TECHNICAL | MEMORANDUM

TO: Pat Tarpey, Lake Winnipesaukee Association

FROM: Kevin Ryan, FB Environmental Associates

SUBJECT: **Moultonborough Bay Inlet Watershed Build-Out Analysis**

DATE: March 11, 2015 (Updated July 22, 2016)

CC: Forrest Bell, FB Environmental Associates

"Build-out" is a theoretical condition that represents the period when all available land suitable for residential, commercial, and industrial construction has been developed to the maximum conditions permitted by local ordinances. A build-out analysis is a planning tool that identifies areas with development potential and projects future development based on a set of conditions (e.g., zoning regulations) and assumptions (e.g., population growth rate).

This memo presents the conditions and assumptions used to conduct a build-out analysis for the portion of the Town of Moultonborough in the Moultonborough Bay Inlet watershed (a.k.a., "study area"), which covers 21,882 acres (68%) of the 32,246 acres of total watershed area (Figure 1) in Carroll County, New Hampshire. The analysis was conducted using CommunityViz version 4.3, an extension program for ArcMap Geographic Information System (GIS) software.

The build-out analysis was conducted according to the following general steps:

1) Collect information on existing conditions within the Town: parcel boundaries, zone boundaries, and location of existing buildings.
2) Collect and/or create development constraints layers (i.e., areas where no development may occur) in GIS.
3) Analyze build-out potential using CommunityViz's Build-Out Wizard Tool, which utilizes information gathered in the previous two steps.
4) Determine potential future rate of development (including projected dates of full build-out attainment) using CommunityViz's TimeScope Analysis Tool.

EXISTING CONDITIONS

Existing Buildings

The number and location of existing buildings within the study area was determined using a polygon shapefile obtained from the Town,[1] depicting the location and size of *all* structures within the study area's boundaries (i.e., principal and accessory structures). The shapefile contained 4,213 individual polygons representing buildings; this number was reduced to 2,345 buildings for use with the analysis, as accessory structures were not included in the analysis. The build-out analysis concerns only principal use buildings. In some cases, the original buildings shapefile had more than one polygon

[1] The shapefile was created by CAI Technologies.

representing a single building; therefore, the number of accessory buildings within the Town cannot be assumed to be the difference between total individual polygons (4,213) and principal use polygons (2,345).

The existing buildings layer (containing 2,345 principal use structures) was created by selecting all parcels containing at least one building polygon and then generating a single point to represent a principal use building in each of those parcels. This layer was spot-checked using 2011 high-resolution digital orthophotographs obtained from the Environmental Systems Research Institute (ESRI).

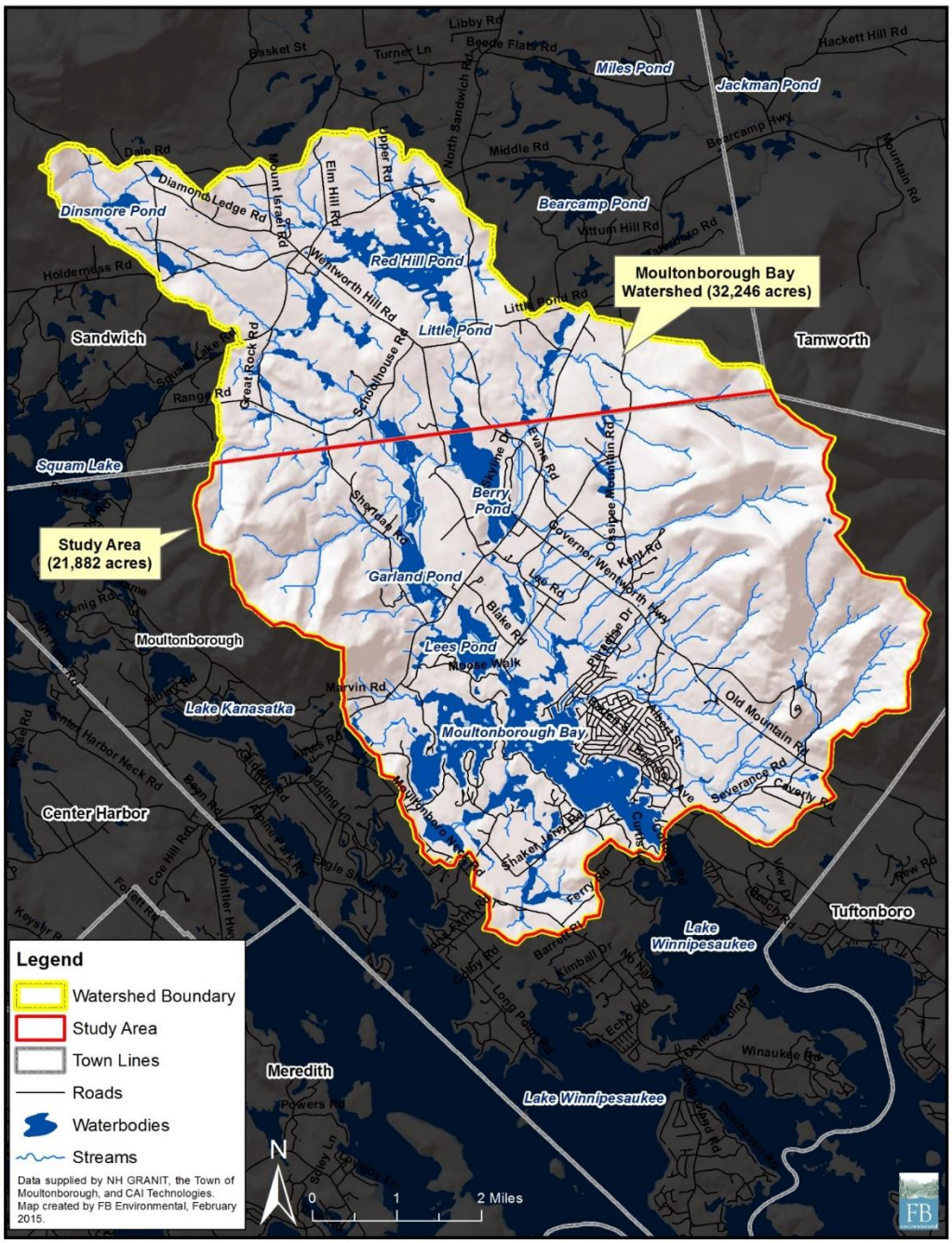

Figure 1. The Moultonborough Bay Inlet watershed covering 32,246 acres. The study area encompasses 21,882 acres (68%) of the overall watershed.

Zoning & Minimum Lot Sizes

Crucial to a build-out analysis is the feasibility of modeling zoning requirements. Certain zoning requirements are too site-specific to incorporate with the analysis. Therefore, the following assumptions were used in the determination of build-out zoning restrictions:

- Future lots were the smallest size allowable for the zoning district, taking into account minimum lot size and minimum buildable area.
- Unit types were not specified.
- Road and shoreland frontage requirements were not specified.

As stated in the Town's zoning ordinance, the minimum lot size upon which a dwelling, structure, building, mobile home, camper, R.V., or house trailer may be constructed or located is 40,000 square feet (just under one acre). However, lot size requirements may increase based on soil type (see Attachment) and slope. For the build-out projections, lot sizes were determined according to the standards set forth in the Town's Zoning Ordinance (Table 1, adapted from Table I on page 3 in Moultonborough's Zoning Ordinance). Minimum lot sizes within the Town were assigned based on the dominant soil type within a given parcel. A shapefile depicting soils within the Town was obtained from New Hampshire's GIS Clearinghouse website, NH GRANIT.

Table 1. Minimum lot sizes (square feet) based on soil type and slope. This table is adapted from Table I in Moultonborough's Zoning Ordinance.

	Soil Group					
Slope	**1**	**2**	**3**	**4**	**5**	**6**
0-8%	40,000 ft^2	45,000 ft^2	60,000 ft^2	60,000 ft^2	Not buildable	Not buildable
8-15%	45,000 ft^2	60,000 ft^2	90,000 ft^2	90,000 ft^2	Not buildable	Not buildable
15-25%	60,000 ft^2	80,000 ft^2	100,000 ft^2	120,000 ft^2	Not buildable	Not buildable

DEVELOPMENT CONSTRAINTS

To determine where development could occur within the study area, build-out calculations deduct land with physical constraints to development, including environmental restrictions (e.g., steep slopes, wetlands; Figure 2), zoning restrictions (e.g., minimum lot size; Table 1), and practical design considerations (e.g., lot layout inefficiencies). Existing buildings also reduce the available capacity for new development. The following GIS data were used to model development constraints within the study area:

- Conserved land (obtained from NH GRANIT)
- Steep slopes (>25%) (created from soils layer)
- Wetlands appearing on the New Hampshire Wetlands Base Map (obtained from NH GRANIT)
- Streams
- Hydric soils (created from soils layer)
- FEMA 100-year Flood Zones (obtained from the Town of Moultonborough)
- Existing buildings (created from a buildings layer obtained from the Town, modified by FBE)
- Unbuildable parcels [i.e., parcels with an existing building and less than double the minimum lot size (lots that cannot be subdivided)] (created by FBE using CommunityViz software)

To account for the Town's Wetland Resources Conservation Overlay District, wetlands greater than 20,000 square feet in size and streams were buffered by 25 feet in the analysis. The buffering results in no projected buildings being placed within 25 feet of these features.

BUILD-OUT ASSUMPTIONS

To determine how many units can be built on available buildable land within the study area, various density and other design factors based on zoning requirements were considered. Below are simplifying assumptions used in the analysis and based on Moultonborough's zoning ordinance. These assumptions were an important component of the model because they facilitated prediction of whether development can occur on a given lot, given Moultonborough's standards for development.

- **Building setbacks** were based on those set forth in Moultonborough's zoning ordinance, which requires a setback of 50 feet from road centerlines[2] and 20 feet from any lot line. Setbacks are measured from building center points in CommunityViz. To avoid building overlap, building footprints were estimated to be 45 feet x 45 feet. This number was then added to the average front/rear setback for each zone to estimate the "Minimum Separation Distance" used in CommunityViz.
- **Minimum lot size** requirements used were based on soil type and slope (Table 1).
- **Efficiency factors** adjust density values to account for common density losses. Lot efficiency refers to the amount of land on a parcel that is available for construction after addressing such considerations as drainage facilities, parcel contiguity, rights-of-way, setbacks, and conservation restrictions. They are entered as a percentage where 100% means complete efficiency (no density lost) and 0% means no buildings will be estimated for that land use. A 50% efficiency factor was used for all zones in the build-out analysis, as many lots are small, and newly constructed roads and other design considerations will likely take up a substantial amount of space on each lot.

RESULTS

Buildable Area

The build-out analysis revealed that 26% of the study area is buildable (Table 2, Figure 3). Note, however, that the development constraints described above do not represent the full range of possible restrictions to development. For example, unmapped wetlands or rare/endangered species may be present in an area, but cannot be considered here as data concerning their presence and specific locations are not available.

[2] The road setback may also be 25 feet from the edge of a right-of-way. The 50-foot setback is more appropriate, and therefore used, for the build-out analysis as distance is measured from the center of a given road.

Table 2. Buildable land by zone within the study area. Areal calculations below exclude area encompassed by roads and waterbodies.

Zone	Total Area (Acres)	Total Buildable Area (Acres)	Percent Buildable Area
Residential/Agricultural	19,375	5,083	26%
Commercial Zone A	270	81	30%
Commercial Zone B	145	56	39%
Commercial Zone C	104	33	32%
Total	**19,894**	**5,253**	**26%**

Projected Buildings

The aforementioned digitization of existing buildings within the study area identified 2,345 principal use buildings. Based on the current input parameters, the build-out analysis projected that an additional 2,184 buildings could be constructed in the future, resulting in a total of 4,529 buildings (Table 3, Figure 4).

Approximately 1,038 buildings currently exist and an additional 967 buildings are projected to exist within 250 feet of a waterbody. Note, however, that locations of points representing existing buildings on parcels may not match up exactly with actual building locations. Also, the build-out analysis cannot predict exactly where buildings will occur on a given lot. Therefore, the actual number of existing and projected buildings within 250 feet of waterbodies might actually be somewhat greater than or less than 1,038 and 967, respectively.

Table 3. Existing and projected buildings within the study area.

Zone	No. Existing Buildings	No. Projected Buildings	No. Buildings at Full Build-Out
Residential/Agricultural	2,234	2,121	4,355
Commercial Zone A	58	30	88
Commercial Zone B	34	21	55
Commercial Zone C	19	12	31
Total	**2,345**	**2,184**	**4,529**

Projected Full Build-Out Dates

CommunityViz's TimeScope Tool was used to look at changes in the amount of development within the study area over time. The tool assigned a "build date" to features within the projected buildings layer based on a specific set of rules, including population growth rate and building sequence type (e.g., random or near roads).

Examination of data obtained from the US Census Bureau showed that Moultonborough has experienced steady population growth since 1970, with the exception of the 10-year period from 2000-2010, which experienced a slight decrease. From 1970-2010, Moultonborough's population increased 209% from 1,310 to 4,044 individuals. Compound annual growth rates (CAGRs) for the 10-, 20-, 30-, and 40-year periods preceding 2010 ranged from -1.03 to 2.86% (Table 4). The 20-, 30-, and 40-year figures were used for three iterations of the TimeScope analysis. Full build-out may be achieved in 2058, 2049, and 2039 for the 20-, 30-, and 40-year CAGR's, respectively (Figure 5).

Table 4. US census population estimates and compound annual growth rates for Moultonborough, NH.

1970	1980	1990	2000	2010	40 yr. Avg. Annual Growth Rate 1970-2010	30 yr. Avg. Annual Growth Rate 1980-2010	20 yr. Avg. Annual Growth Rate 1990-2010	10 yr. Avg. Annual Growth Rate 2000-2010
1,310	2,206	2,956	4,484	4,044	2.86	2.04	1.58	-1.03

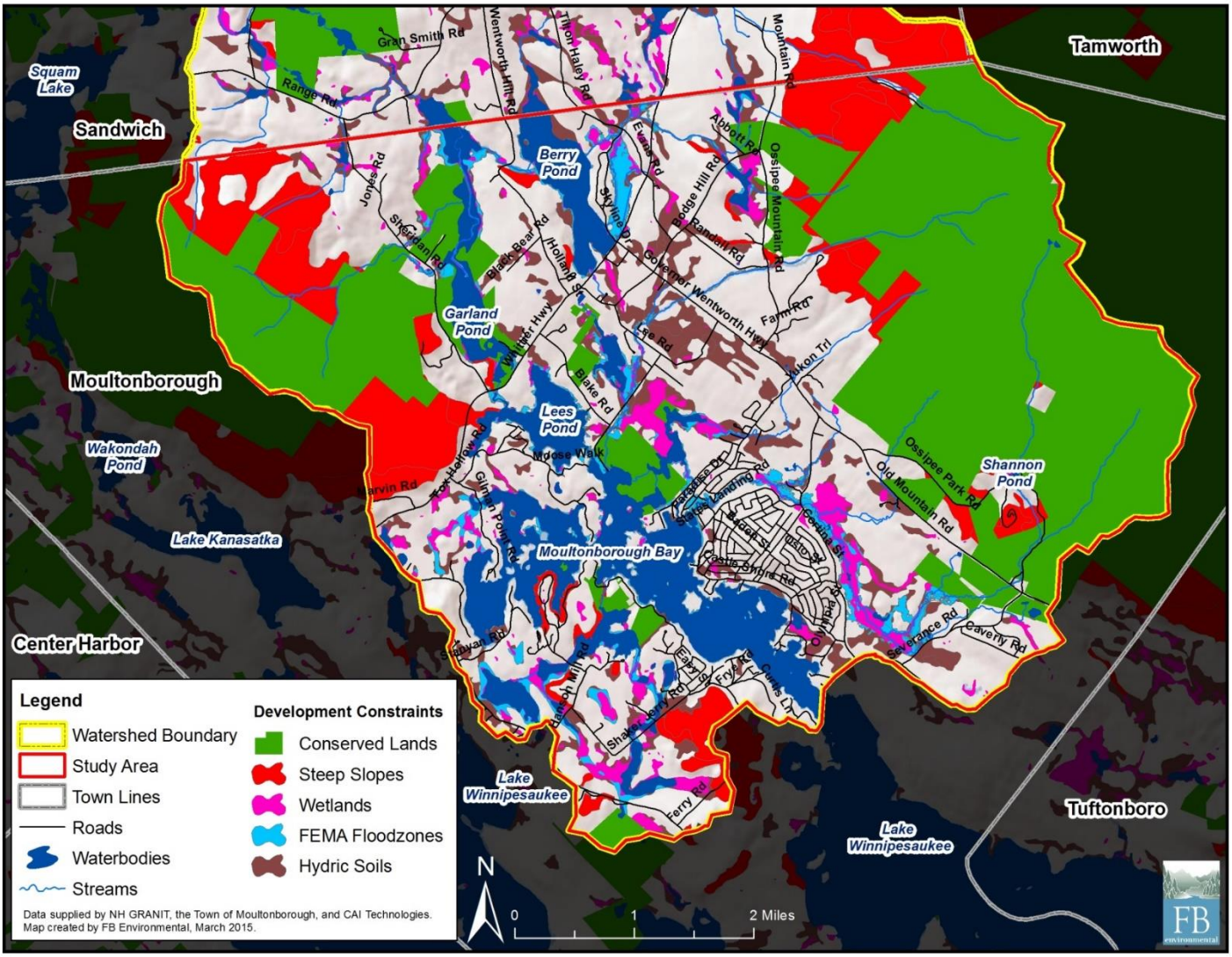

Figure 2. Development constraints within the study area.

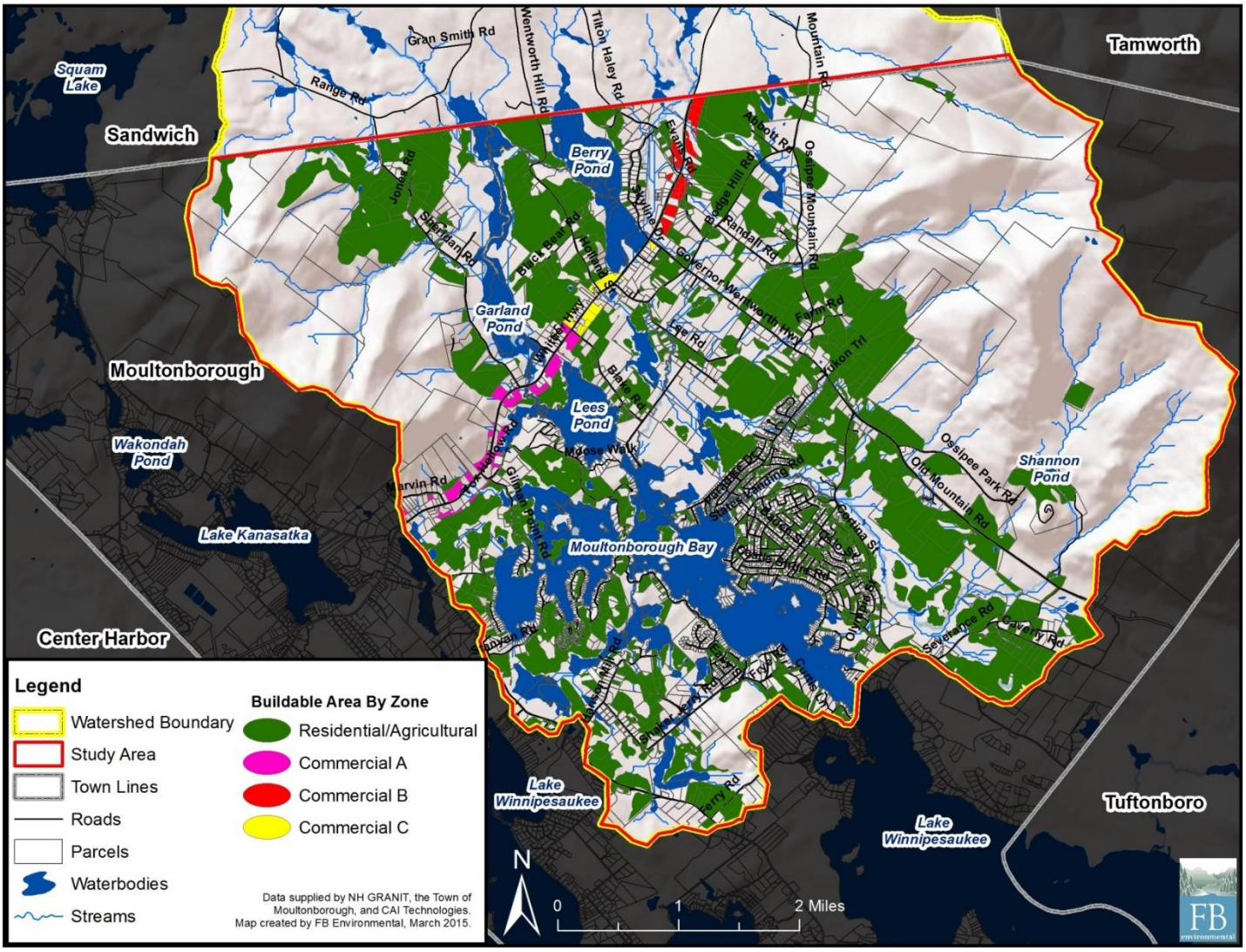

Figure 3. Buildable area by zone within the study area.

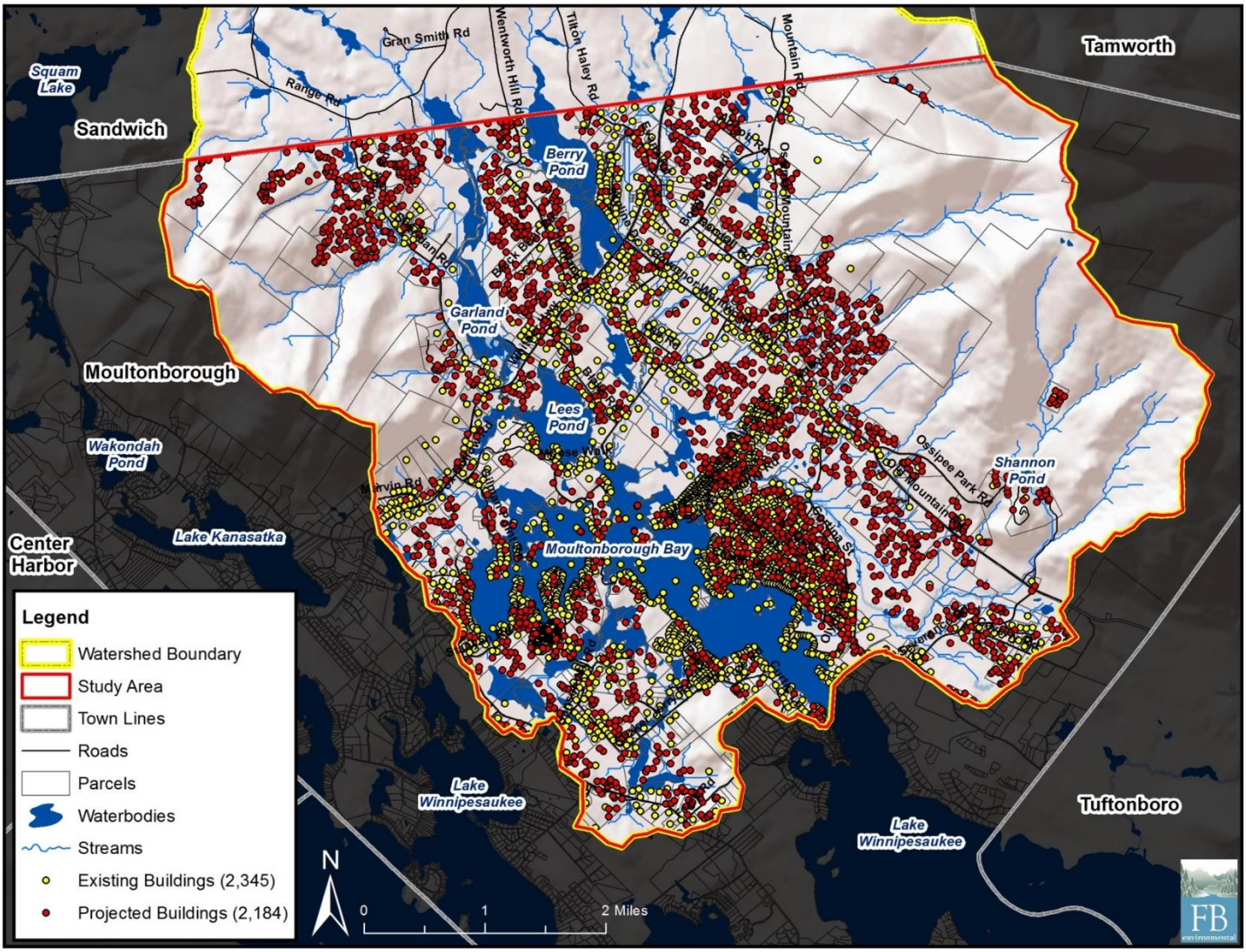

Figure 4. Existing and projected buildings within the study area.

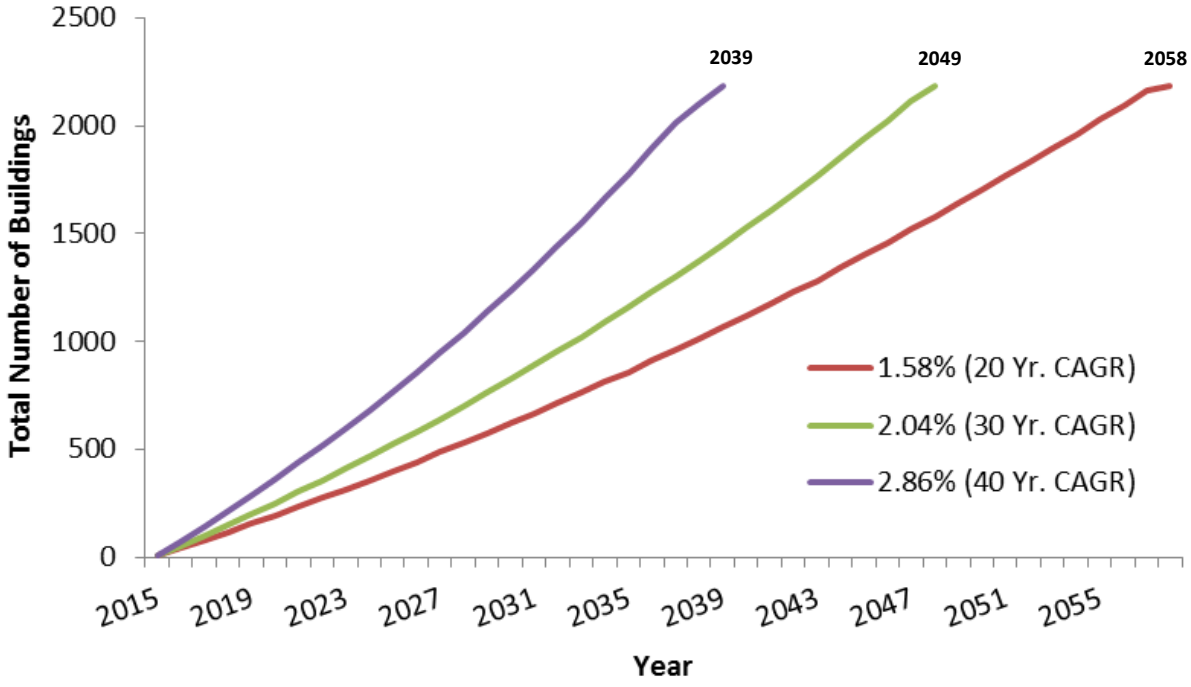

Figure 5. Full build-out projections of the study area using 20-, 30-, and 40-year compound annual growth rates (refer to Table 4).

ATTACHMENT: Soil groupings for establishing lot size from Moultonborough's Zoning Ordinance.

REVISED SOIL GROUPING FOR ESTABLISHING LOT SIZE

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Excessively drained and somewhat excessively drained soils with rapidly or very rapidly permeable receiving layer.	Well-drained soils with moderately permeable surface and subsoil layers and having a moderate to rapidly permeable receiving layer.	Somewhat poorly drained or moederately well drained soils, and well drained soils with a slowly or very slowly permeable receiving layer.	Soils with bedrock within 4 feet of the soil surface.	Poorly drained soil	Very poorly drained soils
Adams Boscawen Ceasar Champlain Colton Gloucester Glover Hermon Hinckley Hoosic Masardis Merrimac Success *Suncook *Sunday Redstone Warwick Windsor Windsor Variant	Abenaki Agawam Allagash Bangor Berkshire Bice Canton Charlton Dutchess *Fryeburg Groveton *Hadley Hartland Haven Houghtonville Lombard Monadnock Occum Ondawa Ondawa Variant Salmon Salmon Variant Stetson Unadilla	Acton Acton Variant Becket Belgrade Barnardston Barnardston Variant Boxford Buckland Buxton Canterbury Chatfield Chesuncook Colonel Colonel Variant Croghan Dartmouth Deerfield Dixmont Duane Eldridge Elmridge Elmwood Finch Henniker Hitchcock **Howland Lanesboro *Lovewell Machais Madawaska Marlow	Melrose Metacomet *Metallak Millis Montauk Muncil Newfields Nicholville Nicholville Variant Ninigret Paxton Peru Pittstown Pittstown Variant Plaisted Plaisted Verient *Podunk *Podunk Variant Poocham *Poratuck Roundabout Scio Scituate Shaker *Sheepscot Sisk Skerry Sudbury Suffield Sunapee Sutton	Canaan Cardigan Chatfield Elliotsville Glebe Hogback Hollis Kearsarge Lyman Macomber Millsite Monson Pennichuck Rawsonville Ridker Saddleback Shapleigh Stratton Thorndike Tunbridge Winnecook Woodstock	Au Gres Bemis Binghamville Brayton Cabot *Charles *Cohas Grange Kinsman Leicester Leicester Variant *Lim *Limerick *Limerick Variant Lyme Monarda Moosilauke Naumburg Pemi Pillsbury Pillsbury Variant Pipestone Raynham Raynham Variant Reypole Ridgebury *Rippowem Roundabout *Rumney *Rumney Variant Saugatuck **Scantic **Scitico Shaker Squamscott Stissing Swanton Walpole Wareham	Biddeford Borohemists Bucksport Burnham Choconua Greenwood Ipswich Matunuck Maybid *Medomak Variant *Medomak Muck Ossipee Pawcatuck Peacham Peat Pondicherry *Saco *Saco Verient Scarboro *Seersport Vassalboro Waskish Westbrook Whitman Wonsqueak

Notes:
1. This chart should be used as a general guide to enable people to make lot size determination. In no way does the series name and description replace an on-site evaluation of conditions in the field.

* These soils are subject to periodic or frequent flooding.

** These soils should be evaluated particularly closely because of possible site problems