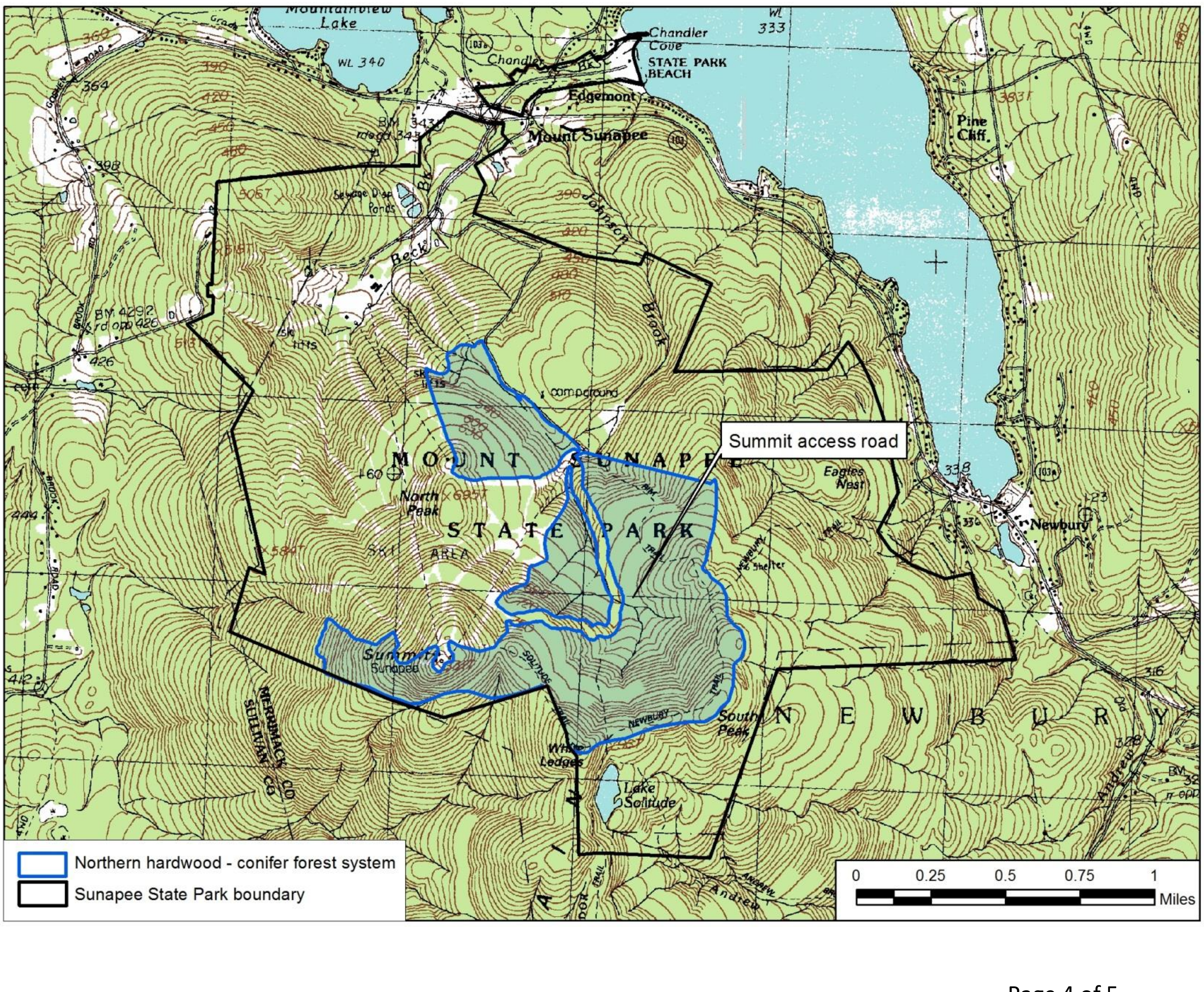
There are three natural communities within the exemplary ***northern hardwood – conifer forest system*** (Image 1) on Mt. Sunapee State Park:

(1) ***high-elevation spruce - fir forest***;

(2) ***sugar maple - beech - yellow birch forest***;

(3) ***northern hardwood - spruce - fir forest***;

Image 1   Location of exemplary natural community system in Mt. Sunapee State Park



The sections of mature trees found in the exemplary natural community system add significant value to the larger forest mosaic of Mt. Sunapee. This mosaic in turn has a high ecological value because of its connection to the extensive Sunapee Highlands Corridor. Large, intact systems are more resistant to impacts from natural disturbance, insects and disease, and human disturbance.