SUPPLEMENTAL INFORMATION

Appendix I
Appendix J
Appendix K

WOLFEBORO ROADWAY EVALUATION

TOWN OF WOLFEBORO
WOLFEBORO, NEW HAMPSHIRE

April 2019

UEI PROJECT 2211

UNDERWOOD engineers

APPENDIX I

- Additional References
  - A Series Quick Maintenance Guides (UNH T^2 Center)
  - Guidelines For Spring Road Use Restrictions (UNH T^2 Center)
  - Hard Road to Travel
  - NHDOT Reclaimed Asphalt Specification
  - Measuring Distresses (UNH T^2 Center)

A Series of Quick Guides for New Hampshire Towns

Assisting Local Road Maintenance & Construction Through Cooperation

NH Association of Conservation Districts

University of New Hampshire
Technology Transfer Center

Soil Conservation Service
U.S. Department of Agriculture

THE NORTH COUNTRY
Resource Conservation and Development Area

UNIVERSITY OF NEW HAMPSHIRE
COOPERATIVE EXTENSION

Foreword and Acknowledgements

This series, *A Quick Guide for New Hampshire Towns, No. 1-10,* has been developed for local road agents, public works personnel, highway crews, other local officials, and contractors. It is designed as an aid to help complete common tasks with a minimum of erosion, sedimentation, and flooding problems. Each *Quick Guide* addresses one task and identifies common problems associated with the job, a set of guidelines to follow, and sources of assistance for additional help.

This series has been developed and compiled through a cooperative effort involving several federal, state, regional, and local agencies and organizations. A list of these contributors has been included for your information. The authors of these guides have given a great deal of time and resources to bring you this project and deserve a note of appreciation. We would also like to acknowledge the Federal Emergency Management Agency (FEMA) and the New Hampshire Office of Emergency Management for providing the funds for this project through Section 404 of the Hazard Mitigation Grant Program.

By design, the *Quick Guide* series is not complete. Additional *Quick Guides* are expected to be developed in the future.

Please keep your *Quick Guide* series intact, either in this folder or a three ring binder. But most of all, please use it and tell us what you like or dislike. Your suggestions for improving a *Quick Guide* or your ideas for new *Quick Guide* topics are welcome and encouraged.

Thank you,

Richard R. DeMark
Project Coordinator
North Country RC&D Area, Inc.

John A. Anderson
Director
Technology Transfer Center

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center.

Register Your Quick Guides!

By design, the *Quick Guide* series is not complete. Additional *Quick Guides* are expected to be developed in the future. Please provide us with your registration information so we may send you new additions and updates in a timely manner.

-- Please Print in the Spaces Below --

Name ______________________________ Title ______________________________

Town or Company ______________________________

Street or P.O. Box ______________________________

Suite or Room Number ______________________________

City ______________________________ State __________ Zip __________

Phone: (   ) ______ - ________

Fold this form on the dotted line, affix a stamp, and place in the mail.

Return Address ______________________

____

____

____

Place
Stamp
Here

Quick Guide Registration
c/o North Country RC&D Area, Inc.
103 Main St. Suite 1
Meredith, NH 03253

List of Contributors

Alan Ammon
U.S. Soil Conservation Service
Federal Building
Durham, NH 03824
868-7581

John Anderson
University of New Hampshire
Technology Transfer Center
Civil Engineering Department
Durham, NH 03824
800-423-0060 (NH Only) 862-4348

Rick DeMark
North Country RC&D Area, Inc.
103 Main St. Suite 1
Meredith, NH 03253
279-6546

Peter Davis
NH Association of Conservation Districts
NH Department of Agriculture
Caller Box 2042
Concord, NH 03302-2042
271-2894

Richard Ellsmore
U.S. Soil Conservation Service
P.O. Box 533
Conway, NH 03818
447-2771

Jim Hersey
U.S. Soil Conservation Service
719 North Main St. Room 203
Laconia, NH 03246
528-8713

Jan Hooper
Belknap County Conservation District
719 North Main St.
Laconia, NH 03246
528-8713

John Kantor
UNH Cooperative Extension
Pettee Hall
Durham, NH 03824

Janet Kucera
Carroll County Conservation District
P.O. 533
Conway, NH 03818
447-2771

Ted Kelsey
U.S. Soil Conservation Service
Federal Building
Durham, NH 03824
868-7581

Gerry Lang
U.S. Soil Conservation Service
Federal Building
Durham, NH 03824
868-7581

Frank Mitchell
UNH Cooperative Extension
111 Pettee Hall
Durham, NH 03824
862-1067

Jim Moore
Bureau of Municipal Highways
NHDOT
John O. Morton Bldg.
P.O. Box 483, Hazen Drive
Concord, NH 03301

Joan Richardson
Carroll County Conservation District
P.O. Box 533
Conway, NH 03818
447-2771

New Hampshire Road Agent Association
c/o University of New Hampshire
Technology Transfer Center
Civil Engineering Department
Durham, NH 03824
800-423-0060 (NH only) 862-2826

A.R. Van de Meulebroecke
University of New Hampshire
Technology Transfer Center
Civil Engineering Department
Durham, NH 03824
800-423-0060 (NH only) 862-2826

Grace Walker
Federal Emergency Management Agency
Office of Emergency Management
State Office Park South
107 Pleasant Street
Concord, NH 03301
800-852-3792 or 271-2231

Murray Fay
New Hampshire Fish & Game Dept.
Region 2
P.O. Box 417
New Hampton, NH 03256
744-5470

Table of Contents

Culvert Installation and Maintenance

A Quick Guide for New Hampshire Towns - No. 1

Task:

Culvert Installation and Maintenance

Description:

Culverts are used through roads and driveways to carry stream flow and stormwater runoff so vehicles do not have to drive through the flowing water.

Potential Problems:

- Sediment problems can develop in waterways downstream of road crossings due to excavation or backfilling operations during installation of culverts.
- Damaged culverts or culverts filled with sediment cannot carry the designed quantity of flow so water may overtop the roadway causing erosion and safety problems from vehicles driving through flowing water.
- Improperly sized culverts can cause upstream flood problems from water backing up at the road crossing.
- Water quality problems can be created from improper grade control during installation of culverts.
- Significant erosion problems can develop at the outlet of culverts if not properly designed or installed.

Guidelines:

- Culverts should be designed with adequate capacity to carry the 10% chance or 10 year frequency storm runoff, minimum requirement by town regulations, or sized to handle the rates used to design upstream structures.
- For small watersheds (less than 20 acres), culverts may be sized using the following rule of thumb: Culvert diameter (inches) = 8 + acres of drainage. For example, a culvert draining 13 acres of land would need to be at least 21 inches in diameter (see approximate method on page 2).
- The design of culverts for watersheds larger than 20 acres should be referred to a professional trained in hydrology and hydraulics.
- Culverts draining water from road ditches, areas adjacent to the road, and the road surface itself should be spaced at distances no greater than 500 feet apart.
- All culverts should be a minimum of 12 inches in diameter, or 18 inches if freezing is a major problem for plugging.

UNIVERSITY OF NEW HAMPSHIRE
TECHNOLOGY TRANSFER CENTER

THE NORTH COUNTRY
RESOURCE CONSERVATION AND
DEVELOPMENT AREA

UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

Soil
Conservation
Service
U.S. Department
of Agriculture

NH ASSOCIATION OF CONSERVATION DISTRICTS

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

- To avoid frost heaving problems, culverts should be installed below frost depth (36 inches minimum).
- A minimum of 1.0 foot of fill over a culvert is recommended.
- The bottom width of a trench for installing the culvert should be twice the width of the culvert and the trench side walls should be at a 1:1 slope or flatter.
- Properly compact the soil around and over the culvert pipe in small layers to prevent seepage along the pipe and reduce settlement of the road over the culvert. The excavated material should be used for the backfill.
- Provide needed erosion and sediment control as noted in *Quick Guide No. 3* for vegetative erosion and sediment control.
- Stabilize the inlet and outlet to protect from erosion.
- Install or conduct maintenance operations during the summer months when streams and brooks are at low flows and when erosion and sedimentation problems are minimal and can be easily solved.
- The outlet of all culverts should be protected against erosion and undermining. One method of protection is a stoned outlet or plunge pool. For culvert sizes of 30 inch diameter or less, an outlet pool lined with 6:12 inch stone constructed one diameter deep, two pipe diameters wide and four pipe diameters long will provide adequate outlet protection (see **Figure 1**). Outlet protection for all culverts larger than 30 inches in diameter should be designed by a professional engineer.

Culvert Design by Approximate Method

Drainage Area	Culvert Diameter
0 - 5 Acres	12"
5 - 10 Acres	18"
10 - 15 Acres	24"
15 - 20 Acres	30"
>20 Acres	Detail Design

References:

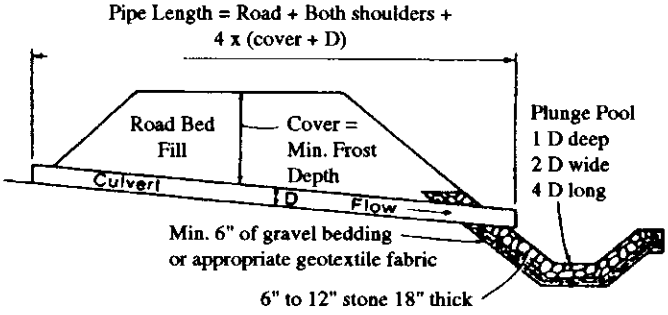
- *Hydraulic Design of Highway Culverts*, Federal Highway Administration, Hydraulic Design Series No. 5, September 1985.
- *Hydraulic Charts for the Selection of Highway Culverts*, Federal Highway Administration, Hydraulic Engineering Circular No. 5, December 1965.
- *Urban Hydrology for Small Watersheds*, USDA, Soil Conservation Service, Technical Release No. 55, June 1986.
- *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, NHDES, USDA-SCS, Rockingham County Conservation District, 1992.

Where to Get More Information:

Your County Conservation District and Soil Conservation Service Office

or

Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824 Call: (603) 862-2826 or (800) 423-0060



Plunge Pool Design

Culvert Diam. (Ft.)	Depth (Ft.)	Width (Ft.)	Length (Ft.)
1.0	1.0	2.0	4.0
1.5	1.5	3.0	6.0
2.0	2.0	4.0	8.0
2.5	2.5	5.0	10.0
>2.5	Need Detailed Engineering Design		

Ditch/Channel Construction & Maintenance

A Quick Guide for New Hampshire Towns - No. 2

Task:

Ditch and Channel Construction and Maintenance

Description:

Roadside ditches and channels are constructed to carry storm runoff and stream flows from one location to an adequate outlet without causing an erosion or sedimentation problem.

Potential Problems:

- During construction sediment problems can develop downstream from the erosion of bare soil in channels and ditches.
- Severely eroded ditches or channels can cause damage to the road or become a safety hazard to motorists.
- Ditches and channels without good quality permanent vegetation cannot remove some roadway pollutants from runoff water.
- Undersized ditches can cause ice build-up onto the roadway presenting safety hazards.
- Improper fertilizer application can cause groundwater and surface water quality problems.

Guidelines:

- Stable outlets should be established before constructing the ditch or channels.
- Install subsurface drains where high ground water or seepage problems are prevalent. Locate drains at the edge of the channel with the top of the drain at least 2-feet below the bottom of the channel.
- Vegetatively lined ditches and channels should be limited to those grades less than two percent.
- Construction operations should be scheduled to allow for immediate seeding within ditch or channel cross sections during optimum grass establishment periods. If construction is not complete then apply adequate mulch or matting.
- Use **Figure 1** to determine the type of protective lining needed in the ditch or channel. For constructed grades of three percent or steeper, channels should be lined with stone.

UNIVERSITY OF NEW HAMPSHIRE
TECHNOLOGY TRANSFER CENTER

THE NORTH COUNTRY
RESOURCE CONSERVATION AND
DEVELOPMENT AREA

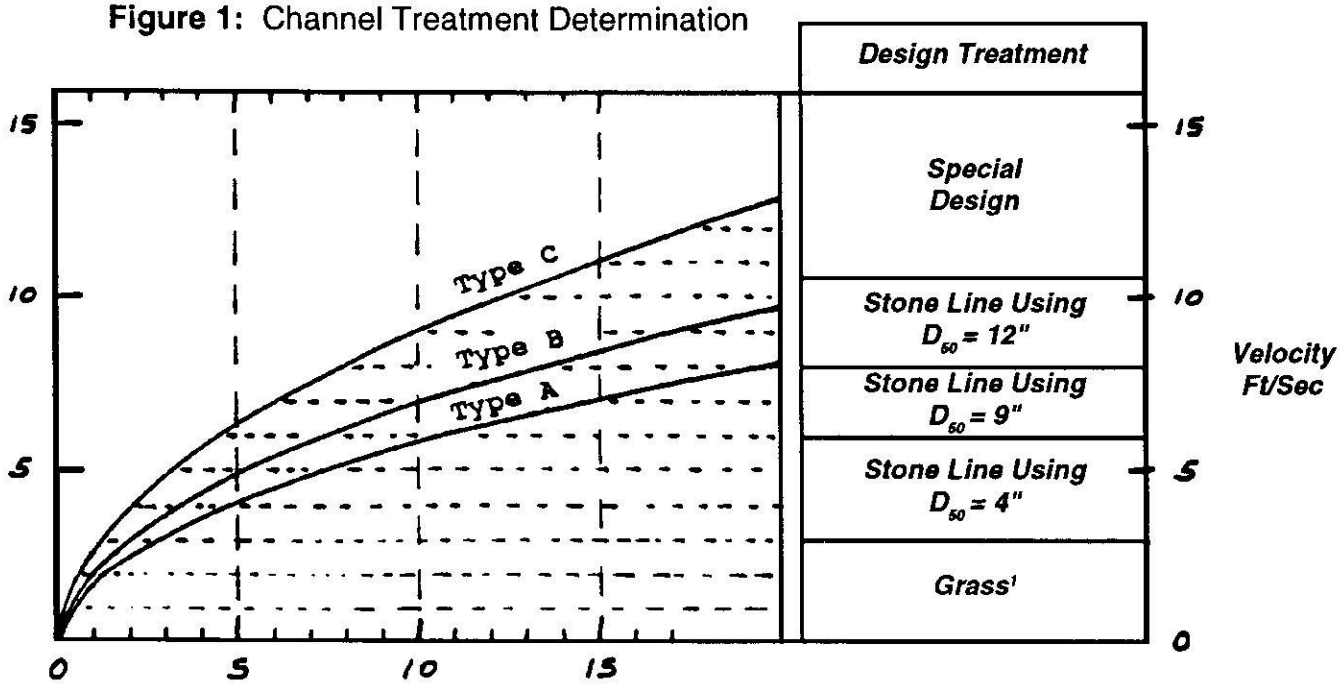
UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

Soil
Conservation
Service
U.S. Department
of Agriculture

NH ASSOCIATION OF CONSERVATION DISTRICTS

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

Figure 1: Channel Treatment Determination



Notes:

- D_{50} *Size of stone for which 50% of the stone is larger and 50% is smaller with good mix of other sizes*
- [1] *Erosion netting may be needed during the establishment of the grass*
- ***Type A, B, & C:*** *defined in Figure 2 (page 3)*

- Channels with grades less than three percent should have stone lined centers if long duration low flows are expected (durations greater than 5 days). See **Figure 1** for stone sizes.
- The lower one-third of the drainageway can be considered the critical area needing protection by stone lining. The depth of flow area (in excess of 1-foot minimum) should be based on the capacity needed. A rule-of-thumb for roadside areas is to provide a minimum capacity of 1.5 cubic feet per second (cfs) for each acre of drainage area. See **Figure 2**.
- Proper bedding of the stone with a layer of bank-run gravel at least 6-inches thick or a suitable filter fabric is needed to provide additional stability to stone lined areas.
- All runoff water should be diverted away from newly seeded areas as much as possible until the vegetation is well established. Repair damaged areas immediately both when initially seeding and also after the vegetation is established.
- Stone lined channels should also be repaired immediately after finding damaged areas to protect the remaining stone.
- Provide needed erosion and sediment control as noted in *Quick Guide No. 3* for vegetative erosion and sediment control. See seeding and mulching recommendations as noted in Table 1 of that guide.
- See **Figure 3** (page 4) for typical ditch cross sections.

References:

- *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, NHDES, USDA-SCS, Rockingham County Conservation District, 1992.
- *SCS Field Office Technical Guides, Standards and Specifications for Waterway Design.*

- *Design of Roadside Drainage Channels, Federal Highway Administration, Hydraulic Design Series* No. 4, Reprinted 1973.
- *Design of Stable Channels with Flexible Linings*, Federal Highway Administration, Hydraulic Engineering Circular No. 15, Reprinted March 1977.
- *Handbook of Channel Design for Soil and Water Conservation*, Soil Conservation Service, SCS-TP-61, Revised June 1954.
- *Runoff and Erosion Control Guidelines for Highway Crew Leaders*, Maine Conservation and DOT agencies, May 1986.

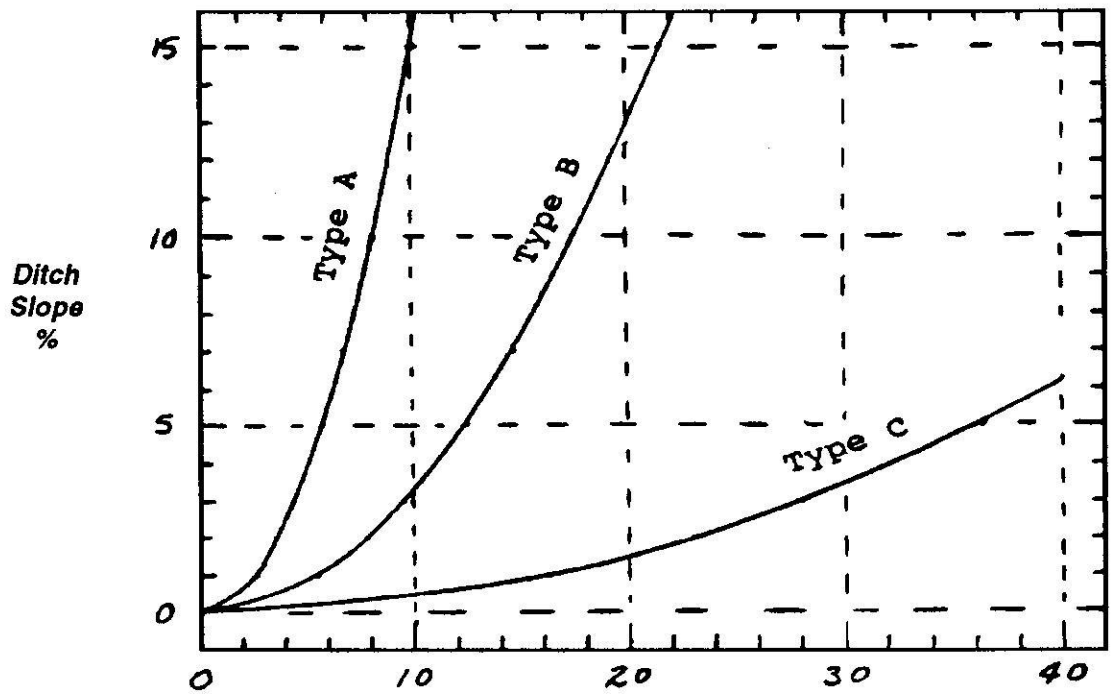
Where to Get More Information:

Your County Conservation District and Soil Conservation Service Office

or

Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824 Call: (603) 862-2826 or (800) 423-0060

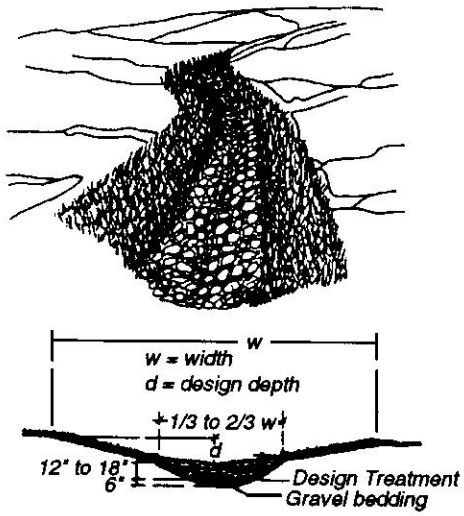
Figure 2: V-Ditch Size Determination



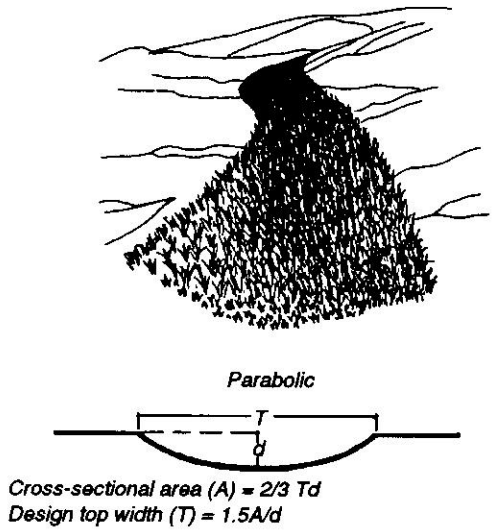
Notes:

- ***Type A -*** *Curve for a Flow Depth of 0.75 ft. in a V-Ditch with 2.5 to 1 side slope and flow area = 1.4 square feet (see Figure 3)*
- ***Type B -*** *Curve for a Flow Depth of 1.0 ft. in a V-Ditch with 2.5 to 1 side slope and flow area = 2.5 square feet (see Figure 3)*
- ***Type C -*** *Curve for a Flow Depth of 1.5 ft. in a V-Ditch with 2.5 to 1 side slope and flow area = 5.6 square feet (see Figure 3)*

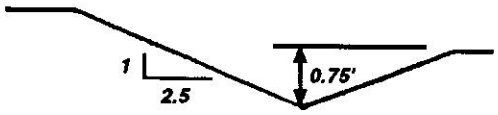
Figure 3: Typical Ditch and Channel Cross Sections



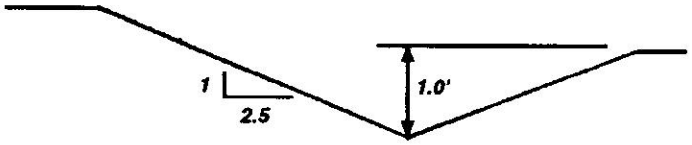
Stone Center Channel



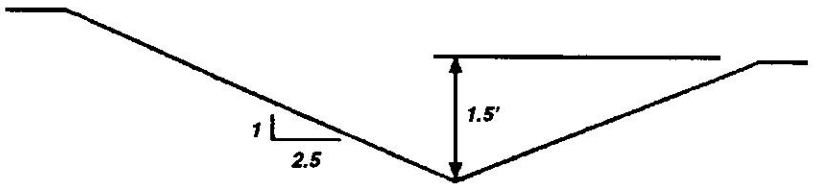
Vegetated Channel



Type A Ditch



Type B Ditch



Type C Ditch

Vegetative Erosion & Sediment Control

A Quick Guide for New Hampshire Towns - No. 3

Task:

Planning and Installing Vegetative Erosion & Sediment Control Measures

Description:

Erosion and sediment control at construction sites and along roadsides is used to control erosion and sedimentation for water quality.

Potential Problems:

- Eroded soil and the nutrients they carry may cause surface water quality problems.
- Eroded areas adjacent to roadway pavements can cause safety problems for motorists and pedestrians.
- Sediment from eroded areas can cause blockage of culverts producing flooding and safety problems.
- Roadsides and ditches without good vegetation cannot improve water quality by filtering runoff.
- Sediment deposition off site can cause safety and legal problems with neighbors.

Guidelines:

- Mulch can be used with plantings or for erosion control and applied at the rate of 2 tons/acre of hay or 2 bales/1000 square feet. Anchor mulch using approved tackifiers tracking or disking into soil surface. See **Table 1**.
- Other protective covers include jute or fibrous mats placed primarily over seeded areas and in high concentrated, long duration flow areas such as channels. Crushed stone .25 to 1.5 inches in diameter spread one to two inches thick is effective in controlling water erosion on driveways and roadsides.
- A temporary seeding can be used protect an area when the job is completed after the recommended cutoff date for permanent seedings (August 15), or in an area that will be disturbed again within one year. Also use temporary seedings anytime during the growing season if an area will be disturbed again. See **Table 1**.

University of New Hampshire
Technology Transfer Center

THE NORTH COUNTRY
Resource Conservation and
Development Area

UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

Soil
Conservation
Service
U.S. Department
of Agriculture

NH Association of Conservation Districts

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

- All seedings, whether permanent or temporary, will benefit from an application of lime and fertilizer. Lime and fertilizer should be mixed into the top three inches of a prepared seedbed. See **Table 2** for recommended rates.

- A permanent seeding of grasses and legumes is made for long term protection of an area from erosion. Seedbed should include a minimum of four inches of top soil. Optimum seeding dates are April and May and the first two weeks of August. Use seed mixtures as recommended in **Table 1**. Concentrated flow areas need to be protected with matting or stone as noted on previous page.

References:

- *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, NHDES, USDA-SCS, Rockingham County Conservation District, 1992.

- *Engineering Field Manual*, USDA, Soil Conservation Service.

Where to Get More Information:

Your County Conservation District and Soil Conservation Service Office

or

Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824 Call: (603)862-2826 or (800)423-0060

Table 1: Seeding and Mulching Recommendations

Mixture or Treatment	Rate (lbs/ac)	Applicable Use
Creeping Red Fescue Redtop Tall Fescue Birdsfoot Trefoil	15 2 15 5	Permanent seeding for areas NOT subject to concentrated surface water flow
Tall Fescue Redtop	20 2	Permanent seeding for areas subject to concentrated surface water flow
Annual Rye Grass	30	Temporary seeding
Hay Mulch	2 Tons or 2 Bales/1000 sq. ft.	Mulching to provide moisture conservation and erosion control

Table 2: Lime and Fertilizer Quantities for Seeding Types

Type of Seeding	Lime	Fertilizer
Temporary	1 ton/acre or 50 lb./1000 sq. ft.	1/2 ton/acre of 10-10-10 or 23 lb./1000 sq. ft.
Permanent	2 tons/acre or 100 lb./1000 sq. ft.	1/4 ton/acre of 10-20-20 or 11.5 lb./1000 sq. ft.

Non-Vegetative Erosion & Sediment Control

A Quick Guide for New Hampshire Towns - No. 4

Task:

Planning and Installing Non-Vegetative Erosion & Sediment Control Measures

Description:

Disturbed soil areas at construction sites and along roadsides need to be stabilized using individual or combinations of vegetative and non-vegetative measures to control erosion and sediment.

Potential Problems:

- Eroded soil and the nutrients they carry may cause surface water quality problems.
- Eroded areas adjacent to roadway pavements can cause safety problems for motorists & pedestrians.
- Sediment from eroded areas can cause blockage of culverts producing flooding and safety problems.
- Roadsides and ditches without good vegetation cannot improve water quality by filtering the runoff.
- Sediment deposited off site can cause safety and legal problems with neighbors.

Guidelines:

- Earth dikes, like diversions, can be used to direct sediment ladened water to a sediment trapping device or to divert clean water away from a construction site. For drainage areas less than 5 acres, construct dike 18 inches high with a 2 foot top width and 4 foot channel width. See **Figure 1**. Make side slopes 2:1 or flatter and channel grade from 0.5 percent to 20 percent. See **Table 1** for channel stabilization criteria. Locations where the diverted water is discharged must be stable for flow conditions.
- Sediment basins or traps are constructed to collect and store sediment during construction operations. A state permit may be required based on the size of the basin. For drainage areas up to 20 acres, the dike top width must be 8 feet and the dam height cannot exceed 10 feet. The total spillway capacities must safely pass the 10 percent chance storm. The minimum storage volume of the basin shall be 1800 cubic feet of storage for each acre of drainage area. Detail design criteria as shown in the

UNIVERSITY OF NEW HAMPSHIRE
TECHNOLOGY TRANSFER CENTER

THE NORTH COUNTRY
RESOURCE CONSERVATION AND
DEVELOPMENT AREA

UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

Soil
Conservation
Service
U.S. Department
of Agriculture

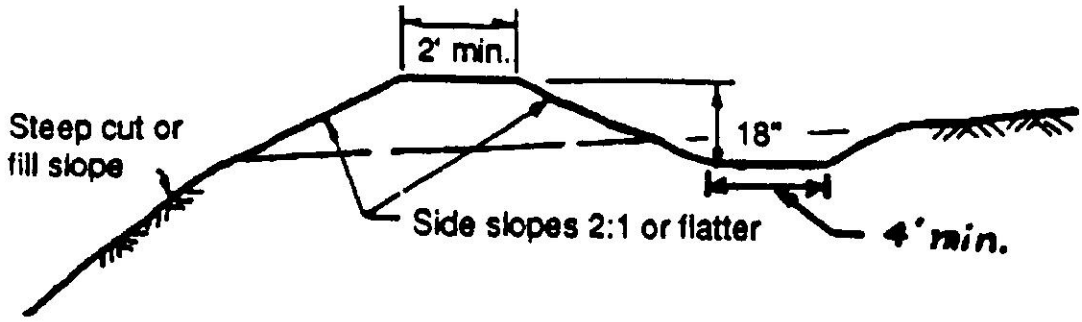
NH ASSOCIATION OF CONSERVATION DISTRICTS

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

Table 1: Channel Stabilization Criteria

Channel Grade	Treatment
0.5 - 2.0%	Seed and Mulch
2.1 - 5.0%	Seed and cover with Jute or Excelsior; Sod or line with 2 - 4" diameter stone
5.1 - 8.0%	Line with 4 - 8" diameter stone
8.1 - 20.0%	Engineering Design

Figure 1: Dike Above Steep Slopes



stormwater management erosion and sediment control handbook should be used for the basin.

- Silt fences are used to intercept overland flow and detain small amounts of sediment from unprotected areas where the fence can be placed in or adjacent to a vegetated or stabilized area below the fence. Slope distance from upper hay bale barrier or top of slope to silt fence shall not exceed 120 feet and fence shall be placed as close to the contour as possible. Silt fence shall not be used where concentrated flow such as in a channel or drainageway will come in contact with the fence. Bottom of fence must be buried in the ground. See **Figure 2** for installation details.

- Hay bale barriers are used to intercept and detain small amounts of sediment from unprotected areas where no other erosion controlling measure is feasible. Slope distance from top of slope or upper barrier to new barrier shall not exceed 100 feet and rows shall be placed as close to the contour as possible. Hay bale barriers shall not be placed across channels or drainageways carrying concentrated flows except for drainage areas less than 1 acre. See **Figure 3**. Barriers should be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized. Hay bales may also be placed around catch basins where the contributing drainage area is less than 1 acre and a relatively level 35 feet square area around the inlet is available to temporarily store the runoff water. See **Figure 4** for installation details.

- Grade stabilization structures are used to reduce or prevent excessive erosion in channels or drainageways by reduction of velocities and hydraulic slope in the watercourse. These structures may be small check dams or larger drop inlet structures. Channel linings of concrete, asphalt, concrete block, half-round metal pipe, or other suitable lining materials can be used to make chutes to carry water from a higher elevation to a lower level. Overfall structures of concrete, metal, rock riprap, or other suitable material can be used to lower water a small difference in elevation. Pipe drop structures with adequate detention storage and trash protection can also be used to lower flow from a higher to lower elevation in a channel. Scour protection at both the inlet and outlet is needed to prevent erosion when using any of these structures. These structures shall have a minimum discharge capacity to handle the bankfull capacity of the channel delivering water to the structure. These structures should be designed by a professional engineer.

REFERENCES:

- *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, NHDES, USDA-SCS, Rockingham County Conservation District, 1992.
- *Engineering Field Manual*, USDA, Soil Conservation Service.
- *Hydraulic Design of Energy Dissipaters for Culverts and Channels*, Federal Highway Administration, Hydraulic Engineering Circular No. 14, December 1975.

Where to Get More Information:

Your County Conservation District and Soil Conservation Service Office

or

Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824 Call: (603) 862-2826 or (800) 423-0060

Figure 2: Installing Silt Fence

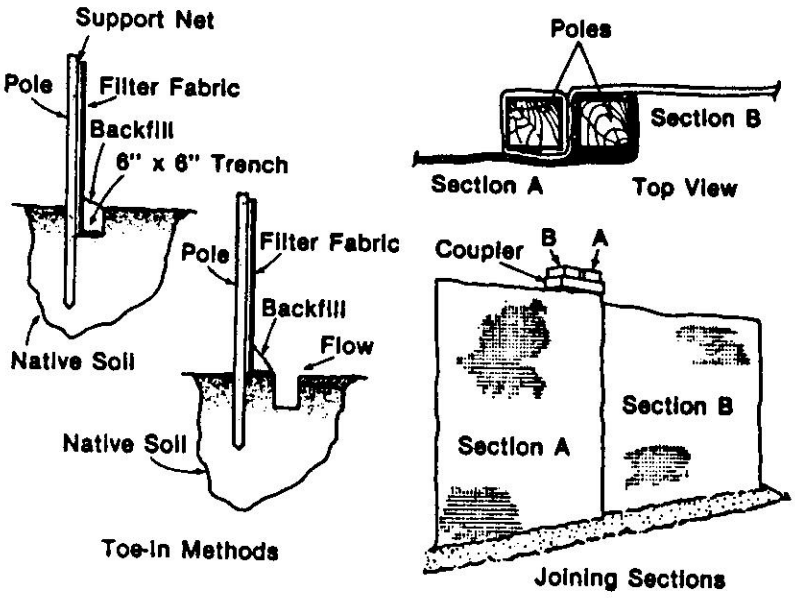
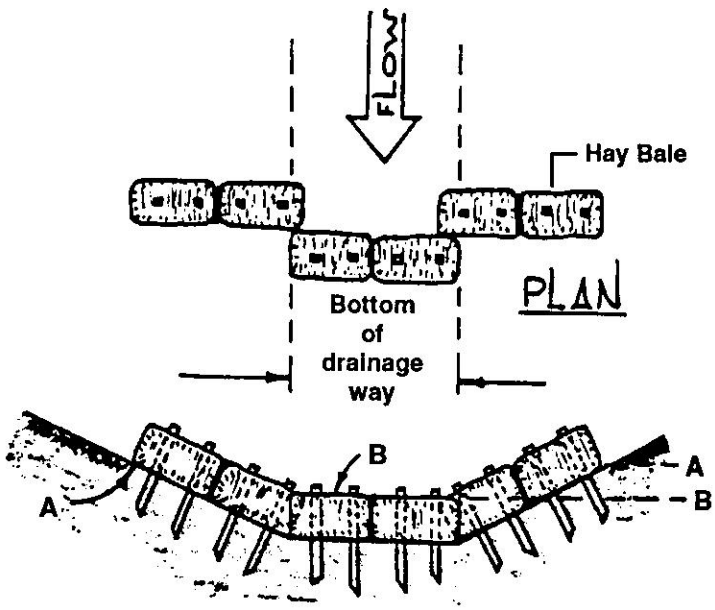
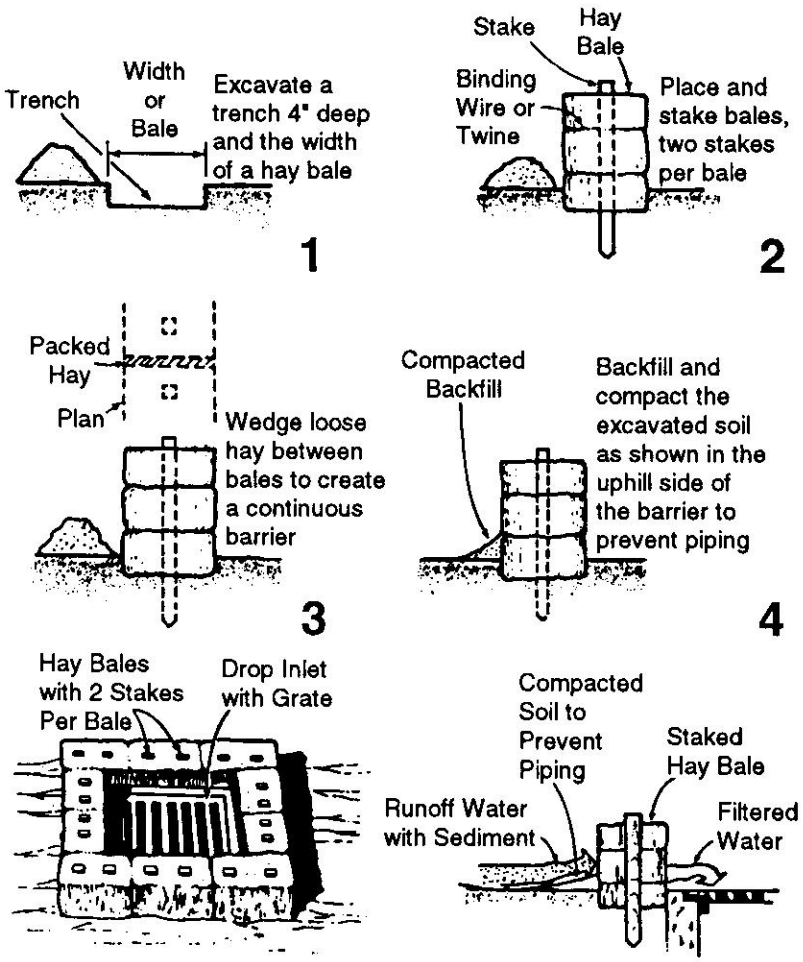


Figure 3: Ditch Flow Check Barrier



Elevation: Points A must be higher than Points B

Figure 4: Installing Hay Bale Barriers



Cut & Fill Slopes

A Quick Guide for New Hampshire Towns - No. 5

Task:

Stabilization and Maintenance of Cut and Fill Slopes

Description:

Slopes developed along roadways from cuts or fills when constructing the road and drainage system require special considerations to keep them stable.

Potential Problems:

- Steep cut and fill slopes may be difficult to vegetate and maintain.
- Steep cuts in large hillsides normally develop seeps and wet spots which may cause landslides and erosion problems.
- Erosion and slides from cut areas can block drainageways and roads causing safety problems.
- Unstable fill areas can settle or erode causing safety problems on the roadway.
- Steep cut slopes constructed close to property lines or structures can fail and damage other land owner structures close to the top of the cut slope.
- Improperly installed culverts in fills which outlet on the fill slope can cause significant erosion and possible failure of the fill slope.

Guidelines:

- Fill and cut slopes should be constructed on a minimum 2:1 horizontal to vertical slope or flatter if possible. If the slopes are to be mowed, then the slopes should be at least 3:1 or flatter.
- Reverse slope benches or diversions should be provided when the height of the cut or fill exceeds 20 feet. Flow from these benches should be discharged only into stable watercourses. See **Figure 1.**
- Berms or diversions should be a minimum of 1 foot deep and 5 feet wide. Grades should be approximately 1 percent with a maximum grade of 2 percent.
- Wherever possible, runoff water shall be diverted away from the top of cut or fill slopes to stable outlets.

UNIVERSITY OF NEW HAMPSHIRE
TECHNOLOGY TRANSFER CENTER

THE NORTH COUNTRY
RESOURCE CONSERVATION AND
DEVELOPMENT AREA

UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

Soil
Conservation
Service
U.S. Department
of Agriculture

NH ASSOCIATION OF CONSERVATION DISTRICTS

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

- Provisions shall be made to safely conduct surface runoff to storm drains, protected outlets, or to a stable watercourse to insure the runoff will not damage the slope.
- Subsurface drainage should be provided in areas having high water tables to intercept drainage which could affect slope stability.
- All disturbed areas should be stabilized structurally or by vegetation in accordance with applicable guides.
- Provide needed erosion and sediment control as noted in the guide for vegetative erosion and sediment control. See seeding and mulching recommendations as noted in Table 1 of that guide.
- Large gullies and landslides should have treatment designed by an engineer.

References:

- *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, NHDES, USDA-SCS, Rockingham County Conservation District, 1992.
- *Engineering Field Manual*, USDA, Soil Conservation Service.

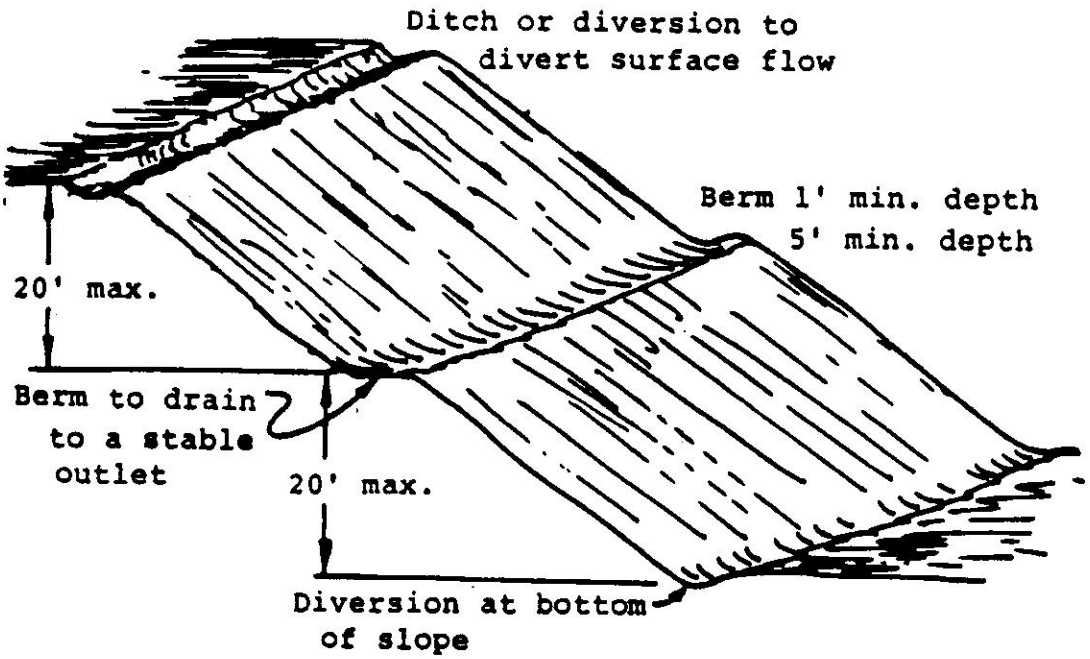
Where to Get More Information:

Your County Conservation District Office

or

Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824 Call: (603) 862-2826 or (800) 423-0060

Figure 1: Slope Detail Showing Reverse Berm



Beaver Pipe: Construction & Maintenance

A Quick Guide for New Hampshire Towns - No. 6

Task:

Construction and Maintenance of "Beaver Pipe".

Description:

Flooding which has been caused by beavers has been successfully controlled in New Hampshire by the use of "beaver pipes". They are inserted in the beaver dam to control water levels. The height of the outlet and the length of the pipe are both factors in producing the desired water level.

Potential Problems:

- Beaver populations are abundant and widespread in New Hampshire. Hence, if an area is attractive to beaver it will likely be repeatedly visited and used by beaver.

- Roadways, culverts and property can be damaged when beaver dams impound water or release flood water.

- Shallow water impoundments created by beaver provide some of the most valuable habitat conditions for many species of wildlife. The process of flooding and subsequent abandonment provide a continuum of changing habitat conditions that are attractive to a succession of wildlife species. Annihilation of beaver in an area can negatively impact this wildlife system.

Guidelines:

- **Construction:** Beaver pipes are about 12 inches square and 24 feet long. They are constructed of 1-inch white pine stock and built in two 12 foot sections. The entire length of one side of the pipe is made of 2-inch by 4-inch 12 ½ gauge galvanized woven wire. The wire is cut in the center of the ninth mesh or 20 inches wide. Three 48-inch long panels are stapled end to end along the bottom of each 12 foot section of pipe. Slats 1-inch by 4-inches by 14-inches are nailed on top of the mesh across the bottom of the pipe. The extra mesh, along with the prongs, remaining from where the wire was cut, are wrapped over the edge of the pipe and attached with 1-inch wire staples to prevent chewing. The upstream end of the finished 24 foot pipe is boarded over to prevent beavers from plugging the pipe. See **Figure 1**.

UNIVERSITY OF NEW HAMPSHIRE
TECHNOLOGY TRANSFER CENTER

THE NORTH COUNTRY
RESOURCE CONSERVATION AND
DEVELOPMENT AREA

UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

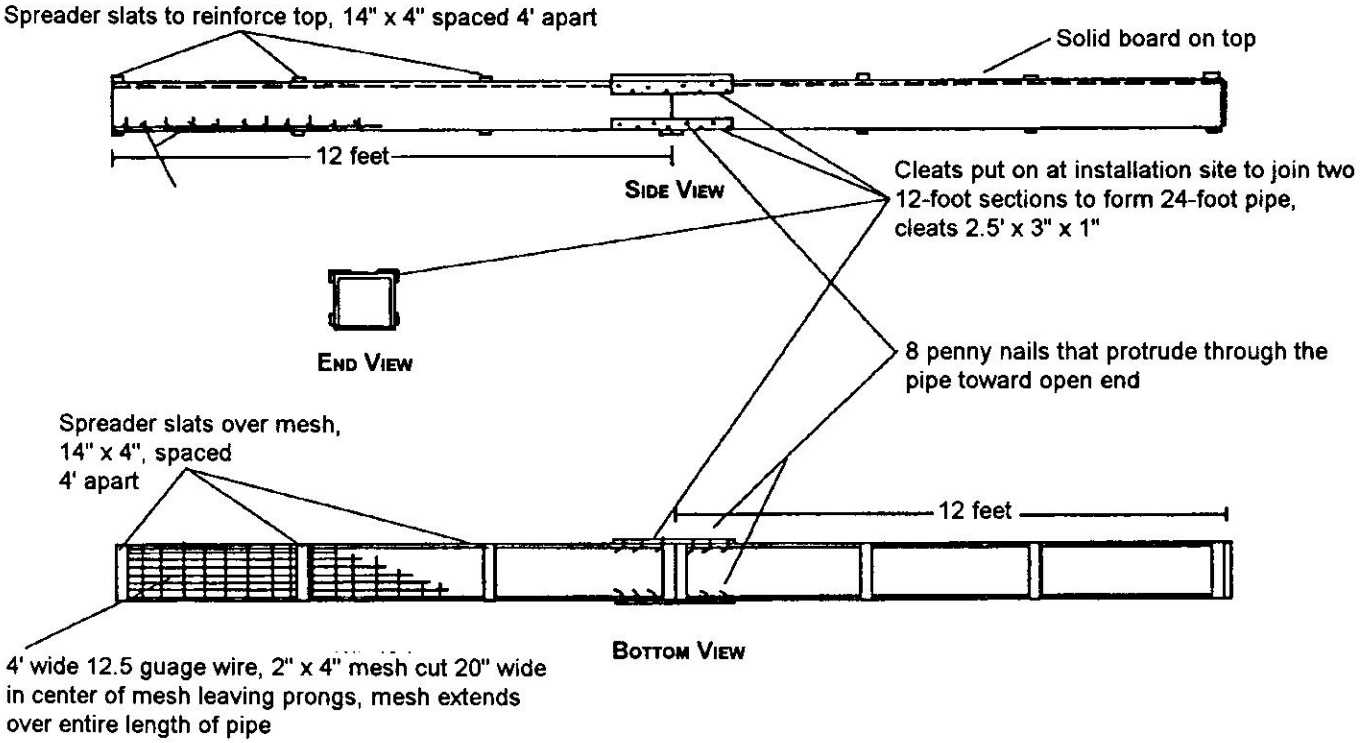
Soil
Conservation
Service

U.S. Department
of Agriculture

NH ASSOCIATION OF CONSERVATION DISTRICTS

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

Figure 1: Details for the Construction of a Beaver Pipe -- Made of Pine or Other Soft Wood



- **Installation:** The usual procedure upon receiving a request to stabilize a beaver impoundment is to check a contour map to determine the location and approximate drainage area.

  Under New Hampshire conditions, one pipe is used for each three square miles of drainage area. The number of pipes required to accomplish the flow are assembled on location. The total length of each pipe is determined mostly through experience. In most situations a minimum of 24 feet per pipe is recommended. The distance from the bottom of the pipe to the bottom of the pond and the amount of free-floating material that might clog the pipe are important considerations in determining length. The closer the pipe is to the pond bottom and the more free-floating material present, the greater the length of pipe needed to ensure trouble-free operation. The minimum distance between the bottom of the pipe and the bottom of the pond should be one foot.

  The pipes are placed through the dam where the depth of upstream water is the greatest. If two or more pipes are required, they should be located as far apart as possible. When separate placement is not practical, such as where outlets must flow into culverts or narrow ditches, the pipes should be placed in a fan shape with outlets together as shown in **Figure 2**. Separated pipes are more difficult for the beaver to bury and plug.

- **Maintenance:** Beaver pipe installations require regular maintenance for proper functioning. Maintenance requirements vary greatly with the individual installation and with season. All pipes should be checked a few days after installation and at least once a month thereafter. Unless it is possible to check them at monthly intervals, more than half of them will likely fail. Routine maintenance is not as costly as it might appear since this may be done by the landowner or other interested local people. After the beavers have rebuilt the dam they will usually extend it back along the pipe for only a short distance. In this situation the pipes need only be cleaned occasionally along the underside with a potato hoe or by hand. In some instances, the beaver will build a dike under the entire length of pipe. If such a dike is built, it is usually easier to change the location of the pipes than to remove the dike. Install the pipes so they slope down into the pond, thus keeping the upstream end under water to discourage diking. Beaver will also try to plug the outlet end by piling brush on it. This is usually unsuccessful.

- **Estimated Costs:** To do a complete installation including one 24 foot beaver pipe, iron stakes, and woven wire fence would cost approximately $100 (in 1992 $). Labor to install the average system runs three or more hours.

- **How Beaver Pipes Work:** Beaver cannot understand the upward movement of water and although they recognize a leak is present in the dam they cannot figure out how it is leaking.

Alternatives:

- **Cultural Control:** Eliminating potential food supplies and habitat by clearing trees and brush near ponds (especially aspen), and keeping crops at least 100 yards from streams and ponds may persuade beaver to not occupy, or leave an area.

- **Lethal Control:** Control of this type may be resorted to, however, before attempting any form of lethal control contact your local conservation officer or your nearest NH Fish and Game Regional Office.

Reference:

- Laramie, H.A. and S.W. Knowles (1990) *Beavers and Their Control*, Wildlife Fact Sheet 10. University of New Hampshire Cooperative Extension. Durham, NH.

Where to Get More Information:

- New Hampshire Fish and Game Regional Office

- UNH Cooperative Extension, Wildlife Specialist
  Rm 101 Pettee Hall
  UNH Durham, NH 03824

- Your County Conservation District and Soil Conservation Service Office

- Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824
  Call: (603) 862-2826 or (800) 423-0060

Figure 2: Top View of Beaver Pipe Installation

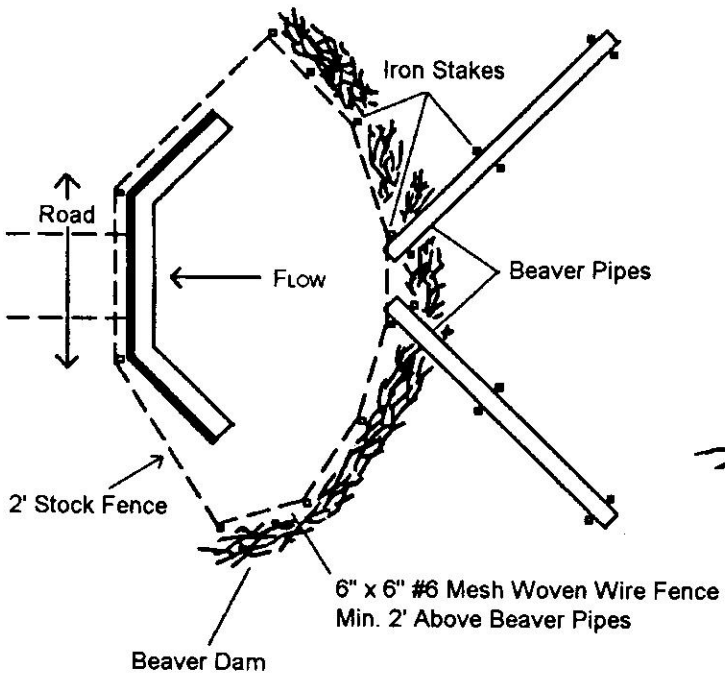
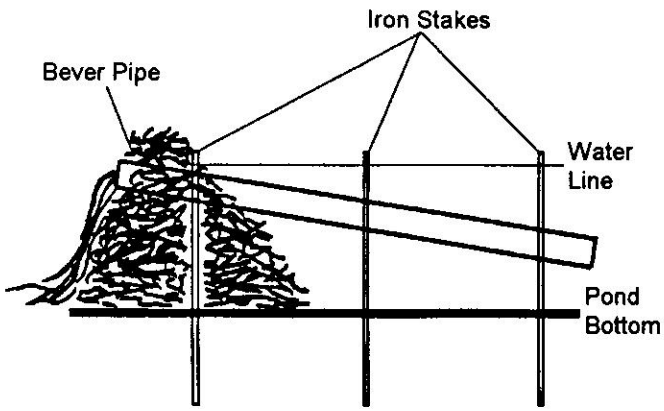


Figure 3: Side View of Beaver Pipe Installation



Stormwater Inlets & Catch Basins

A Quick Guide for New Hampshire Towns - No. 7

Task:

Construction and Maintenance of Stormwater Inlets and Catch Basins

Description:

Catch basins and surface inlets are used to allow storm runoff to enter underground pipelines carrying storm flows from a drainage area to an appropriate outlet.

Potential Problems:

- Steep slopes are subject to erosion from stormwater.
- Stormwater systems discharging directly into surface water bodies carry road pollutants directly into the water.
- Improperly maintained catch basins cannot trap sediment or pollutants from roads.

Guidelines:

- Whenever possible, use vegetated ditches and channels to carry stormwater runoff instead of catch basins and stormwater sewers.
- Catch basins and stormwater sewer systems should be used where sensitive areas need to be protected from untreated stormwater discharges from roadways and urban areas.
- Stormwater sewer systems are effective when installed along steep roads or roads constructed on high fills. Significant erosion damage can be reduced or eliminated by carrying the stormwater in pipes instead of surface flow over steep land areas.
- There are three general types of stormwater inlets used; grate inlet, curb inlet, and combination inlet. Each inlet requires special design and should be depressed to insure runoff from the road enters the basin. The spacing and number depends on the amount of control desired.
- Proper compaction of backfill material under and around the catch basin will reduce settlement and possible heaving problems. Unplanned settlement can cause pavement cracks resulting in potholes and possible damage to the catch basin or stormwater pipes.

University of New Hampshire
Technology Transfer Center

The North Country
Resource Conservation and
Development Area

University of
New Hampshire
Cooperative Extension

Soil
Conservation
Service
U.S. Department
of Agriculture

NH Association of Conservation Districts

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

- Catch basins installed with sumps can be used to trap sediment and road pollutants. This trapping measure is only effective if sumps are cleaned periodically to maintain capacity.

References:

- *Urban Storm Drainage - Criteria Manual*, Volume 1, Denver Regional Council of Governments, March 1969, Revised 1991

Where to Get More Information:

- Your County Conservation District and Soil Conservation Service Office
- Consulting Engineers

or

- Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824
  Call: (603) 862-2826 or (800) 423-0060

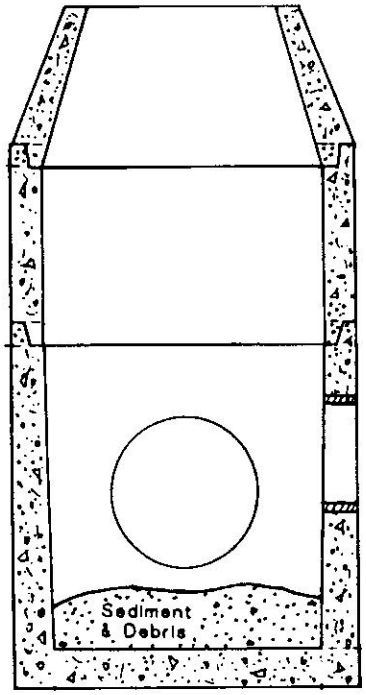


Figure 1: Catch Basin

Mowing & Brush Control

A Quick Guide for New Hampshire Towns - No. 8

Task:

Mowing and Controlling Roadside Vegetation

Description:

Mowing of roadside grasses and brush suppression are accomplished to: (a) prevent extensive tree growth from occurring, (b) prevent encroachment of bushy growth in ditches, (c) maintain a grass/legume sod, (d) improve visibility for signing and sight distance, (e) improve visibility for trash clean up, and (f) improve roadside aesthetics.

Potential Problems:

- A lack of vegetation can cause erosion to occur.
- Destruction of grasses and legumes occurs with close mowing.
- Destruction of desirable vegetation can occur with the improper choice and use of herbicides.
- Where soils are dry and sandy and vegetation is weak, mower wheels can destroy existing vegetation.
- Elimination of wild flowers along the roadside occurs with improper mowing.

Guidelines:

- Set mower blades high (four to five inches) when mowing grasses and legumes.
- When using herbicides for brush suppression, follow regulations of the New Hampshire Pesticide Control Division of the New Hampshire Department of Agriculture, guides of the Cooperative Extension, and container label instructions.
- Do not mow areas where weak vegetation of moss occurs on sandy soils unless necessary to control encroaching shrubs.
- Where wild flowers are to be encouraged, either no mowing or mowing late in the season after flowers have gone to seed are two options to consider.
- Where woody shrubs are a recurring problem consider renovating the area and seeding to grasses and legumes.

UNIVERSITY OF NEW HAMPSHIRE
TECHNOLOGY TRANSFER CENTER

THE NORTH COUNTRY
RESOURCE CONSERVATION AND
DEVELOPMENT AREA

UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

Soil
Conservation
Service

U.S. Department
of Agriculture

NH ASSOCIATION OF CONSERVATION DISTRICTS

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

Roadside Mowing Safety Tips

1. Read the operator's manual thoroughly. Supervisors, as well as equipment operators, need to complete this step.

2. Leave room for a mower between trees and bridges or other structures. Strip grass from around the tree in a circle to help avoid mower wounds that can kill trees. The radius of the circle should be 1 to 3 feet, depending on the size of the tree. Remove low tree branches that can click an eye or throw the operator off balance. Keep holes filled for a level terrain.

3. Once mowing begins, mow in the direction of oncoming traffic. This results in less impact if an object is hit and thrown out. It also provides better visibility.

4. Ballast or weight the tractor properly. This becomes especially important when mowing on a hillside, or when using boom mowers.

5. Be sure your mower has a roll-over protection structure. Use the seat belt at all times. Contrary to an old myth, jumping clear in a roll-over accident does not provide safety.

6. Before you mow, visually inspect the area. Watch for washouts and for debris that can be thrown. Remove the debris and work carefully around washouts.

7. Check and prepare the mowing vehicles for proper operations. Use flashing lights, "Slow Moving Vehicle" signs, and road signals to alert traffic.

8. Always be aware of how close you are to the edge of the roadside.

9. Always look both ways before cautiously proceeding across roads.

10. Wear protective equipment, safety glasses, hard hat, etc. Rocks come off gravel trucks and hit tractor drivers. Because loose clothing can snag on controls, tuck in shirttails.

11. Herbicide used to control weeds can be a hazard. Check with a local safety director on personal protective devices warranted.

12. Protect yourself from the sun. Use a canopy on the mower, wear sun screen and a shirt and hat.

13, Keep all guards, shields and safety devices in place. The shields reduce the chance of being hit by a thrown object. Never defeat safety items such as operator presence systems (seat switches).

14. Produce safety in maintenance and lubrication. When working on the unit, keep it turned off and lowered to the ground or properly supported.

15. Never carry riders or allow others nearby when mowing.

16. Never by-pass the safety start system. Keep the starting and safety start systems in good working order.

17. When mowing, let others know your intentions. Use hand signals.

18. Follow all of the warnings in the operator's manual. Never get complacent. Keep a positive safety attitude.

19. Set the height of the mower's back one inch higher than the front. The resulting angle tends to force objects to be hit forward and down so that chains are more effective in deflecting them to the ground.

20. Be aware of the danger zone to the right side rear of the mower. Field experiments with rotary mowers show that most debris exited the right side rear of the mower.

References:

- *New England Guide to Chemical Control of Problem Weeds and Brush on Non-Cropland.* Revised annually and available from the UNH Cooperative Extension.
- *Tech Info Sheet #46.* Pennsylvania Local Roads Program, Penn. DOT & Penn. State University.
- *Better Roads, Vol. 61, No. 2, Feb. 1991.*

Where to Get More Information:

- New Hampshire Cooperative Extension
- The New Hampshire Department of Agriculture, Division of Pest Control
- Your County Conservation District and Soil Conservation Service Office

or

- Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824
  Call: (603) 862-2826 or (800) 423-0060

Snow & Ice Control

A Quick Guide for New Hampshire Towns - No. 9

Task:

Snow and ice control

Description:

Plowing snow, melting ice on roadways, opening frozen culverts

Potential Problems:

- Groundwater and surface water contamination by road salt from storage & handling area and road application
- Destruction of roadside vegetation due to salt applications
- Groundwater contamination by cyanide used in anti-caking compounds
- Surface water pollution by sediment from sand applied to roads
- Sediment from erosion caused by ditches filling with sand from road application

Guidelines:

- Store salt in covered building
- Handle and load salt on impermeable pad, preferably a roofed one.
- Use a minimum salt to sand ratio (e.g., 1:20.)
- Calibrate truck spreaders
- Apply sand or salt after, rather than before or during storms. Apply the sand or salt, if safety permits, before the snow is packed by traffic. In blowing snow, salt will cause drifting snow to stick to pavement -- if salt is not used, snow is likely to blow off the cold road surface.
- Adjust salt application rates to temperature conditions. When temperature is below 20 degrees, salt is ineffective in melting snow and ice. Avoid salt application when it is below this temperature.
- Strip application of salt (as opposed to broadcasting across the road surface) can expose a portion of the road surface to the sun, increasing the melting rate.

UNIVERSITY OF NEW HAMPSHIRE
TECHNOLOGY TRANSFER CENTER

THE NORTH COUNTRY
RESOURCE CONSERVATION AND
DEVELOPMENT AREA

UNIVERSITY OF
NEW HAMPSHIRE
COOPERATIVE EXTENSION

Soil
Conservation
Service
U.S. Department
of Agriculture

NH ASSOCIATION OF CONSERVATION DISTRICTS

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

- Use a portable heater or large generator to thaw culverts, not salt (request the Technology Transfer Center Publication, *Road Business,* Vol. 5, No. 3: *Thawing a Culvert with a Tar Kettle* and *Frozen Culverts: An old time remedy for reducing frozen culvert problems*).

- If snow is removed and dumped, place it where it will not affect drinking water supplies, wetlands or surface waters, for example, away from sand and gravel aquifers, drinking water wells, wetlands, rivers, streams, lakes and ponds.

- See checklist below, adapted from Mass. Audubon Society

References:

- *Salt and Sand for Winter Maintenance* in Road Business. Technology Transfer Center, Univ. of NH, Dept. of Civil Engineering, Durham, NH 03824, Vol. 3, No. 4, December, 1988.

- *Road Salt and Groundwater Protection*, Flyer #9. Mass. Audubon Society, February 1987.

Where to Get More Information:

- NH Department of Transportation

- New Hampshire Department of Environmental Services

- Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824
  Call: (603) 862-2826 or (800) 423-0060

Snow & Ice Control Checklist

Salt Storage Areas

- ❑ Are storage areas far away from water supplies, wells, aquifers, lakes, ponds, wetlands, bogs, and other sensitive areas?
- ❑ Are all salt piles in sheds?
- ❑ If not, are storage areas covered and on impervious pads?
- ❑ Are storage areas properly drained?
- ❑ Can brine from drainage systems be dried for use on roads?
- ❑ Is handling area unobstructed and clean of spilled chemicals?
- ❑ Are truck loading and unloading operations shielded from wind and weather?
- ❑ Are salt shipments planned so no extra handling or outside storage is needed?

Chemical Application

- ❑ Have sensitive areas (water supplies, aquifer recharge areas, etc.) been identified?
- ❑ Are reduced salting rates or other special measures used to protect sensitive areas?
- ❑ Are different levels of service used for different road types and weather conditions?
- ❑ Is no-salt alternative used whenever possible?
- ❑ Are individual maintenance crew members assigned the same section of road and the same equipment for each storm?
- ❑ Is information on new techniques sought and used when appropriate?

Equipment and Maintenance

- ❑ Are ground-speed controllers used for all salt spreaders
- ❑ Are spreaders calibrated before the winter season begins, with actual tests of material to be used?
- ❑ Are "underbody" scrapers used to scrape the road before applying chemicals?
- ❑ Is preseason maintenance done before the winter begins?
- ❑ Is equipment maintenance done immediately after each storm?
- ❑ Are spare parts on hand before the season begins?

Snow Dumping

- ❑ Is snow that is removed from highways, parking lots, and other salt-treated areas disposed of in areas where water supplies will not be contaminated?
- ❑ Is direct dumping into rivers, wetlands, lakes, ponds, and bogs avoided?
- ❑ Is snow dumped away from sanitary landfills, to avoid additional leaching of wastes?

Training & Planning

- ❑ Are "snow schools" or other training sessions held for snow removal equipment operators?
- ❑ Do crew members know where sensitive areas are and how to treat them, especially on their individual sections of road?
- ❑ Are crew members familiar with the location of aquifers and other sensitive areas in relation to the roads and salt-storage areas?
- ❑ Are outside experts brought in to explain groundwater issues at snow schools?
- ❑ Are crew members asked for suggestions on maintenance of the areas they are familiar with?
- ❑ Do local conservation commissions and planning board members help in developing snow and ice control policies and plans?
- ❑ Are levels of service planned before the winter starts?
- ❑ Do crew members understand the connection between salt levels and public health?
- ❑ Is the public warned to drive carefully in areas that are not salted or are given minimal chemical treatment?

Obtaining Permits

A Quick Guide for New Hampshire Towns - No. 10

Task:

Obtaining permits for excavating or filling in wetlands or ponds, culvert work in stream channels or banks, land clearing, and alteration of stone walls.

Description:

The type of work listed above usually requires permits from state agencies, in accordance with state law. Municipalities, as well as individuals are required to comply with these requirements. In addition, towns may also have requirements about such work, such as ordinances and scenic road designations.

Regulations are intended to protect water quality, wildlife habitat and the scenic and historic values associated with certain land areas. Compliance will help protect valuable natural resources and save time and money in the long run.

Guidelines:

- Any excavation, filling, operation of equipment or construction in a pond, stream, or wetland (poorly drained and very poorly drained soils) generally requires a permit from the NH Wetlands Board (PO Box 2008, Concord, NH 03301). Permit applications are available from town clerks. Some activities which are purely for forestry purposes are required to follow "best management practices" and can be undertaken using an abbreviated permit notification process.

- Land clearing in excess of 100,000 square feet (about 2 ½ acres) requires a permit from the NH Water Supply & Pollution Control Division (PO Box 95, Concord, NH 03301) unless it is within 250 feet of a lake or river shoreline. In such a case a permit is needed for land clearing in excess of 50,000 square feet. The state requires that erosion and sediment be controlled on sites cleared of vegetation. Towns may have similar requirements for smaller projects.

- Cutting of trees near streams, rivers, lakes, ponds, or roads is controlled by RSA 224:44-a, the "basal area law", which limits cutting to 50% of the basal area of tree trunks within 150 feet of any pond over 10 acres, within 150 feet of any navigable river, within 50 feet of any stream which flows throughout the year, and within 150 feet of any public highway.

University of New Hampshire
Technology Transfer Center

The North Country
Resource Conservation and
Development Area

University of
New Hampshire
Cooperative Extension

Soil
Conservation
Service
U.S. Department
of Agriculture

NH Association of Conservation Districts

A Quick Guide for New Hampshire Towns, is published in cooperation with the NH Association of Conservation Districts, Carroll County Conservation District, North Country RC&D, UNH Cooperative Extension, Soil Conservation Service, and the Technology Transfer Center. Any opinions, findings, conclusions, or recommendations presented in this publication are those of the authors and do not necessarily reflect views of the sponsoring organizations. Any product mentioned is for informational purposes only and should not be considered a product endorsement. All programs and activities of this project and its sponsors are available to anyone without regard to race, color, religion, sex, age, handicap, marital status, or national origin.

- The "slash law", RSA 224:44-b, requires that slash from tree cutting (piles over 4 feet high) not be left within 100 feet of an occupied building; not within 50 feet of any pond, river, or public highway; not within 25 feet of any stream which flows throughout the year; and not within 25 feet of an abutting landowner. No slash may be left in any pond, stream or river.

- In towns with designated scenic roads, cutting trees with a circumference of 15 inches or greater, or altering stone walls requires a public hearing and written consent of the planning board and any other town board designated by the town.

- Many stone walls are boundary markers and they are protected under RSA 472:6. Stone walls acting as boundaries should not be disturbed.

- Because permits and regulations involve agency review and sometimes public hearings, construction or maintenance activities should be planned reasonably far in advance in order to allow time for necessary approvals.

References:

- *Handbook for Municipal Conservation Commissions in New Hampshire.* New Hampshire association of Conservation Commissions, Concord, NH 1988

- *Best Management Practices for Controlling Soil Erosion on Timber Harvesting Operations in New Hampshire.* New Hampshire Timberland Owners' Association, 1990.

- Town ordinances and town reports, regarding requirements for erosion control or scenic road designation.

Where to Get More Information:

- NH Department of Environmental Services

- UNH Cooperative Extension

- NH Division of Forests and Lands

- Your County Conservation District and Soil Conservation Service Office

  or

- Technology Transfer Center, UNH, CiE Dept., Durham, New Hampshire 03824
  Call: (603) 862-2826 or (800) 423-0060

GUIDELINES FOR SPRING ROAD USE RESTRICTIONS

A Publication of

The University of New Hampshire

Technology Transfer Center

December 1996

Revised December 2000

GUIDELINES FOR SPRING ROAD USE RESTRICTIONS

A Publication of

The University of New Hampshire

Technology Transfer Center

33 College Road, Kingsbury Hall
Durham NH 03824-3591
603-862-2826
800-426-0060
www.t2.unh.edu

December 1996

Revised December 2000

Acknowledgments

The December 1996 booklet was prepared from Guidelines for Spring Highway Use Restrictions, Report No. FHWA TS-87-209, published by the Federal Highway Administration. Dr. David H. Fluharty, Director of the University of New Hampshire Technology Transfer Center, edited it. He was assisted by David Rand, a consultant to the Center. It

was revised to reflect users' experiences, especially Douglas Dowey, Maintenance Supervisor, NH Department of Transportation District 3.

GUIDELINES FOR SPRING ROAD USE RESTRICTIONS

Introduction

In many areas that have cold weather, especially those above the 40th parallel, pavements become damaged during the thawing periods. Damage usually occurs during late winter and early spring, but also occurs during warm weather periods in the mid-winter months. To prevent potholes and cracks from forming, highway agencies can:

1. Apply truck load restrictions during the thawing (or critical) period, or
2. Change the pavement structure to prevent or reduce damage.

Due to budget constraints, many agencies have only the first alternative.

In the 1980s the Washington State Transportation Center (WSTC) completed studies in cooperation with the Washington State Department of Transportation, Oregon State University, the Federal Highway Administration, and numerous state, city, and country agencies. Prior to these studies, few straightforward procedures existed that would determine the amount of load restrictions needed, when to apply them, and when to remove them. Therefore, a need existed to develop guidelines to help local agencies handle this serious problem. On the following pages a method is described to help local agencies more effectively apply load restrictions. (The method is also described in a videotape available from the UNH T² Center).

Douglas Dowey, a Maintenance Supervisor, applied the method during three winters in District 3 of the NH Department of Transportation. Mr. Dowey found that the method worked well for beginning road use restrictions. He found that the user had to exercise judgement to determine when to end restrictions. The factors users should consider are discussed in the section "Estimating the Duration of Road Use Restrictions."

The Problem

Frost action in soils can cause several damaging effects. A commonly known effect is frost heave. Less information is available on an equally serious problem, loss in the ability of the road base to support heavy vehicles. Reduced base course strength occurs during the thaw period (usually late winter or early spring). Water that penetrated the roadway layers freezes during the winter cold. During a thaw the ice melts from the top down, trapping water until the lower ice layers melt. The trapped water saturates the wearing and base course layers.

This effect is similar to the effects of a rising groundwater table, infiltration of water through a porous pavement surface or shoulder, or water penetrating a roadbed cut into a hillside or located in a water-saturated terrain. Whatever the cause, when the amount of moisture is above the amount the pavement was designed for, the strength (or stiffness) of the pavement and its supporting base is reduced.

Most pavement design methods are based on studies of pavement behavior when the subgrade moisture and density are optimum. In other words, design methods are based on the assumption that water will be diverted away from the road or will drain out of the base course.

The damage to a pavement structure, even with acceptable moisture levels, is directly related to the weights and frequency

of the applied loads. A majority of the state DOTs use the AASHTO Interim Guide for Design of Pavement Structures[1] for designing their pavement thicknesses. In designing a specific pavement using this method the traffic is changed to equivalent 18,000 lb. single axle loads for a given design period and for known or assumed materials. Any lowering of material strength or increase in the number of equivalent 18,000 lb. single axle loads reduces the life of the pavement. Thus, the method of reducing loads when the strength of the pavement materials is reduced is a reasonable way to maintain the design life and general serviceability of the pavement. Hence, there is often a need for load restrictions during spring thaw because excessive water is present in the subgrade.

The Guidelines

The WSTC researches found that local and state highway agencies have a wide variety of practices for applying load restrictions before the "spring thaw." Truck load enforcement programs differ widely in terms of the load limits applied, the forms the restrictions take, and their implementation. The decision to close or open a highway or street is largely determined by experience and sometimes political pressure. There has been very little information to help decision-makers. Because federal and state research projects generally focus on high volume roads, little information has been available for secondary and lower category highways, even though these types of highways form a large part of county and municipal road systems. Local governments generally have low to modest maintenance budgets; few can afford to overlay the pavements damaged during the spring snowmelt. Therefore, a need exists for criteria for determining truck weight restrictions during the spring thaw.

The following guidelines are based on research and analysis of the WSTC,[2] and Mr. Dowey's use in New Hampshire. These guidelines provide criteria to help determine:

1. Where to apply load restrictions,
2. The amount of the load restrictions to apply, and
3. When to apply and when to remove load restrictions.

The guidelines are general and must be applied with judgment. The time period and degree of the problem are site specific.

Guidelines for Where to Apply Load Restrictions

The WSTC researchers concluded that agencies should consider the following criteria when selecting pavements for load restrictions.

1. Surface thickness,
2. Type of subgrade,
3. Local experience relating to observed moisture and pavement distress, and
4. Surface deflections.

Surface Thickness. Agencies should consider load restrictions if the pavement surface thickness is about two inches or less and where the Cumulative Freezing Degree-Days (defined in Degree-Days, page 4) is greater than 400. All areas in New Hampshire will have Cumulative Freezing Degree-Days greater than 400.

Type of Subgrade. Pavements or unpaved roads with a fine-grained subgrade

[1] _____. 1990. Geometric Design of Highways. Washington DC: American Association of State Highway and Transportation Officials.

[2] Rutherford, M.S., J.P. Mahoney, R.G. Hicks, and T.Rwebangera. 1985. "Guidelines for Spring Highway Use Restrictions," Final Report. Olympia WA: Washington State Department of Transportation.

are candidates for load restrictions. Silts and clays, common in New Hampshire, are considered fine-grained soils.

Local Experience. Site drainage and road behaviors are significant in determining the need for load restrictions. Poor drainage from side ditches, available ground water, and high winter precipitation should be considered. Observation of pavement distress, such as fatigue (alligator) cracking and rutting, may also determine the need for load restrictions. If these distress types primarily occur during the spring thaw, load restrictions are needed if options such as strengthening the overall pavement structure are not possible or appropriate. The experience of highway agency managers should be used as much as possible.

Surface Deflections. Finally, WSTC researchers concluded that pavement sections are candidates for load restrictions if the surface deflects 40 to 45 percent more during the spring thaw than during the summer. However, site specific conditions can significantly alter the deflection threshold. For example, a relatively "weak" pavement section may have relatively high summer deflections. Thus, spring thaw deflections less than 40 to 45 percent might still require load reductions. By inference, surface deflection increases of unpaved roads indicates a need for spring road use restrictions.

Guidelines for Load Restriction Amount

The load reductions used by the agencies interviewed in the WSTC studies ranged from about 20 to 60 percent. The average load reduction for seven locations (grouped state areas) was approximately 44 percent. This suggests that reducing the load on individual axles (or tires) by about 40 to 50 percent reduces the associated pavement response to levels that prevent or reduce the resulting pavement distress to acceptable levels.

The research results showed that the more loads are reduced, the greater the increase in the associated pavement life. As shown in Table 1, potential pavement life increases are dependent on load reduction (starting with a load reduction of 20 percent). Thus, if the 44 percent load reduction level is used (average of the several grouped state areas previously noted), this results in a potential improvement in pavement life of about 90 percent.

Table 1

Pavement Load Reduction (%)	Pavement Life Increases (%)
20	62
30	78
40	88
50	95

However, the necessary level of load reductions is not as simple as the preceding numbers suggest. For example, many thin or generally weak pavement structures need high levels of load reduction during the spring thaw period to prevent significant pavement damage (i.e., small or even modest levels of load reduction will not prevent significant pavement damage). Unpaved roads, especially those with a poor subgrade, are

even more susceptible to damage from heavy vehicles.

The WSTC study showed that, if load restrictions are to be used, the load reductions should be a minimum of 20 percent. Load reductions greater than 60 percent appear to be excessive for paved roads. The general national practice for paved roads was to use load reductions ranging from 40 to 50 percent. The analysis performed in the study confirmed the 40 to 50 percent range of load reduction for paved roads.

The analysts had insufficient data to draw conclusions about unpaved roads. Because many unpaved roads, especially very old roads, were not designed for modern truck loads, greater reductions than recommended for paved roads might be warranted in some situations. Local experience becomes especially important in the application of these guidelines to unpaved roads.

Degree-Days

The guidelines on when to apply and remove load restrictions are based on air temperature data. From average daily air temperatures the user calculates degree-days.

Degree-days are the number of degrees between some datum and the average temperature for a particular day. The datum for Freezing Degree-Days is 32°F. The summation of Freezing Degree-Days is a measure of the extent to which the road surface and base are subject to below-freezing temperatures. This summation, called Cumulative Freezing Degree-Days (CFDD) indicates the depth of freezing that has occurred.

The datum for Melting Degree Days is 29°F. An air temperature datum of 29°F is used to account for bituminous pavement surface heating effects since the pavement surface is about 32°F when the air temperature is 29°F. The 29°F datum is also used for unpaved roads for consistency.

The summation of Melting Degree-Days is a measure of the extent to which the road surface and base are subject to above-freezing, i.e., melting, temperatures. This summation, called Cumulative Melting Degree-Days (CMDD), indicates the rate of thawing over time.

Calculating Cumulative Freezing Degree Days

Freezing Degree-Days (FDD) are the differences between the 32°F and the average daily temperature. Cumulative Freezing Degree-Days (CFDD) are the amount and duration of temperature differences during the freezing period. CFDD are the sum of FDD over time.

The Degree-Days Log at the end of this booklet eases calculation of CFDD. In many instances, average daily temperatures for each are available from newspapers, government weather stations, private meteorologists, or businesses such as heating oil companies. These are entered in Column E. If average temperatures are not available, highs and lows will be available from these sources. Highs and lows are entered into Columns C and D of the Log. Their difference divided by "2" is entered in Column E.

Subtraction of the average from 32 yields the Freezing Degree-Days for that day, and is entered in Column F. The CFDD, the running total of these values, is recorded in Column G.

To minimize errors, one should indicate positive and negative values when recording FDD. For an average temperature less than 32°F, the FDD should be recorded with a "+"

sign and the value added to the CFDD from the prior day. Conversely, an average greater than 32°F yields a negative FDD, which should be recorded with a "-" sign and its value subtracted from the CFDD for the previous day.

The positive and negative notation also helps a user determine when to start the accumulation for CFDD. Average daily temperatures often fluctuate above and below 32° during November and early December. As they fluctuate, the road base freezes but then thaws. To be a measure of freezing depth, CFDD must be for that period of continuing freezing temperatures. Therefore, when the user identifies a clear pattern of positive FDD, he or she continues calculation of CFDD.

When it is clear that the maximum CFDD has been reached, recording FDD and CFDD can cease. It is the maximum CFDD that will be used later to calculate road use restriction duration.

Calculating Cumulative Melting Degree Days

Melting Degree-Days (MDD) are the differences between the average daily temperature and 29°F. Cumulative Melting Degree-Days (CMDD) are the amount and duration of temperature differences during the thawing period. Cumulative Melting Degree Days are the sum of MDD over time.

The Degree-Days Log also eases calculation of CMDD. When averages occur above 29°F, subtract 29 from the average and enter it in Column H. This is the MDD for that day. CMDD is the running total of these values and are recorded in Column I.

One should also indicate positive and negative values when recording MDD. When an average for a given day is more than 29°F, the MDD should be recorded with a "+" sign and the value added to the CMDD from the prior day. Conversely, an average less than 29°F yields a negative MDD, which should be recorded with a "-" sign and its value subtracted from the CMDD for the previous day.

Similar to the CFDD calculation, the positive and negative notation helps determine when to start CMDD calculation. In the spring, average daily temperature vary above and below 29°F. The user begins CMDD when there is a clear pattern of positive MDD. This will indicate a period of consistent melting of the road base.

CMDD are used to determine when to establish load limits. CFDD and CMDD are used together to determine when to remove them. Their applications are described below. It should be noted that the data for the study came from paved roads. The researchers suggest that the values for thin pavements be used for unpaved roads until the agency has data based on its experiences.

Guidelines for When to Apply Load Restrictions

As shown in Table 2, thermal analyses performed in the WSTC study resulted in two possible times for applying load restrictions. They are also a function of total pavement thickness.

Should Post

The "should" load restriction application time occurs after thin pavements accumulate 10 Cumulative Melting Degree-Days. For thick pavements, load restrictions "should"

Table 2

Pavement Structure	Pavement Thickness (Inches)	Base Course Thickness (inches)	Cumulative Melting Degree Day Should Post	Cumulative Melting Degree Day Must Post
Thin	2 inches or less	6 inches or less	10	40
Thick	More than 2 in.	More than 6 in.	25	50

begin when they accumulate 25 CMDD following the start of the thawing period. These thresholds are estimates of when thawing will be sufficient to reduce pavement strength. The "Should Post" threshold of 10 CMDD for thin pavements is also recommended for unpaved surfaces.

Must Post

The "must" load restriction application time occurs after thin pavements accumulate a 40 CMDD and thick pavements accumulate 50 CMDD following the start of the thawing period. These thresholds are estimates of when thawing will reach approximately four inches into the base course.

Discussion

A note should be entered in Column J of the Degree-Days Log when "Should Post" and "Must Post" values are calculated in Column I. In addition, users should note road conditions in Column J.

It is recommended that users apply the most conservative values during the initial years of application. Then, using the suggested documentation, they can determine the best thresholds for all or groups of their roads.

The above criteria are best suited for use during the start of the spring thaw period, generally February through April. A different condition exist for mid-winter thawing cases. The sun angle is lower during a mid-winter thaw and is less than the sun angle calculated in the analysis. A higher MDD base temperature (such as 31°F) might better predict mid-winter road restrictions. However, the researchers did not develop a specific value. Local experience remains the best basis for mid-winter restrictions.

The temperature based Melting Degree Days criteria are best applied to fine-grained soils. The analysis performed in the study showed more consistent results for this soil type than for course-grained soils. Fine-grained soil bases are common in local roads in New Hampshire.

Guidelines for Duration of Load Restrictions

The length of the load restriction period should approximate the time required to achieve complete thawing. The WSTC equation to estimate the time required for complete thawing is

$$CMDD = 0.3 \bullet CFDD_{max}$$

In words, Cumulative Melting Degree Days for ending load restrictions equals 0.3 times the maximum value for Cumulative Freezing Degree Days (CFDD). Experience in New Hampshire, however, has indicated that the 0.3 multiplier varies due to a number of factors.

- Variations in road construction -- pavement thicknesses, base thicknesses and materials, shoulders and ditches.
- Shaded areas that limit sunlight reaching the road surface.
- Elevation differences sufficient to influence average daily temperatures.
- Water remaining on roadsides due to residual snow and ice.

The suggested procedure is to make duration judgements based on experience during the initial years of applying the guidelines. Users should note the maximum CFDD in Column J. They should also document road conditions relative to the CMDD for specific road types. After several years, they can determine a factor that applies to road types, and substitute it for 0.3 in the equation $CMDD = 0.3 \bullet CFDD_{max}$.

Summary of Restriction Start and Duration

The following is a summary of the steps to determine when to begin and how long to apply spring road use restrictions.

1. Using the Degree Days Log calculate degree days, freezing degree days (FDD), and melting degree days (MDD) as described on pages 4 and 5.
2. Begin calculating CFDD -- cumulative freezing degree-days -- when there is a clear pattern of positive FDD.
3. Begin calculating CMDD -- cumulative melting degree-days -- when there is a clear pattern of positive MDD.
4. Consider posting roads when CMDD reaches the values in Table 2 on page 5.
5. Continue to calculate CMDD to determine the duration of load restrictions. During the first years of applying the guidelines, make duration judgements based on judgement. Calculate the multiplier "m" for future determinations using the equation $CMDD = m \bullet CFDD_{max}$.

Placing Load Restrictions

When a highway agency sets a load restriction, it should notify the public through the press or letters. It should place temporary signs on all limited roadways.

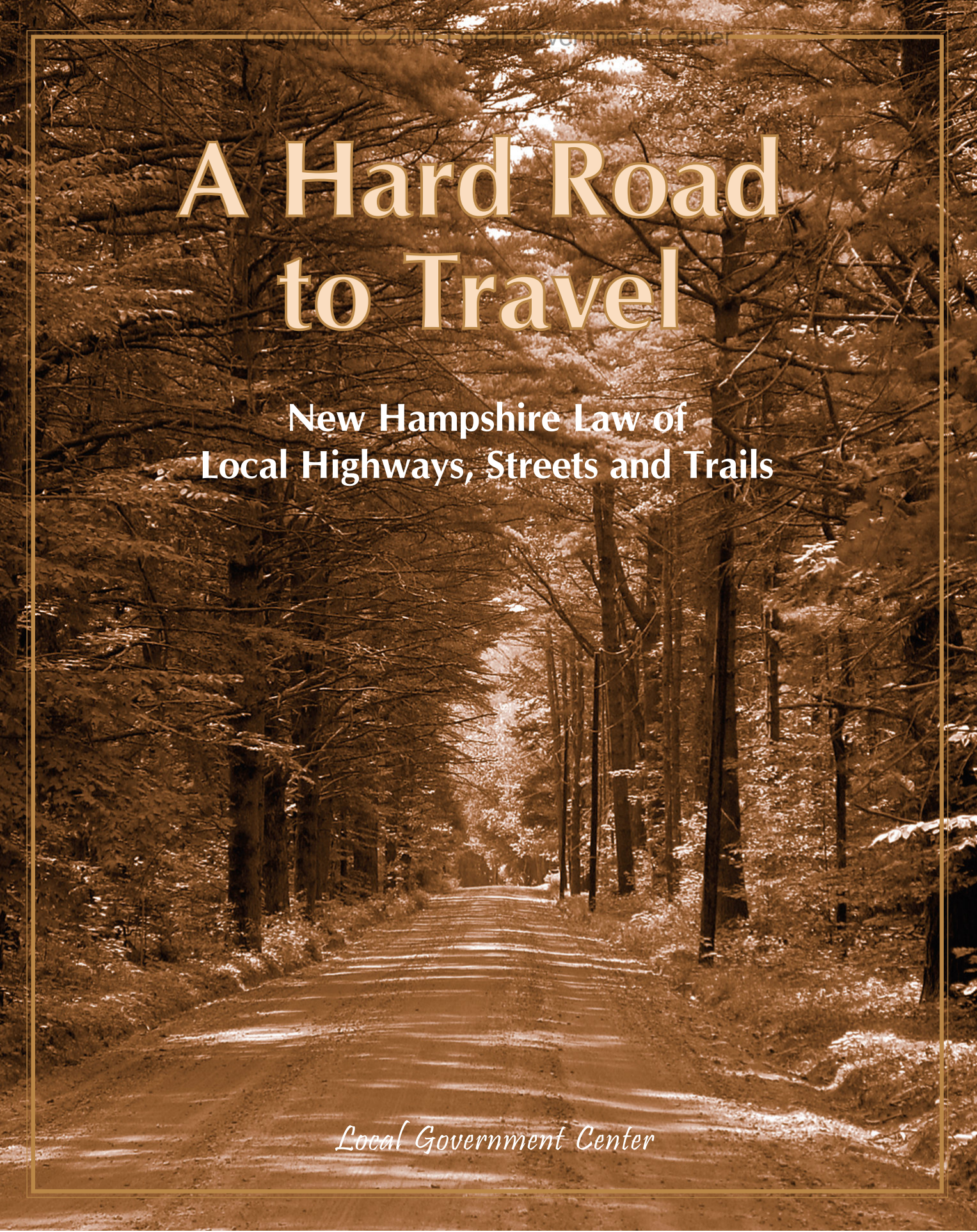
It is recommended that agency staff notify contractors and loggers who frequently use the affected roads. Because the need for restriction happens quickly, this notification should be by telephone, fax, and/or email. If the agency has a policy for partial road use, such as early morning for certain roads, it should provide affected users with the procedures to apply the policy. The agency should also establish exceptions to the policy. For example, transport of perishable or essential products such as milk or fuel oil.

The agency should keep a record of the effective dates of posting and removal for each road or set of roads. Once it has applied load restrictions, it should monitor roadways to determine when it can remove restrictions. These records will document specific road behaviors, and be useful in applying the guidelines in future years.

Degree-Days Log

A	B	C	D	E	F	G	H	I	J
Month	Day	High Temp	Low Temp	Avg. Temp (C-D)/2	FDD 32-Avg.	Cumu-lative FDD	MDD Avg.-29	Cumu-lative MDD	Notes
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								
	26								
	27								
	28								
	29								
	30								
	31								

FDD = Freezing Degree Days
MDD = Melting Degree Days



A Hard Road to Travel

New Hampshire Law of Local Highways, Streets and Trails

Local Government Center

Winter Roads

Roads may be laid out that are open and maintained only between November 15 and April 1. They are called "winter roads." RSA 231:24. The only way a road can become a "winter road" is to be laid out that way, by petition, through a proceeding under the layout laws. See Chapter 2 for a detailed description of the layout process. Municipalities can charge yearly rentals to the property owners benefited by the winter road layout.

The winter road law was enacted in 1897, and has never been cited in a reported court opinion. The intent of the statute may have been an attempt to legitimize the plowing of private roads by towns, a practice not legally allowed without reimbursement to the municipality by benefited property owners. *Clapp v. Jaffrey*, 97 N.H. 456 (1952). Laying out winter roads for this purpose is not recommended, for several reasons. First, since the winter road law was enacted, highway liability law has changed significantly. New Hampshire municipalities no longer have complete sovereign immunity. Instead, municipalities now have the duty to prevent "insufficiencies" on all town-maintained highways. RSA 231:90 through 92-a. See Chapter 6 for more on liability.

Second, the New Hampshire Supreme Court has held, "Snowplowing alone does not keep a road in a state of repair or preserve it from decline. Maintenance or repair work such as repaving or 'cold-patching' in summer is required to protect against and combat the road's yearly erosion caused by rain, snow, and freezing temperatures." *Catalano v. Windham*, 133 N.H. 504, 511 (1990). Attempting to confer winter road status on an otherwise private road, where the only work to be done by the town is snowplowing, raises too great a risk that the town may be found liable for road insufficiencies caused by a private party's off-season maintenance, or lack thereof.

Scenic Roads

WHAT ARE THEY?

Any road other than a Class I or II highway can be designated a scenic road (RSA 231:157) by the legislative body of a city or town. Scenic road designation requires the state and/or the municipality to obtain written permission of the planning board prior to any repair, maintenance, reconstruction or paving work on the road if such work requires the cutting, damage or removal of trees, or the removal

or destruction of stone walls. Likewise, any utility or other person who wishes to install or maintain poles, conduits, cables, wires, pipes or similar structures must obtain prior written consent of the planning board if the work involves tree cutting or removal of stone walls. RSA 231:158, II. Scenic road designation does not affect a municipality's eligibility to receive construction, maintenance or reconstruction aid. RSA 231:158, III.

Trees Defined. RSA 231:157, I defines "tree" as "any woody plant" that is at least 15 inches in circumference at four feet from the ground.

NOTICE AND PUBLIC HEARING

The planning board must hold a public hearing on any request from the municipality or a utility to cut trees or remove stone walls. Notice of the public hearing must be advertised in a local newspaper two times. The second notice must appear in the newspaper at least seven days before the public hearing.

EXCEPTIONS

There are several important exceptions to the limitations on cutting trees and removing stone walls imposed by the scenic road statute, and local residents or municipal officials do not generally understand these exceptions. Lack of awareness of these exceptions has led to the common misconception that scenic road designation is a way to prevent tree cutting and stone wall removal altogether on designated roads. But abutting landowners are exempt from the statute's limitations, and road agents and public utilities enjoy significant exceptions as well. Scenic road status is not a way to make sure landowners get notice before trees are cut on the highway right of way adjoining their land. Municipalities are already legally required to give prior notice to owners before cutting trees on any public highway, not just on scenic roads (RSA 231:145 and 146). In addition, even without scenic road status, utilities are required not only to give notice to landowners, but also to get their permission to cut trees. RSA 231:172.

Road Agent. The road agent may remove trees that have been designated a public nuisance, in accordance with the process outlined in RSA 231:145 and 146, when the trees pose "an imminent threat to safety or property" without the consent of and prior public hearing by the planning board. However, the road agent must first obtain the written permission of the board of selectmen before removing nuisance trees. RSA 231:158, II.

Utility. When a public utlity is involved in "the emergency restoration of service," it may perform work necessary to promptly restore utility service that has been "interrupted by facility damage" without

a prior public hearing of the planning board or written permission of the selectmen. After performing such work, the utility must inform the selectmen of the nature of the emergency and the work performed. RSA 231:158, II.

Landowners. Scenic road designation does not affect the rights of landowners to cut trees on their own property, unless the municipality has acquired the trees as shade or ornamental trees under the provisions of RSA 231:139 through 156. Landowners are also free to remove or alter stone walls on their property despite scenic road designation, within the limits provided in RSA 472:6 regarding boundary markers. The only way for a municipality to prevent owner/abutters from cutting trees is by acquiring title to the highway strip, or by taking tree rights under the tree warden law. RSA 231:154. See also Chapter 1.

ADDITIONAL MUNICIPAL PROVISIONS

Municipalities can adopt scenic road regulations that are different from or in addition to those outlined above as part of a scenic road designation, or as an amendment to a previous designation. Additional provisions can include, but are not limited to, criteria used by the planning board in deciding upon requests to cut trees or remove stone walls, or protections for trees smaller than 15 inches in circumference at four feet from the ground in order to establish regenerative growth along scenic roads. RSA 231:158, V.

PENALTY

Any person who violates the scenic road law or any additional local regulations governing scenic roads is guilty of a violation and shall be liable for all damages resulting from such violation. RSA 231:158, VI.

DESIGNATION PROCEDURE

A petition signed by 10 voters, or landowners abutting the road, can initiate the scenic road designation process, details of which are found in RSA 231:157. The petitioners must provide the town clerk with a list of the names of owners of property abutting the road. Within 10 days of receiving the petition, the clerk must notify, by regular mail, all the property owners abutting the road, informing them that a

scenic road petition has been received and that an article to designate the road will appear in the warrant of the next town meeting. Designation can be rescinded in like manner. In fact, in *Neville v. Highfields Farm, Inc.*, 144 N.H. 419 (1999), the New Hampshire Supreme Court held that town meeting had the authority to rescind scenic road designation in order for the landowner to have a portion of the road relocated and then designate the relocated road as scenic, over the objections of the planning board.

Although the statute provides for a process initiated by petition, RSA 31:131 authorizes the selectmen to insert in the town meeting warrant themselves any article that can be inserted by petition. The selectmen then would have the duty to notify the abutters, as required by RSA 231:157.

In cities and in towns with councils, voters or abutting property owners would initiate the scenic road petition, which would then be voted on by the city or town council. Presumably, the council would have authority to initiate the scenic road designation upon notification of abutting property owners.

PUBLIC LIST

Each municipality must maintain a public list of all roads, or portions thereof, that have been designated as scenic. The list must be updated annually, and must contain sufficient information to permit ready identification of the location and extent of each scenic road by reference to a town map. RSA 231:157.

CONSTITUTIONALITY

In *Webster v. Town of Candia*, 146 N.H. 430 (2001), the Court held that the provisions of the scenic road statute were not impermissibly vague and that the statute gave adequate warning to the plaintiffs that certain size trees could not be cut without planning board approval. The Court upheld the planning board's denial of a request from a developer to cut trees on a Class VI road designated as scenic in order to improve the road for reclassification as Class V. Under the town zoning ordinance cluster development was not permitted on Class VI roads. The developer had argued that the statute failed to include standards by which the planning board decides upon the request to cut trees. But the Court wrote, "We find it implied that the planning board will exercise its discretion consistent with the purpose of the road's scenic designation." That purpose, according to the statute's legislative history, was to "encourage the tourist attractiveness of our scenic roads in our towns and…permit the retention of trees and stone walls so characteristic of our New England scenery."

Before altering speed limits, a town must perform an engineering or traffic investigation. A municipality is not required to hire outside consultants, if it has sufficient staff to perform the investigation internally. RSA 265:63, II-a. The DOT commissioner must approve any speed limit alteration on a state highway—including, presumably, Class II and IV portions maintained by a town or city. RSA 265:63, IV.

LOAD WEIGHT LIMITS

RSA 231:190 and 231:191 authorize the council or board of selectmen to enact exact maximum weight limits on Class IV, V and VI highways. In order for municipalities to have enforceable road weight limits, they should make every effort to comply with the following:

Minutes Should Memorialize Testimony. Whenever the governing body votes to establish a weight limit (whether year-round or seasonal), the written minutes of the meeting should reflect testimony from the road agent or highway engineer. Particularly, the record should reflect that the limit was necessary "to prevent unreasonable damage or extraordinary municipal maintenance expense," citing facts and experience as much as possible to back up this conclusion.

Limits Must be Posted. The weight limit must be posted at all entrances from other highways using "weather resistant materials."

Identify Officials with Authority to Grant Exemptions. The names of those officials legally authorized to grant exemptions from the weight limit (that is, selectmen, highway agents or street commissioners) must be posted in the town or city hall. A municipality may condition an exemption upon bonding and restoration, but cannot impose restoration costs on anybody without "reason to believe that the…damage…is attributable" to that person.

Grant Exemption if Limitation Imposes 'Significant Interference.' A municipality must grant an exemption to a person if the weight limit causes "significant interference." However, it can require the person to post a bond and/or restore the road. It may deny the exemption if it "would be detrimental to public safety."

PRIVATE WORK ON OR DAMAGE TO PUBLIC HIGHWAYS

It is impermissible to excavate or disturb the ditches, shoulders, embankments, or improved

2.7.2 The general composition limits given in Table 411-1 indicate target value ranges of mixtures permissible under Section 411. The job mix formula shall lie within the target value ranges indicated for the particular type of hot asphalt mix.

2.8 General - Bridge pavement base course shall be 3/8" wearing course.

2.9 General - Non-modified asphalt binder shall contain silicone additive with the concentration being 3 parts per million plus or minus 1 part per million of silicone to asphalt binder, unless otherwise directed. Silicone additive shall be in liquid form and have a viscosity of 1,000 centipoises (1 Pas) at 77 ºF. Asphalt binder containing silicone shall meet the requirements of 401.2.2

2.10 Allowed Recycled Materials – General.

2.10.1 Reclaimed asphalt pavement (RAP) may be used in the production of hot mix asphalt. The allowed dust to asphalt ratio shall be as identified in AASHTO M 323. The maximum allowable total reused " asphalt" binder (TRB) in HMA mixes shall be 1.5%. Any changes in the combination of recycled materials shall require a new mix design unless otherwise approved by the Bureau of Materials & Research.

2.10.2 Reclaimed Asphalt Pavement (RAP).

RAP shall consist of recycled asphalt pavement and shall be processed by crushing, cold milling, or other approved sizing techniques approved by the Bureau of Materials and Research to meet the required gradation specifications. The mixture of RAP and new aggregate shall meet the requirements specified in Table 401-1 for aggregate gradation. The RAP shall be tested every 1,000 tons for gradation and asphalt binder content as a stockpile is being built. These test results shall remain on file by the Contactor until such time as the entire RAP stockpile has been utilized.

2.10.2.1 The PG grade of added asphalt shall be as specified by the Bureau of Materials and Research. The aggregate component of the RAP shall meet the requirements of 401.2.1. The bitumen component of the RAP shall be asphalt cement and shall be free of significant contents of solvents, tars, and other volatile organic compounds or foreign substances that will make the RAP unacceptable for recycling as determined by the Bureau of Materials and Research.

2.10.2.2 RAP materials may be rejected if deemed unsuitable for any reason or require an increase or decrease in the mix asphalt content. The Contractor shall submit representative samples, and gradation and asphalt cement content test results of the RAP to be incorporated into the Recycled Mixture for approval by the Bureau of Materials and Research at least 30 calendar days prior to the start of paving.

2.10.3 For all designs containing TRB in an amount greater than 1% of the total mix:

(a) RAP stockpiles shall be covered by a roof.
(b) Prior to the start of production, the composite RAP and virgin binder shall be tested by the Contractor to determine the appropriate grade of virgin binder to be added.
(c) Only allowed in a drum mixer.
(d) Only allowed for binder & base courses.
(e) Test RAP for gradation & AC% every 1000 tons.
(f) Run split samples at start of production and every 10k tons thereafter for composite binder testing.

2.11 Asphalt Modifiers.

General. The generic type of each asphalt binder admixture, modifier and/or additive shall be identified on the certificate of analysis, which shall be furnished by the manufacturer for each load of asphalt delivered. Modifiers shall be pre-blended with the asphalt binder.

2.11.1 Asphalt binder modification to produce high-strength mix shall utilize either a styrene-butadiene or styrene-butadiene-styrene polymer to achieve the specified performance grade of asphalt. The Section 401 contract Special Provision specifying the asphalt binder grade shall also identify the AASHTO test method by which the binder grade shall be determined. The modified binder shall be pre-blended, storage-stable and homogeneous.

2.11.2 The use of Warm Mix Technologies is permitted in mix production. Qualified technologies are listed on the Qualified Warm Mix Asphalt (WMA) Technologies List.

2.12 Pavement Joint Adhesive.

Pavement Joint Adhesive shall be a product that is listed on the Qualified Products List.

2.12.1 Joint adhesive shall meet the following requirements:

Measuring Distresses

TYPE

SEVERITY

EXTENT

Condition Survey

- Identify Travel Plan
- Sequence Plan
- Determine Surface Distresses
- Determine Drainage
- Collect only Necessary Data

Asphalt Roads
Surface Distresses

- Alligator Cracking
- Longitudinal/ Transverse Cracking
- Edge Cracking
- Patching/Potholes
- Roughness
- Rutting
- Drainage

Alligator Cracking

- Interconnected or interlaced cracks forming connected irregular shaped polygons
- Causes
  - Repeated Heavy Load
  - Poor Drainage

Alligator Cracking

- Severity
  - Low - cracks just visible
  - Medium - crack width < 1/8”, no displaced pieces
  - High - crack width > 1/8” and/or displaced pieces

Alligator Cracking

Low Severity

Alligator Cracking

Medium Severity

Alligator Cracking

High Severity

Alligator Cracking

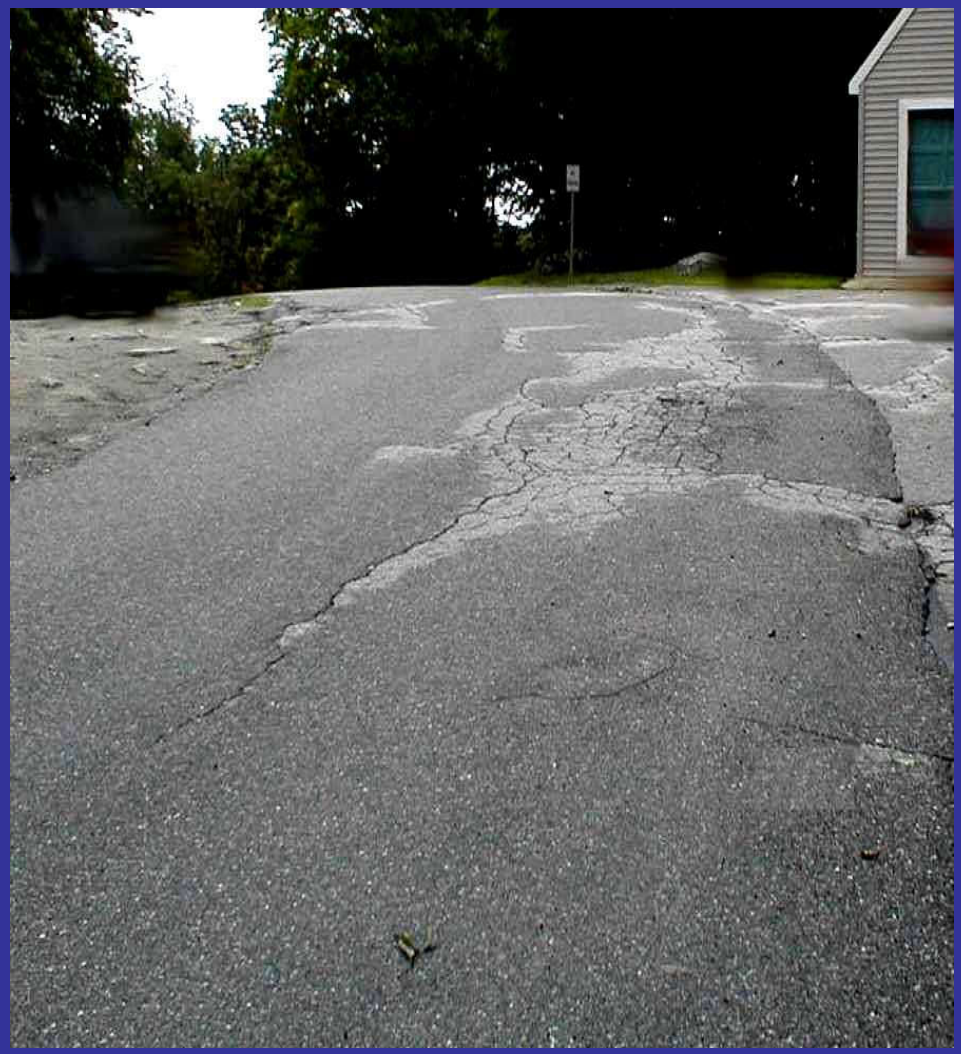
- Extent (percent of surface area)
  - Low - <10%
  - Medium - 10% to 30%
  - High - >30%

Alligator Cracking

Low Extent

Alligator Cracking

Medium Extent



Alligator Cracking

High Extent

Longitudinal Cracking

- Cracks/breaks parallel to center line
- Causes
  - Poorly Constructed Paving Joints
  - Shrinkage/Temperature
  - Reflection
  - Settlement

Transverse Cracking

- Cracks/breaks across roadway
- Causes
  - Shrinkage/Temperature
  - Reflection
  - Culverts
  - Utility Cuts

Longitudinal/Transverse Cracking

- Severity
  - Low - none or very narrow
  - Medium - ¼”
  - High - > ¼”

Longitudinal/ Transverse Cracking

Low Severity

Longitudinal/ Transverse Cracking

Medium Severity

Longitudinal/ Transverse Cracking

High Severity

Longitudinal/Transverse Cracking

- Extent (Longitudinal Cracking)
  - Low - <10%
  - Medium - 10% to 30%
  - High - >30%

Longitudinal/Transverse Cracking

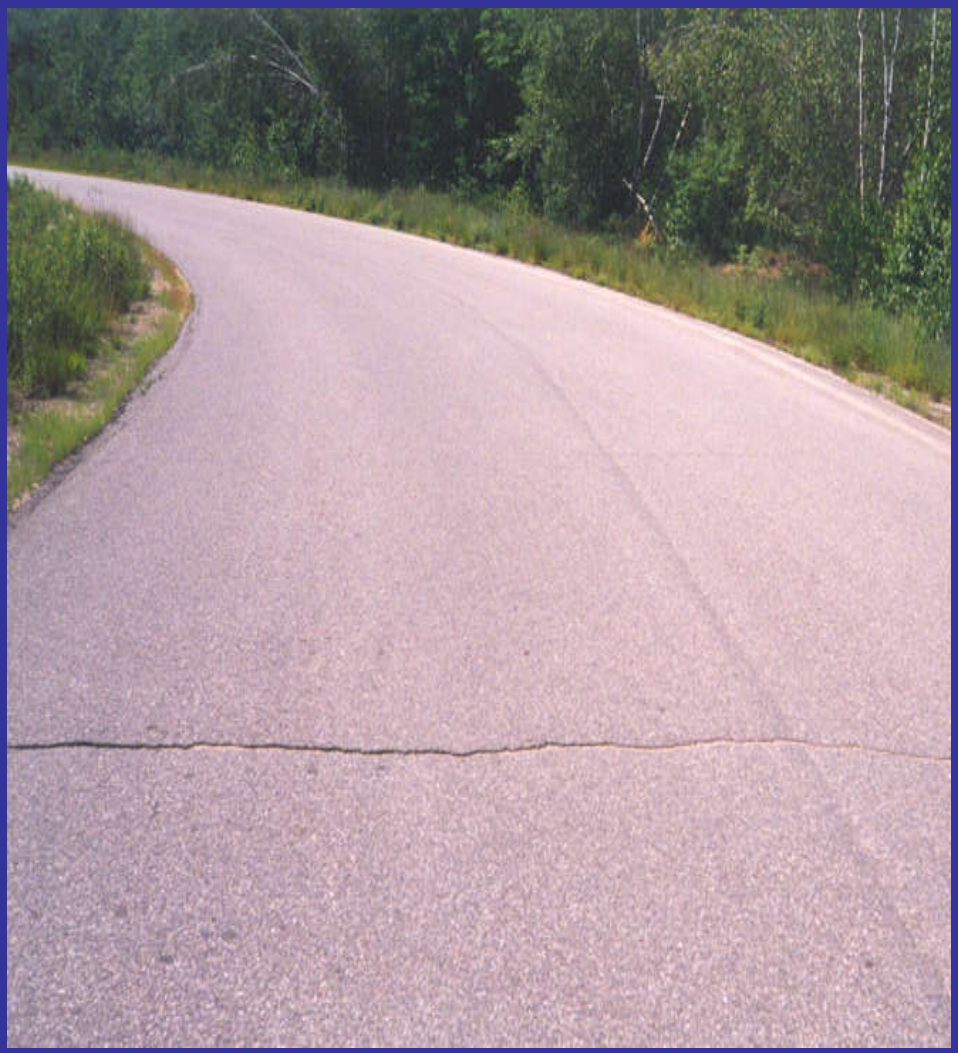
- Extent (Transverse Cracking)
  - Low - cracks > 50’ apart
  - Medium - cracks 25’ to 50’ apart
  - High - cracks < 25’ apart

Longitudinal/Transverse Cracking

- Extent (longitudinal and transverse)
  - Low - If both occur, crack sealing is the best solution
  - Medium - If both occur to a degree that surface treatment is the best maintenance option
  - High - if both occur to a degree that rehabilitation is the best solution

Longitudinal/ Transverse Cracking

Low Extent



Longitudinal/ Transverse Cracking

Medium Extent

Longitudinal/ Transverse Cracking

High Extent

Edge Cracking

- Cracking and/or loss of pavement edges
- Causes
  - Loads on Edge of Pavement
  - Lack of Edge Support (Shoulders)
  - Materials
  - Moisture

Edge Cracking

- Severity
  - Low - thin cracks, < 12” from pavement edge
  - Medium - larger cracks, < 24” from pavement edge
  - High - breakup, > 24” from edge

Edge Cracking

Low Severity

Edge Cracking

Medium Severity

Edge Cracking

High Severity

Edge Cracking

- Extent
  - Low - < 10%
  - Medium - 10% to 30%
  - High - > 30%

Edge Cracking

Low Extent

Edge Cracking

Medium Extent

Edge Cracking

High Extent

Patching

- Isolated small areas of new paving material placed over a previous distress or in place of removed materials
- Causes
  - Highway Departments
  - Utility Cuts

Patching

- Extent (percent of road length)
  - Low - <10%
  - Medium - 10% to 30%
  - High - >30%

Potholes

- Bowl shaped voids in pavement surface, full or partial depth
- Causes
  - Loads
  - Water in Base
  - Materials/Construction

Potholes

- Extent - number per road length
  - Low - < 5 per 100 ft
  - Medium - 5-10 per 100 ft
  - High - > 10 per 100 ft

Patching/ Potholes

Low Condition

Patching/ Potholes

Medium Condition

Patching/ Potholes

High Condition

Roughness

- All irregularities in the pavement surface that interfere with a smooth ride
- Causes
  - Shoulders
  - Ditch depth and slope
  - Soils
  - Erosion and obstructions

Roughness

- The “ride” at posted speed.
- Good - water on dash only ripples.
- Fair - water on dash splashes within glass.
- Poor - water on dash splashes out of glass.

Roughness

Good Condition

Roughness

Fair Condition

Roughness

Poor Condition

Rutting

- Longitudinal depressions in one or both wheel paths
- Causes
  - Loads
  - Consolidation of Lateral Movement

Rutting

- Good - depth of ruts < 1”
- Fair - depth 1” to 2”
- Poor - depth > 2”

Rutting

Good Condition

Rutting

Fair Condition

Rutting

Poor Condition

Drainage

- The 3 D's
- Three most important features of a road
  - Drainage
  - Drainage
  - Drainage.

Drainage

- Ability for water to drain from pavement surface and base
- Causes
  - Irregular surface and/or cracks
  - Inadequate ditches and culverts
  - Inadequate maintenance

Drainage

- Good - water drains off roadway and away from road
- Fair - water drains off roadway but remains on side of road
- Poor - water remains on roadway and on side of road

Drainage

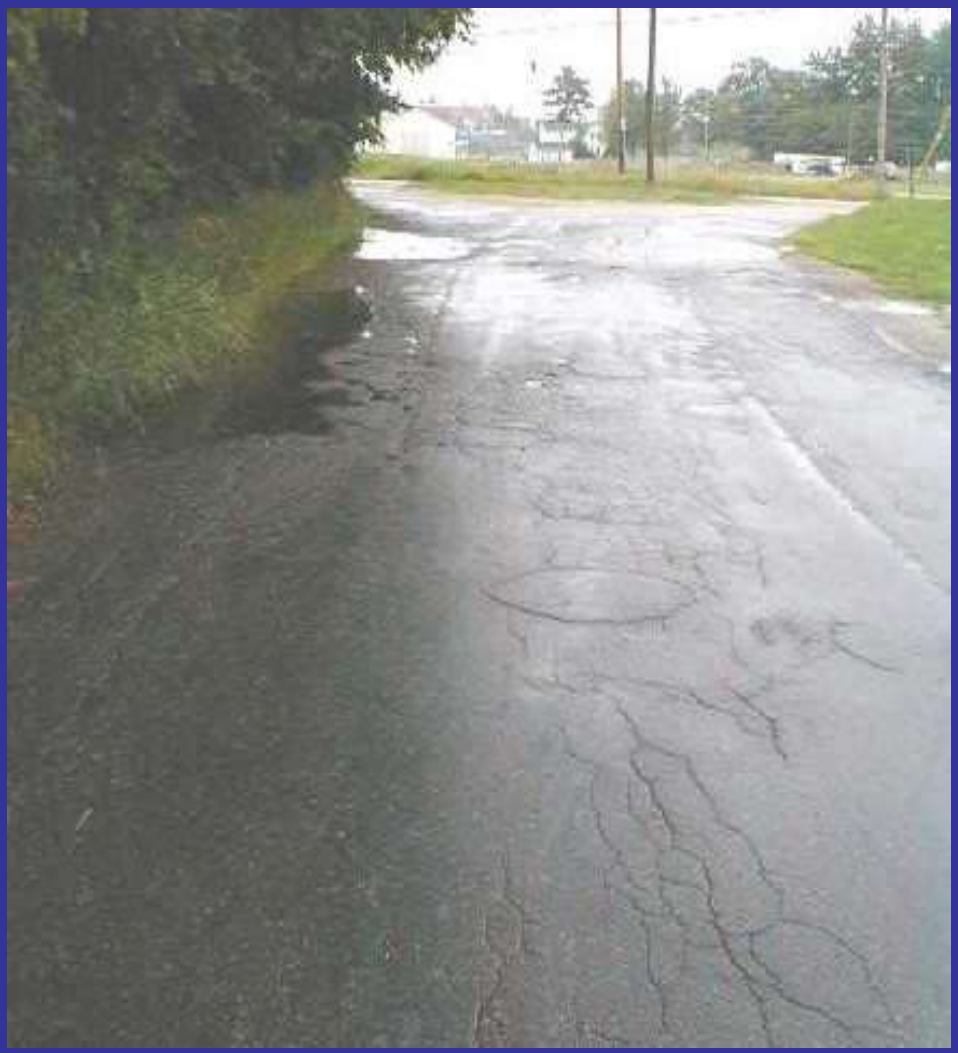
Good Condition

Drainage

Fair Condition

Drainage

Poor Condition



Unpaved Roads
Surface Distresses

- Primary Distresses
  - Cross Section
  - Roadside Drainage
  - Dust
- Traffic Induced Distresses
  - Corrugations
  - Potholes
  - Rutting
  - Loose Aggregate

Cross Section

- Does water drain off of road surface?
- Condition
  - Good - good crown, water flows off roadway
  - Fair - minimal crown and/or moderate amounts of ponding on roadway
  - Poor - water flows on roadway and/or large amounts of ponding

Cross Section

Good Condition

Cross Section

Fair Condition

Cross Section

Poor Condition

Roadside Drainage

- Does water drain away from roadway?
- Condition
  - Good - water flows in ditches & culverts
  - Fair - moderate amounts of water remains along roadside
  - Poor - large amounts of water remains along roadside

Roadside Drainage

Good Condition

Roadside Drainage

Fair Condition

Roadside Drainage

Poor Condition

Corrugations

- Washboard surface, ridges and valleys perpendicular to direction of travel
- Causes
  - Traffic
  - Moisture
  - Loose Aggregate

Corrugations

- Severity
  - Low - < 1” deep
  - Medium - 1” to 3” deep
  - High - > 3” deep

Corrugations

Low Severity

Corrugations

Medium Severity

Corrugations

High Severity

Corrugations

- Extent
  - Low - < 10%
  - Medium - 10% to 30%
  - High - > 30%

Corrugations

Low Extent

Corrugations

Medium Extent

Corrugations

High Extent

Potholes

- Bowl shaped depressions in road surface
- Causes
  - Loads
  - Moisture
  - Loose Aggregates

Potholes

- Severity
  - Low - < 1” deep and/or < 1’ diameter
  - Medium - 1-3 “ deep and/or 1’ to 2’ diameter
  - High - > 3” deep and/or > 2’ diameter

Potholes

Low Severity

Potholes

Medium Severity

Potholes

High Severity

Potholes

- Extent
  - Low - <10% and/or <5 per 100’ section
  - Medium - 10-30% and/or 5-10 per 100’ section
  - High - >30% and/or >10 per 100’ section

Potholes

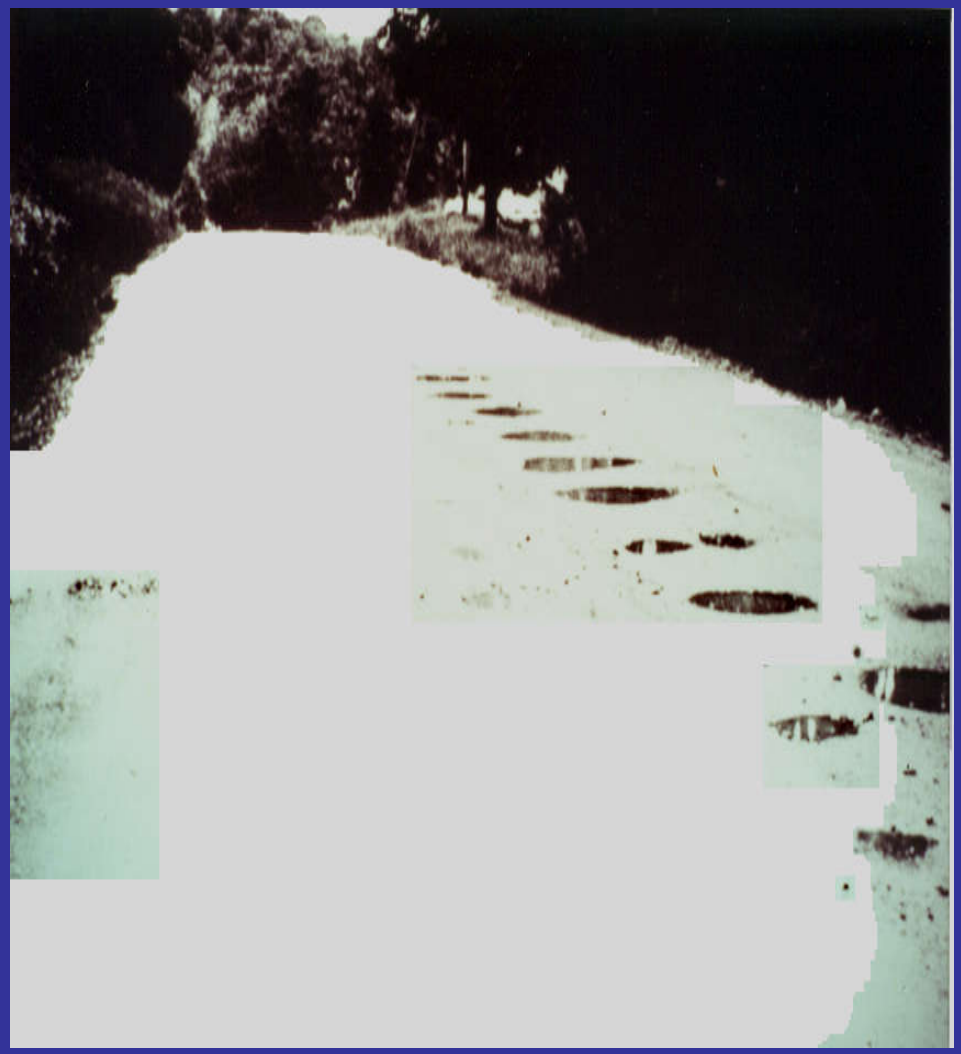
Low Extent

Potholes

Medium Extent

Potholes

High Extent



Rutting

- Channels in wheel paths
- Water flows along road rather than off it.
- Causes
  - Traffic
  - Moisture

Rutting Depth Check

Rutting

- Severity
  - Low - < 1” deep
  - Medium - 1” to 3”
  - High - > 3”

Rutting

Low Severity

Rutting

Medium Severity

Rutting

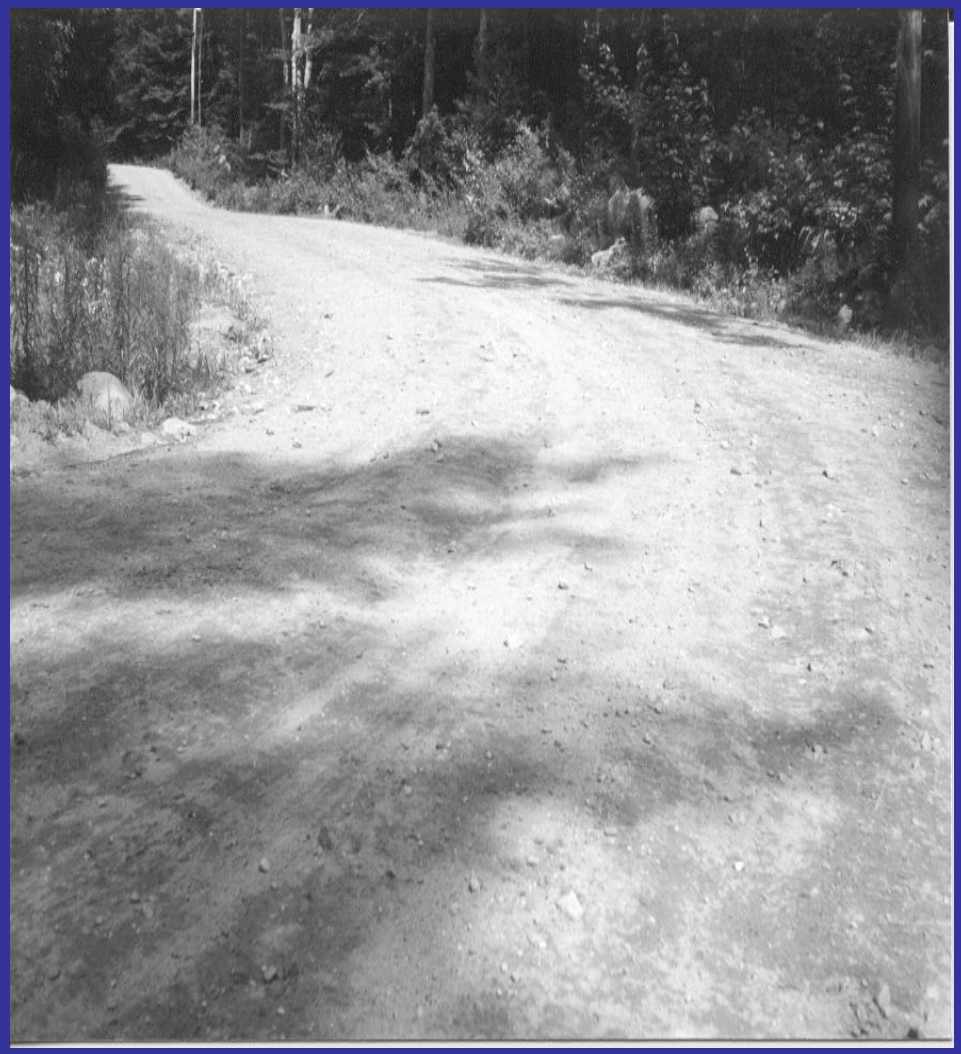
High Severity

Rutting

- Extent
  - Low - <10%
  - Medium - 10% to 30%
  - High - > 30%

Rutting

Low Extent



Rutting

Medium Extent

Rutting

High Extent

Loose Aggregate

- Loose material, along shoulder or centerline
- Causes
  - Improper Gradation
  - Traffic

Loose Aggregate

- Severity
  - Low - < 2” deep
  - Medium - 2-4”
  - High - > 4”

Loose Aggregate

Low Severity

Loose Aggregate

Medium Severity

Loose Aggregate

High Severity

Loose Aggregate

- Extent
  - Low - < 10%
  - Medium - 10% to 30%
  - High - > 30%

Loose Aggregate

Low Extent

Loose Aggregate

Medium Extent

Loose Aggregate

High Extent

Dust

- Loss of fine materials from road surface
- Larger particles become unstable
- Causes
  - Improper gradation
  - Traffic

Dust

- Light - normal traffic produces thin dust
- Medium - normal traffic produces moderately thick cloud
- Heavy - normal traffic produces thick cloud

Dust

Light Condition

Dust

Medium Condition

Dust

Heavy Condition

APPENDIX J

- Mapping References
  - NHDOT Nodal Maps (2017)
  - Field Mapping from Previous Assessment (2013)

New Hampshire DOT
Department of Transportation

Maps and data sets are not guaranteed to be free from errors and omissions. Data is in a constant state of update and correction by various groups and agencies. Information displayed on this map is the best available at the time of publication.

2017 Nodal Reference Bookmap

LEGEND

Divided Highway
Linited Access

Turnpike
Toll Road

U.S. Route

N.H. Route

State Roads
(Carries NO Route Number)

Local Roads

Class 6 Roads
(Not Maintained)

Private Roads

State Line

County Line

Town Line

Rivers & Streams

Lakes & Ponds

State Parks

National & State Forests

Reference Nodes

NHDOT will accept crash locations based on the State of NH Uniform Police Traffic Accident Report.

Crash occurred on:

Option 1

Street Address
123 Main Street

Option 2

Route No and/or Street name	Distance from Intersecting Street	NESW	Intesecting Road, Bridge, Town/County line
Main Street	*500*	*E*	*Oak Street*

Option 3

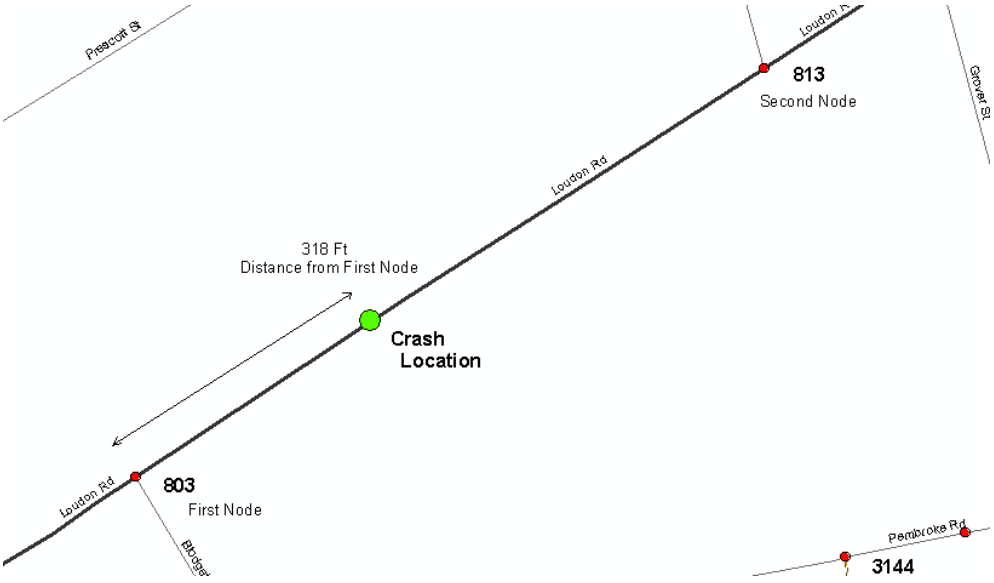
First Node	Distance from First Node	Second Node
515	*212*	*632*

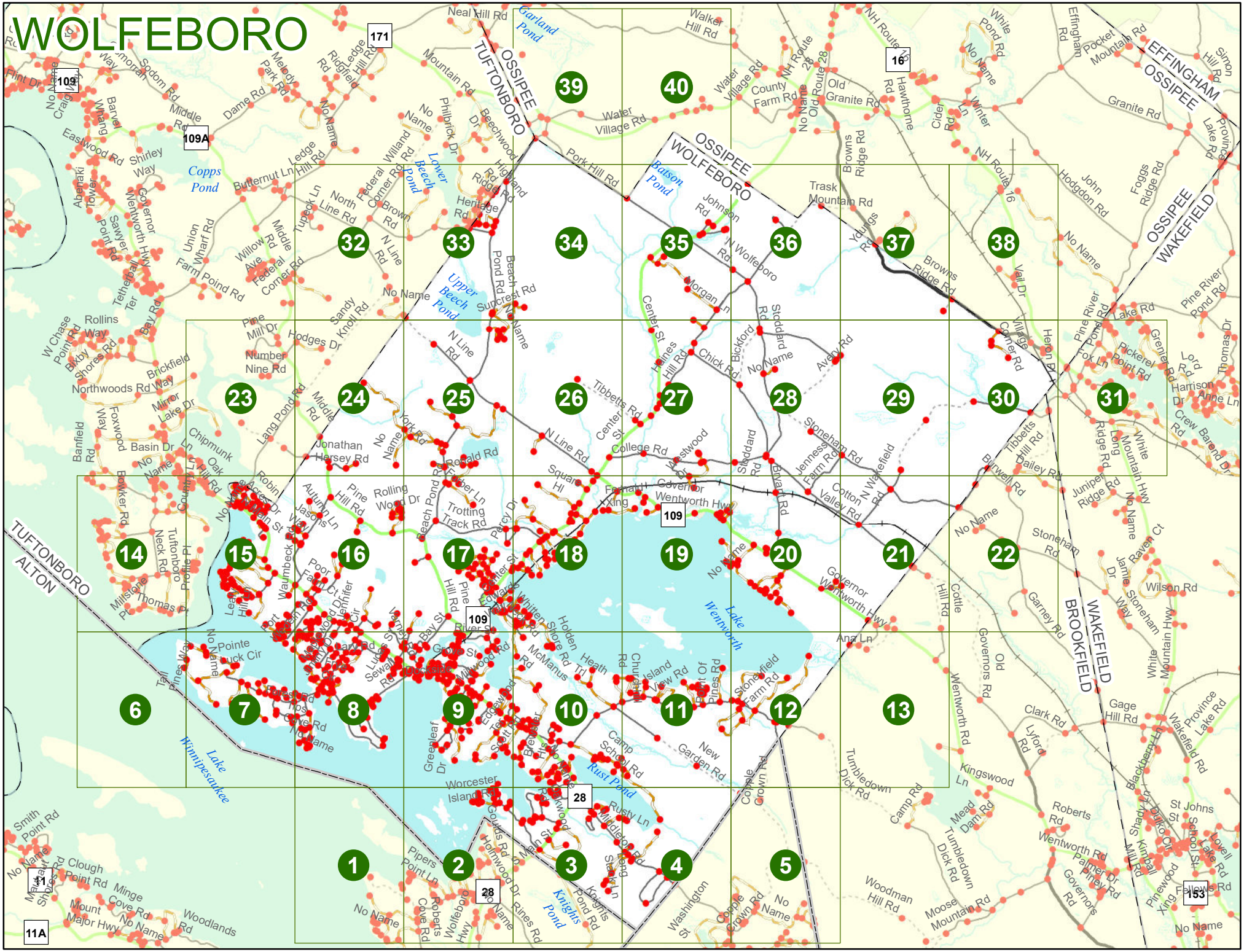
Option 4

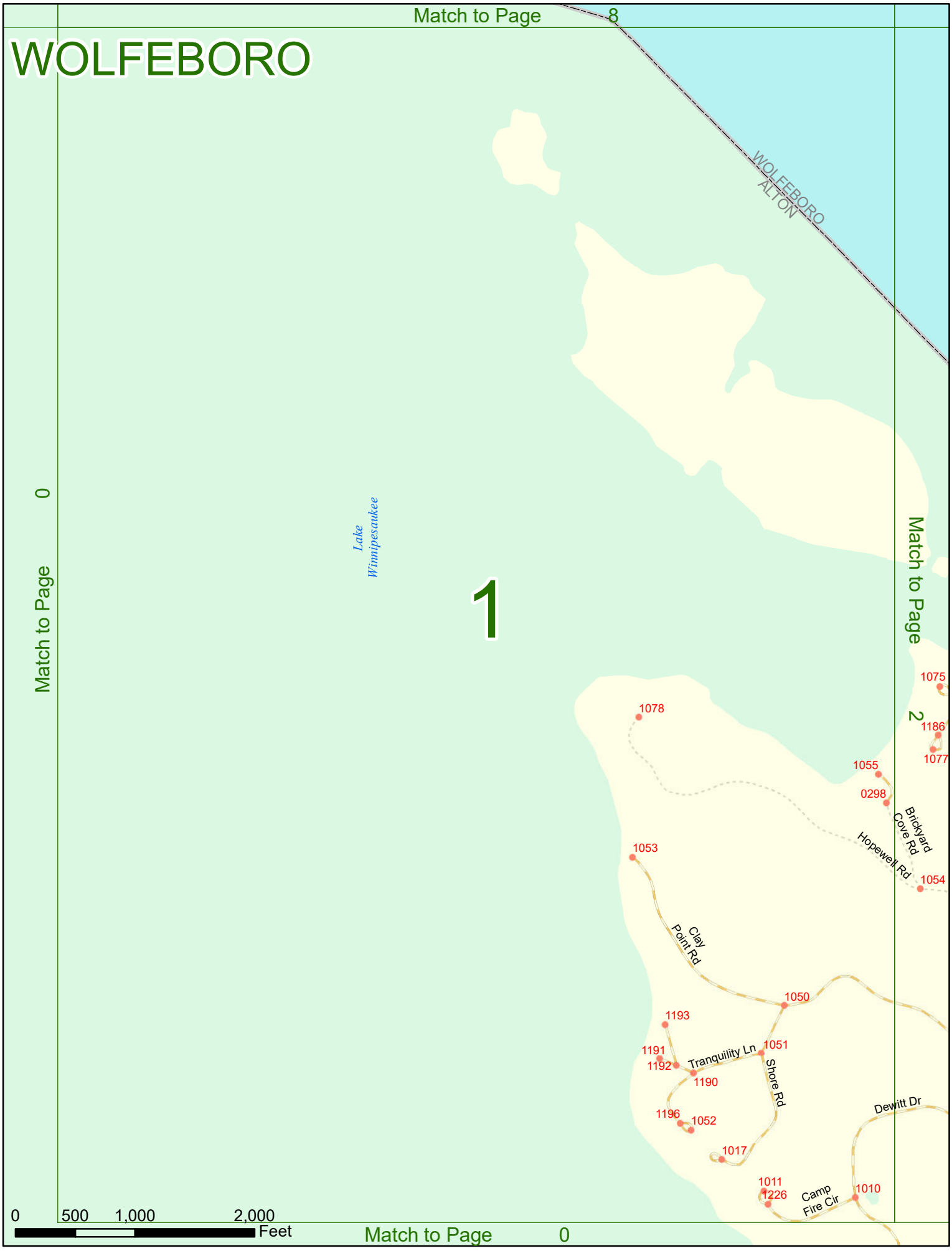
Route No and/or Street name	Mile Marker on Interstate Only	NESW	Mile (Marker)
I89S	*700 feet*	*S*	*36.8*

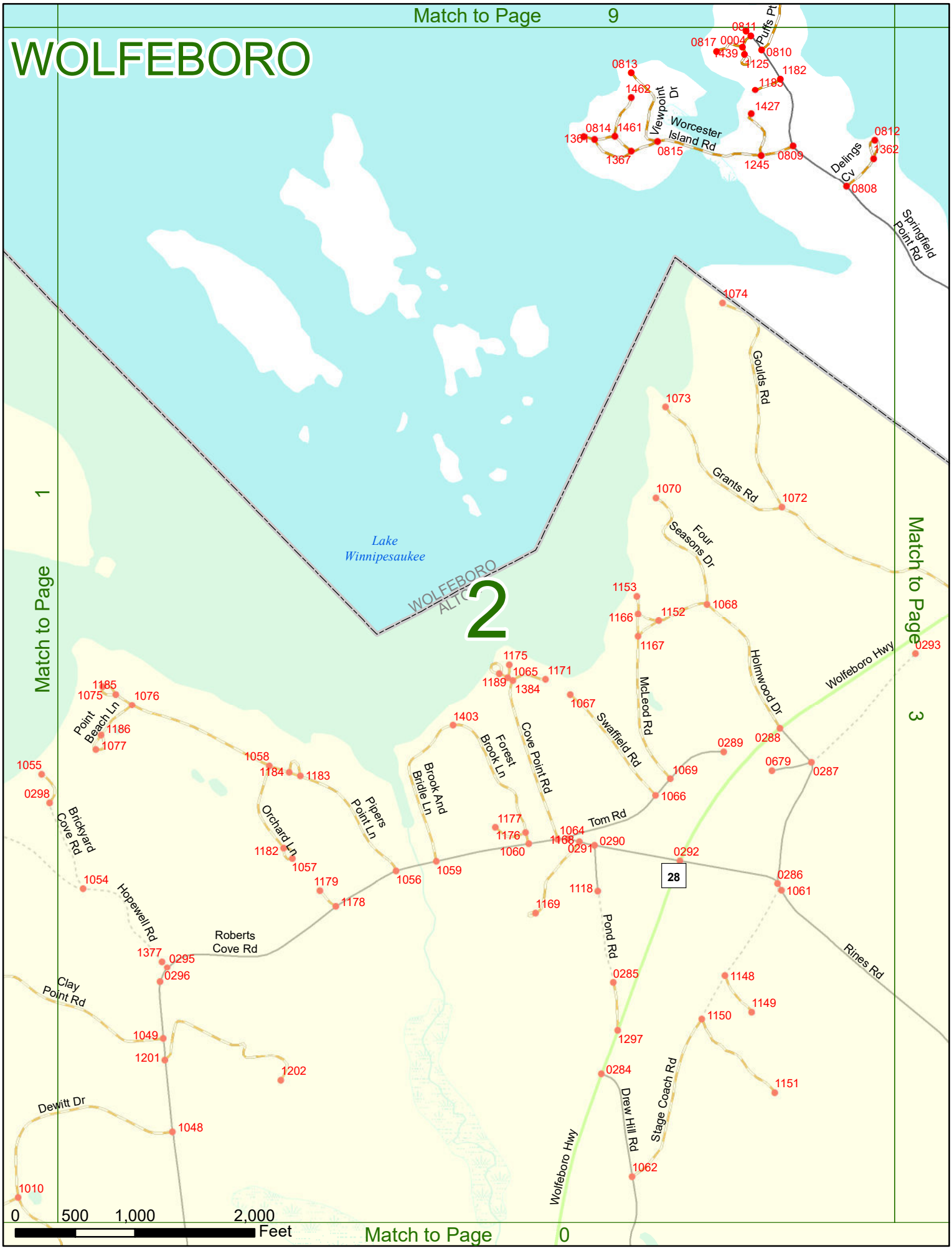
Option 3 – Example

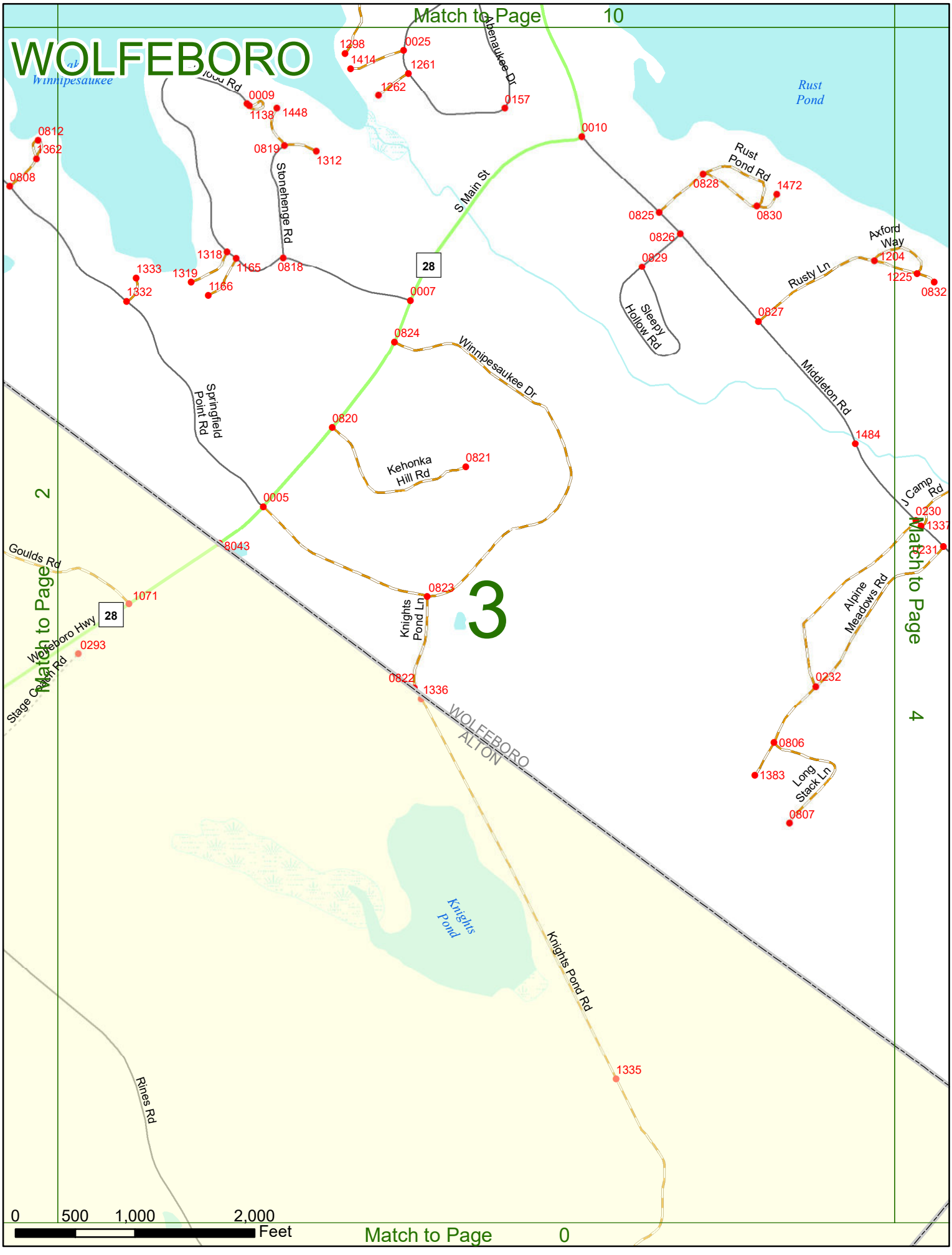
Street Name	*Loudon Road*
First Node	*803*
Distance from First Node	318 Ft
Second Node	*813*

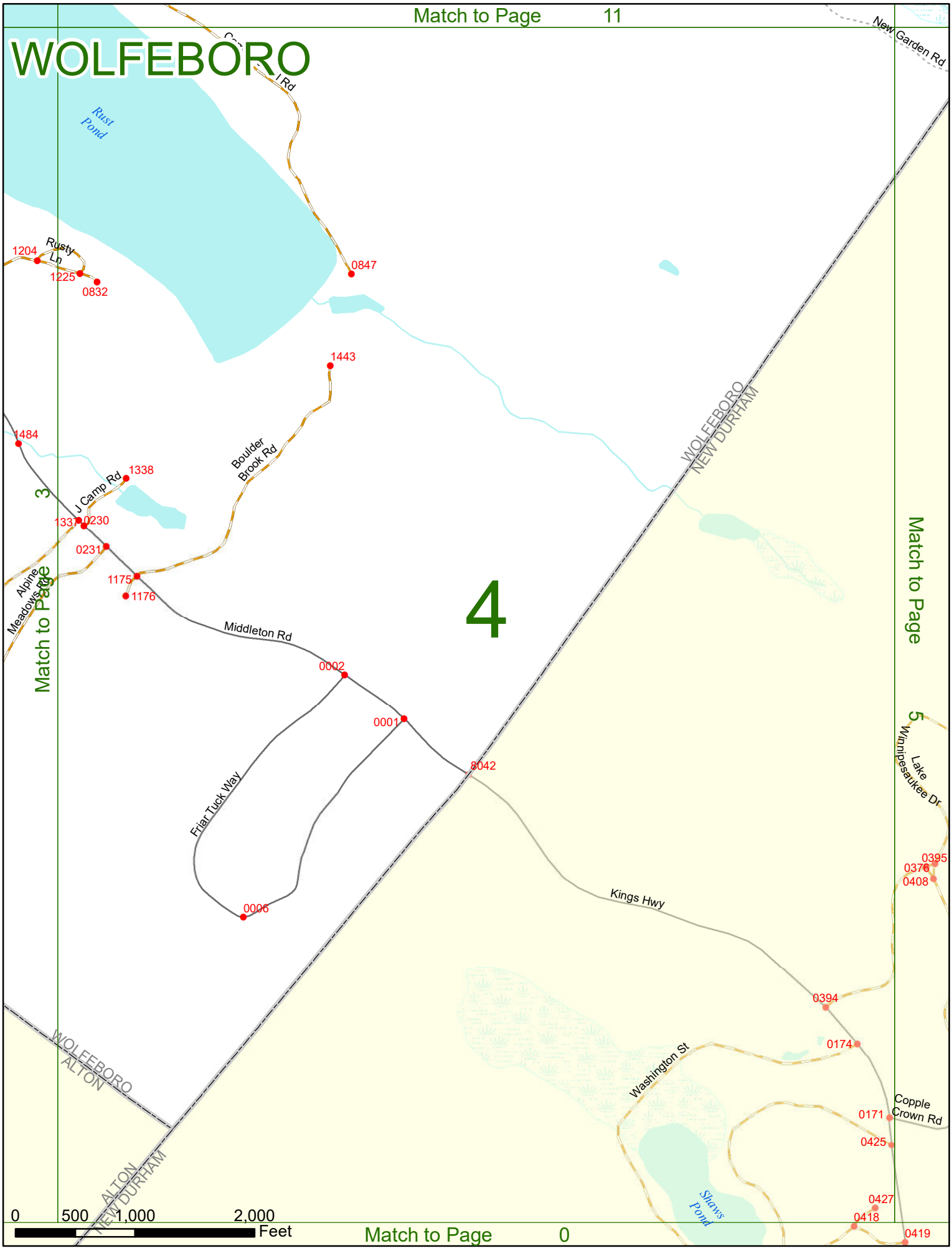


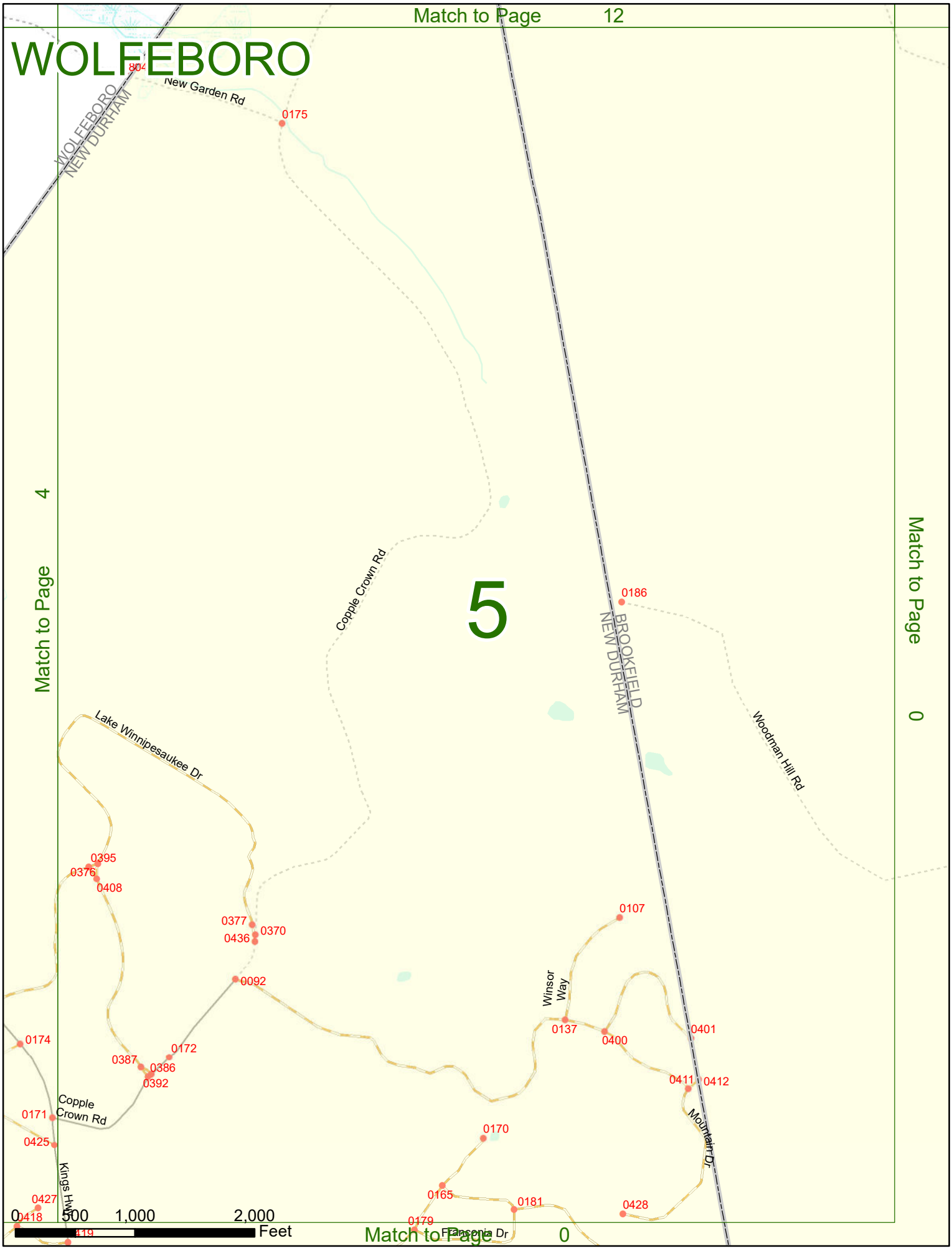

WOLFEBORO
TUFTONBORO
OSSIPEE
EFFINGHAM
WAKEFIELD
BROOKFIELD
ALTON
Lake Wentworth
Lake Winnipesaukee
Copps Pond
Garland Pond
Lower Beech Pond
Upper Beech Pond
Batson Pond
Rusty Pond
Knights Pond
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
Date: 1/6/2017

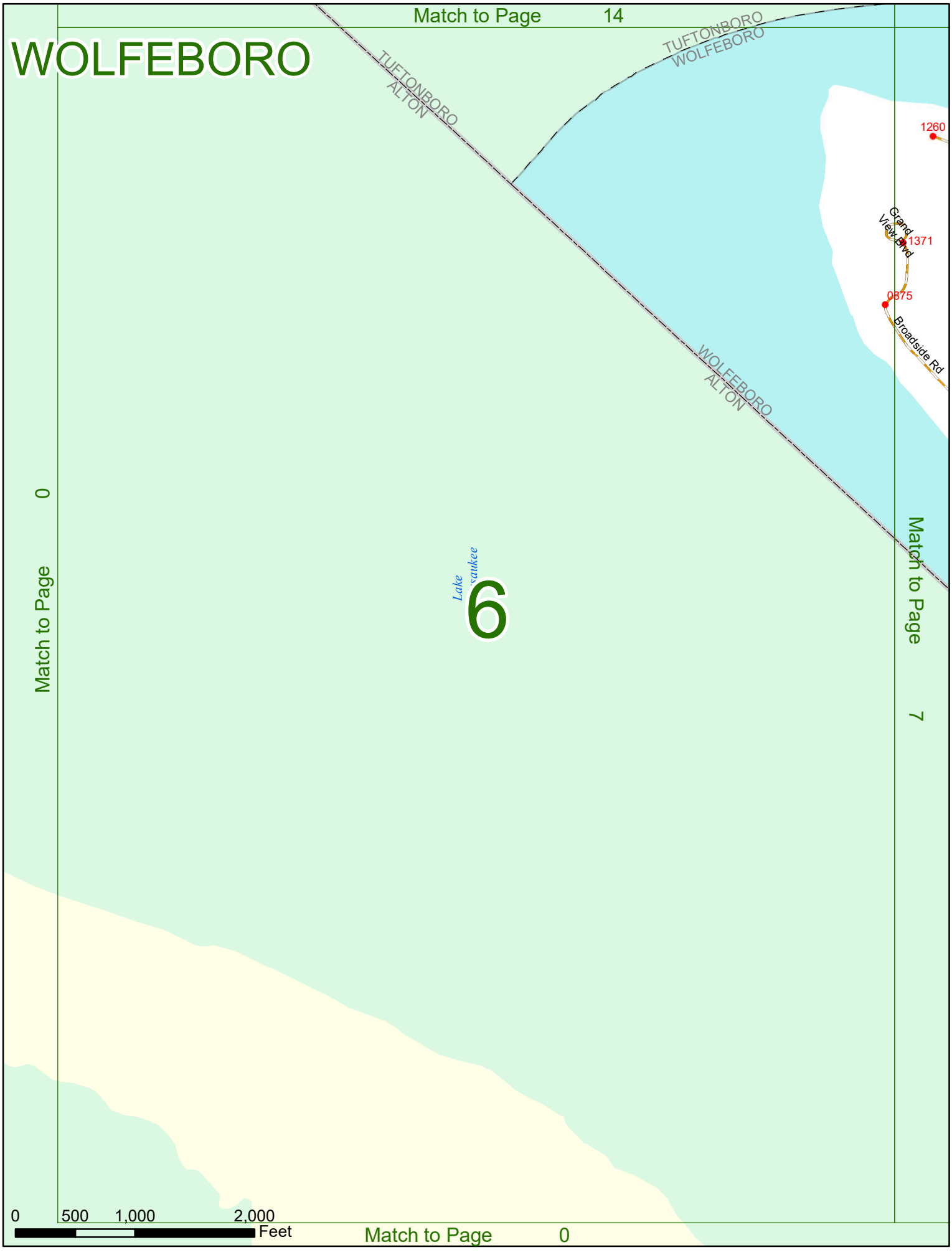

Match to Page 8
WOLFEBORO
WOLFEBORO
ALTON
Lake
Winnipesaukee
1
2
Match to Page 0
Match to Page
1075
1078
1186
1077
1055
0298
Brickyard
Cove Rd
Hopewell Rd
1053
1054
Clay
Point Rd
1050
1193
1191
1192
Tranquility Ln
1051
Shore Rd
1190
Dewitt Dr
1196
1052
1017
1011
1226
Camp
Fire Cir
1010
0
500
1,000
2,000
Feet
Match to Page 0


Match to Page 9
WOLFEBORO
Match to Page 1
Match to Page 3
Match to Page 0
Lake Winnipesaukee
WOLFEBORO ALT
2
Puffs Pt
Viewpoint Dr
Worcester Island Rd
Delings Cv
Springfield Point Rd
Goulds Rd
Grants Rd
Four Seasons Dr
Holmwood Dr
Wolfeboro Hwy
McLeod Rd
Swaffield Rd
Cove Point Rd
Forest Brook Ln
Brook And Bridle Ln
Pipers Point Ln
Orchard Ln
Tom Rd
Brickyard Cove Rd
Hopewell Rd
Roberts Cove Rd
Clay Point Rd
Dewitt Dr
Point Beach Ln
Pond Rd
Rines Rd
Drew Hill Rd
Stage Coach Rd
28
0 500 1,000 2,000 Feet

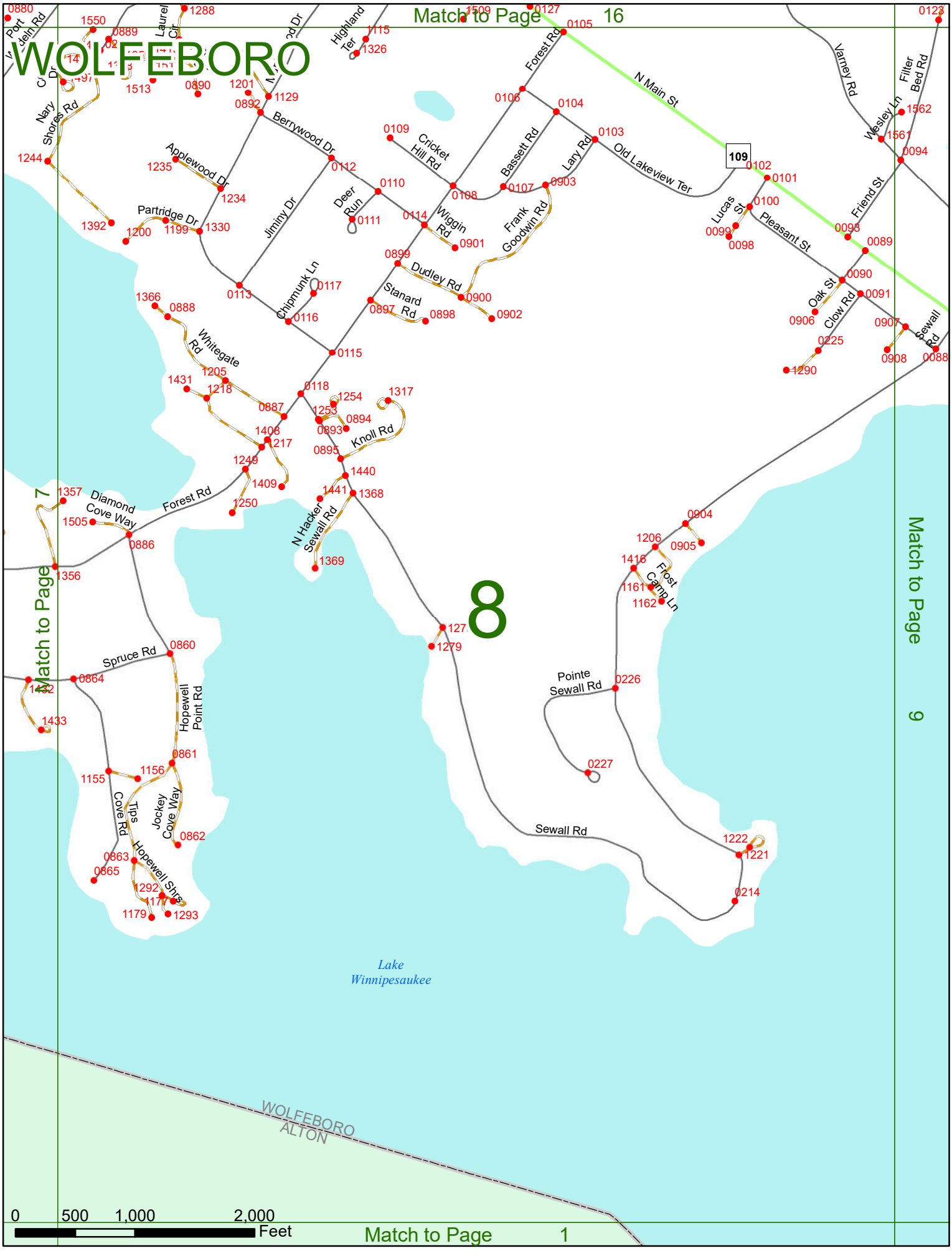

Match to Page 10
WOLFEBORO
Winnipesaukee
Rust Pond
Abenaukee Dr
1298
1414
0025
1261
1262
0157
0009
1138
1448
0819
1312
0812
1362
0808
0010
Rust Pond Rd
0828
1472
0830
0825
0826
0829
Axford Way
1204
1225
0832
Rusty Ln
0827
Sleepy Hollow Rd
Middleton Rd
1484
Stonehenge Rd
S Main St
28
1318
1165
0818
1333
1319
1166
1332
0007
0824
Winnipesaukee Dr
Springfield Point Rd
0820
Kehonka Hill Rd
0821
0005
8043
Goulds Rd
1071
28
Wolfeboro Hwy
0293
Stage Coach Rd
0823
Knights Pond Ln
0822
1336
3
2
Match to Page 2
Match to Page 4
J Camp Rd
0230
1337
1231
Alpine Meadows Rd
0232
0806
1383
Long Stack Ln
0807
WOLFEBORO
ALTON
Knights Pond
Knights Pond Rd
1335
Rines Rd
0
500
1,000
2,000
Feet
Match to Page 0

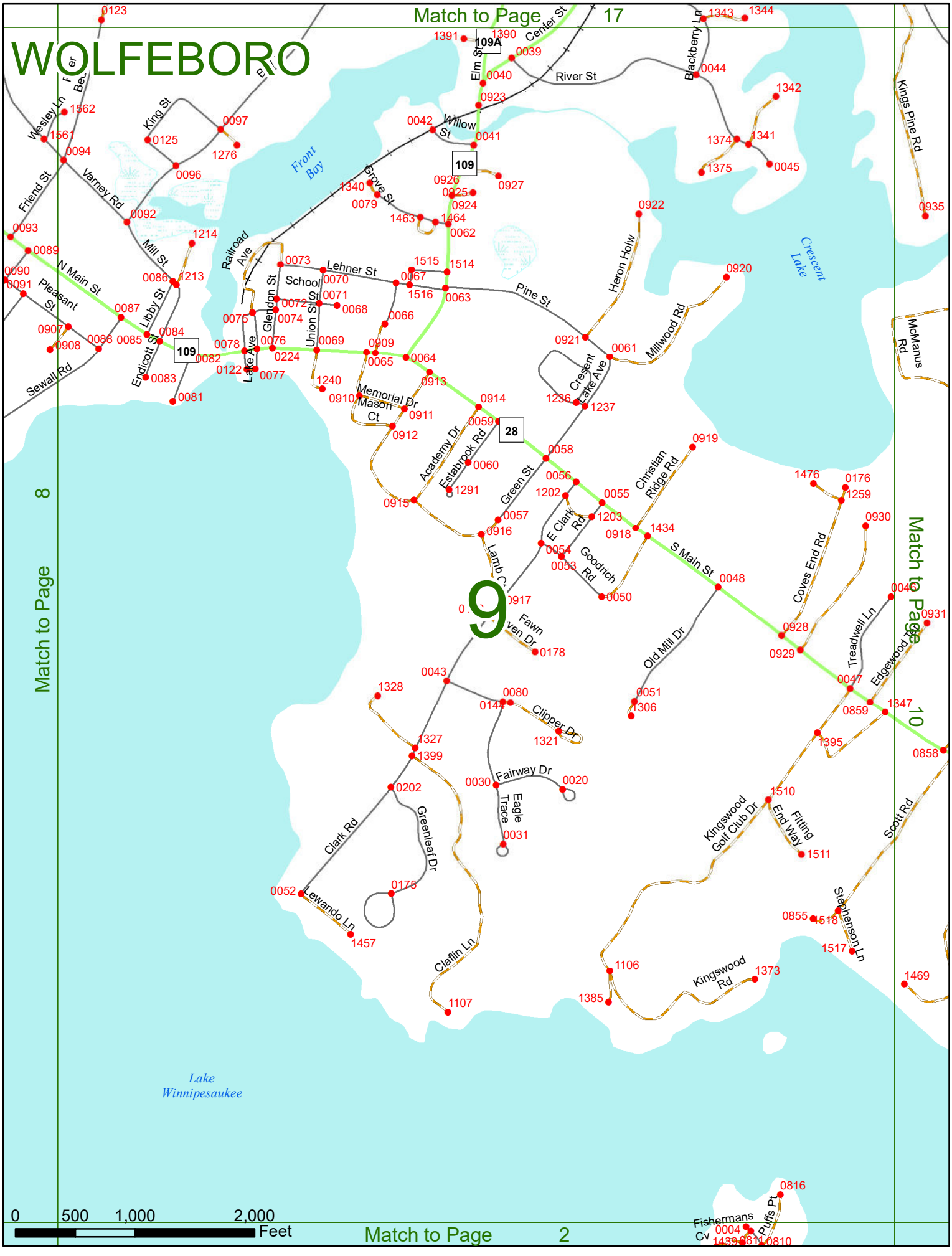

Match to Page 11
WOLFEBORO
New Garden Rd
Rust Pond
Rusty Ln
1204
1225
0832
0847
1443
1484
Boulder Brook Rd
1338
J Camp Rd
1337
0230
0231
1175
1176
Alpine Meadows Rd
Middleton Rd
0002
0001
8042
Friar Tuck Way
0006
WOLFEBORO
NEW DURHAM
Match to Page 3
Match to Page 5
4
Kings Hwy
0394
0174
Washington St
Lake Winnipesaukee Dr
0395
0376
0408
Copple Crown Rd
0171
0425
0427
0418
0419
Shaws Pond
WOLFEBORO
ALTON
ALTON
NEW DURHAM
0
500
1,000
2,000
Feet
Match to Page 0

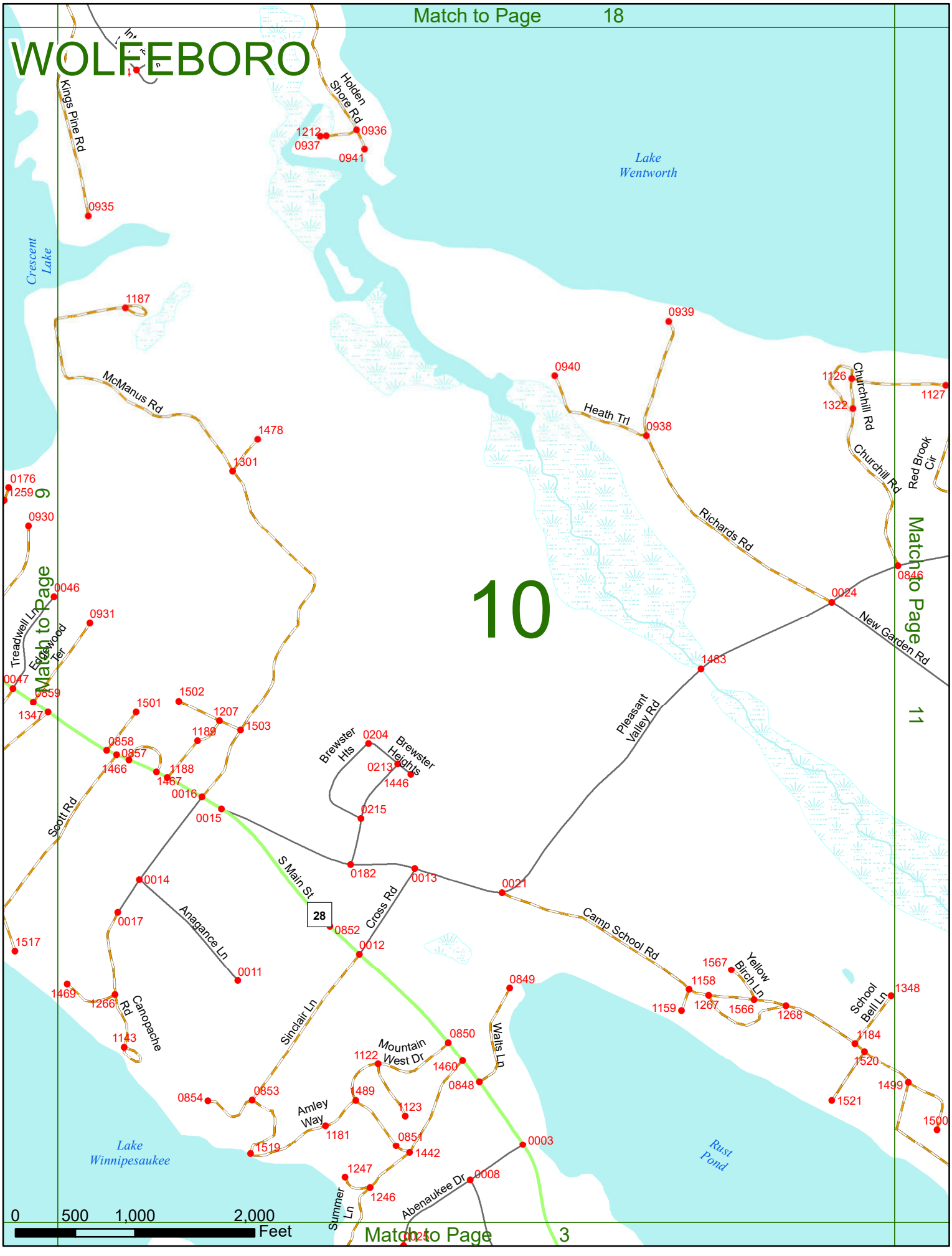

Match to Page 12
WOLFEBORO
New Garden Rd
WOLFEBORO
NEW DURHAM
0175
Copple Crown Rd
5
0186
BROOKFIELD
NEW DURHAM
Woodman Hill Rd
Match to Page 4
Match to Page 0
Lake Winnipesaukee Dr
0395
0376
0408
0377
0436
0370
0092
0107
Winsor Way
0137
0400
0401
0411
0412
Mountain Dr
0174
0387
0172
0386
0392
Copple Crown Rd
0171
0425
0170
0165
0181
0428
Kings Hwy
0427
0418
0419
0179
Flanconia Dr
0 500 1,000 2,000 Feet
Match to Page 0


Match to Page 14
WOLFEBORO
TUFTONBORO
ALTON
TUFTONBORO
WOLFEBORO
1260
Grand View Blvd
1371
0375
Broadside Rd
WOLFEBORO
ALTON
Lake Winnipesaukee
6
Match to Page 0
Match to Page 7
0
500
1,000
2,000
Feet
Match to Page 0


WOLFEBORO
Match to Page 15
Match to Page 6
Match to Page 8
Match to Page 0
7
0135
0880
1550
1117
0877
1547
1345
Port Wedeln Rd
1498
1649
0878
1173
1497
Cedar Dr
1172
Shore Rd
Earl
1335
Nary Shores Rd
1244
1392
1260
1210
1209
1282
Forest Rd
0119
Grand View Blvd
1371
1555
1556
0875
0871
Broadside Rd
0873
Umbrella Pt
0874
1554
Parker Island Rd
1553
0881
0872
Storytelling Rock Rd
0870
Campfire Chapel Ln
1108
Wyanoke Gate Ln
1449
0869
0882
1425
1357
1505
0498
0884
1397
0883
Forest Rd
1356
1231
1215
1216
1453
Rocky Shore Rd
0867
1232
Wyman Dr
1323
1248
Spruce Rd
1432
Tips Cove Rd
0864
0866
1433
1155
0865
WOLFEBORO
ALTON
Lake
Winnipesaukee
0
500
1,000
2,000
Feet

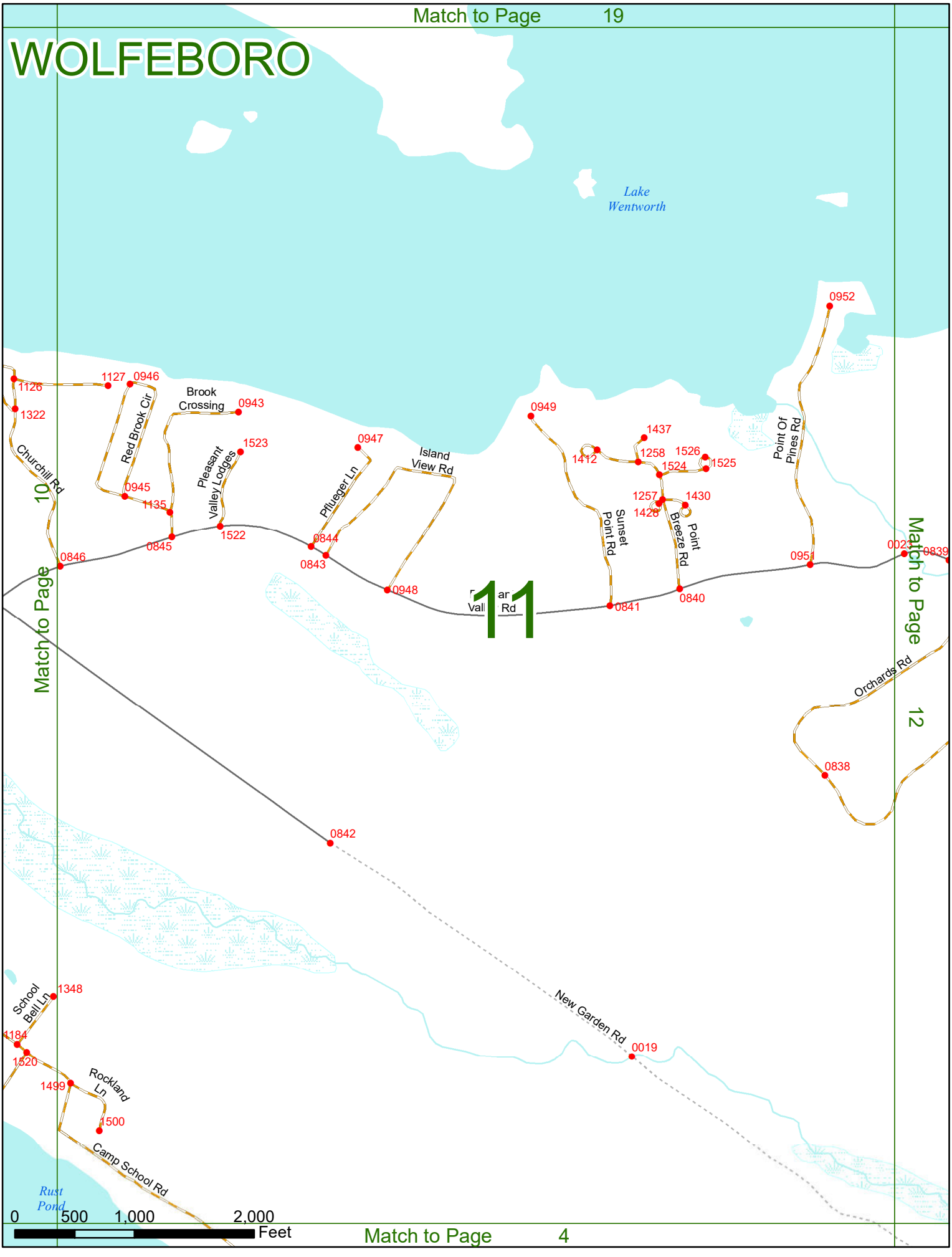

WOLFEBORO
Match to Page 16
Match to Page 7
Match to Page 9
Match to Page 1
8
N Main St
109
Forest Rd
Berrywood Dr
Applewood Dr
Partridge Dr
Jiminy Dr
Deer Run
Cricket Hill Rd
Bassett Rd
Lary Rd
Old Lakeview Ter
Wiggin Rd
Frank Goodwin Rd
Dudley Rd
Stanard Rd
Chipmunk Ln
Whitegate Rd
Knoll Rd
N Hacker Sewall Rd
Diamond Cove Way
Spruce Rd
Hopewell Point Rd
Tips Cove Rd
Jockey Cove Way
Hopewell Shrs
Sewall Rd
Pointe Sewall Rd
Frost Camp Ln
Lucas St
Pleasant St
Friend St
Oak St
Clow Rd
Sewall Rd
Wesley Ln
Varney Rd
Filter Bed Rd
Highland Ter
Laurel Cir
Nary Shores Rd
Port Jeln Rd
Lake Winnipesaukee
WOLFEBORO
ALTON
0 500 1,000 2,000
Feet


WOLFEBORO
Match to Page 17
Match to Page 8
Match to Page 10
Match to Page 2
9
Front Bay
Crescent Lake
Lake Winnipesaukee
Wesley Ln
King St
Friend St
Varney Rd
Mill St
N Main St
Pleasant St
Libby St
Endicott St
Sewall Rd
Railroad Ave
Lehner St
School St
Glendon St
Union St
Lake Ave
Grove St
Willow St
Elm St
Center St
River St
Blackberry Ln
Kings Pine Rd
Heron Holw
Millwood Rd
McManus Rd
Pine St
Cresent Lake Ave
Memorial Dr
Mason Ct
Academy Dr
Estabrook Rd
Green St
E Clark Rd
Goodrich Rd
Christian Ridge Rd
S Main St
Coves End Rd
Treadwell Ln
Edgewood Dr
Old Mill Dr
Lamb Ct
Fawn Ven Dr
Clipper Dr
Fairway Dr
Eagle Trace
Clark Rd
Greenleaf Dr
Lewando Ln
Claflin Ln
Kingswood Golf Club Dr
Fitting End Way
Kingswood Rd
Spott Rd
Stephenson Ln
Fishermans Cv
Puffs Pt
109
109A
28
0 500 1,000 2,000 Feet


Match to Page 18
WOLFEBORO
Kings Pine Rd
Holden Shore Rd
1212
0936
0937
0941
Lake Wentworth
0935
Crescent Lake
1187
McManus Rd
1478
1301
0176
1259
9
0930
0046
0931
Treadwell Ln
Eastwood Ter
0047
0659
1347
1501
1502
1207
1503
1189
0858
0857
1466
1188
1467
0016
0015
Scott Rd
Match to Page 9
0939
0940
Heath Trl
0938
Richards Rd
1126
1322
Churchill Rd
1127
Red Brook Cir
0846
0024
10
New Garden Rd
1483
Pleasant Valley Rd
Brewster Hts
0204
Brewster Heights
0213
1446
0215
0182
0013
0021
S Main St
28
0852
Cross Rd
0012
0014
0017
Anagance Ln
0011
1517
1469
1266
Canopache Rd
1143
Sinclair Ln
Camp School Rd
1567
Yellow Birch Ln
1158
1159
1267
1566
1268
School Bell Ln
1348
1184
1520
1521
1499
1500
0849
0850
Walls Ln
Mountain West Dr
1122
1460
0848
0854
0853
1489
1123
Amley Way
1181
1519
0851
1442
0003
1247
1246
Abenaukee Dr
0008
Summer Ln
Lake Winnipesaukee
Rust Pond
0 500 1,000 2,000 Feet
Match to Page 3
Match to Page 11

Match to Page 19

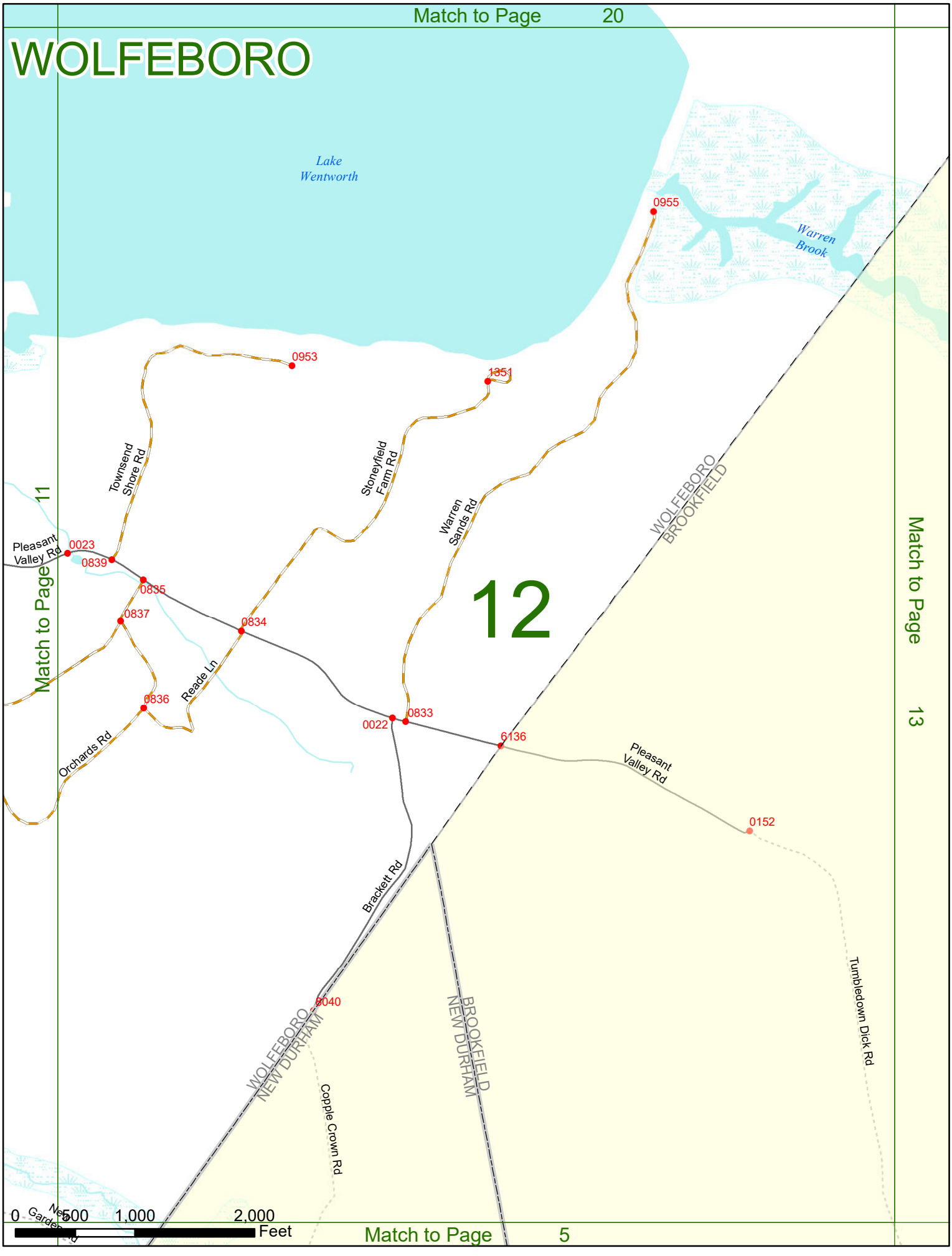
WOLFEBORO

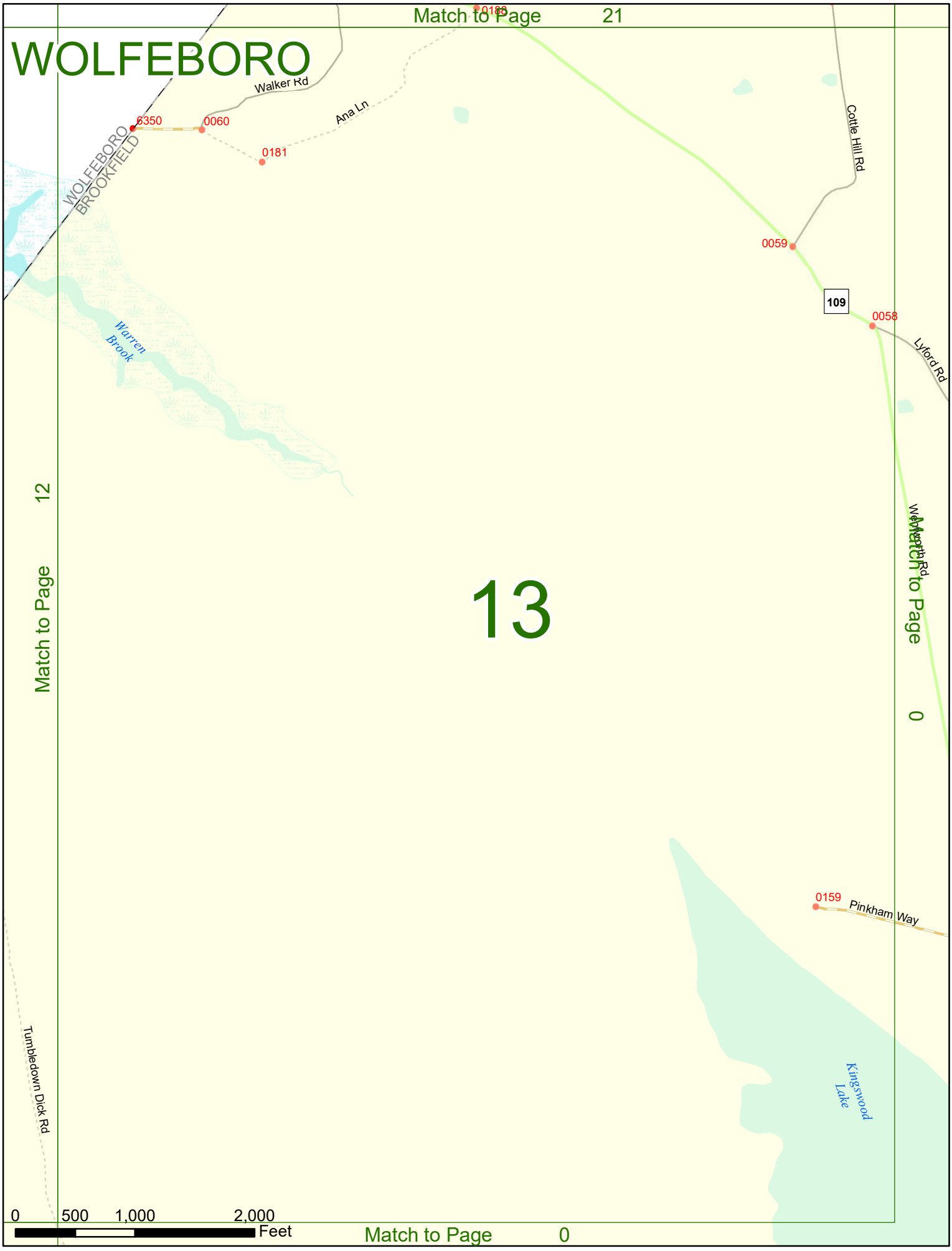


Match to Page 10

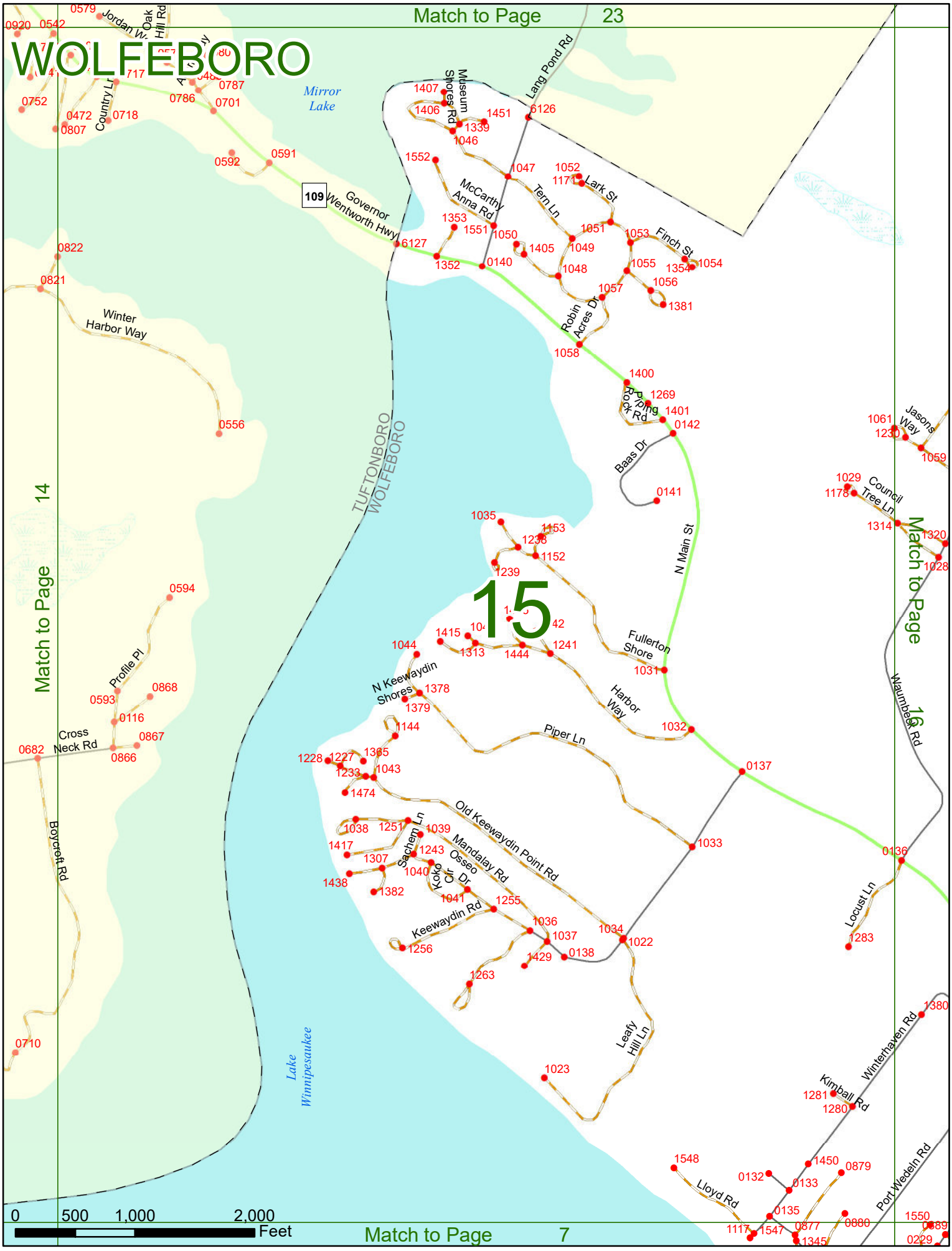
Match to Page 12

Match to Page 4


Match to Page 20
WOLFEBORO
Lake Wentworth
Warren Brook
0955
0953
1351
Townsend Shore Rd
Stoneyfield Farm Rd
Warren Sands Rd
WOLFEBORO BROOKFIELD
Pleasant Valley Rd
0023
0839
0835
0837
0834
12
Reade Ln
0836
Orchards Rd
0022
0833
6136
Pleasant Valley Rd
0152
Brackett Rd
Tumbledown Dick Rd
WOLFEBORO NEW DURHAM
0040
BROOKFIELD NEW DURHAM
Copple Crown Rd
Match to Page 11
Match to Page 13
0 500 1,000 2,000 Feet
Match to Page 5

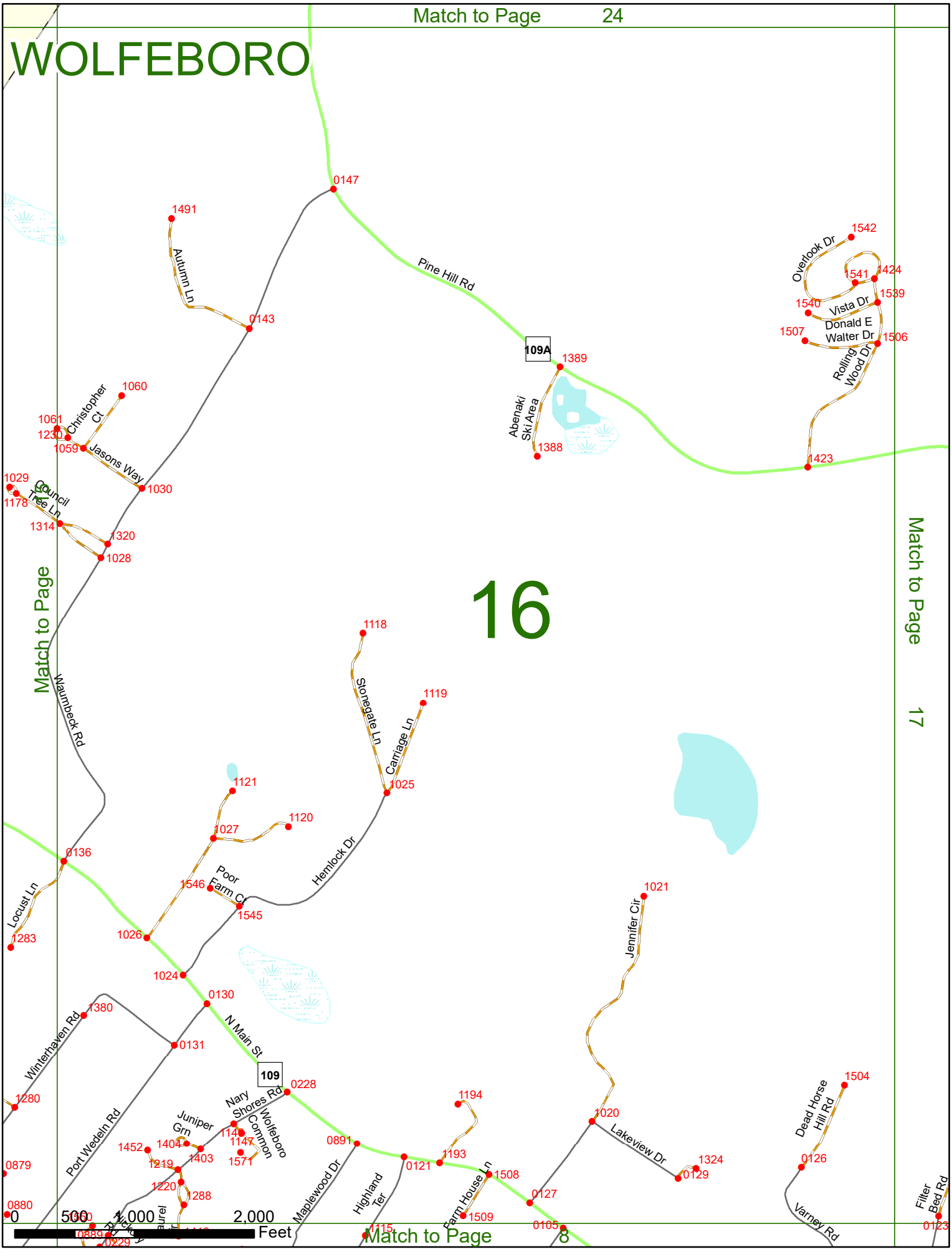

Match to Page 21
WOLFEBORO
Walker Rd
Ana Ln
Cottle Hill Rd
6350
0060
0181
0059
109
0058
Lyford Rd
WOLFEBORO
BROOKFIELD
Warren
Brook
Match to Page 12
13
Match to Page 0
Wentworth Rd
0159
Pinkham Way
Tumbledown Dick Rd
Kingswood
Lake
0
500
1,000
2,000
Feet
Match to Page 0

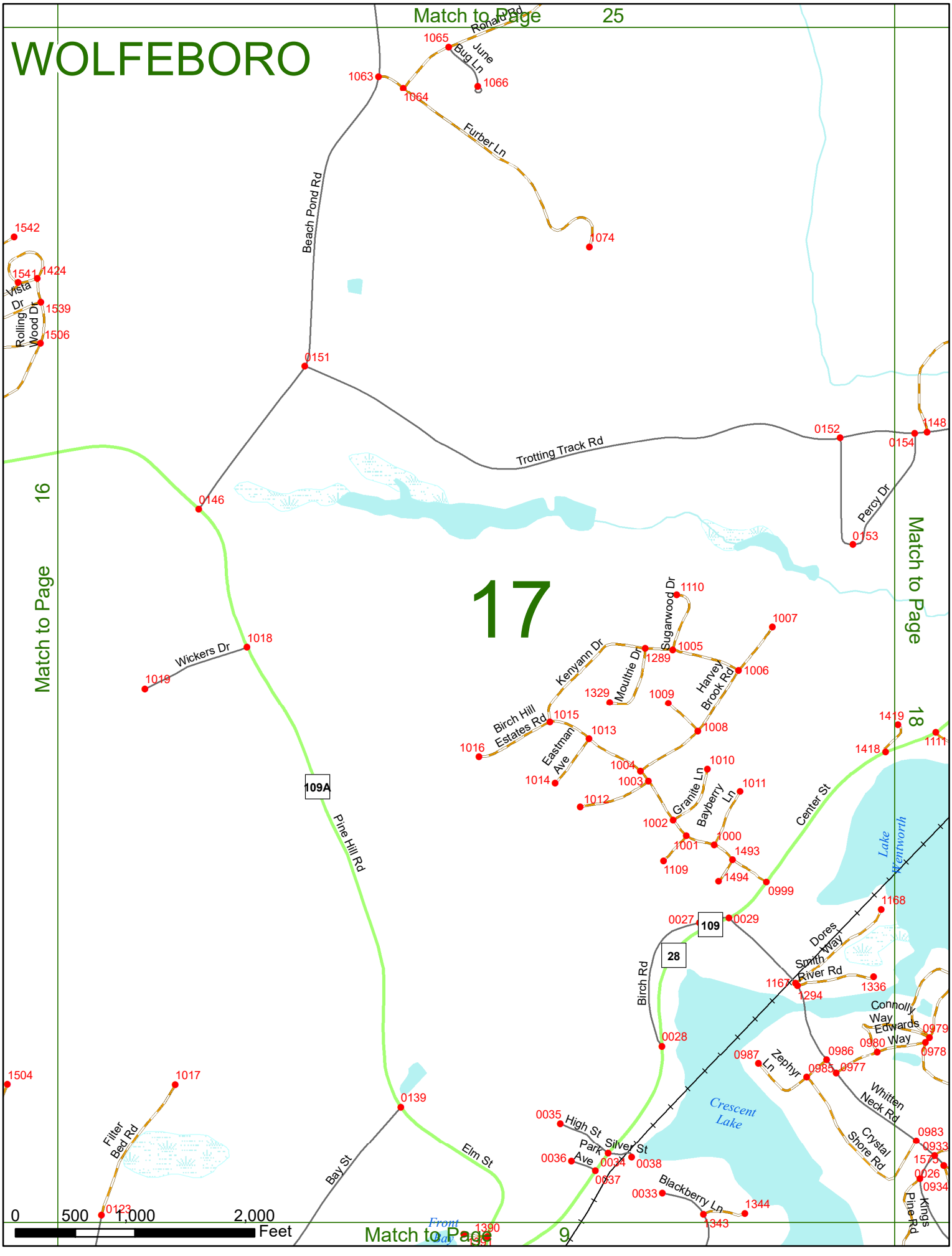

WOLFEBORO
14
Match to Page 0
Match to Page 0
Match to Page 15
Match to Page 6
The Basin
Lake Winnipesaukee
TUFTONBORO
ALTON
TUFTONBORO
WOLFEBORO
Barber Pole Rd
Fick Point Rd
Windleblo Rd
Bowker Rd
Shohl Camp Rd
Eaglemere Rd
Eaglemere South
Backlanders Dr
Hibbs Way
Hibbs Ln
Tuftonboro Neck Rd
Hideaway Shrs
Christian Cove Rd
Hennessey Dr
Winter Harbor Way
Cross Neck Rd
Elm Pt
Plantes Way
Friends Point Rd
Hurlburt Way
Millstone Pt
Thomas Pt
Boycroft Rd
Country Ln
109
0862
0622
0564
0120
0565
0509
0864
0803
0802
0625
0877
0749
0746
0748
0745
0462
0463
0119
0751
0822
0454
0514
0821
0747
0631
0552
0551
0679
0775
0543
0630
0118
0818
0678
0117
0799
0798
0783
0782
0934
0819
0571
0589
0113
0114
0115
0744
0460
0743
0560
0728
0727
0461
0501
0111
0815
0110
0772
0682
0112
0653
0677
0710
0641
0920
0542
0753
0808
0471
0541
0752
0718
0807
0472
0579

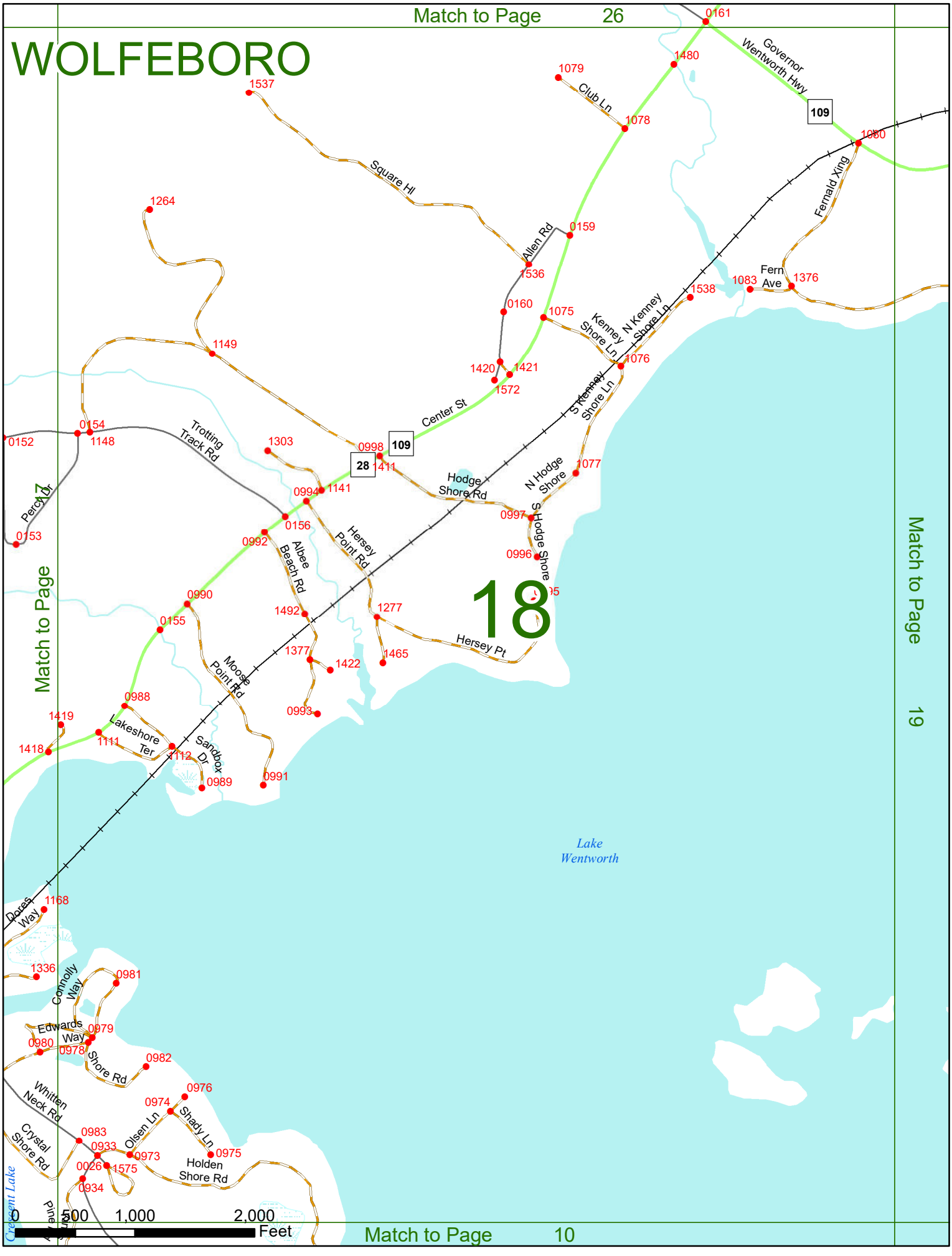

WOLFEBORO
Match to Page 23
Match to Page 14
Match to Page 16
Match to Page 7
15
Mirror Lake
Lake Winnipesaukee
TUFTONBORO
WOLFEBORO
109
Governor Wentworth Hwy
Lang Pond Rd
Museum Shores Rd
McCarthy Anna Rd
Tern Ln
Lark St
Finch St
Robin Acres Dr
Piping Rock Rd
Baas Dr
N Main St
Fullerton Shore
Harbor Way
Piper Ln
Old Keewaydin Point Rd
Mandalay Rd
Osseo Cir
Koko Dr
Sachem Ln
Keewaydin Rd
N Keewaydin Shores
Leafy Hill Ln
Locust Ln
Waumbek Rd
Winterhaven Rd
Kimball Rd
Lloyd Rd
Port Wedeln Rd
Jasons Way
Council Tree Ln
Winter Harbor Way
Profile Pl
Cross Neck Rd
Boycroft Rd
Country Ln
Oak Hill Rd
Jordan W...
0 500 1,000 2,000 Feet

Match to Page 24

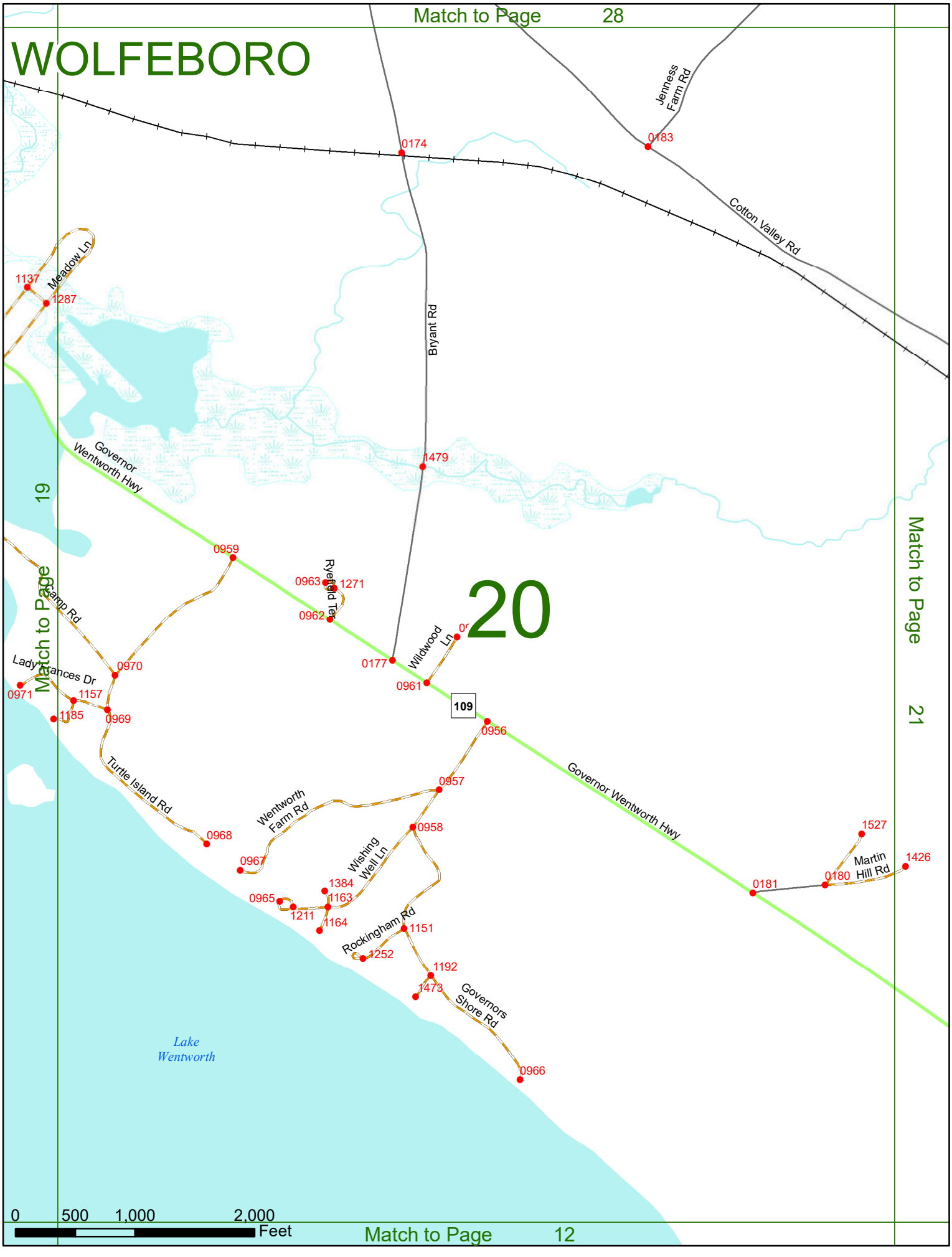
WOLFEBORO

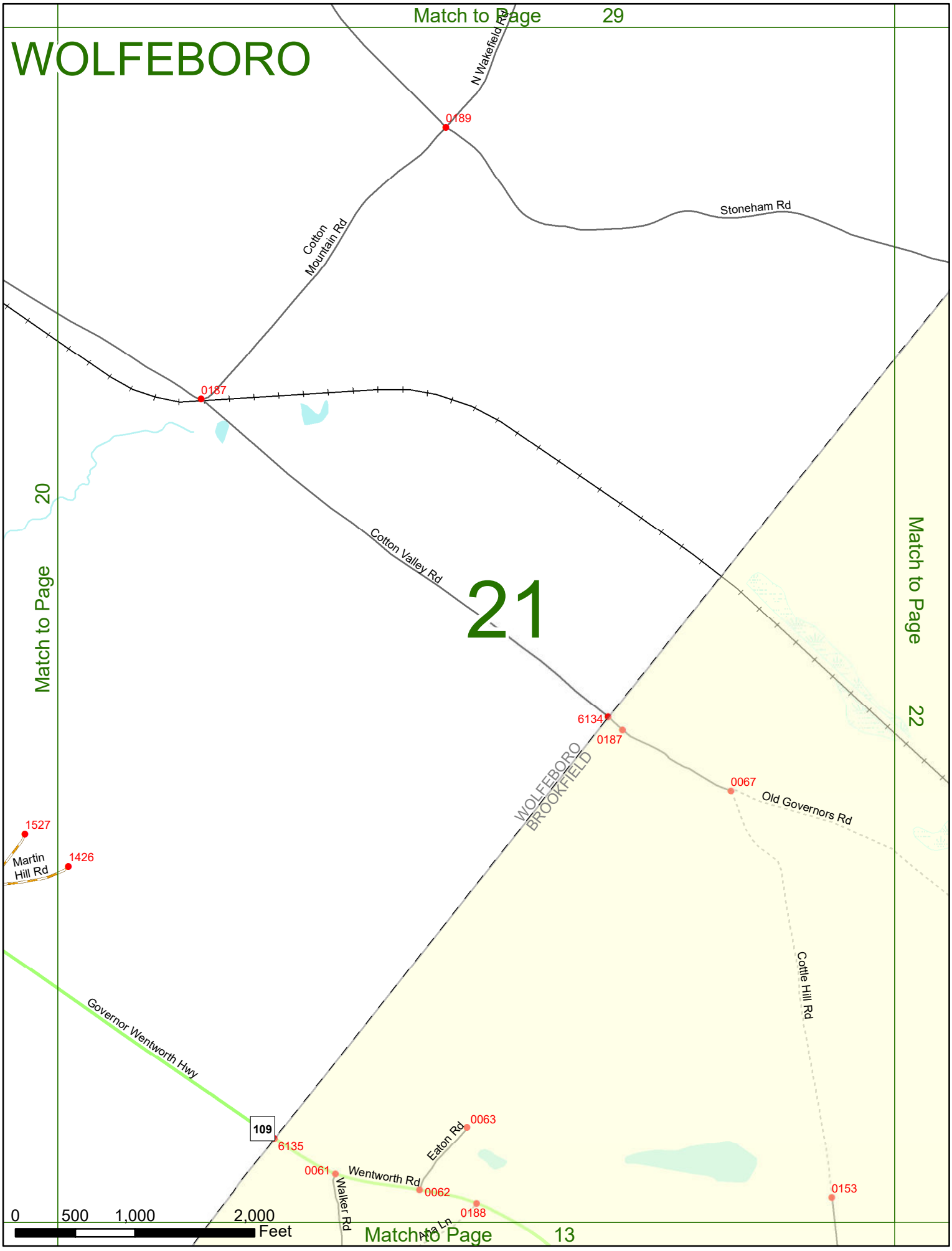


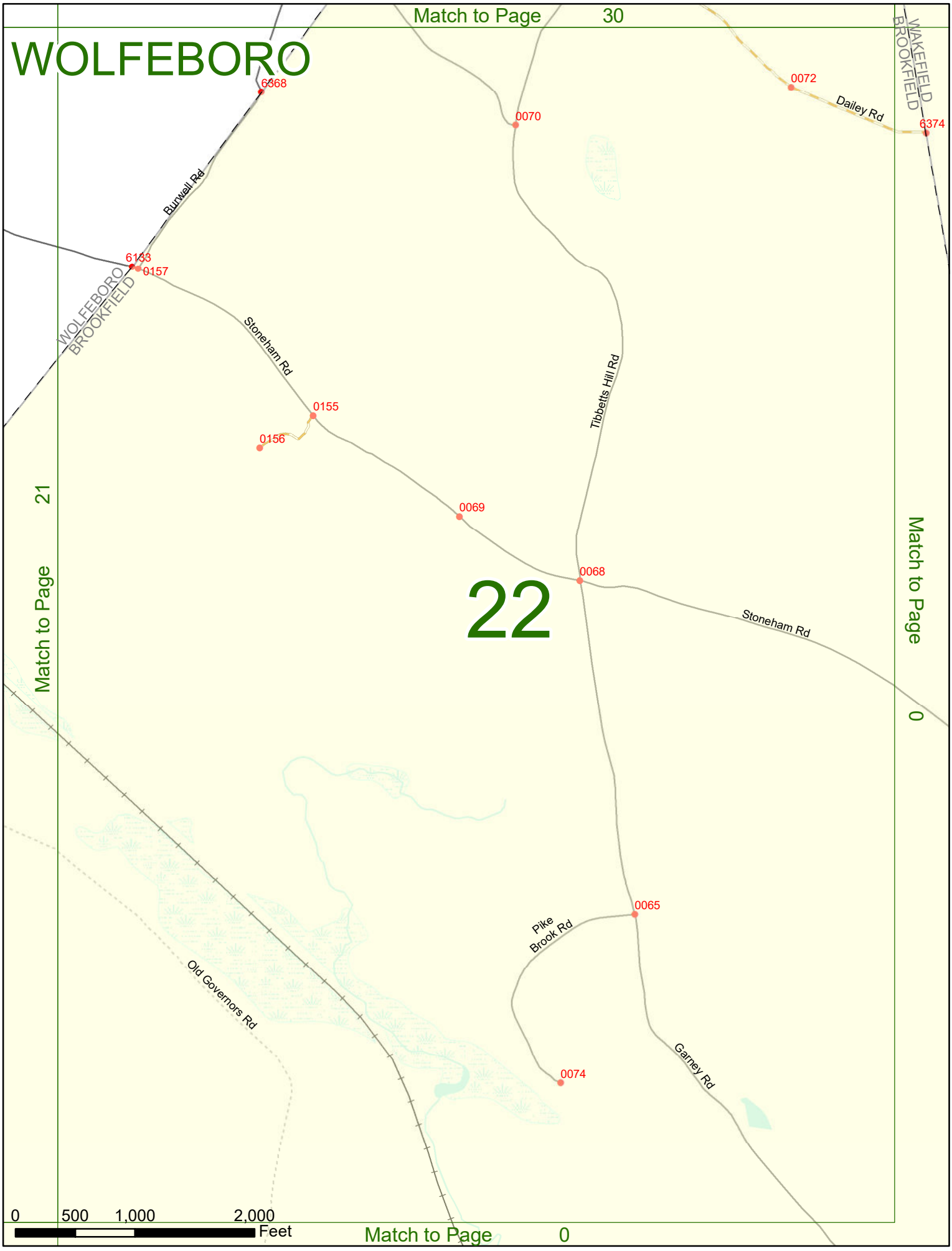

WOLFEBORO
Match to Page 25
Match to Page 16
Match to Page 18
Match to Page 9
17
Roland Rd
June Bug Ln
Furber Ln
Beach Pond Rd
Trotting Track Rd
Percy Dr
Vista Dr
Rolling Wood Dr
Wickers Dr
Pine Hill Rd
109A
Sugarwood Dr
Kenyann Dr
Moultrie Dr
Harvey Brook Rd
Birch Hill Estates Rd
Eastman Ave
Granite Ln
Bayberry Ln
Center St
109
28
Birch Rd
Dores Smith Way
River Rd
Connolly Way
Edwards Way
Zephyr Ln
Whitten Neck Rd
Crystal Shore Rd
Kings Pine Rd
High St
Silver St
Park Ave
Blackberry Ln
Filter Bed Rd
Bay St
Elm St
Front Bay
Lake Wentworth
Crescent Lake
1065
1063
1064
1066
1074
1542
1541
1424
1539
1506
0151
0146
1018
1019
1110
1007
1005
1289
1006
1329
1009
1008
1015
1016
1013
1014
1004
1003
1010
1012
1011
1002
1000
1001
1493
1109
1494
0999
1419
1111
1418
1148
0152
0154
0153
1168
0027
0029
1167
1336
1294
0028
0979
0980
0978
0986
0987
0985
0977
0983
0933
1575
0026
0934
0035
0036
0034
0038
0037
0033
1344
1343
1504
1017
0139
0123
1390
1391
0
500
1,000
2,000
Feet

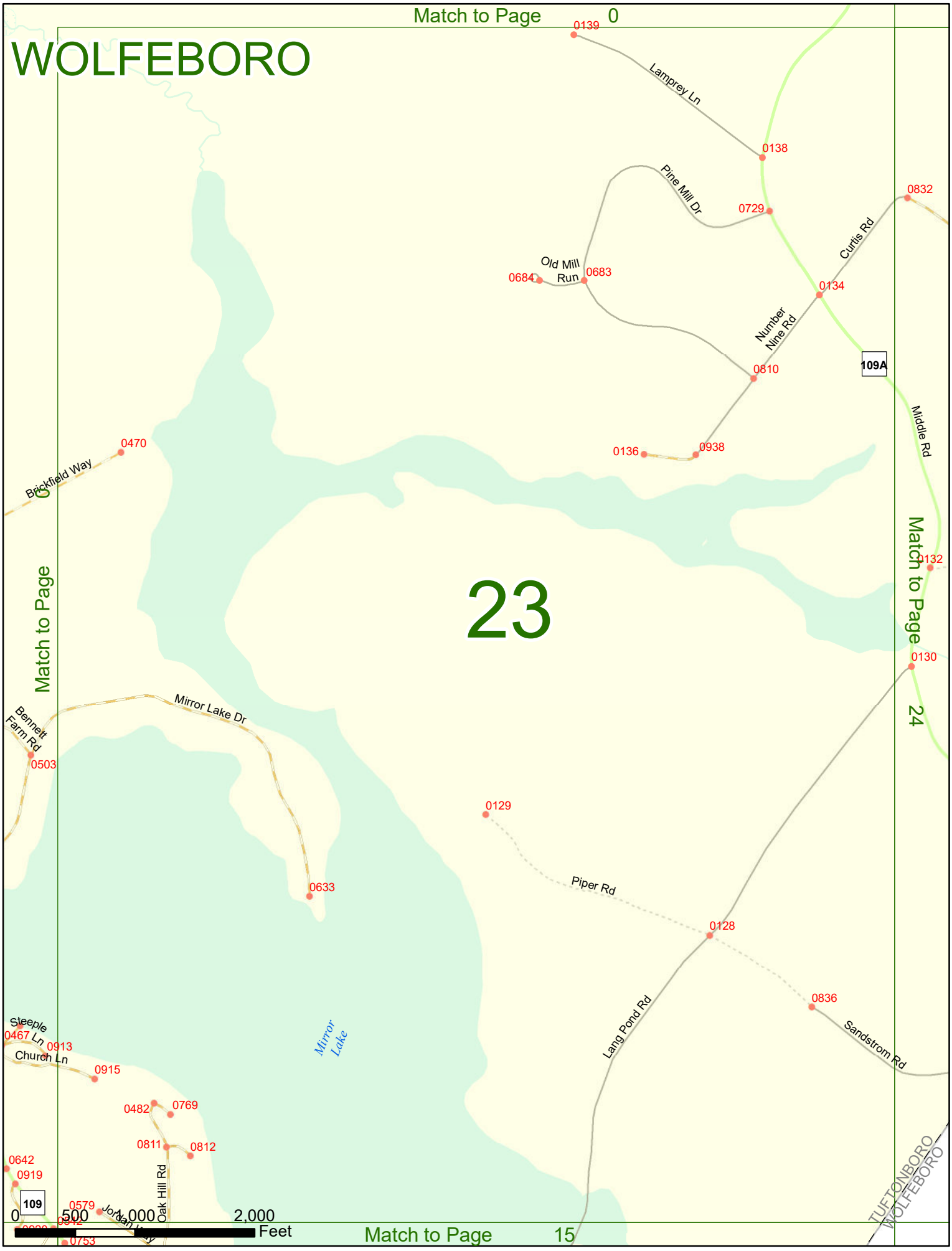

Match to Page 26
WOLFEBORO
Governor Wentworth Hwy
109
Club Ln
Square Hl
Allen Rd
Fernald Xing
Fern Ave
Kenney Shore Ln
N Kenney Shore Ln
S Kenney Shore Ln
Center St
28
Trotting Track Rd
Percy Dr
Hodge Shore Rd
N Hodge Shore
S Hodge Shore
Albee Beach Rd
Hersey Point Rd
Hersey Pt
Moose Point Rd
Lakeshore Ter
Sandbox Dr
Dores Way
Connolly Way
Edwards Way
Shore Rd
Whitten Neck Rd
Crystal Shore Rd
Olsen Ln
Shady Ln
Holden Shore Rd
Pine St
Crescent Lake
Lake Wentworth
18
Match to Page 17
Match to Page 19
Match to Page 10
0 500 1,000 2,000 Feet

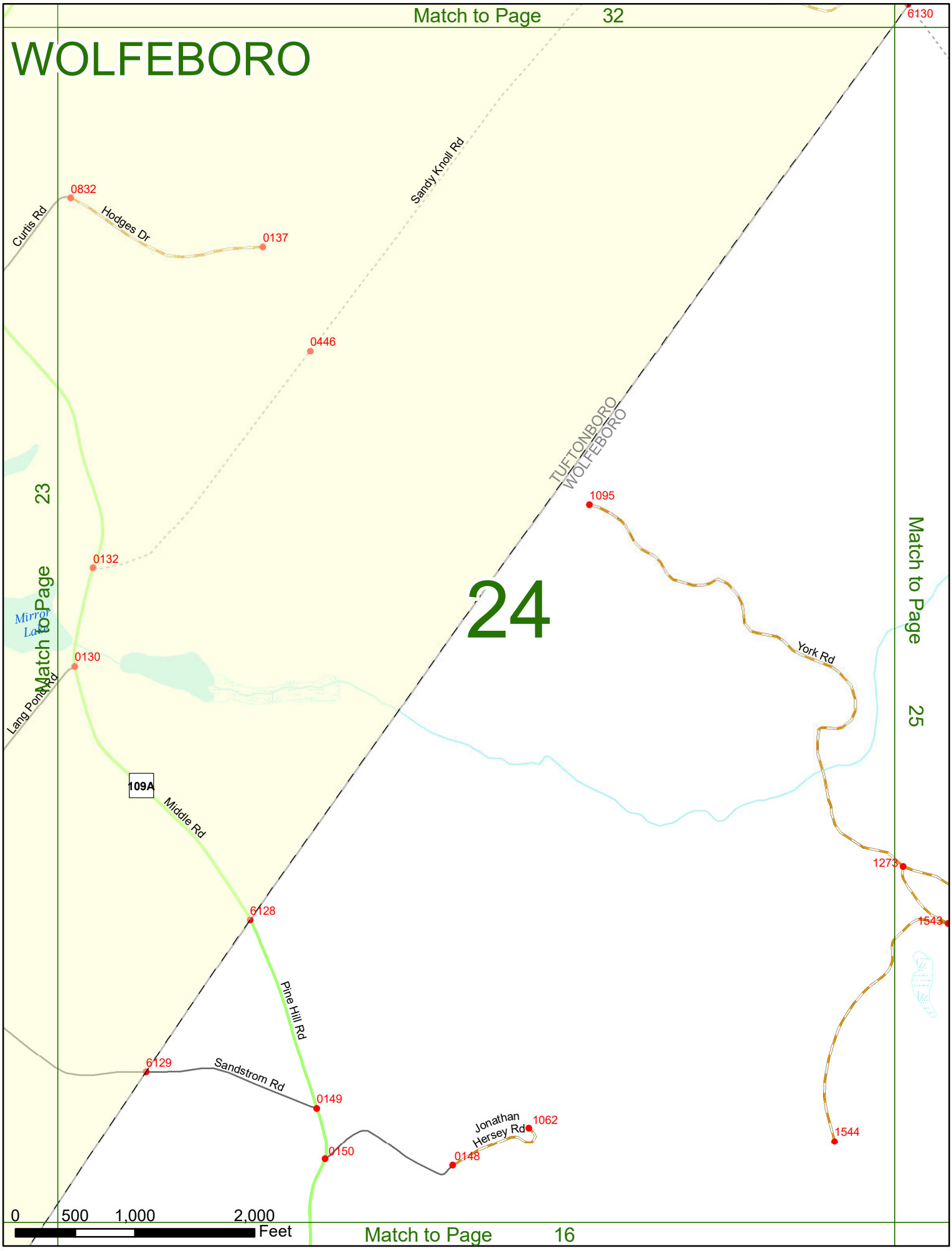

WOLFEBORO
Match to Page 27
Westwood Dr
1534
Tennis Court Ln
1535
1080
0165
1458
1459
1082
Fernald Xing
1496
Burroughs Ln
1495
Governor Wentworth Hwy
109
Wentworth SP
0960
0168
1529
1528
1137
Meadow Ln
1287
Meadow Rd
1087
1086
0972
Camp Rd
Lady Frances Dr
0971
1157
1185
0969
Match to Page 18
Match to Page 20
19
Lake Wentworth
0 500 1,000 2,000
Feet
Match to Page 11

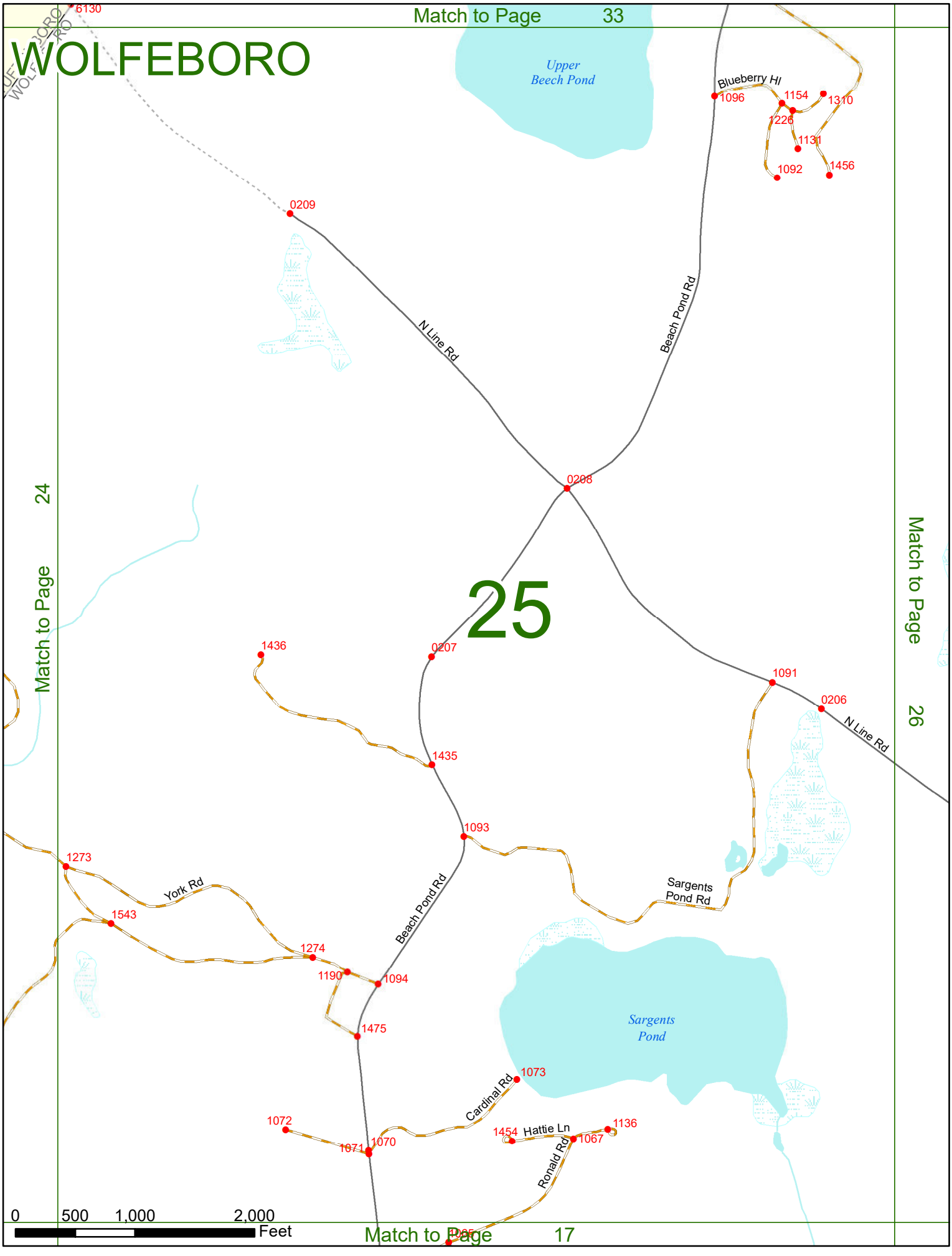

Match to Page 28
WOLFEBORO
Jenness Farm Rd
0183
0174
Cotton Valley Rd
Meadow Ln
1137
1287
Bryant Rd
Governor Wentworth Hwy
1479
19
Match to Page
20
0959
Ryefield Ter
0963
1271
0962
Camp Rd
Wildwood Ln
0177
0961
Lady Frances Dr
0971
1157
1185
0970
0969
109
0956
Turtle Island Rd
0957
Governor Wentworth Hwy
Wentworth Farm Rd
0958
0968
0967
Wishing Well Ln
1384
1163
0965
1211
1164
1527
Martin Hill Rd
1426
0180
0181
Rockingham Rd
1151
1252
1192
1473
Governors Shore Rd
0966
Lake Wentworth
Match to Page 21
0
500
1,000
2,000
Feet
Match to Page 12


Match to Page 29
WOLFEBORO
N Wakefield Rd
0189
Stoneham Rd
Cotton Mountain Rd
0187
Match to Page 20
Cotton Valley Rd
21
Match to Page 22
6134
0187
WOLFEBORO
BROOKFIELD
0067
Old Governors Rd
1527
Martin Hill Rd
1426
Cottle Hill Rd
Governor Wentworth Hwy
109
6135
0063
Eaton Rd
0061
Wentworth Rd
Walker Rd
0062
0188
Ha Ln
0153
0 500 1,000 2,000 Feet
Match to Page 13


WOLFEBORO
Match to Page 30
Match to Page 21
Match to Page 0
Match to Page 0
22
6368
0070
0072
6374
Dailey Rd
WAKEFIELD
BROOKFIELD
Burwell Rd
6133
0157
WOLFEBORO
BROOKFIELD
Stoneham Rd
0155
0156
Tibbetts Hill Rd
0069
0068
Stoneham Rd
0065
Pike
Brook Rd
Old Governors Rd
0074
Garney Rd
0
500
1,000
2,000
Feet

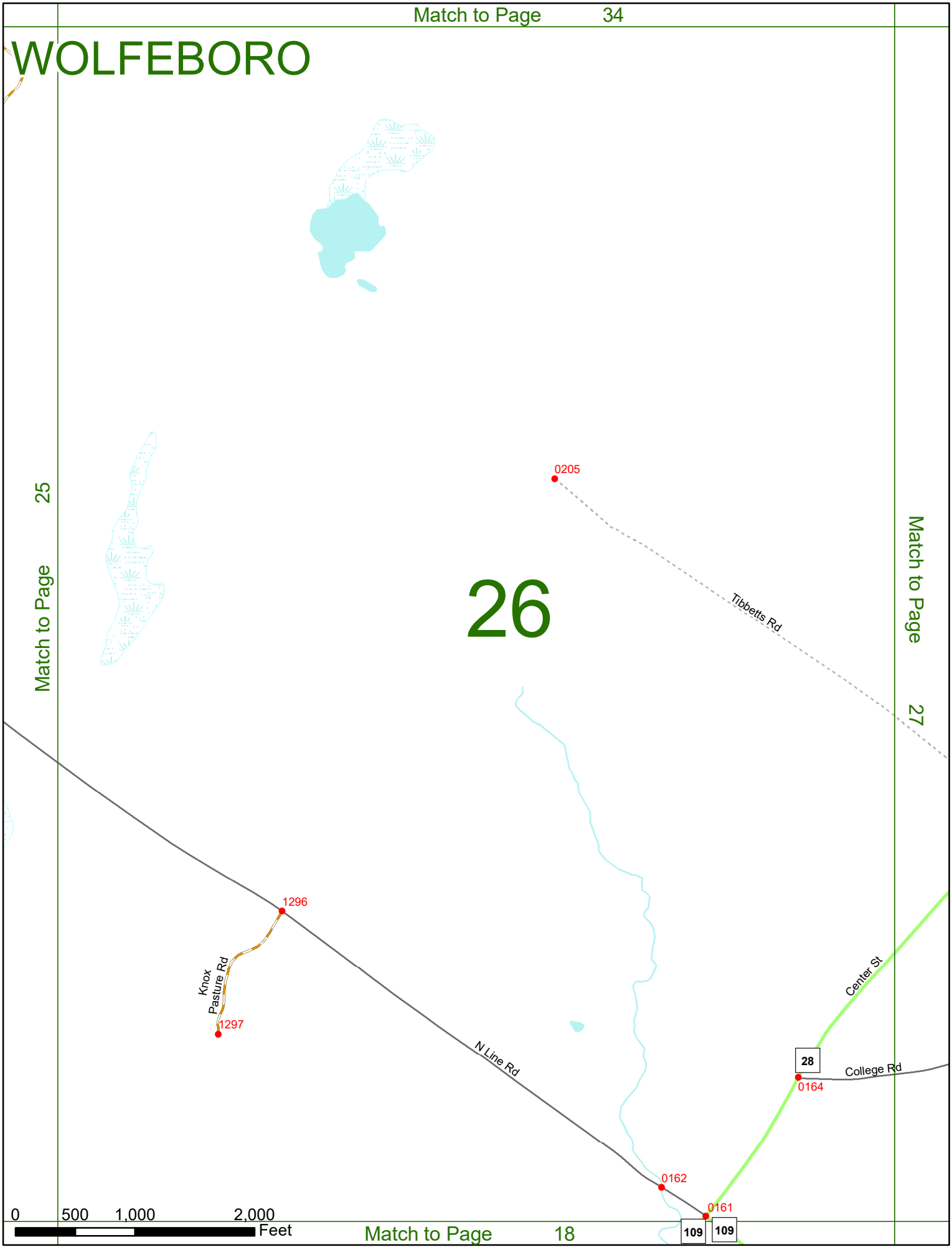

Match to Page 0
WOLFEBORO
0139
Lamprey Ln
0138
Pine Mill Dr
0729
0832
Curtis Rd
Old Mill Run
0684
0683
0134
Number Nine Rd
109A
0810
Middle Rd
0136
0938
0470
Brickfield Way
Match to Page 0
23
Match to Page 24
0132
0130
Mirror Lake Dr
Bennett Farm Rd
0503
0129
Piper Rd
0633
0128
0836
Lang Pond Rd
Sandstrom Rd
Steeple
0467 Ln
0913
Church Ln
0915
Mirror Lake
0482
0769
0811
0812
0642
0919
109
0579
Jordan Way
Oak Hill Rd
0753
0 500 1,000 2,000 Feet
Match to Page 15
TUFTONBORO
WOLFEBORO


Match to Page 32
WOLFEBORO
Sandy Knoll Rd
Curtis Rd
Hodges Dr
0832
0137
0446
TUFTONBORO
WOLFEBORO
1095
York Rd
6130
24
Match to Page 23
Match to Page 25
0132
Mirror Lake
0130
Lang Pond Rd
109A
Middle Rd
6128
Pine Hill Rd
1273
1543
1544
6129
Sandstrom Rd
0149
Jonathan Hersey Rd
1062
0150
0148
0 500 1,000 2,000 Feet
Match to Page 16

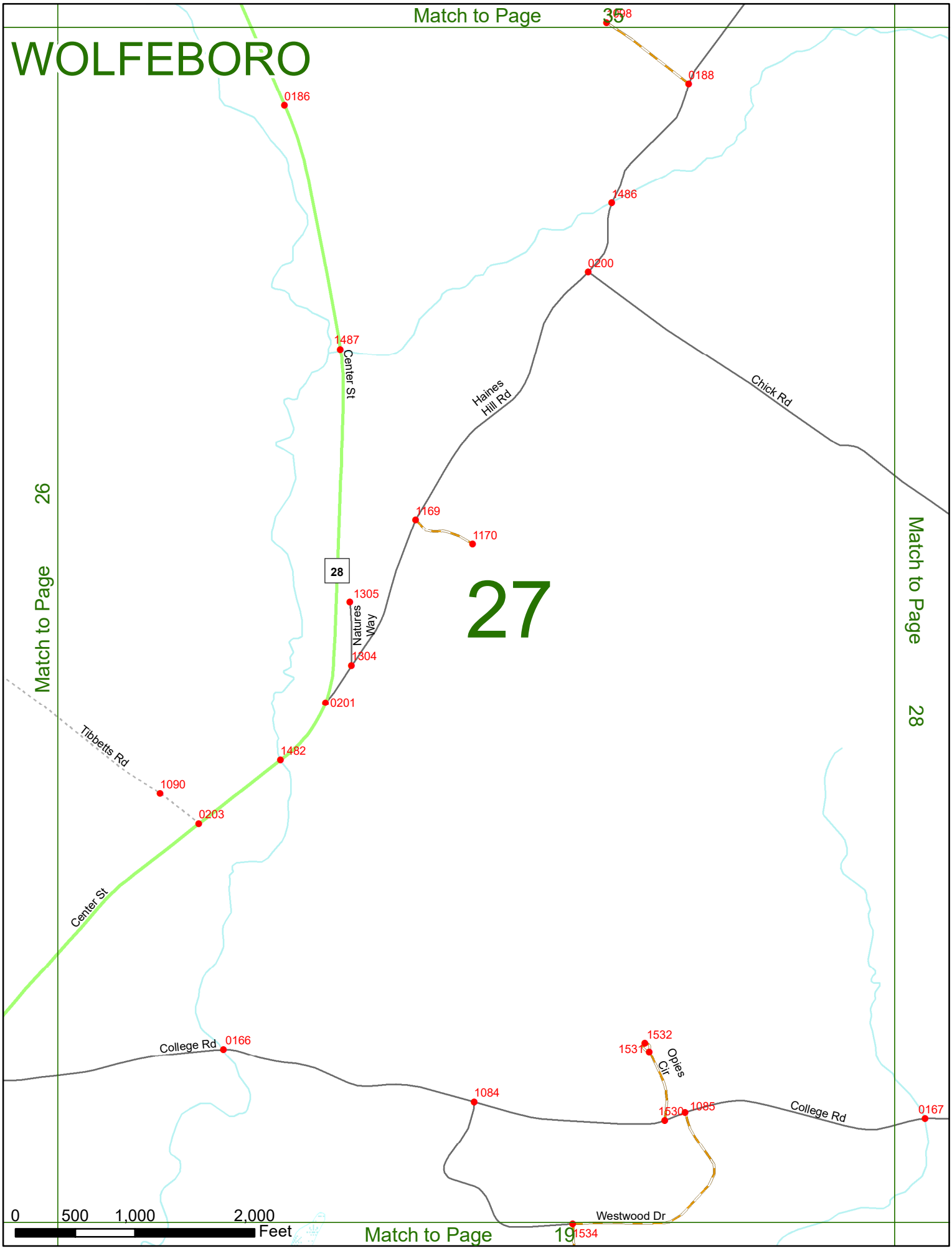

Match to Page 33
WOLFEBORO
6130
Upper
Beech Pond
Blueberry Hl
1096
1154
1310
1226
1131
1092
1456
0209
N Line Rd
Beach Pond Rd
0208
25
Match to Page 24
Match to Page 26
1436
0207
1435
1091
0206
N Line Rd
1093
1273
York Rd
1543
Beach Pond Rd
Sargents
Pond Rd
1274
1190
1094
1475
Sargents
Pond
1073
Cardinal Rd
1072
1071
1070
1454
Hattie Ln
1136
1067
Ronald Rd
0 500 1,000 2,000
Feet
Match to Page 17

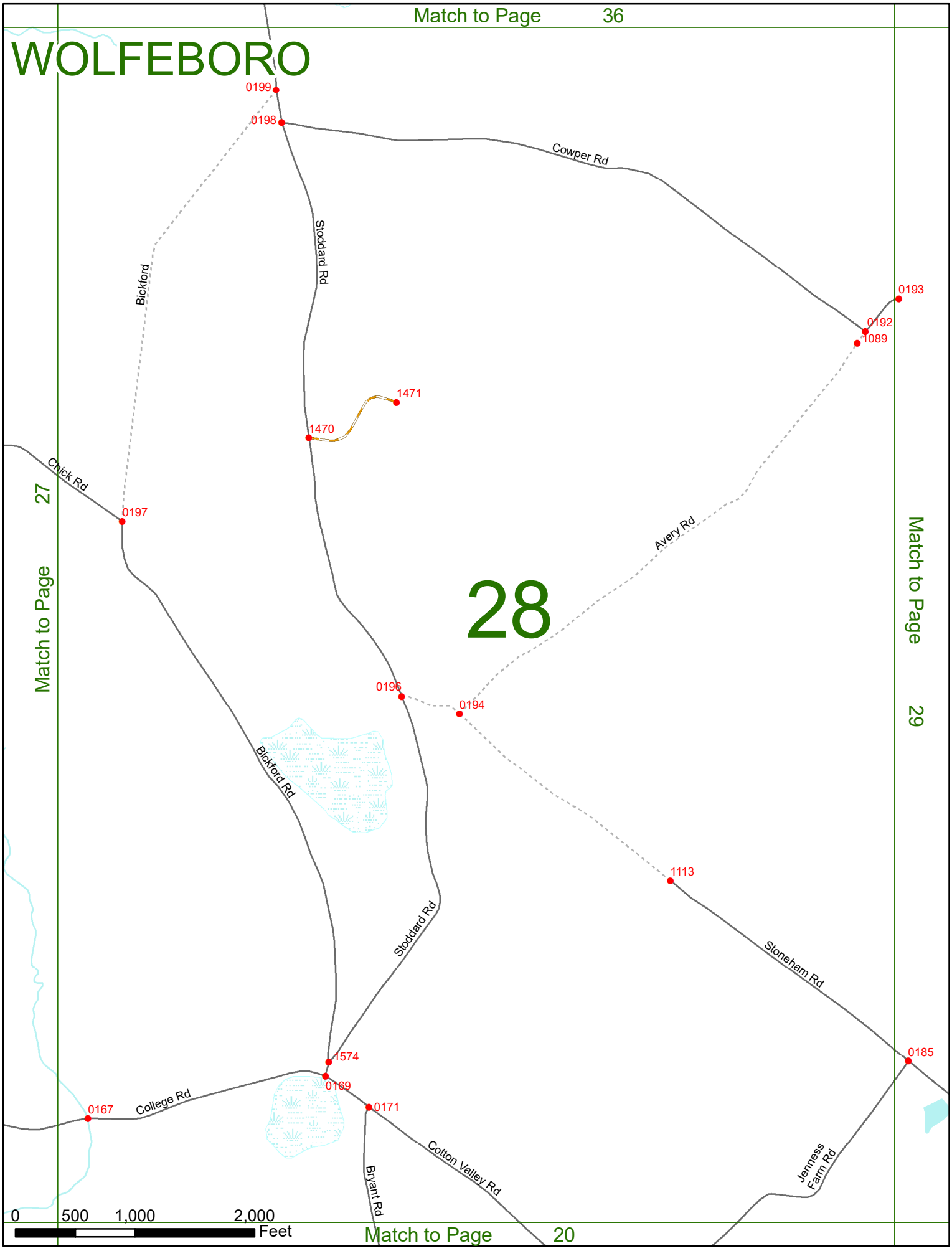
Match to Page 34

WOLFEBORO



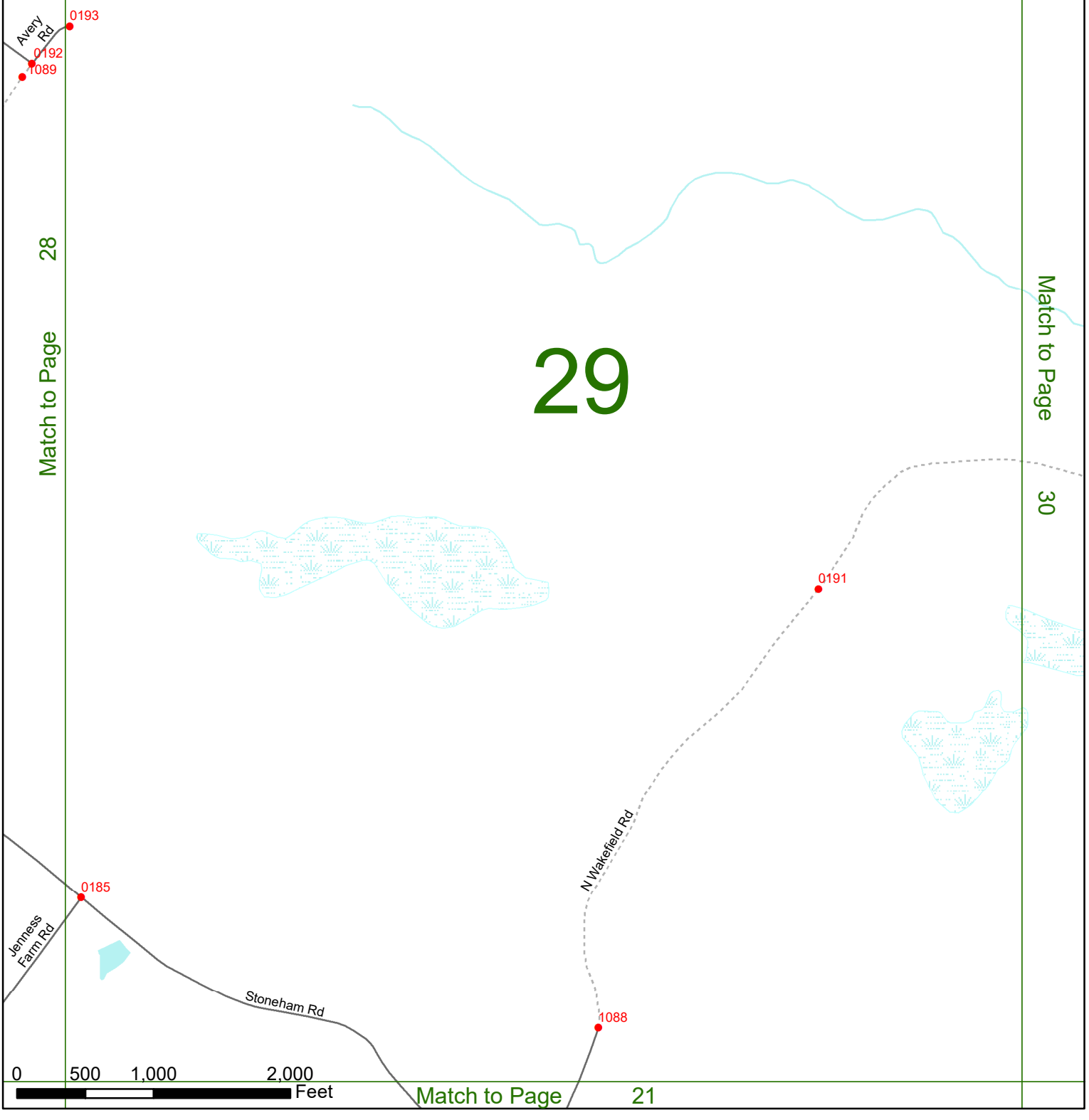
Match to Page 25
Match to Page 27
Match to Page 18


WOLFEBORO
Match to Page
0188
0186
1486
0200
1487
Center St
Haines Hill Rd
Chick Rd
1169
1170
28
1305
Natures Way
1304
27
0201
Tibbetts Rd
1482
1090
0203
Center St
College Rd
0166
1532
1531
Opies Cir
1084
1530
1085
College Rd
0167
Westwood Dr
1534
Match to Page
19
Match to Page
26
Match to Page
28
0
500
1,000
2,000
Feet

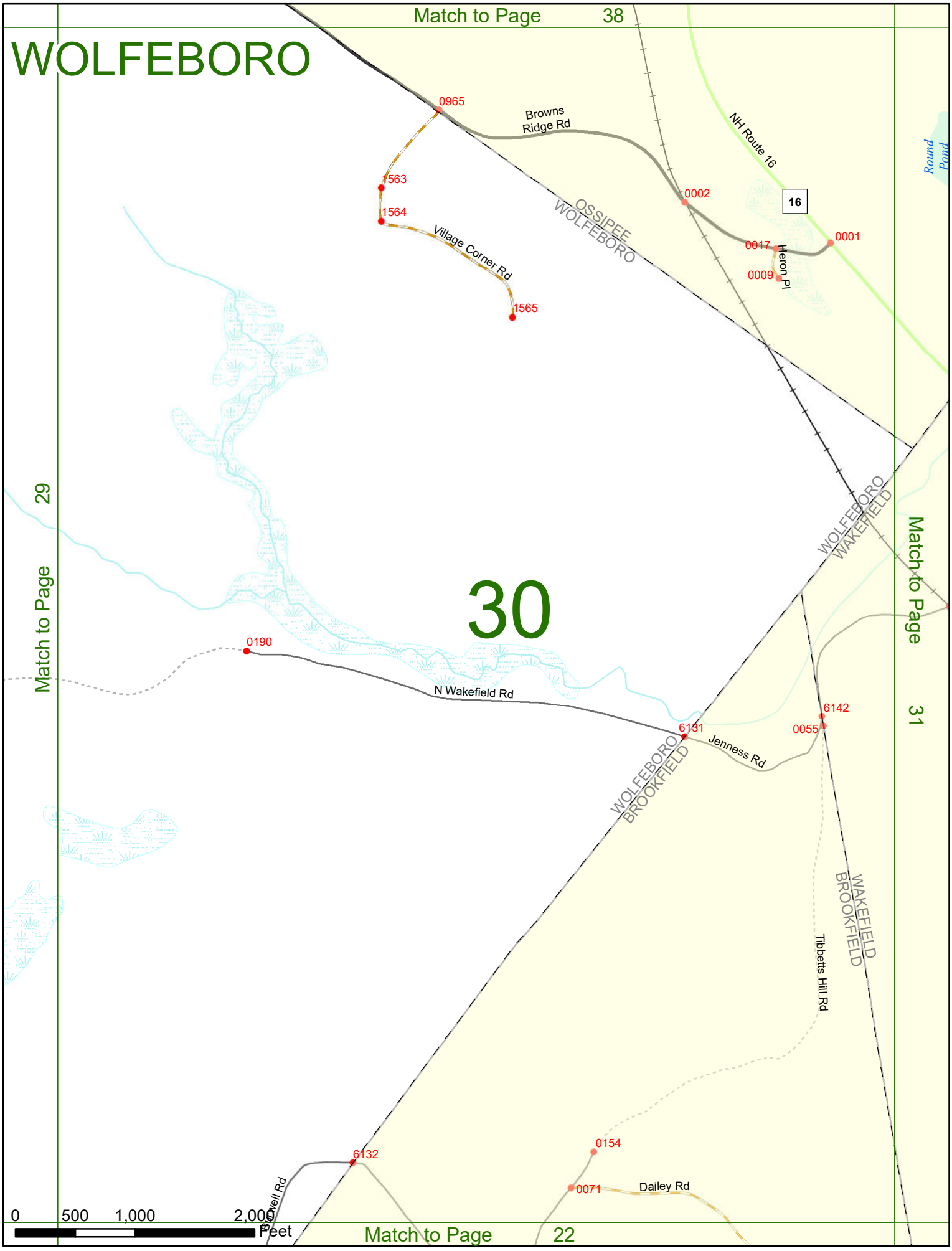

Match to Page 36
WOLFEBORO
0199
0198
Cowper Rd
Stoddard Rd
Bickford
0193
0192
1089
1471
1470
Chick Rd
0197
Avery Rd
28
Match to Page 27
Match to Page 29
0196
0194
Bickford Rd
1113
Stoddard Rd
Stoneham Rd
1574
0169
0185
0167
College Rd
0171
Cotton Valley Rd
Bryant Rd
Jenness Farm Rd
0 500 1,000 2,000 Feet
Match to Page 20

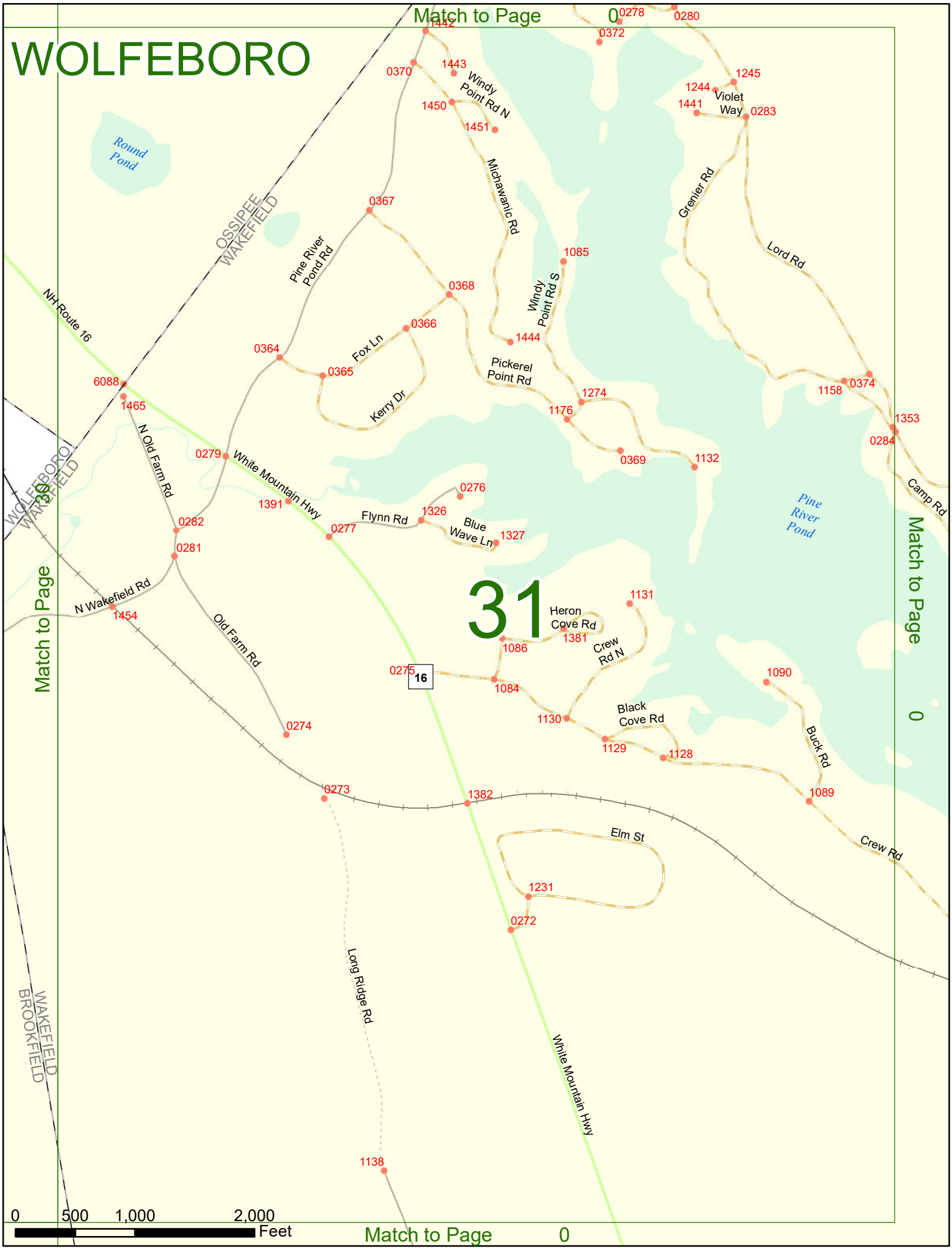
Match to Page 37

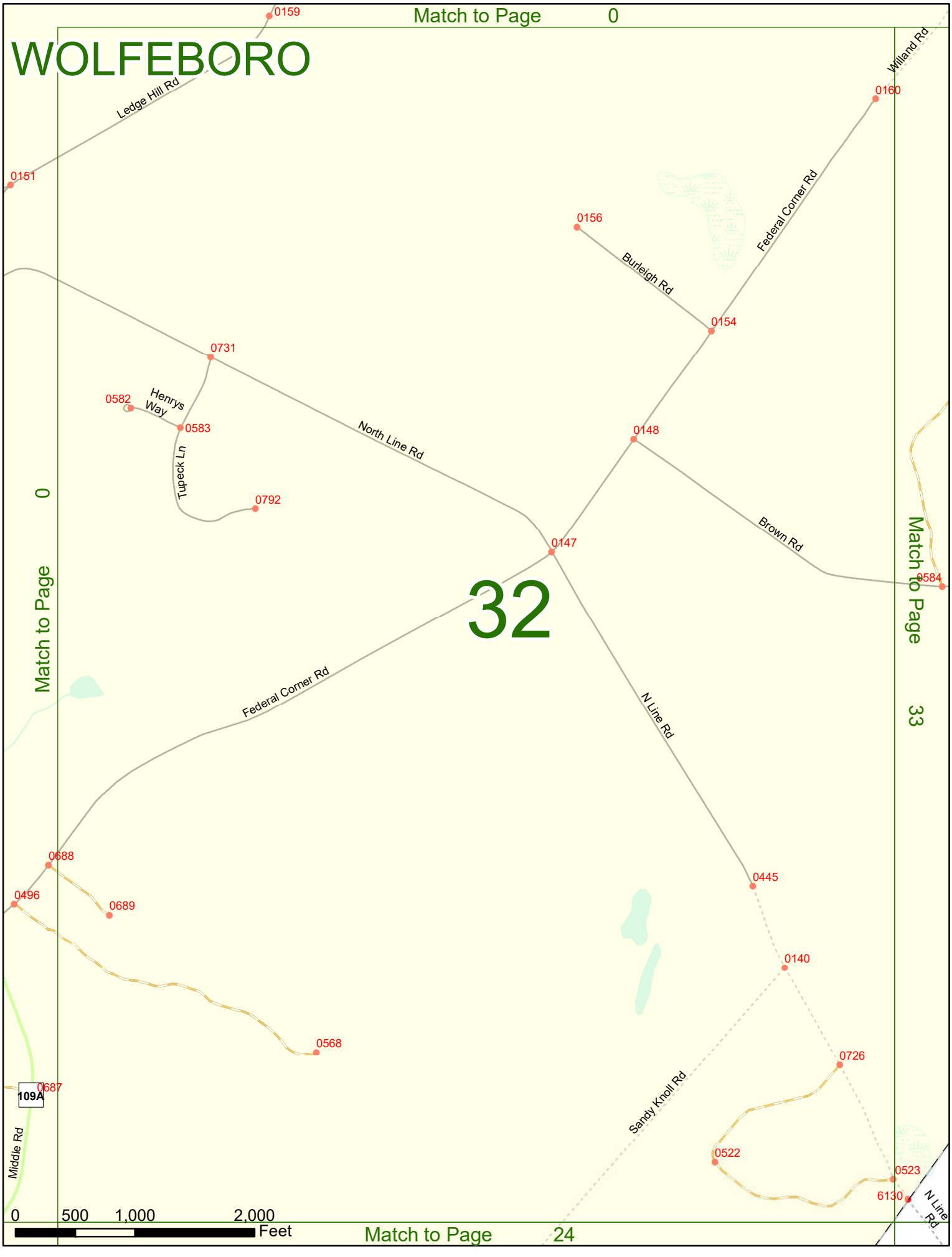
WOLFEBORO

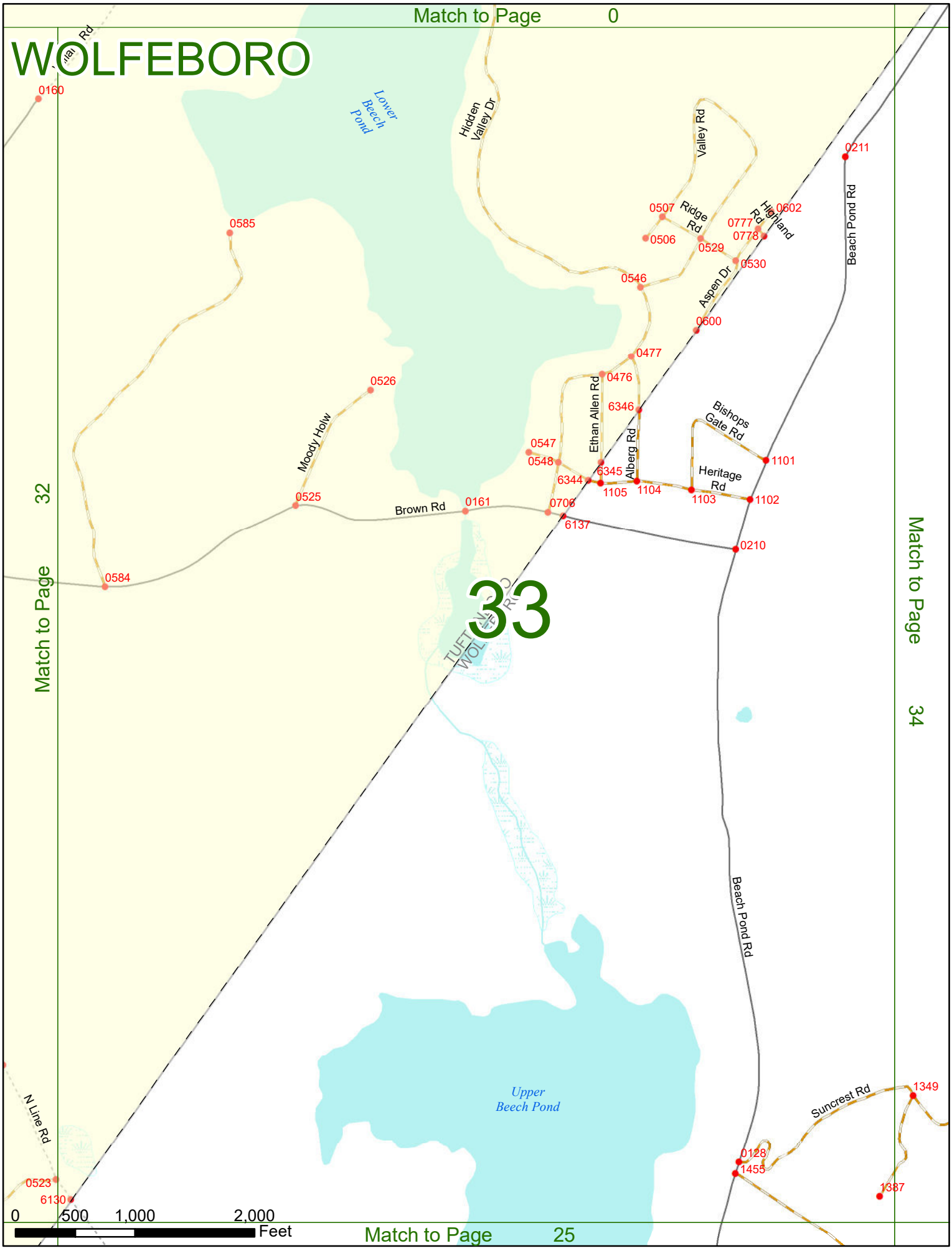


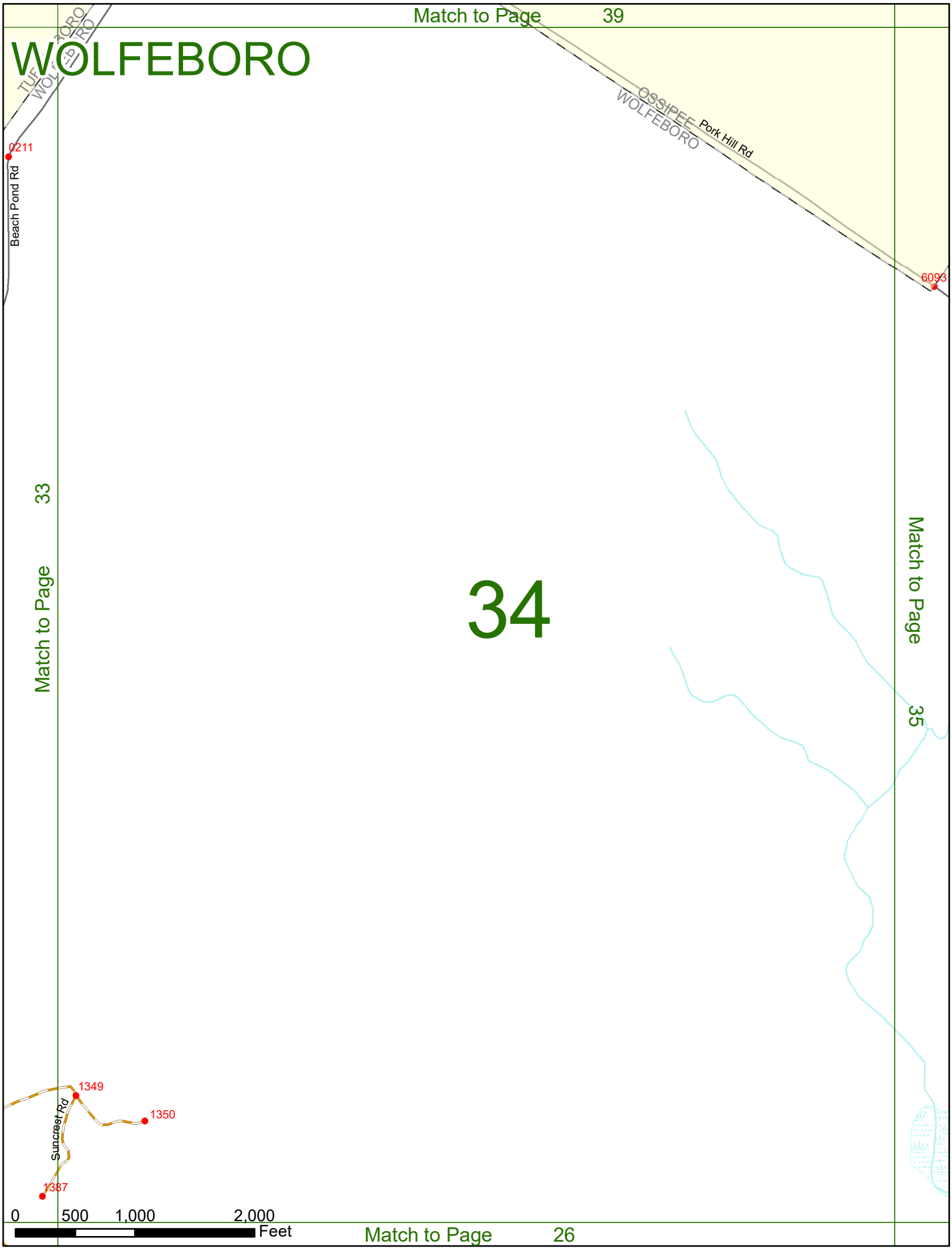
Match to Page 21

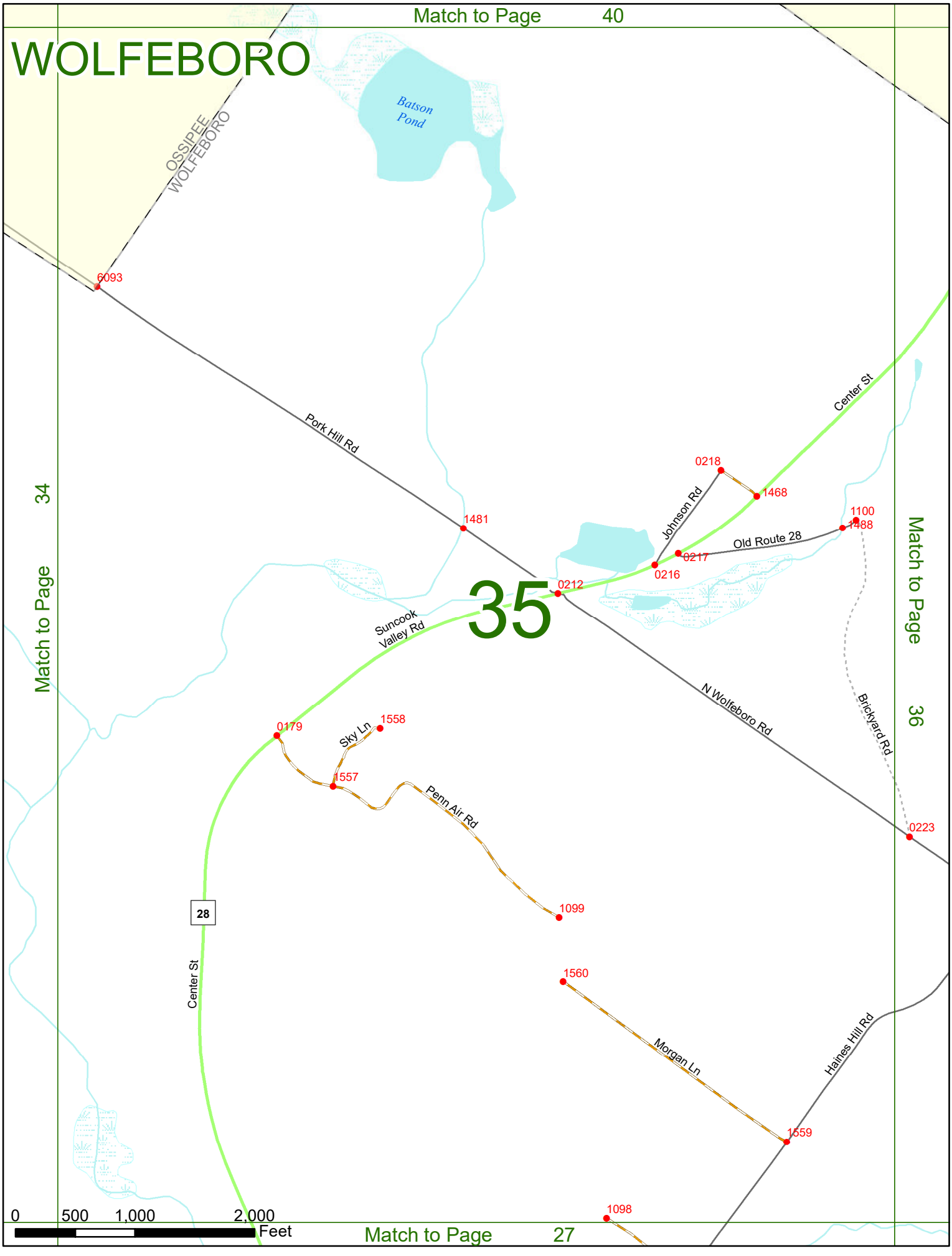

Match to Page 38
WOLFEBORO
0965
Browns Ridge Rd
NH Route 16
Round Pond
1563
1564
Village Corner Rd
1565
OSSIPEE
WOLFEBORO
0002
16
0001
0017
Heron Pl
0009
WOLFEBORO
WAKEFIELD
Match to Page 29
30
Match to Page 31
0190
N Wakefield Rd
6142
0055
6131
Jenness Rd
WOLFEBORO
BROOKFIELD
WAKEFIELD
BROOKFIELD
Tibbetts Hill Rd
0154
6132
Powell Rd
0071
Dailey Rd
0 500 1,000 2,000 Feet
Match to Page 22

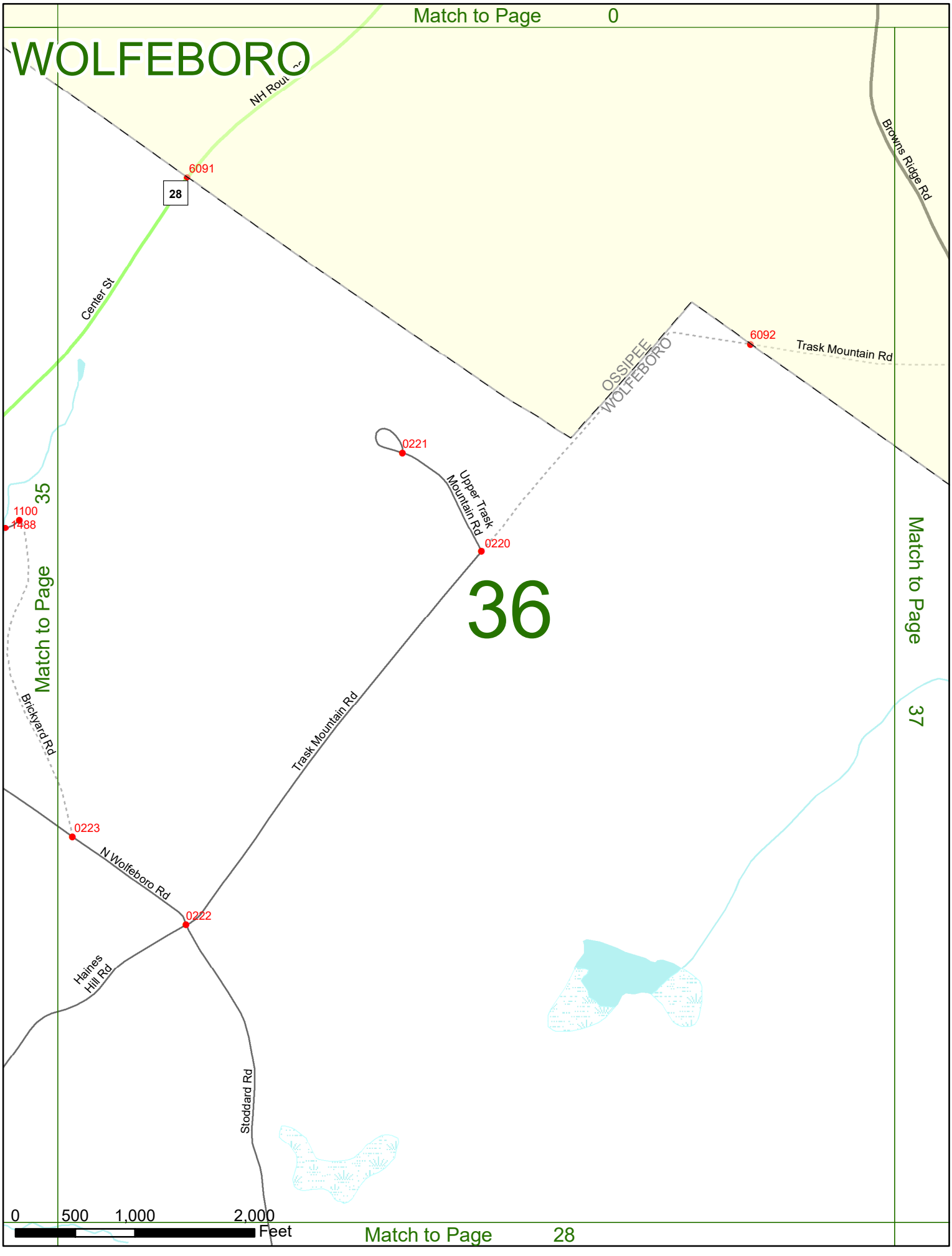

WOLFEBORO
Match to Page 0
Match to Page 30
Match to Page 0
Match to Page 0
31
Round Pond
Pine River Pond
OSSIPEE
WAKEFIELD
WOLFEBORO
WAKEFIELD
WAKEFIELD
BROOKFIELD
NH Route 16
Pine River Pond Rd
Michawanic Rd
Windy Point Rd N
Windy Point Rd S
Pickerel Point Rd
Fox Ln
Kerry Dr
Grenier Rd
Lord Rd
Violet Way
Camp Rd
N Old Farm Rd
White Mountain Hwy
Flynn Rd
Blue Wave Ln
Heron Cove Rd
Crew Rd N
Black Cove Rd
Buck Rd
Crew Rd
Elm St
Old Farm Rd
N Wakefield Rd
Long Ridge Rd
White Mountain Hwy
16
0 500 1,000 2,000
Feet

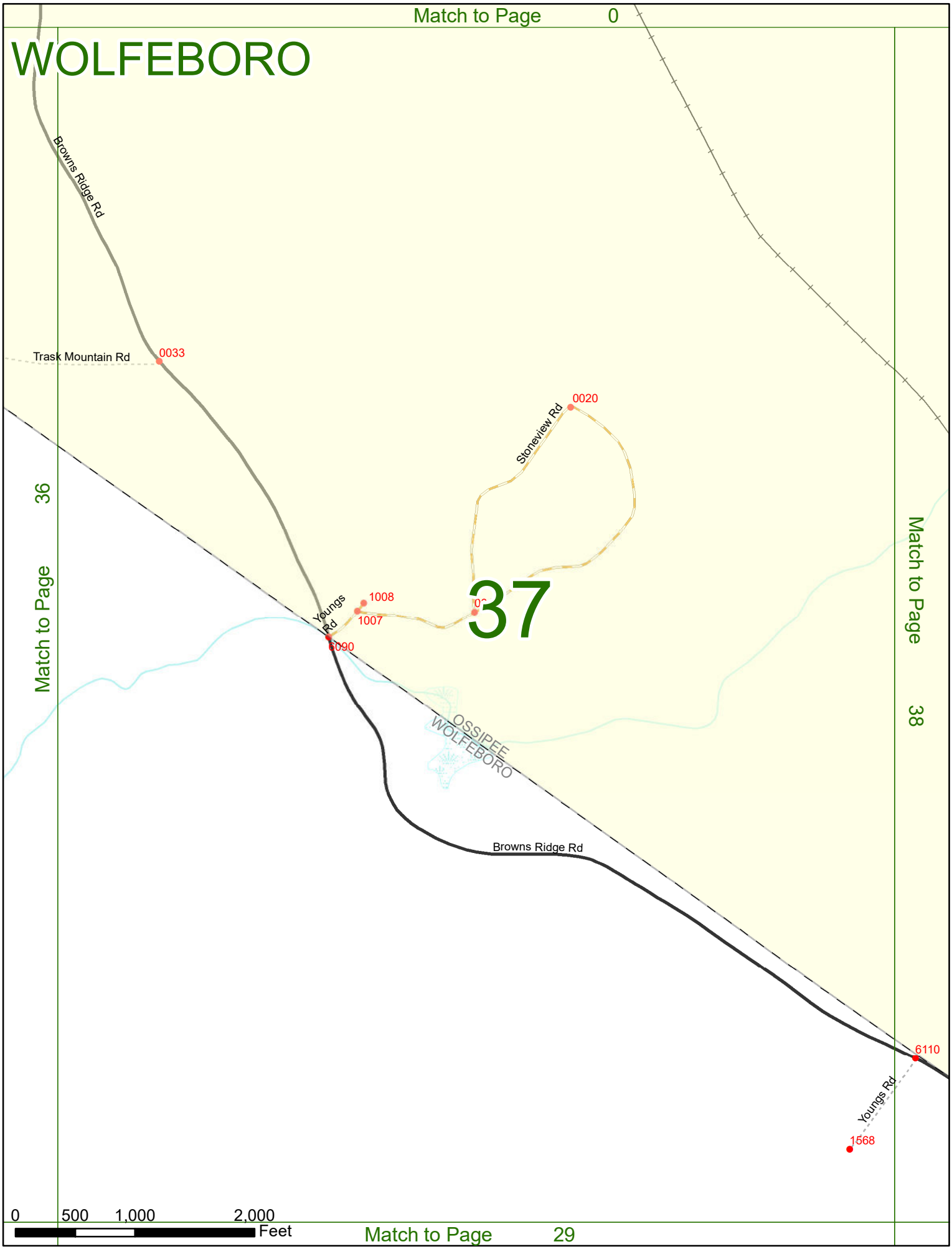

WOLFEBORO
Match to Page 0
Match to Page 0
Match to Page 33
Match to Page 24
32
0159
0160
0151
0156
0154
0731
0582
0583
0792
0148
0147
0584
0688
0496
0689
0568
0445
0140
0726
0687
0522
0523
6130
Ledge Hill Rd
Willand Rd
Federal Corner Rd
Burleigh Rd
Henrys Way
Tupeck Ln
North Line Rd
Brown Rd
Federal Corner Rd
N Line Rd
Sandy Knoll Rd
Middle Rd
109A
N Line Rd
0
500
1,000
2,000
Feet

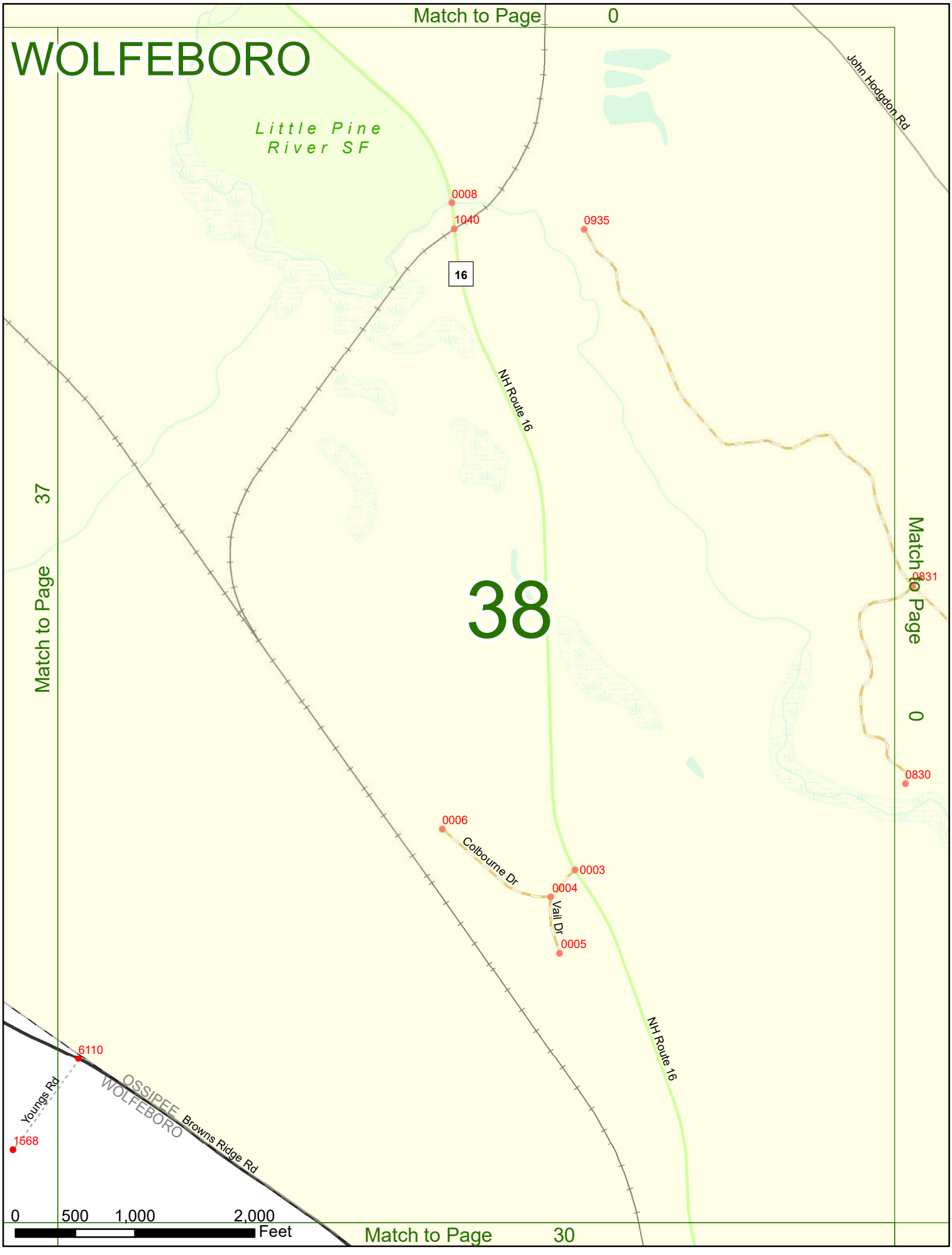

Match to Page 0
WOLFEBORO
0160
Lower Beech Pond
Hidden Valley Dr
Valley Rd
0211
0507
Ridge Rd
0602
0777
Highland Rd
0778
0506
0529
0530
Beach Pond Rd
0585
0546
Aspen Dr
0600
0477
0476
0526
6346
Ethan Allen Rd
Alberg Rd
Bishops Gate Rd
Moody Holw
0547
0548
6345
6344
1105
1104
1103
Heritage Rd
1101
1102
0525
Brown Rd
0161
0706
6137
0210
0584
33
TUFT
WOLFE RD
Match to Page 32
Match to Page 34
Beach Pond Rd
Upper Beech Pond
Suncrest Rd
1349
0128
1455
1387
N Line Rd
0523
6130
0
500
1,000
2,000
Feet
Match to Page 25

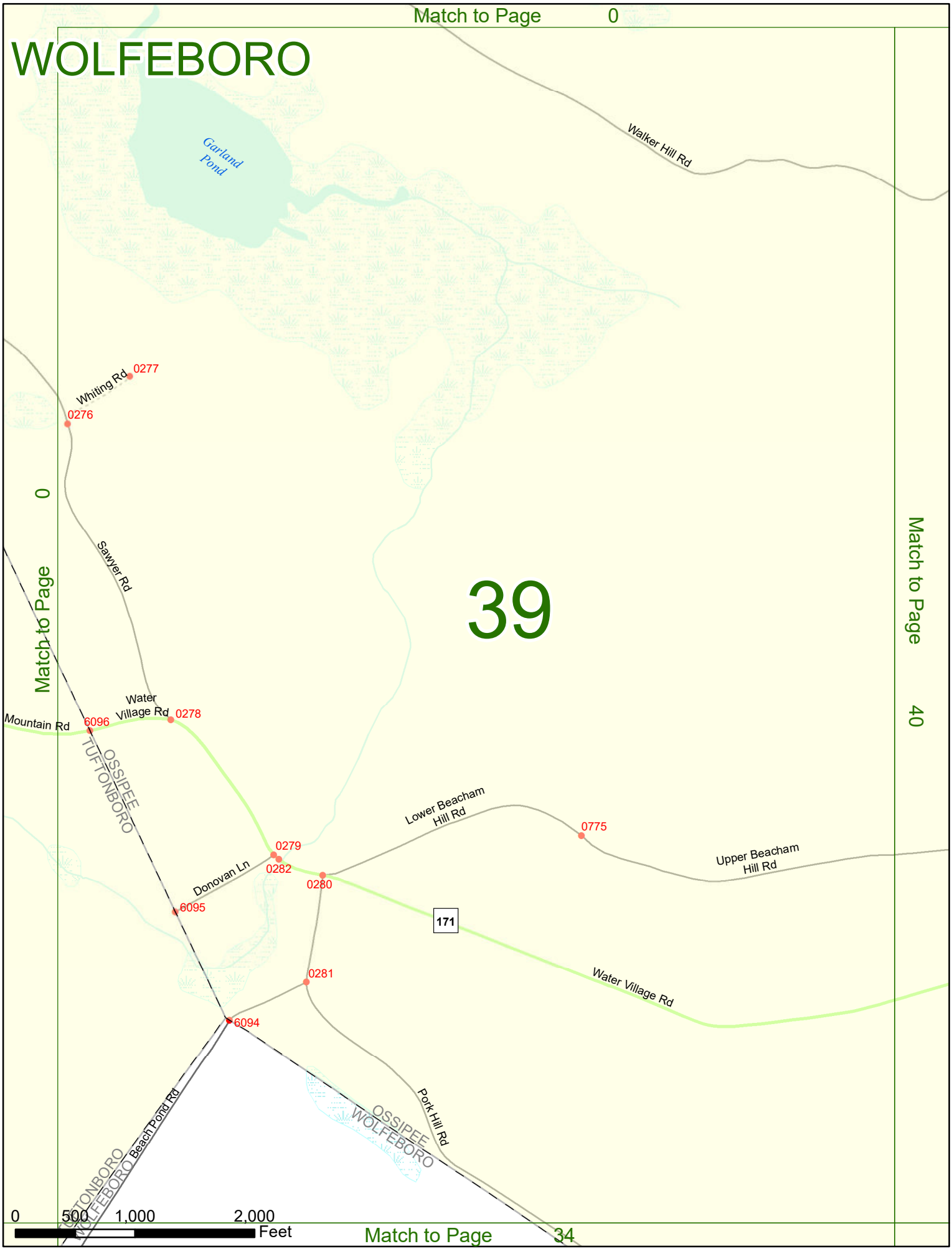

Match to Page 39
WOLFEBORO
TUFTONBORO
WOLFEBORO
OSSIPEE
WOLFEBORO
Pork Hill Rd
0211
Beach Pond Rd
6093
Match to Page 33
34
Match to Page 35
1349
1350
Suncrest Rd
1387
0
500
1,000
2,000
Feet
Match to Page 26


Match to Page 40
WOLFEBORO
OSSIPEE
WOLFEBORO
Batson Pond
6093
Pork Hill Rd
1481
Center St
0218
1468
Johnson Rd
1100
1488
Old Route 28
0217
0216
0212
35
Suncook Valley Rd
N Wolfeboro Rd
Brickyard Rd
0223
0179
Sky Ln
1558
1557
Penn Air Rd
1099
28
Center St
1560
Morgan Ln
Haines Hill Rd
1559
1098
Match to Page 34
Match to Page 36
0 500 1,000 2,000 Feet
Match to Page 27


Match to Page 0
WOLFEBORO
NH Route
6091
28
Center St
Browns Ridge Rd
6092
Trask Mountain Rd
OSSIPEE
WOLFEBORO
0221
Upper Trask Mountain Rd
0220
1100
1488
35
Match to Page
36
Match to Page
37
Brickyard Rd
Trask Mountain Rd
0223
N Wolfeboro Rd
0222
Haines Hill Rd
Stoddard Rd
0
500
1,000
2,000
Feet
Match to Page 28

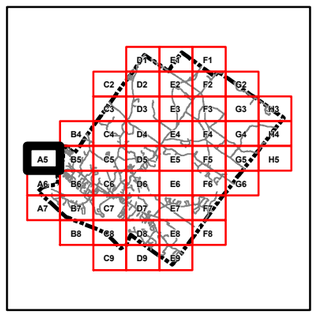

Match to Page 0
WOLFEBORO
Browns Ridge Rd
Trask Mountain Rd
0033
0020
Stoneview Rd
Youngs Rd
1008
1007
6090
37
Match to Page 36
Match to Page 38
OSSIPEE
WOLFEBORO
Browns Ridge Rd
6110
Youngs Rd
1568
0 500 1,000 2,000
Feet
Match to Page 29


Match to Page 0
WOLFEBORO
Little Pine River SF
John Hodgdon Rd
0008
1040
0935
16
NH Route 16
Match to Page 37
38
Match to Page 0
0831
0830
0006
Colbourne Dr
0003
0004
Vail Dr
0005
NH Route 16
6110
Youngs Rd
OSSIPEE
WOLFEBORO
Browns Ridge Rd
1568
0 500 1,000 2,000
Feet
Match to Page 30


Match to Page 0
WOLFEBORO
Garland Pond
Walker Hill Rd
Whiting Rd
0277
0276
Sawyer Rd
Match to Page 0
39
Match to Page 40
Water Village Rd
0278
Mountain Rd
6096
OSSIPEE
TUFTONBORO
Lower Beacham Hill Rd
0775
Upper Beacham Hill Rd
0279
0282
0280
Donovan Ln
6095
171
Water Village Rd
0281
6094
Pork Hill Rd
OSSIPEE
WOLFEBORO
TUFTONBORO
WOLFEBORO
Beach Pond Rd
0
500
1,000
2,000
Feet
Match to Page 34

Road Management Segments

Wolfeboro, NH



WOODARD & CURRAN

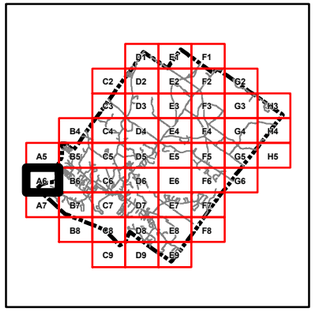
0 300 600 1,200 Feet

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

A5

Road Management Segments

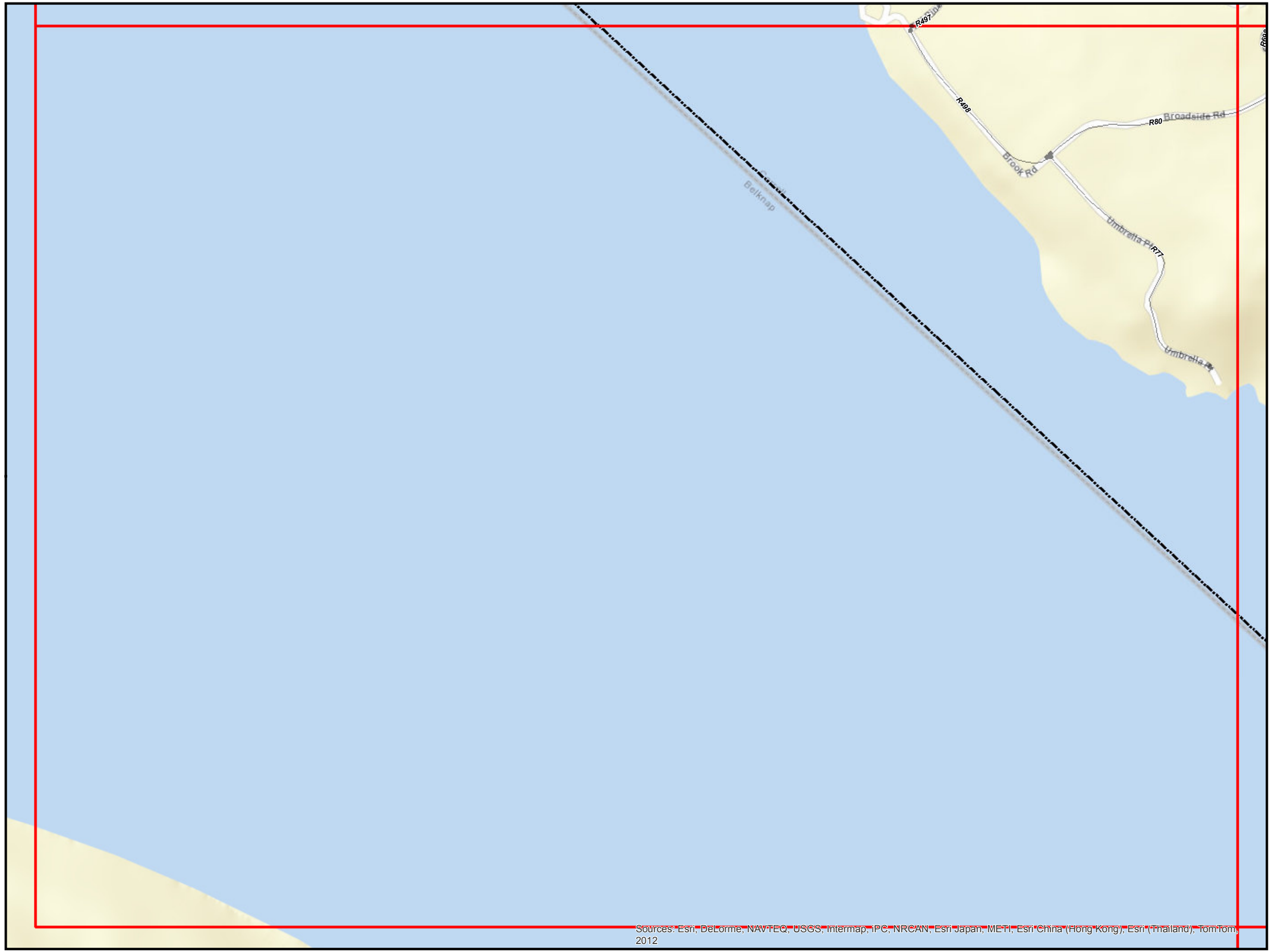
Wolfeboro, NH



WOODARD &CURRAN

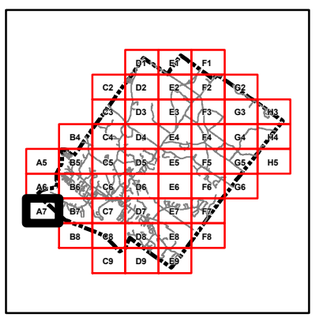
0 300 600 1,200 Feet

A6



Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

N

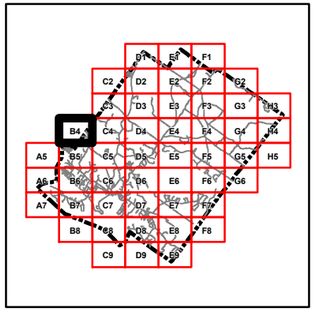
0 300 600 1,200 Feet

A7

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

0 300 600 1,200 Feet

B4

Road Management Segments

Wolfeboro, NH

WOODARD & CURRAN

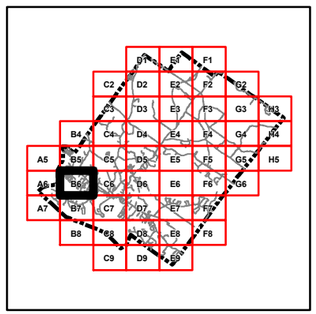
0 300 600 1,200 Feet

B5

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

Road Management Segments

Wolfeboro, NH



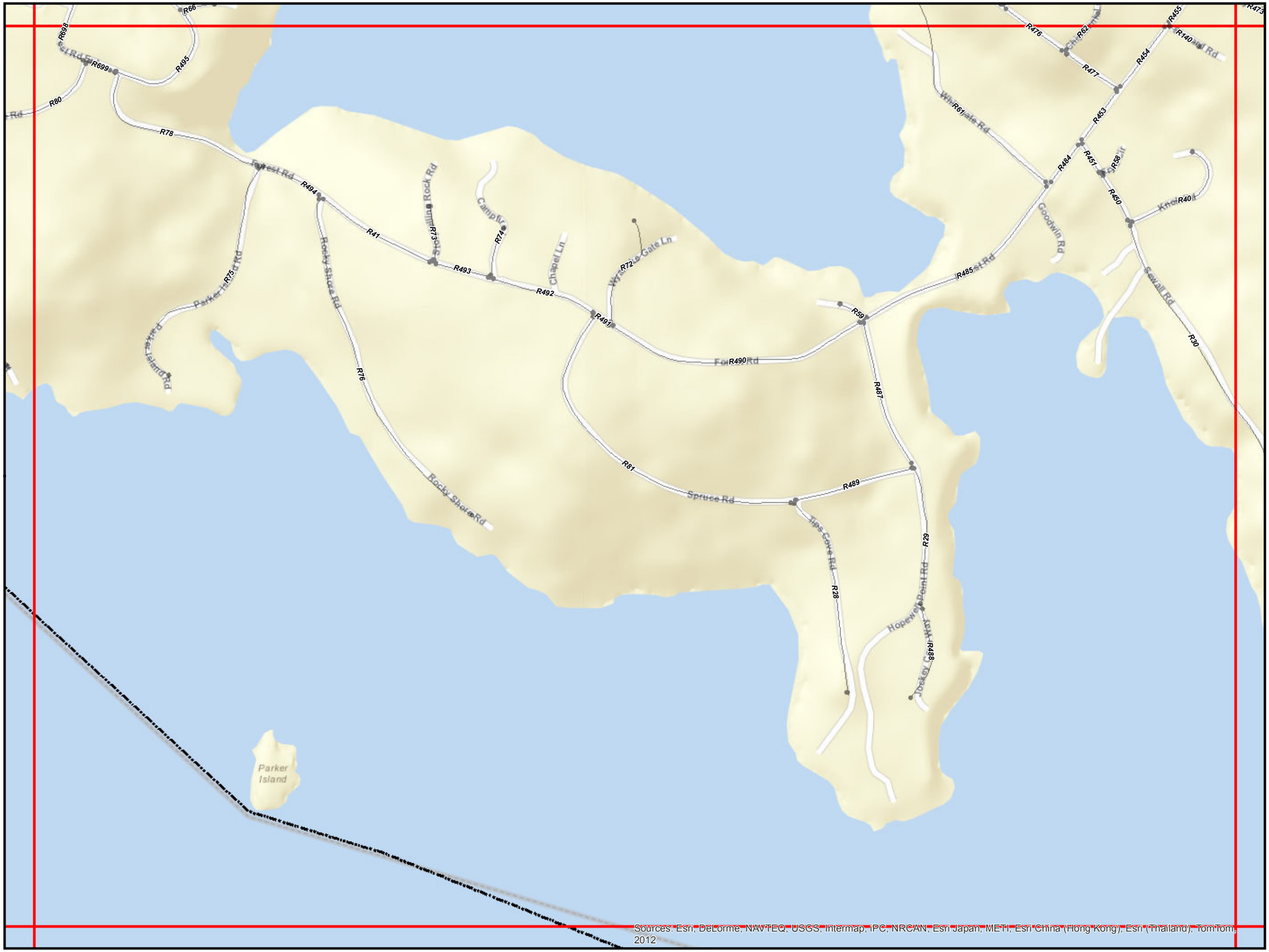
WOODARD &CURRAN

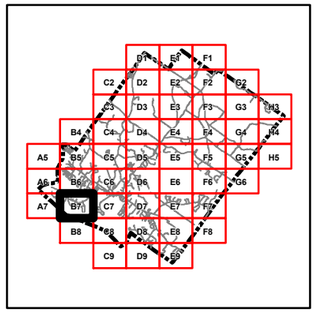
0 300 600 1,200 Feet

B6

Road Management Segments

Wolfeboro, NH





WOODARD &CURRAN

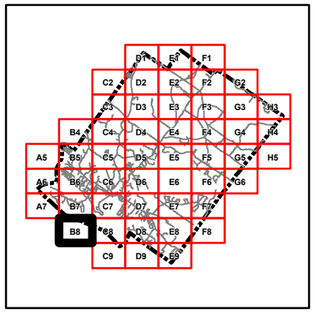
N

0 300 600 1,200 Feet

B7

Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

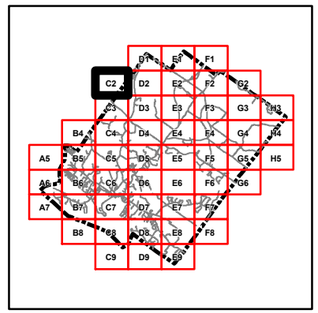
0 300 600 1,200 Feet

B8

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

Road Management Segments

Wolfeboro, NH



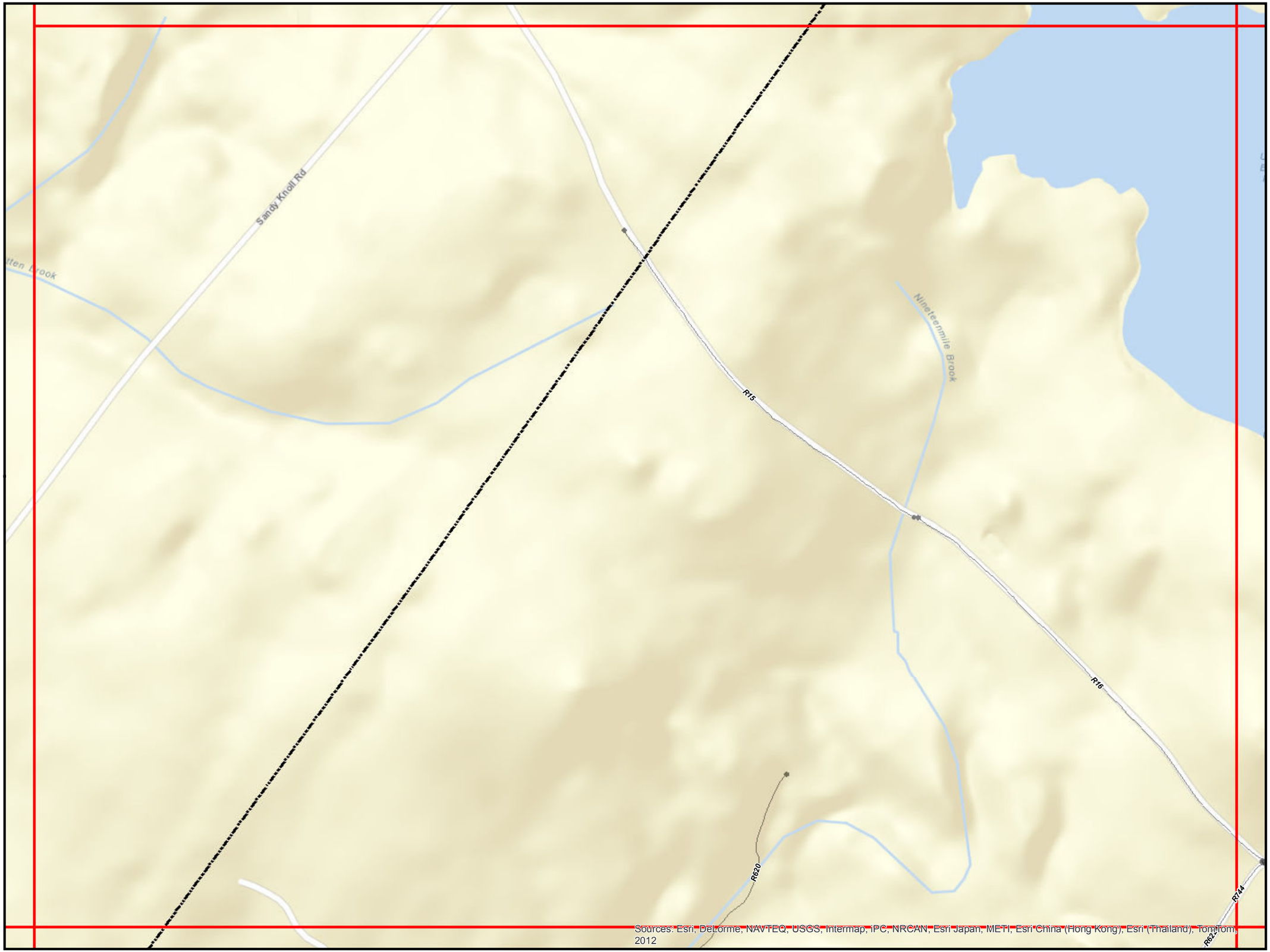
WOODARD &CURRAN

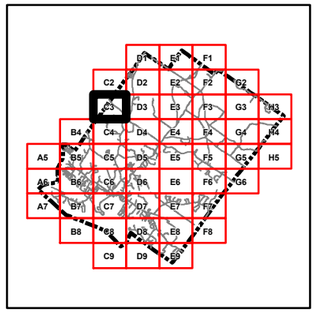
0 300 600 1,200 Feet

C2

Road Management Segments

Wolfeboro, NH





WOODARD &CURRAN

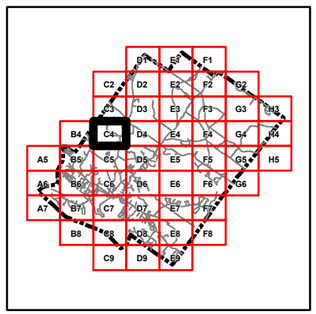
N

0 300 600 1,200 Feet

C3

Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

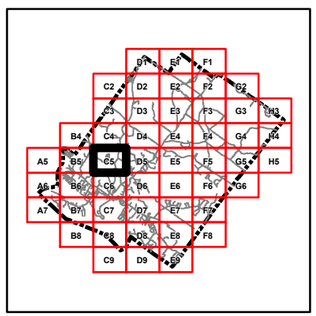
0 300 600 1,200 Feet

C4

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

0 300 600 1,200 Feet

C5

Road Management Segments

Wolfeboro, NH

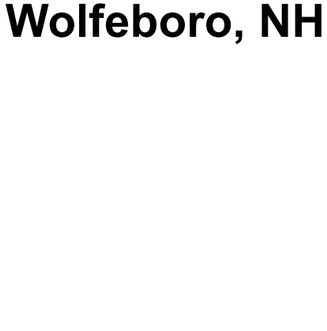
WOODARD &CURRAN

0 300 600 1,200 Feet

C6

Road Management Segments

Wolfeboro, NH



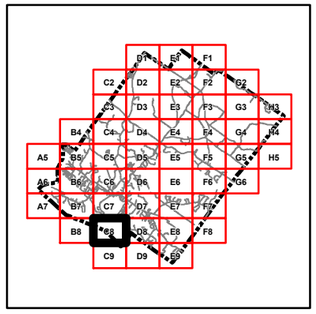
WOODARD &CURRAN

0 300 600 1,200 Feet

C7

Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

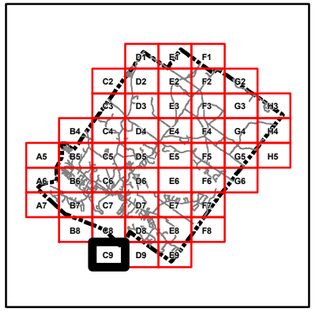
0 300 600 1,200 Feet

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

C8

Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

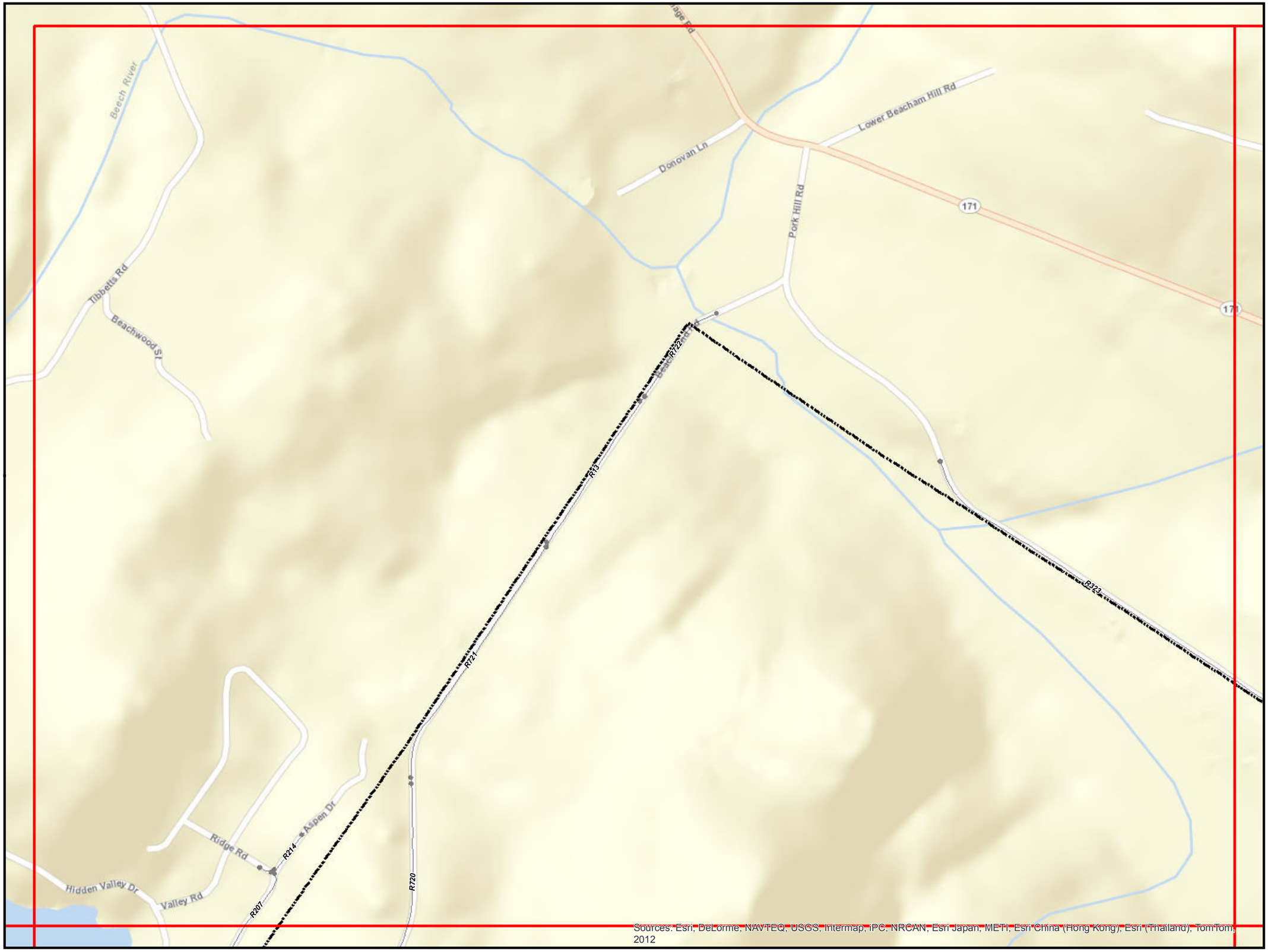
0 300 600 1,200 Feet

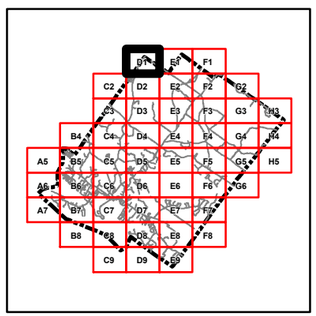
C9

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

Road Management Segments

Wolfeboro, NH





WOODARD &CURRAN

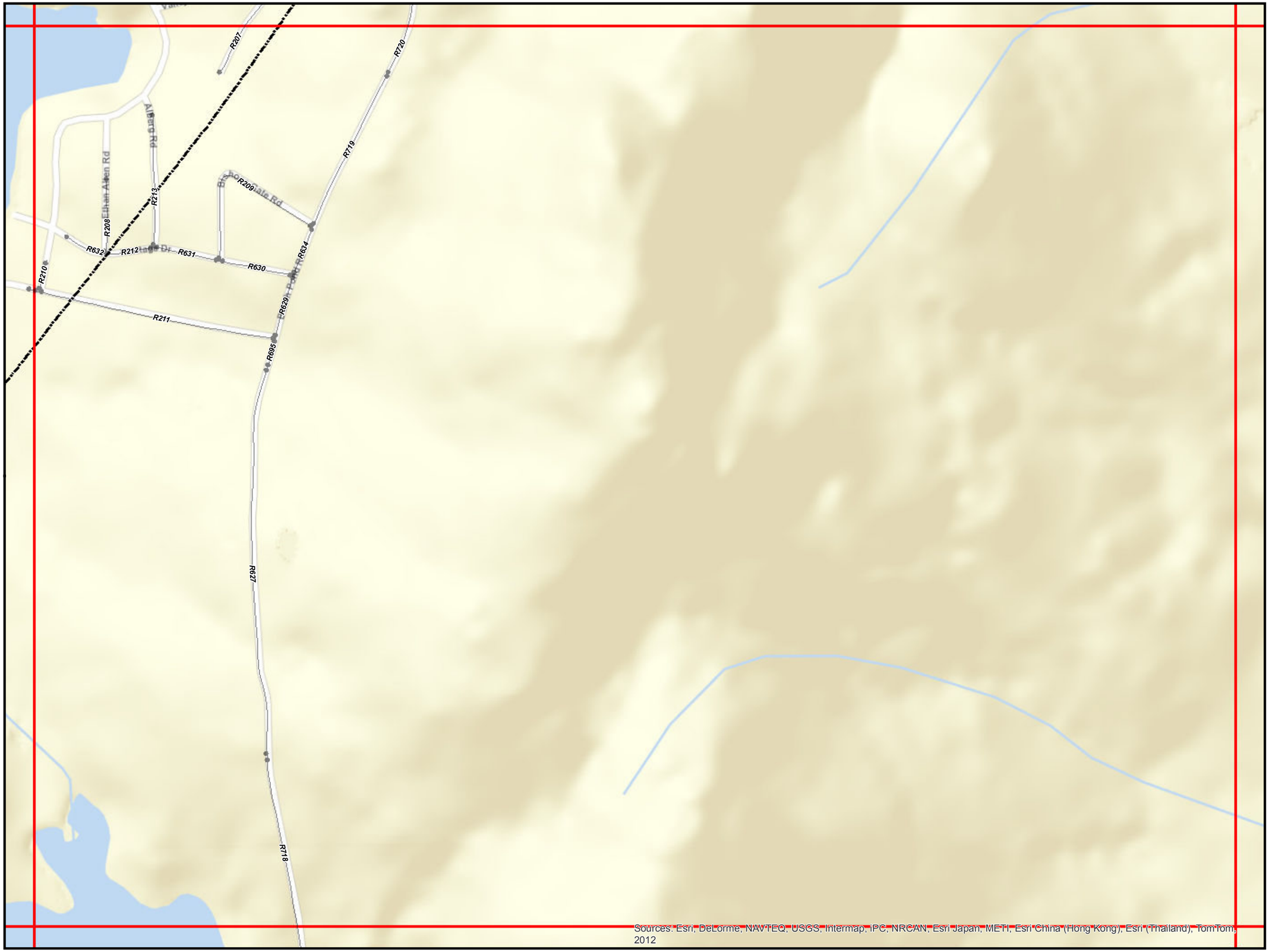
N

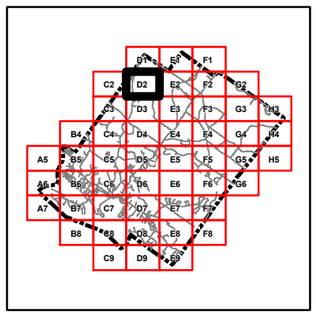
0 300 600 1,200 Feet

D1

Road Management Segments

Wolfeboro, NH





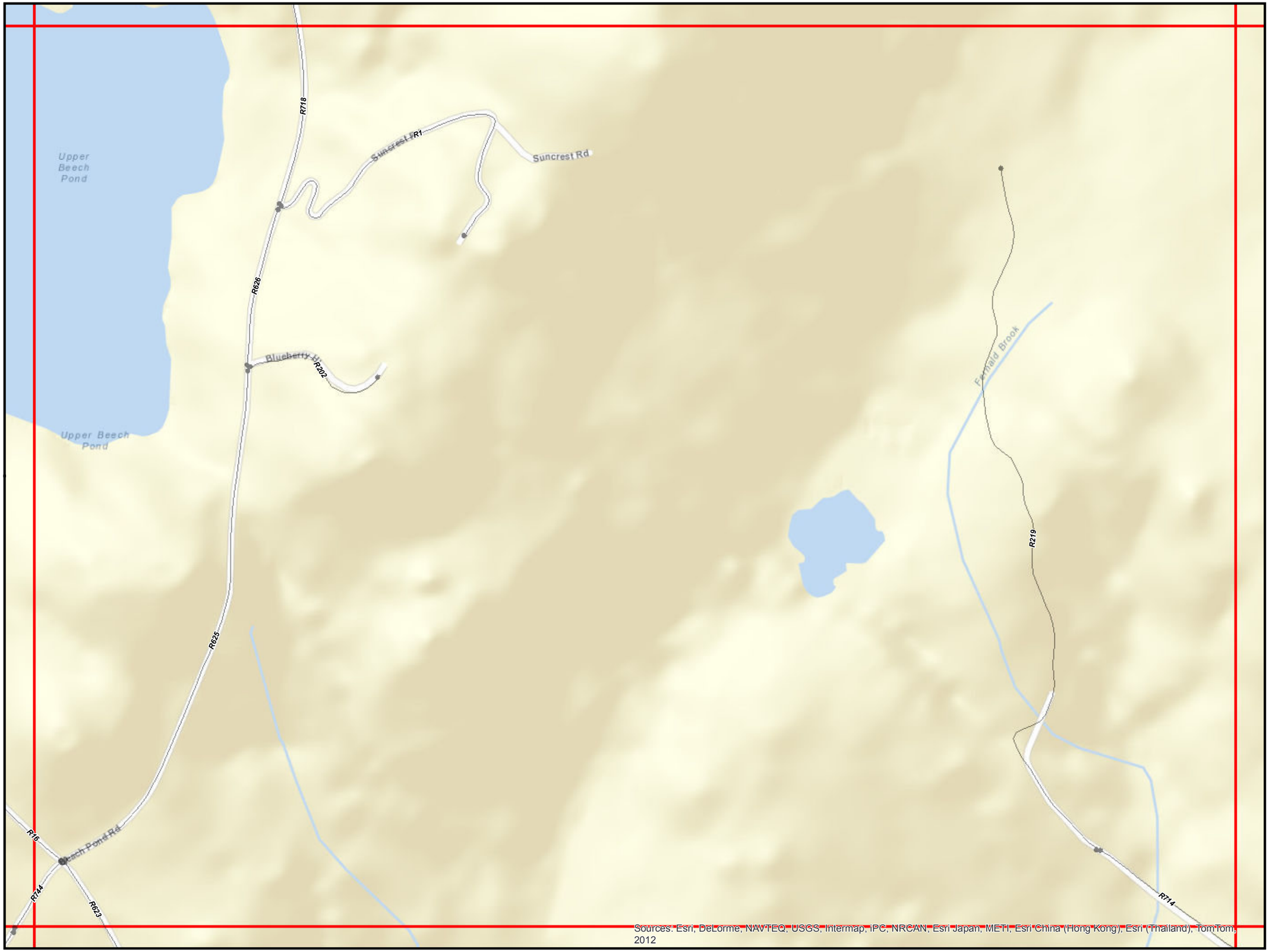
WOODARD &CURRAN

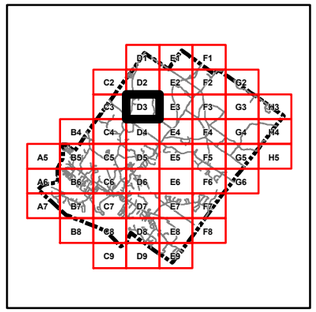
0 300 600 1,200 Feet

D2

Road Management Segments

Wolfeboro, NH





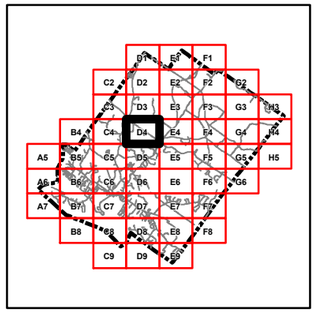
WOODARD &CURRAN

0 300 600 1,200 Feet

D3

Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

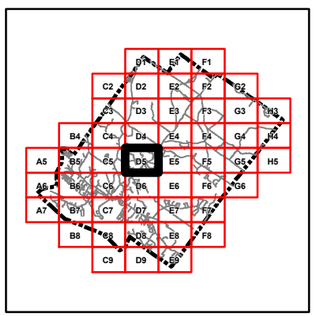
0 300 600 1,200 Feet

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

D4

Road Management Segments

Wolfeboro, NH



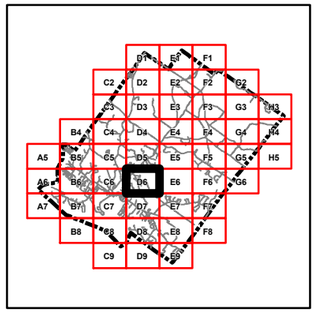
WOODARD &CURRAN

0 300 600 1,200 Feet

D5

Road Management Segments

Wolfeboro, NH



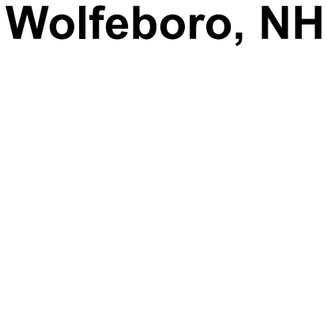
WOODARD &CURRAN

0 300 600 1,200 Feet

D6

Road Management Segments

Wolfeboro, NH



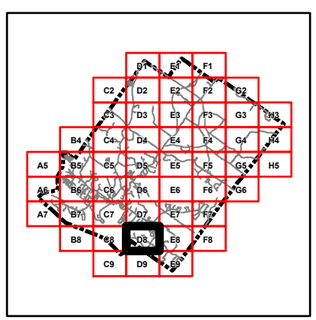
WOODARD & CURRAN

0 300 600 1,200 Feet

D7

Road Management Segments

Wolfeboro, NH



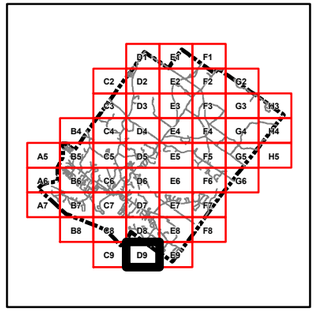
WOODARD &CURRAN

0 300 600 1,200 Feet

D8

Road Management Segments

Wolfeboro, NH



WOODARD &CURRAN

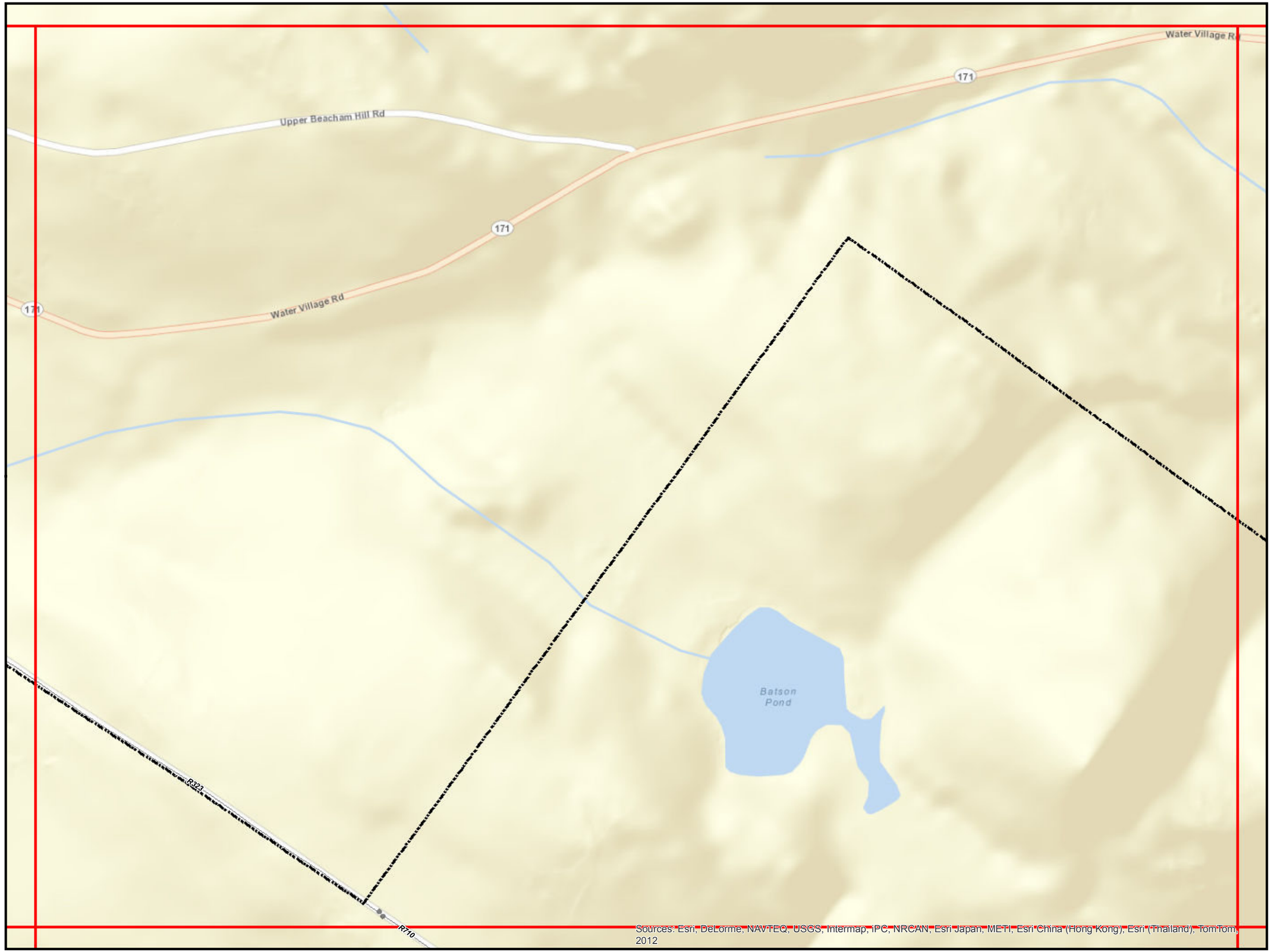
0 300 600 1,200 Feet

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

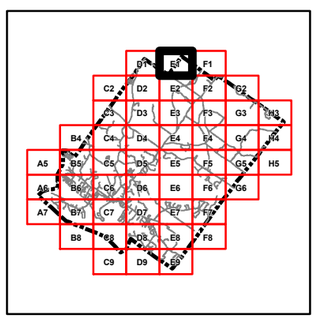
D9

Road Management Segments

Wolfeboro, NH



Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012



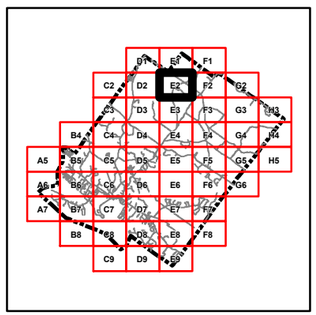
WOODARD &CURRAN

0 300 600 1,200 Feet

E1

Road Management Segments

Wolfeboro, NH



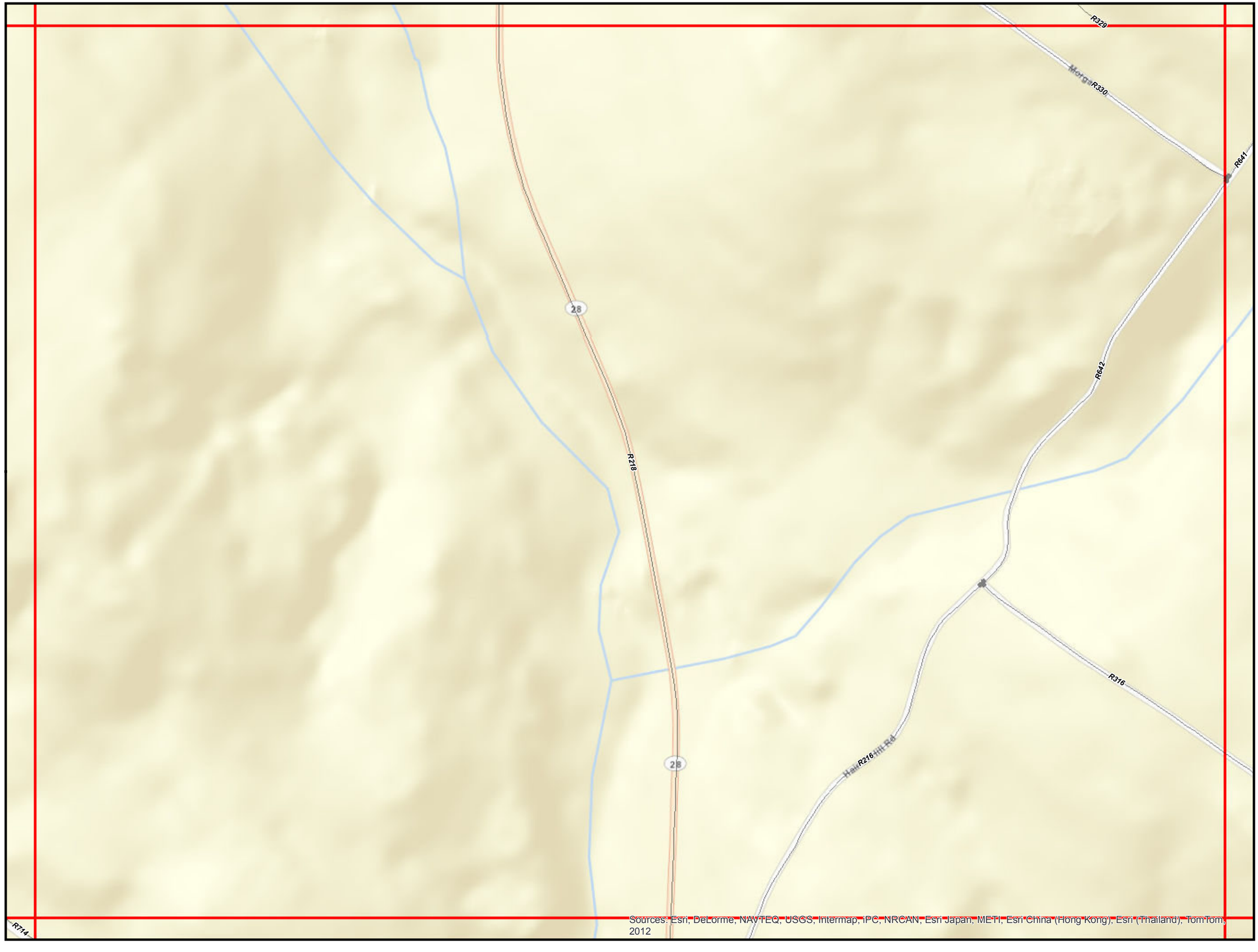
WOODARD & CURRAN

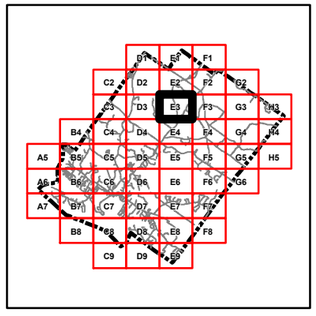
0 300 600 1,200 Feet

E2

Road Management Segments

Wolfeboro, NH





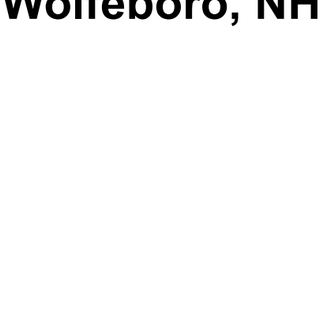
WOODARD &CURRAN

0 300 600 1,200 Feet

E3

Road Management Segments

Wolfeboro, NH

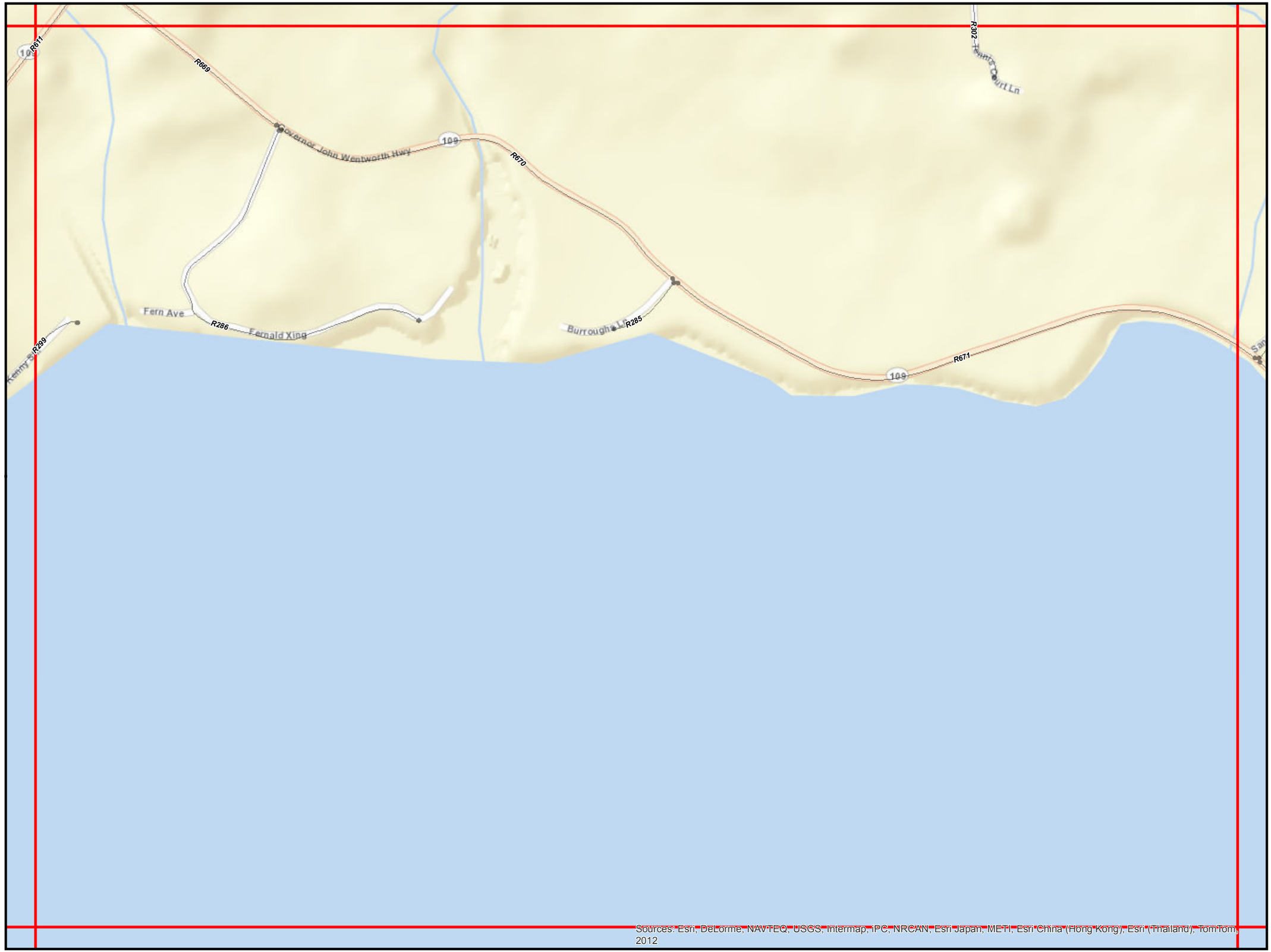


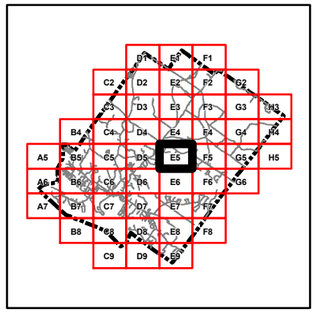
0 300 600 1,200 Feet

E4

Road Management Segments

Wolfeboro, NH





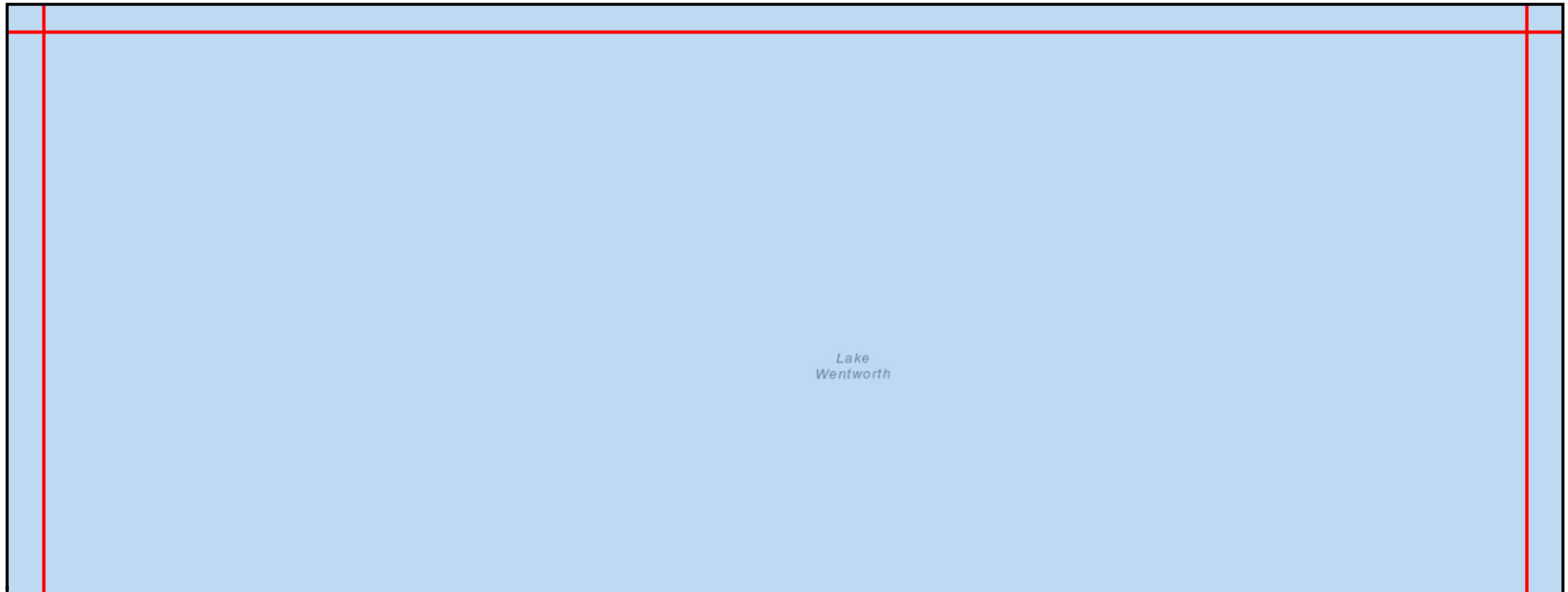
WOODARD &CURRAN

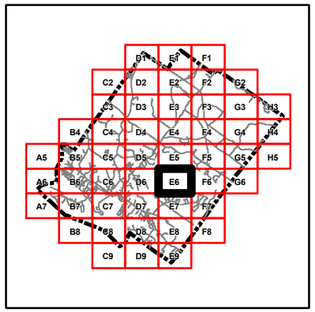
0 300 600 1,200 Feet

E5

Road Management Segments

Wolfeboro, NH





WOODARD &CURRAN

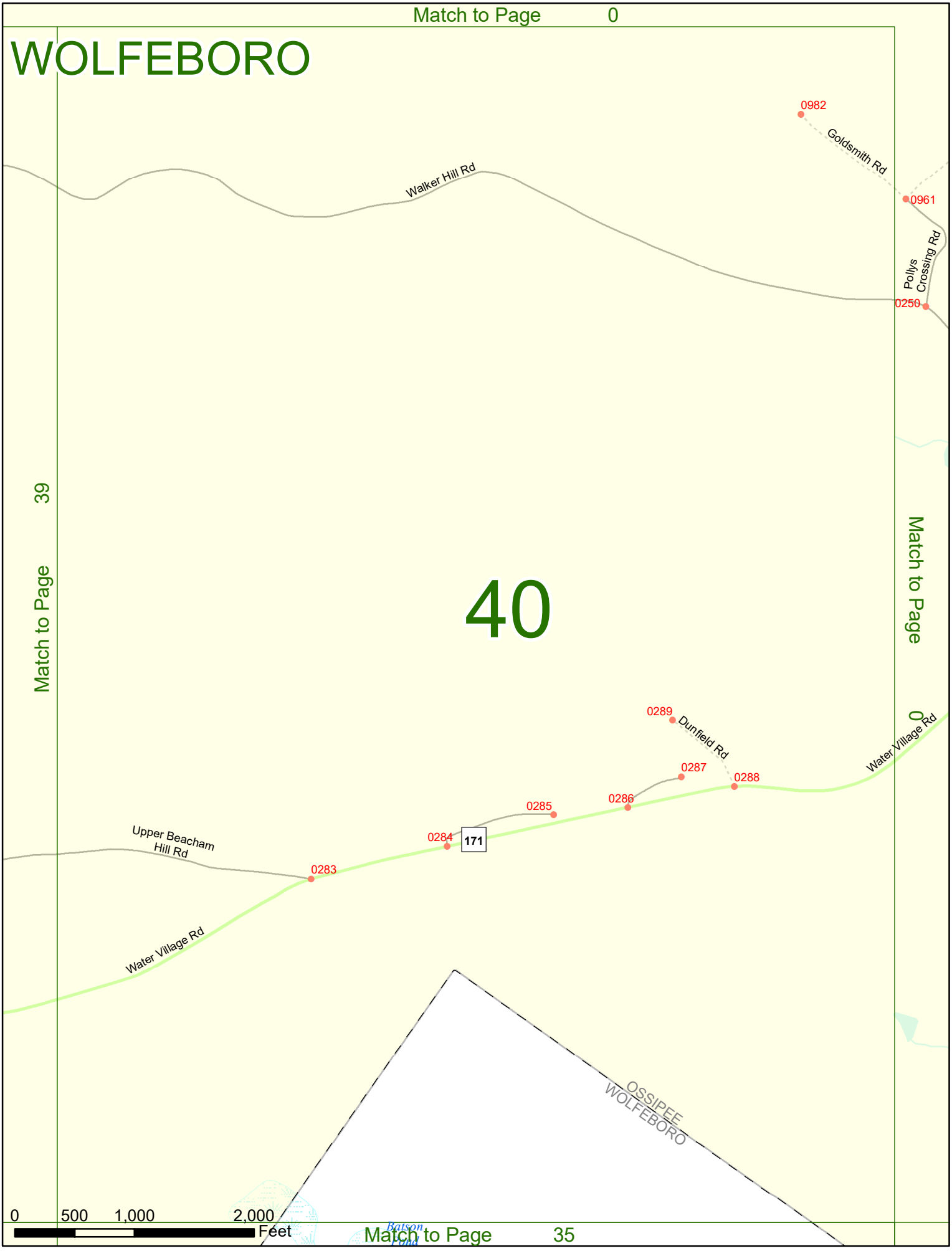
0 300 600 1,200 Feet

E6

Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012

Match to Page 0

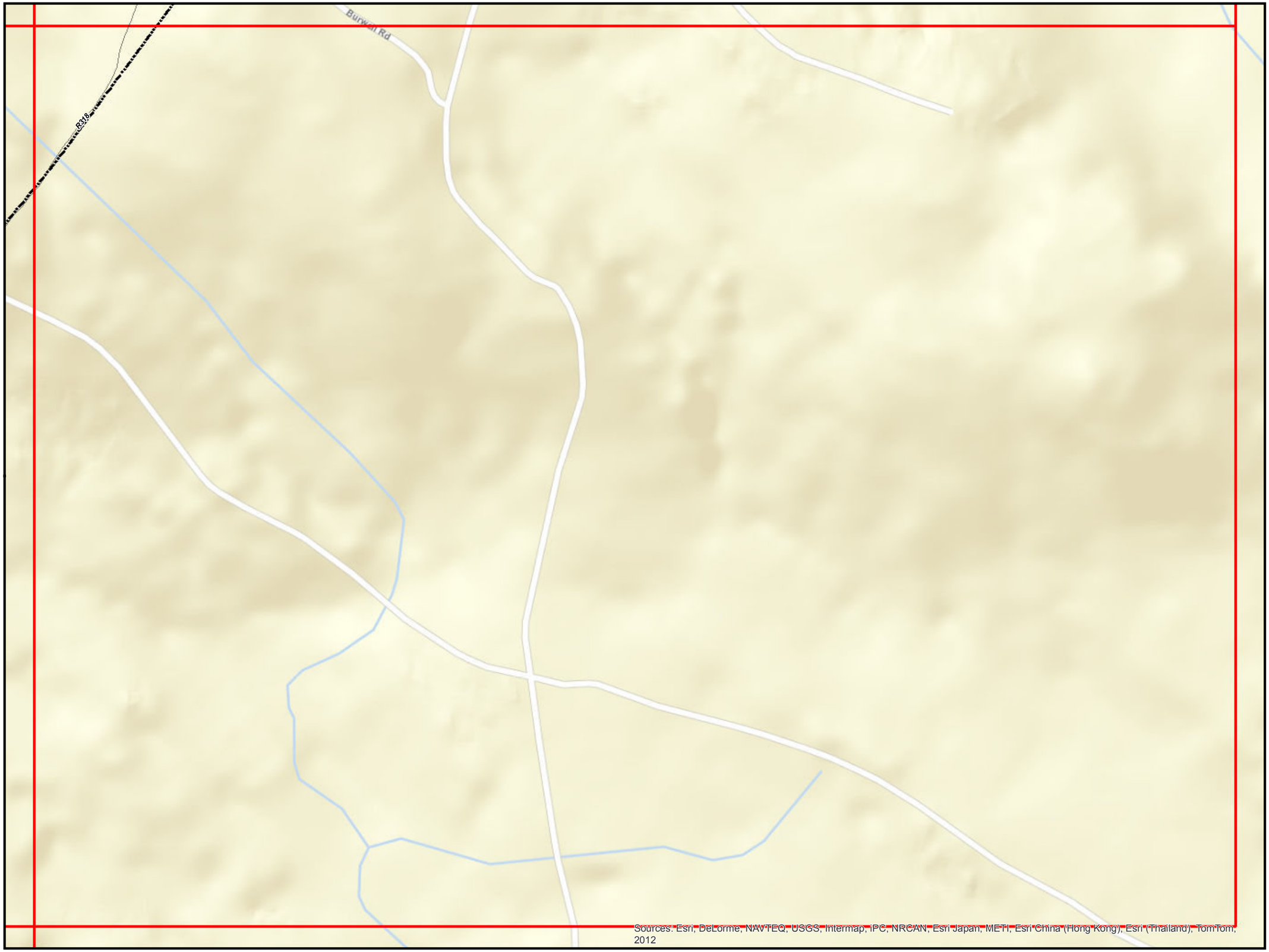
WOLFEBORO

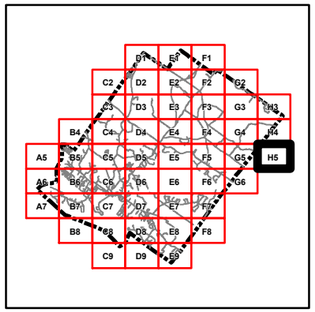


Match to Page 35

Road Management Segments

Wolfeboro, NH





WOODARD &CURRAN

0 300 600 1,200 Feet

H5