CUMMINGS SCHOOL OF VETERINARY MEDICINE AT TUFTS UNIVERSITY

Grafton, Massachusetts

Volume I

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JANUARY 2014

AMENDED GRAFTON CAMPUS MASTER PLAN

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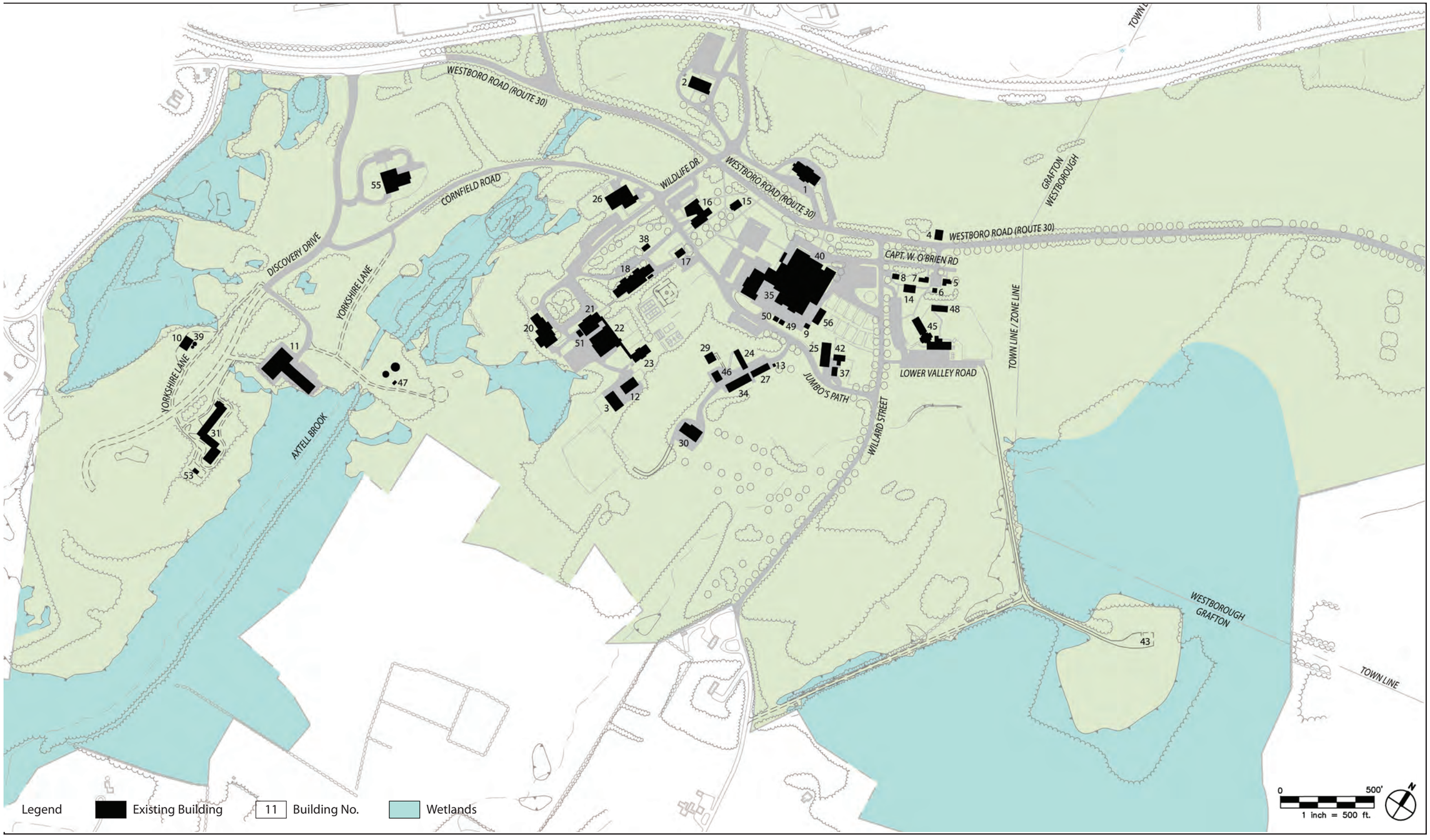
Appendix B: Conceptual Stormwater Management Plan, Fuss & O'Neill, January 2014

Appendix C: Annual Parking and Traffic Demand Management/Campus Stormwater Maintenance Plan Certification, September 2013

Figure 1: Existing Conditions



SECTION ONE: EXECUTIVE SUMMARY

This amended Master Plan ("Master Plan") updates and amends an original Master Plan approved by the Grafton Planning Board on March 29, 1999 (the "Master Plan Approval") and its first amendment and extension approved by the Grafton Planning Board on January 22, 2007, which approval is scheduled to expire on January 22, 2014 pursuant to Section 9.6.1.4 of the Grafton Zoning By-law ("Zoning Bylaw"). By submission of this Master Plan, the Cummings School of Veterinary Medicine at Tufts University ("TCSVM") requests that the Planning Board extend the Master Plan Approval for a period of seven years from January 22, 2014 to January 22, 2021. This Master Plan documents development that has been completed from June 1998 through December 2013, and outlines projected construction over the next 20 years.

TCSVM in Grafton educates veterinarians for careers in veterinary practice, agriculture, government, science and industry. Its veterinarians are broadly trained biomedical scientists who study the relationships between animal health, human health and the environment. TCSVM's 100 veterinarians, engineers, and basic biomedical scientists are best known for their work in infectious diseases, global public health, oncology, neurophysiology, reproductive and musculoskeletal research.

The school has grown significantly since its inception in the late 1970s on the site of the former Grafton State Mental Hospital. TCSVM's 594-acre campus includes 445 acres in the town of Grafton and 149 acres in the town of Westborough. Existing buildings contain approximately 494,000 gross square feet (GSF) of building area, of which over 129,000 GSF has been added since June 1998. Educational, administrative, and clinical facilities, including Tufts Veterinary Medical Center, total nearly 175,000 GSF. Faculty laboratories comprise an additional 143,000 GSF. Facilities for cattle, pigs, sheep, goats and smaller animal species, plus space for operational support to the school, comprise another 95,800 GSF. About 39,000 GSF of building area is not in present use.

As New England's only veterinary school, TCSVM provides unique and necessary services to the New England region. The school has also made valuable

contributions to the growing health sciences industry cluster in Central Massachusetts and to Grafton's economy. The school is well positioned both geographically and programmatically to continue these contributions, especially in the expanding fields of health science, high tech, and alternative energy research and development.

An important part of the school's mission and that of its scientists is research aimed at curing and preventing animal and human diseases. This research is traditionally sponsored by the federal government, but a significant percentage of the school's research involves collaborative efforts with biotechnology, pharmaceutical, and medical device companies. These companies bring their research, and occasionally, their real estate needs, to TCSVM because of its unique combination of expertise, facilities, and research capabilities.

The desire of health science companies to have facilities near their university collaborators, as well as the continuing growth prospects for this industry, have led Tufts to continue pursuing its development planning for Grafton Science Park ("Science Park") at the western edge of the campus.

This Master Plan describes a program for continued growth of TCSVM and the further development of the Science Park. This Master Plan describes the existing campus and facilities, specifies proposed development, and describes how the proposed development conforms to the requirements of the Zoning Bylaw. The plan respects the school's status as a Massachusetts historic site; proposed layouts and building designs maintain the site's pastoral context. The proposed development described in this Master Plan is, in most respects, similar in scope and scale to that outlined in the 1998 and 2006 plans. As a result, utility and traffic impacts of the proposed development and potential costs, revenues, and benefits to the Town of Grafton are anticipated to be consistent with those described in detail in the 2006 Master Plan.

VETERINARY SCHOOL AND CLINICAL FACILITIES

Since 1998, TCSVM has constructed 129,398 square feet of facilities and removed eight support buildings totaling 39,070 square feet. The David McGrath Veterinary Teaching Laboratory, the Bernice Barbour Wildlife Medicine Building, a significant expansion and renovation to the Swine II facility, the Agnes Varis Campus Center, and the New England Regional Biosafety Laboratory were completed, along with three hospital expansions, including a Magnetic Resonance Imaging (MRI) addition and the Large Animal Isolation Facility. Several animal housing facilities were also completed.

Projects with near-term priority now include the Avian Rehabilitation Cage; two sites on which commercially-owned photovoltaic solar arrays will be constructed; and phased expansion and renovation of the Foster Hospital for Small Animals, comprised initially of a small animal hospital lobby renovation and addition. Later phases of the veterinary hospital complex expansion under consideration include a small animal hospital west office wing addition; radiology, surgery, and ward expansions; and an east clinical oncology service expansion. Equine functions now housed in the large animal hospital would be located in four separate new facilities as another component of the veterinary hospital complex expansion, renovation and re-purposing. Other future projects under consideration include expansion to the Center for Animals and expansion of the Swine I facility.

Projects that are planned for the long term development of the campus include relocation and reuse of goat housing for a teaching barn, a Simulation Center, a mid-size lecture hall, conference rooms and offices added to the existing Franklin M. Loew Veterinary Medical Education Center, and an addition to the Barbour building.

This Master Plan also identifies a series of more speculative building projects, the construction of which will depend on future need, and, as yet, unplanned fund-raising. We include these in this Master Plan to illustrate the kinds of buildings that

may be built in the future. Potential projects include relocation and repurposing of the Locust Barn; additional animal housing; renovation or demolition/ reconstruction of the one remaining vacant brick building, 18, and reconstruction of Building 19, which was razed in 2012, for research/general education; construction of a new research/general education building on the south research quadrangle; construction of a recreation facility for use by the campus community; relocation of the buildings and grounds operation; and a new storage building for buildings and grounds. The school also proposes to construct an equine exercise training center in either Westborough or Grafton within the east campus Valley Farm Area.

All planned school development, with the exception of the solar arrays, equine training center, some animal housing, and the storage building will occur on the current core campus. The intent is to enhance existing major spaces and improve the spatial qualities of an already effective and pleasant campus. For example, the recreation facility proposed to be built north of Route 30 will complete a campus green east of the existing Loew building. The proposed reconstruction of Building 19 and construction of a second research/ general education building will complete the existing south quadrangle. The new swine unit will be contiguous with the current swine units on the west campus. Three facilities proposed in earlier master plans - the Progressive Swine Barn on the east campus, Large Animal Shelter to replace the razed Bull Barn and Telecommunications Backup Building - are no longer programmatically required and have been removed from the list of the proposed projects in this Master Plan.

The proposed parking conforms to the Zoning Bylaw. Parking lots are to be located on the periphery of the main campus quadrangles, preserving these quadrangles as pedestrian environments.

GRAFTON SCIENCE PARK

The school continues to propose development of a Science Park, which will include a mix of commercial and accessory uses, on the western edge of the campus. Upon full completion, the Science Park could now provide as much as 662,900 GSF of additional space devoted to research and development, pilot manufacturing, and other activities related to the biotechnology, medical and pharmaceutical industries, and to the physical, biological, behavioral and environmental sciences.

Phase I of the Science Park under development on approximately 35 acres of the campus near Route 30, could contain up to 348,000 GSF of building area at build-out. The approximately 39,100 GSF New England Regional Biosafety Laboratory (NE-RBL) is currently located in Phase I. Although the NE-RBL is an educational use, TCSVM continues to believe it will be a catalyst for further Science Park commercial development as the regional real estate market improves. For planning purposes, we describe subsequent configurations of the Phase I space in three additional buildings of between 60,200 and 136,500 GSF each. Phase I is expected to be built out over the next 10 years, depending on market demand. Phase II could add up to another 354,000 GSF during a subsequent 10 year period. This Master Plan also shows a commercial solar array project as an accessory use in Phase II that will occupy 5.1 acres. The school has consequently reallocated Phase II's permitted GSF into four, rather than the six, buildings shown in earlier Master Plans. The approximate boundaries within the west campus on which the Science Park will be developed, as well as the actual time frames for development, may change further as demand and market conditions dictate.

Although the emphasis of future development is on health science, high tech, and alternative energy-related uses, the school anticipates additional development for other, ancillary uses permitted in the Campus Development Overlay District zone, such as office, food and administrative service, and conference facilities. To maintain the flexibility necessary to allow the development program to respond to a dynamic market, only broad space-type estimates are made at this point.

The Science Park preserves the rural and agricultural characteristics of the west campus that give value

and beauty to this site. Development will be restricted to less than half of the total site, in order to conserve significant environmental and natural features including wetlands, streams, and steep slopes. The arrangement of these features creates an elongated development envelope and determines the configuration of the proposed layout. Buildings will face a "village green" in Phase I and the existing agricultural landscape in Phase II. To further enhance the rural nature of this development, all parking will be located behind the buildings, tucked into surrounding forest cover.

Discovery Drive, the access road in Phase I of the Science Park and its associated utility infrastructure were substantially completed in 2005-2007. Last year, the Zoning Bylaw was amended to allow alternative and renewable energy uses in the Campus Development Overlay District, accelerating corporate interest in the Science Park at that time. As market conditions continue to improve from the recent recession, TCSVM remains hopeful that more robust interest from a wide array of commercial tenant prospects will emerge.

DEVELOPMENT IMPACTS

A 2006 study prepared by Vanasse Associates, Inc. and submitted as part of our first amendment to the Master Plan analyzed the impact of the proposed development on traffic in the Town of Grafton. In general, Phase I site-generated traffic is not expected to degrade traffic operations appreciably in the study area. The study recommends that, as the development progresses towards full build-out, four intersections in the Town of Grafton should be monitored for possible future improvements.

Public and private utilities are adequate to serve the proposed development in the near term. However, in the mid term – in the event a heavy power user emerges as a tenant prospect – or long term, improvements to electric power capacity will be required.

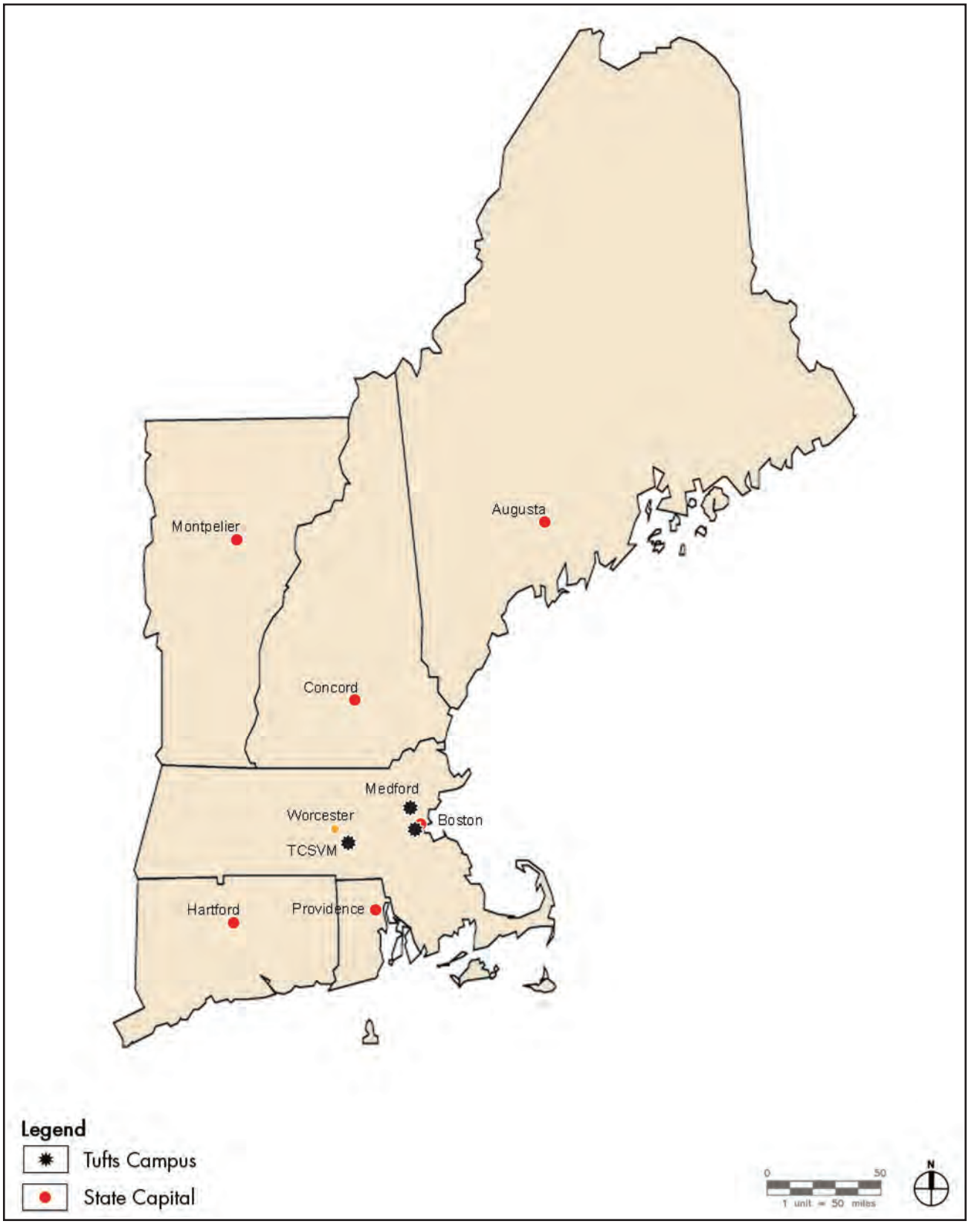
This Master Plan mitigates the development's potential effects on water resources, open space, historic resources, and the ecology of the area through careful design that protects and enhances existing assets.

MUNICIPAL COSTS AND BENEFITS

Development of the Science Park will have a substantial positive economic impact on the Town of Grafton. Projected private investment in Phase I is now expected to range from $77 million to $139 million, generating upon completion $1.3 - $2.4 million in annual tax revenue at current rates. Private investment and tax revenues would roughly double at full build-out. Tenants of the Science Park are expected to provide nearly 1,600 jobs at full build-out: 745 jobs in Phase I and another 832 jobs in Phase II.

TCSVM expenditures for campus activities and Science Park improvements will continue to contribute significantly to the local economy. A 2006 study projected that the school's expenditures and planned investment in the Science Park would contribute more than 946 jobs annually, generate $459 million in output and $195 million in disposable personal income. Ongoing costs to the Town of Grafton are expected to be minimal.

Figure 2: New England Locale

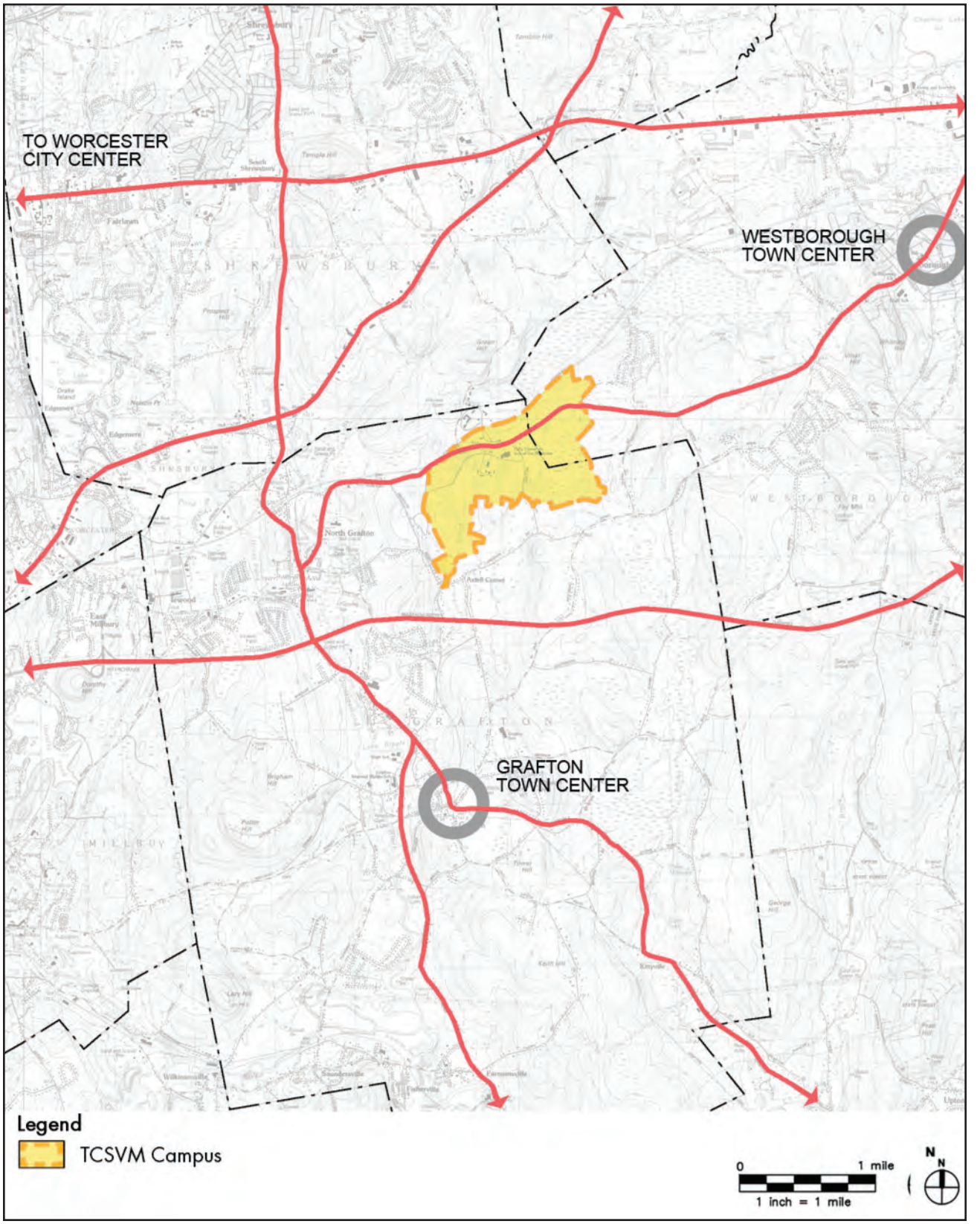


SECTION TWO:
EXISTING CONDITIONS AND DEVELOPMENT POTENTIAL

Tufts University created its Cummings School of Veterinary Medicine in the late 1970s on the site of the former Grafton State Hospital. At that time, students in their first three years of school attended classes at the Tufts Medical campus in Boston. Other school education and research activities took place in renovated state hospital buildings in Grafton. Since then, the school has renovated and converted a number of existing buildings to accommodate the needs of the school and its faculty. The first new building, the Hospital for Large Animals (HLA), was constructed in 1982. At the same time, the Jean Mayer Administration Building was renovated. In 1985 the Henry and Lois Foster Hospital for Small Animals was constructed and connected to the HLA. In the late eighties and early nineties, Building 20 became Tufts' Veterinary Diagnostic Laboratories, the Loew Center was developed as a library/student building, and Building 21 became a biotechnology business incubator. The McGrath Teaching Laboratory and Bernice Barbour Wildlife Medicine were constructed in the early 2000s. Other recent major renovations and new construction include a significant expansion and renovation to the Swine II facility, the Agnes Varis Campus Center, and the New England Regional Biosafety Laboratory. Three hospital expansions were completed, including a Magnetic Resonance Imaging (MRI) addition and the Large Animal Isolation Facility. Several animal housing facilities were also constructed.

Today, the school occupies approximately 454,791 gross square feet (GSF) of space. Another 39,070 GSF of building area is not currently in use, for a total of 493,861 GSF on campus.

Figure 3: Worcester Region Locale



REGIONAL CONTEXT

Tufts' 594-acre[1] Grafton and Westborough campus is located in central Massachusetts, Worcester County, about 40 miles west of Boston and five miles southeast of the City of Worcester. Worcester County, which contains sixty cities and towns, is the largest county in land area (1,513 square miles). With 798,552 inhabitants, it is the second most populous county in the state. It contains 19% of the state's land area and 12.2% of its population.

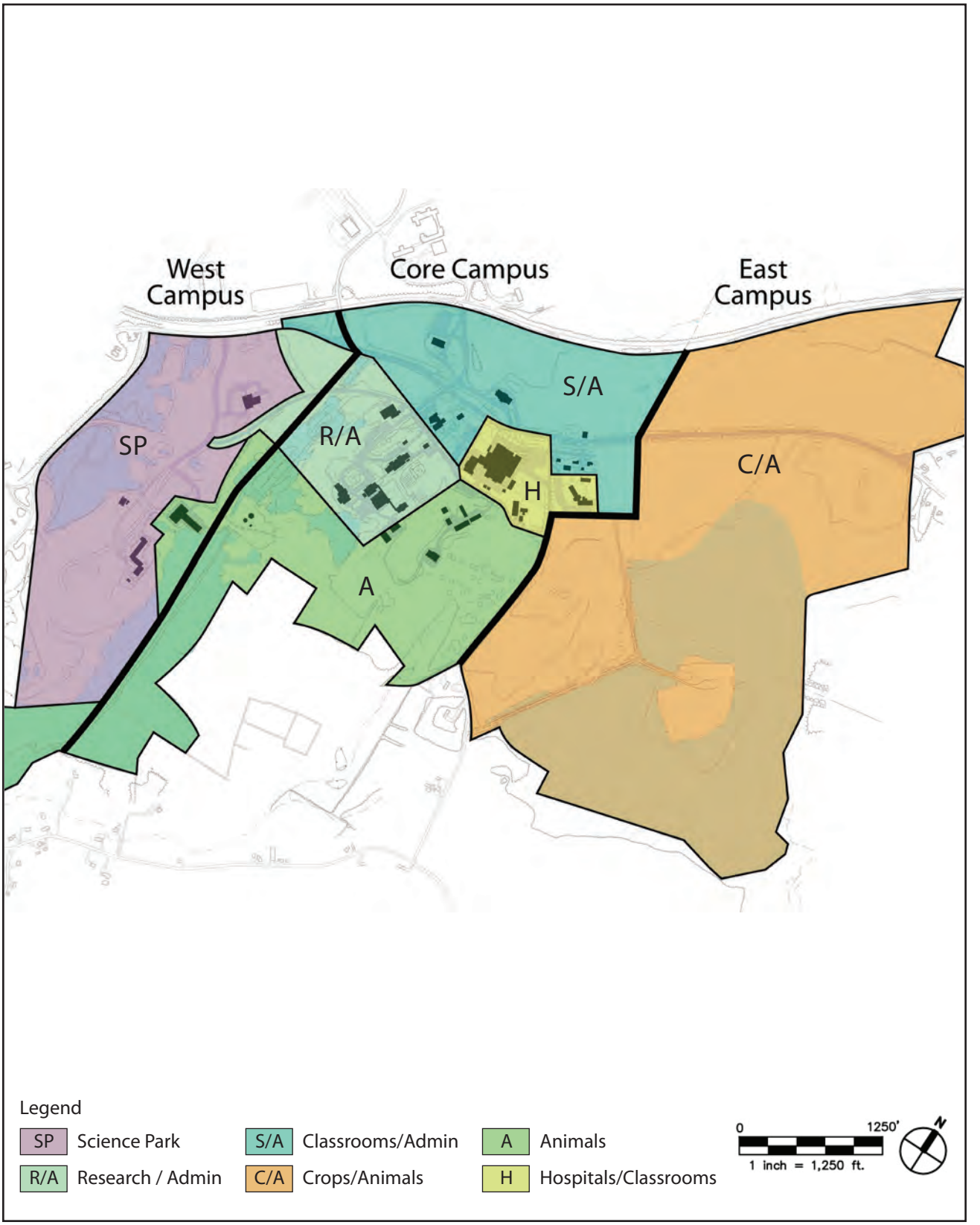
The campus is also located in the Blackstone Valley corridor, the eleven communities in south central Massachusetts along or near the Blackstone River.[2] These communities had a combined population of 109,044 in 2010.

TCSVM is the only veterinary school in New England. It is part of a cluster of colleges and universities in Worcester County, which includes, among others, Clark University, College of the Holy Cross, Worcester Polytechnic Institute, Worcester State College and the University of Massachusetts Medical School. The school is accessible from Tufts University's campuses in Medford and Boston via the Massachusetts Turnpike; the Boston-Worcester commuter rail service directly links the Boston and Grafton campuses.

The campus straddles the boundary between the towns of Grafton, a community incorporated in 1735, and Westborough, incorporated in 1717. About three quarters of the campus (445 acres) and all of the buildings are in Grafton; one quarter of the campus (149 acres) is in Westborough. The two towns have similar population densities – about 600 inhabitants per square mile. Grafton's 2010 population was 17,765. Westborough's 2010 population was 18,272.

[1]The acreage included is property unambiguously owned by Tufts; about 40 acres have been excluded because of competing claims.
[2]Blackstone, Millville, Douglas and Uxbridge (which border Rhode Island), Hopedale, Mendon, Northbridge, Sutton, Millbury, Upton and Grafton.

Figure 4: Campus Land Use



PRESENT CAMPUS

Land Use

The bulk of the 594-acre campus is located on one legally described parcel. For ease of reference in describing existing conditions, Figure 4 depicts three general areas, shown as the Core Campus, East Campus and West Campus. Table 2.1 describes the approximate acreage on each of the three areas and the current institutional and agrarian uses.

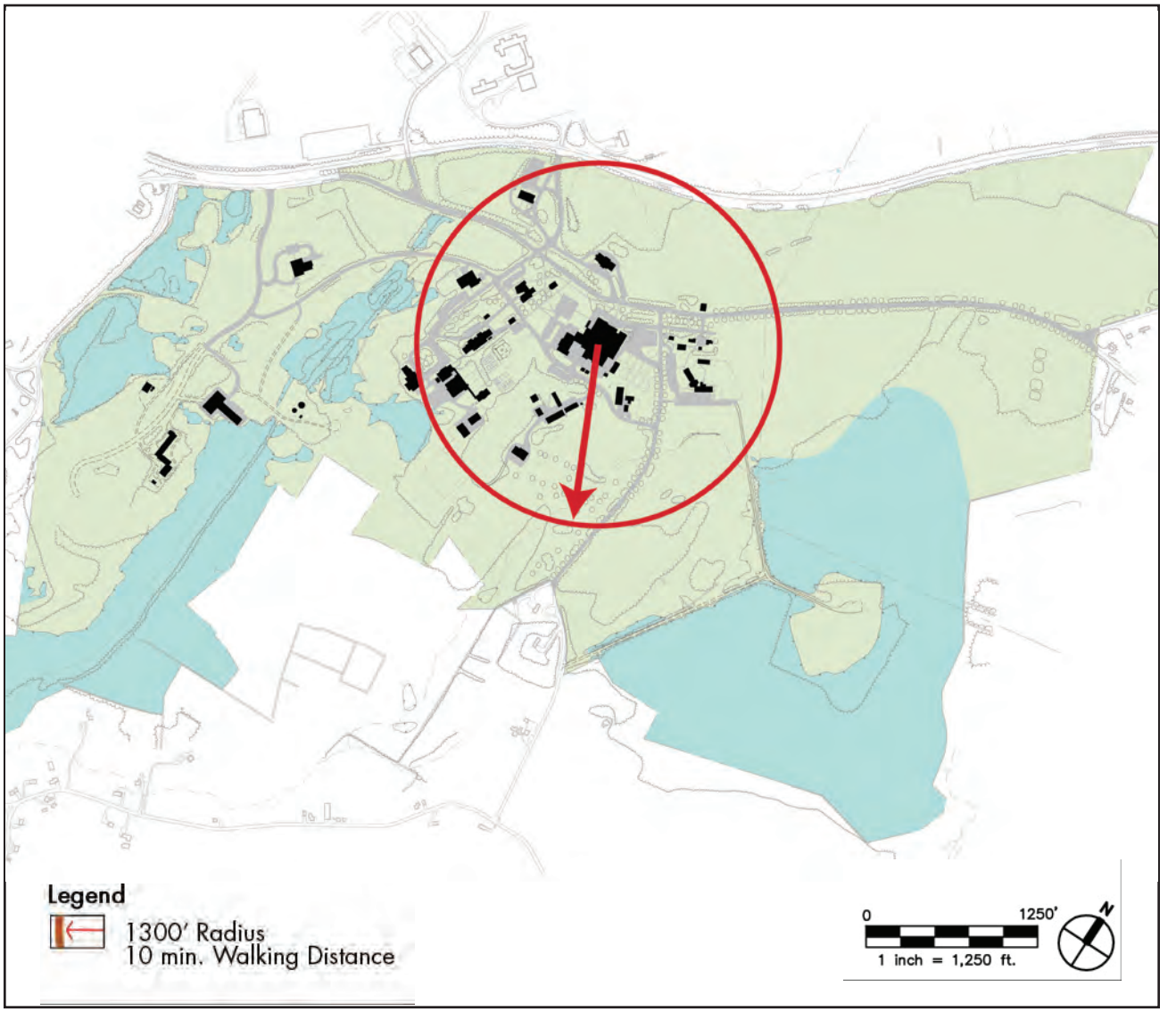
The Core Campus contains academic, research, administration and hospital facilities. Additional veterinary school programs are located south of the academic core and on outlying parcels east and west of the campus. Part of the East Campus is in agricultural use as pasture or cropland; the remaining area is woodland, a significant portion of which is classified as wetland. Activities on the West Campus include 151 acres in school use, containing the regional biosafety laboratory, swine units, and agriculture operations, woodlands and wetlands. While currently in educational use, much of the West Campus south of Route 30 is available for commercial health sciences, high tech or alternative energy research and development, as tenants emerge in the future.

Table 2-1: Current Land Use Distribution

LOCATION	ACRES	% TOTAL
Core Campus, School Use	**173**	**29%**
School Administration		
Hospital		
Research/General Education		
Animals		
East Campus, School Use	**270**	**45%**
Crops, Animals and Woodland		
Town of Westborough	149	
Town of Grafton	121	
West Campus, School Use	**151**	**26%**
Crops, Research/Administration, Animals and Woodland		
North of Route 30	2	
South of Route 30*	149	
TOTAL CAMPUS LAND	**594**	**100%**

* including 98+ acres available for Grafton Science Park development

Figure 5: Limits of Core Campus Development



Limits of Core Campus Development

The core academic, hospital and research areas should be accessible to each other by walking no more than ten minutes (the time of a class-change interval) and in order to reduce vehicular use on campus. This limits the development of the core campus to approximately 125 acres. The Limits of Core Campus Development are shown in Figure 5. The center of this area is the hospital complex. Knolls east of Willard Street and the Axtell Brook vale on the west visually define and bound this central campus. Undeveloped sites within the academic core provide a land reserve for future school programs proximate to academic, administration and research resources. To a limited extent, corporate collaborative programs may also occur within the core campus area.

Development Activities Since 1998

Since 1998, TCSVM has constructed 129,398 square feet of facilities and removed eight support buildings totaling 39,070 square feet.

The following projects have been completed:

Building 8 Alpha Psi Addition – 125 square feet

Building 26 David McGrath Veterinary Teaching Laboratory –13,339 square feet

Building 45 Bernice Barbour Wildlife Medicine Building – 11,250 square feet

Building 48 Eagle Flight Cage – 3,591 square feet

Building 40 Small Animal Hospital Expansion/MRI Suite – 7,211 square feet

Building 46 Large Animal Bedding and Feed Barn – 2,136 square feet

Building 14 Clinical Faculty Office Building – 2,013 square feet

Building 30 Beef Cattle Barn Addition – 538 square feet

Building 42 Equine Housing Addition – 432 square feet

Building 13 Sheep Equipment Storage – 153 square feet

Building 53 Feed Storage – 540 square feet

Building 51 Office Modulars – 572 square feet

Building 45SR Wildlife Cage Storage – 416 square feet

Building 45SS1, 2, 3 Wildlife Equipment Storage Sheds (3) – 480 square feet

Building 47 Sewer Pump House – 260 square feet

Building 49 Hospital Waste Storage – 96 square feet

Building 7SR Advancement Records Storage – 80 square feet

Building 41A Dining Service Storage– 96 square feet

Building 40SS Foster Hospital for Small Animals Storage Shed – 160 square feet

Building 18SR Tufts Facilities Services Storage Shed – 630 square feet

Building 23SS Universal Waste Accumulation Shed – 160 square feet

Building 56 Large Animal Isolation Facility – 3,432 square feet

Building 11 Swine II Expansion – 13,815 square feet

Building 27 Sheep Barn – 3,000 square feet

Building 55 New England Regional Biosafety Laboratory – 39,071 square feet

Building 16 Agnes Varis Campus Center – 24,737 square feet

The support facilities removed were:

Building 26 Teaching Barn – 3,000 square feet

Building 28 Laboratory Modules – 450 square feet

Building 33 Residence – 2,370 square feet

Building 36 Horse Shelter – 1,150 square feet

Building 29 Bull Barn – 900 square feet

Building 19 Vacant Building – 25,800 square feet

Building 27 Old Sheep Barn – 3,000 square feet

Building 41 Dining Facility – 2,400 square feet

Figure 6: Building Inventory – Core Campus

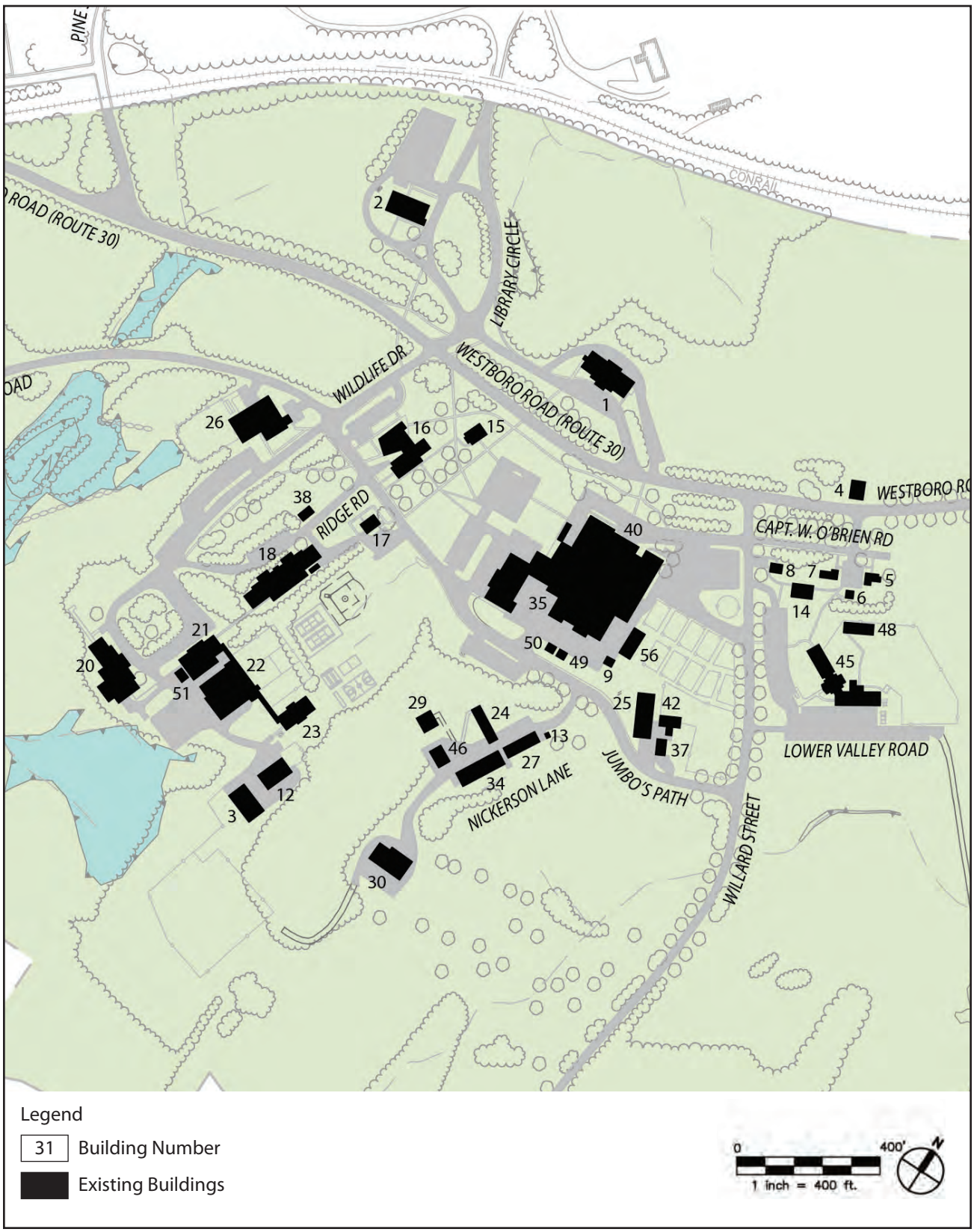
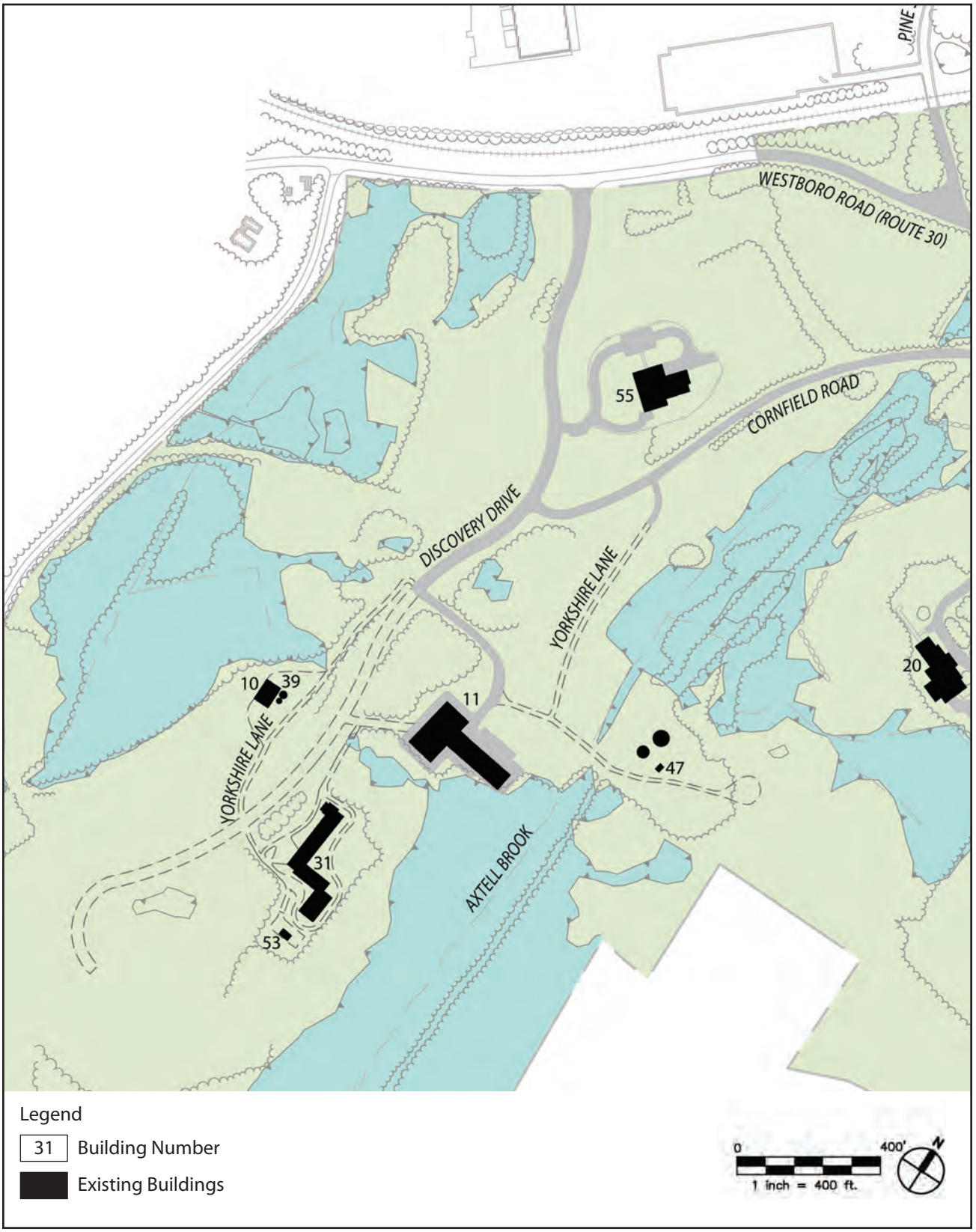


Figure 7: Building Inventory – West Campus



Existing Building Inventory and Use

Primary academic programs, administration and hospital activities are located in the academic core. These activities comprise the largest gross square feet of current building use. Research and general education activities are primarily, but not exclusively, located in renovated buildings in the southern part of the core campus and on the west campus. Support functions, used by all veterinary school programs, are located in the academic core and outlying campus areas. About 8% of the existing buildings are not now in present use.

Table 2.2 identifies these uses and notes buildings designated as of critical importance on the Massachusetts Register of Historic Places. Building numbers in the table refer to Figures 6 and 7.

Table 2-2: Building Inventory – 2013

BLDG #	BUILDING NAME	2013 BLDG. AREA (GSF)
SCHOOL ADMINISTRATION AND HOSPITAL		
G001	Jean Mayer Administration Building*	32,946
G002	Franklin M. Loew Veterinary Medical Education Ctr*	18,789
G005	Center for Animals and Public Policy*	2,650
G007	Advancement & Alumni Relations*	3,048
G008	Alpha Psi Student Center*	2,701
G014	Clinical Faculty Office Building	2,013
G015	Central Services Campus Police*	5,281
G016	Agnes Varis Campus Center	24,737
G017	LAMS - Faculty Offices @ 1 Ridge Road*	3,575
G035	Large Animal Hospital	82,141
G040	The Henry & Lois Foster Hospital for Small Animals	33,833
G051	Office modulars	752
G056	HLA Isolation Ward	3,432
	TOTAL	215,898
RESEARCH AND GENERAL EDUCATION		
G020	Veterinary Diagnostic & Testing Lab*	30,566
G021	Laboratory Support Building (Tufts Biotechnology Transfer Center)*	19,142
G022	Amelia Peabody Pavilion	29,790
G026	David McGrath Veterinary Teaching Laboratory	13,339
G045	Bernice Barbour Wildlife Medicine Building	11,200
G055	New England Regional Biosafety Laboratory	39,071
	TOTAL	143,108

* Listed as 'Critical' importance on the Massachusetts Register of Historic Places.

Table 2-2: Building Inventory – 2013 (continued)

BLDG #	BUILDING NAME	2013 BLDG. AREA (GSF)
SUPPORT FACILITIES		
G003	Goat Reproduction Barn I	4,286
G004	Locust Barn	3,678
G006	Seasonal Equipment Storage	400
G009	Medical Gas Storage	400
G010	Grain Feed Storage Barn	2,520
G011	Swine Housing Unit II	22,815
G012	Goat Reproduction Barn II	4,833
G013	Sheep Equipment Storage	153
G023	Building 23 (Unheated Storage)	8,010
G024	Poultry Instructional Barn	2,898
G025	Equine Housing I	6,293
G027	Sheep Instructional Barn	3,000
G030	Beef Cattle Instructional Barn	5,417
G031	Sewerage Treatment Tanks	-
G032	Swine Housing Unit I*	11,900
G034	Farm Machinery Shop	5,438
G037	Sand & Salt Storage*	450
G038	Flight Cage	960
G039	Corn Bin	828
G040SS	Foster Hospital for Small Animals Shed	160
G042	Equine Housing II	2,227
G044	Old Pump House	480
G046	Hay Storage Barn	2,136
G047	Pump House	206
G048	Eagle Flight Cage	3,591
G049	Hospital Waste Storage	96
G050	Hospital Feed Storage	208
G053	Swine I Feed Storage Barn	540
G018SR	TFS Equipment Storage	630
G023SS	Universal Waste Accumulation Shed	160
G041A	Dining Services Storage	96
G045SR	Wildlife Cage Storage	416
G045SS1	Wildlife Equipment Storage	160
G045SS2	Wildlife Equipment Storage	160
G045SS3	Wildlife Equipment Storage	160
G007SR	Advancement Records Storage	80
	TOTAL	95,785
BUILDING NOT NOW IN USE		
G018	Building 18*	39,070
	TOTAL	39,070
TOTAL EXISTING BUILDINGS		**493,861**

* Listed as 'Critical' importance on the Massachusetts Register of Historic Places.

Figure 8: Open Space Structure

Historic Buildings and Open Space

The special landscape qualities of the campus result from an interweaving of woodlands, rural farmland, and formal grounds created when the site was the Grafton State Hospital. The campus, listed on the Massachusetts Register of Historic Places, represents a distinctive setting associated with mid and late 19th century mental institutions in which the landscape and grounds were considered important elements in the therapeutic environment. Although built in the early 20th century, former state hospital buildings are distinguished for their Victorian gothic architecture. Recognition of the importance to the campus environment of landscape and architectural quality directs the arrangement of land uses and selection of building and parking sites.

Three varieties of agricultural landscapes prevail: pasture/cropland, woodland, and paddock. Animal pasture and crop fields create the most dramatic landscapes, with views from Route 30 to north-oriented vistas in the east campus, and views to pasture land knolls and vales from Willard Street in the academic core. Oaks and maples line Route 30 from the east campus bounds to the campus core and form an edge to the adjacent farm fields. Open agriculture landscapes reveal the varying topography.

Woodland, the predominant landscape in total acreage, ranges from oak, maple and white pine on higher elevations to red and silver maple on the poorly drained soils of low-lying sites. Woodland frames the major open space vistas and provides a future resource to screen institutional support functions and nonacademic activities in or adjacent to the academic core.

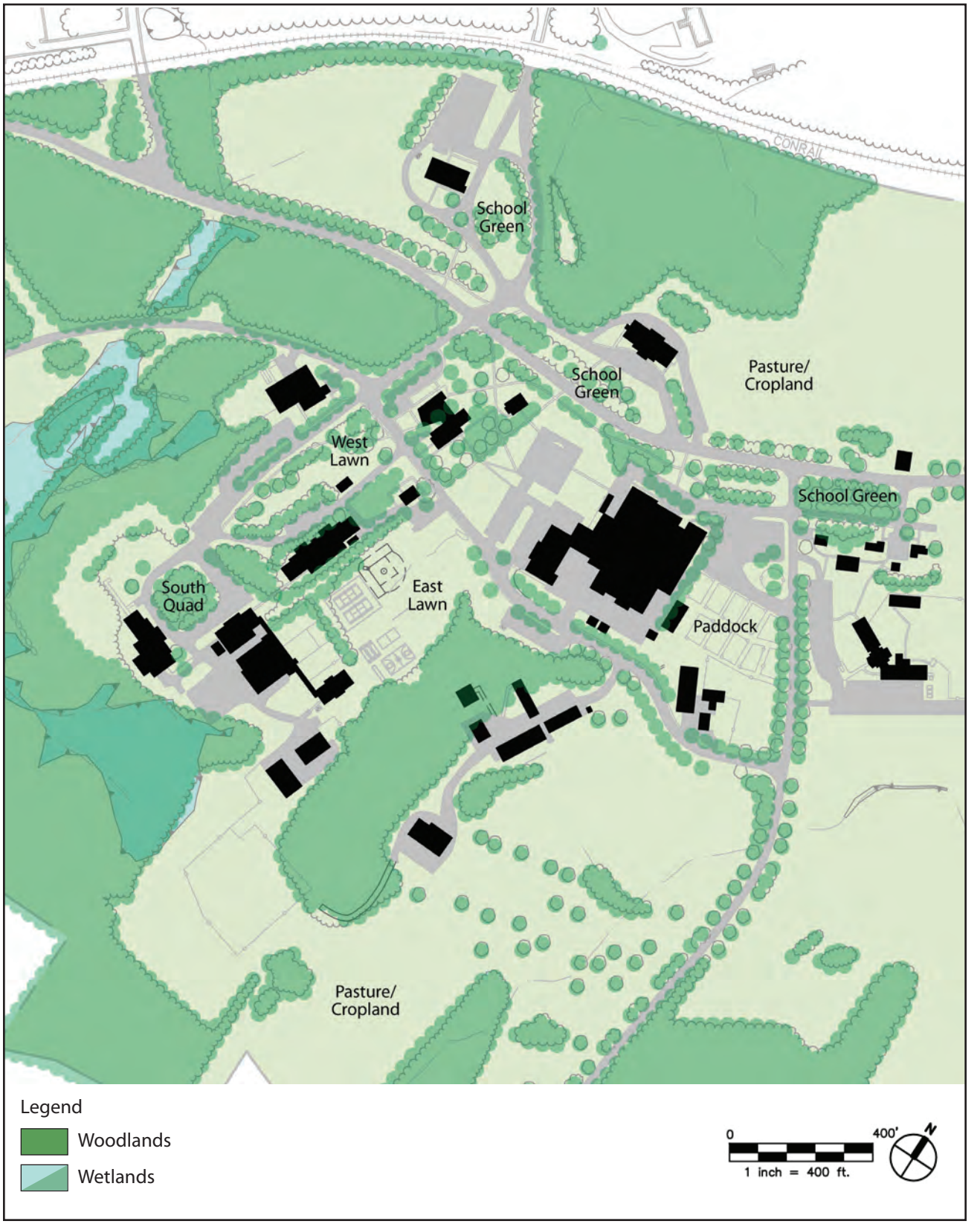
Paddocks adjoining the hospital for large animals and the agricultural science buildings provide outdoor space for large animals. The white paddock enclosures frame the east campus entrance and screen parking lots from Route 30, Willard Street, and the open landscape of adjoining pasture land.

Pasture/Crop Landscape: View West from Willard Street

Woodland Landscape: Willard Street View South

Paddock Landscape: View Southwest from Willard Street

Figure 9: Open Space – Core Campus



Route 30 and Willard Street provide a transition from rural farm land to campus center. These roads are distinguished by varying horizontal and vertical alignment and trees planted close to the pavement.

Core Campus Landscapes

Landscapes of the core academic campus include a linear green, lawns, and quadrangles. The school green is a sequence of public spaces that parallel Route 30 from the Locust Barn and wood frame houses on the east to the Loew Education Center on the west. Mature trees line Route 30 and the adjoining campus ways, creating a memorable passage through the heart of the campus. Campus walks join school administrative and student services located on parts of the upper, middle and lower green.

East and west lawns are significant open spaces framed by buildings for research, medical, student and administration activities. Trees line roads, walks, and buildings in formal alignment; the lawns contain more informal tree placements. Parking lots within and at the edge of the lawns visually interrupt the expanse of open space in the academic center.

Figure 9 depicts these open space zones on the core campus. Figure 10 shows the historical development of the campus and identifies key landscape features.

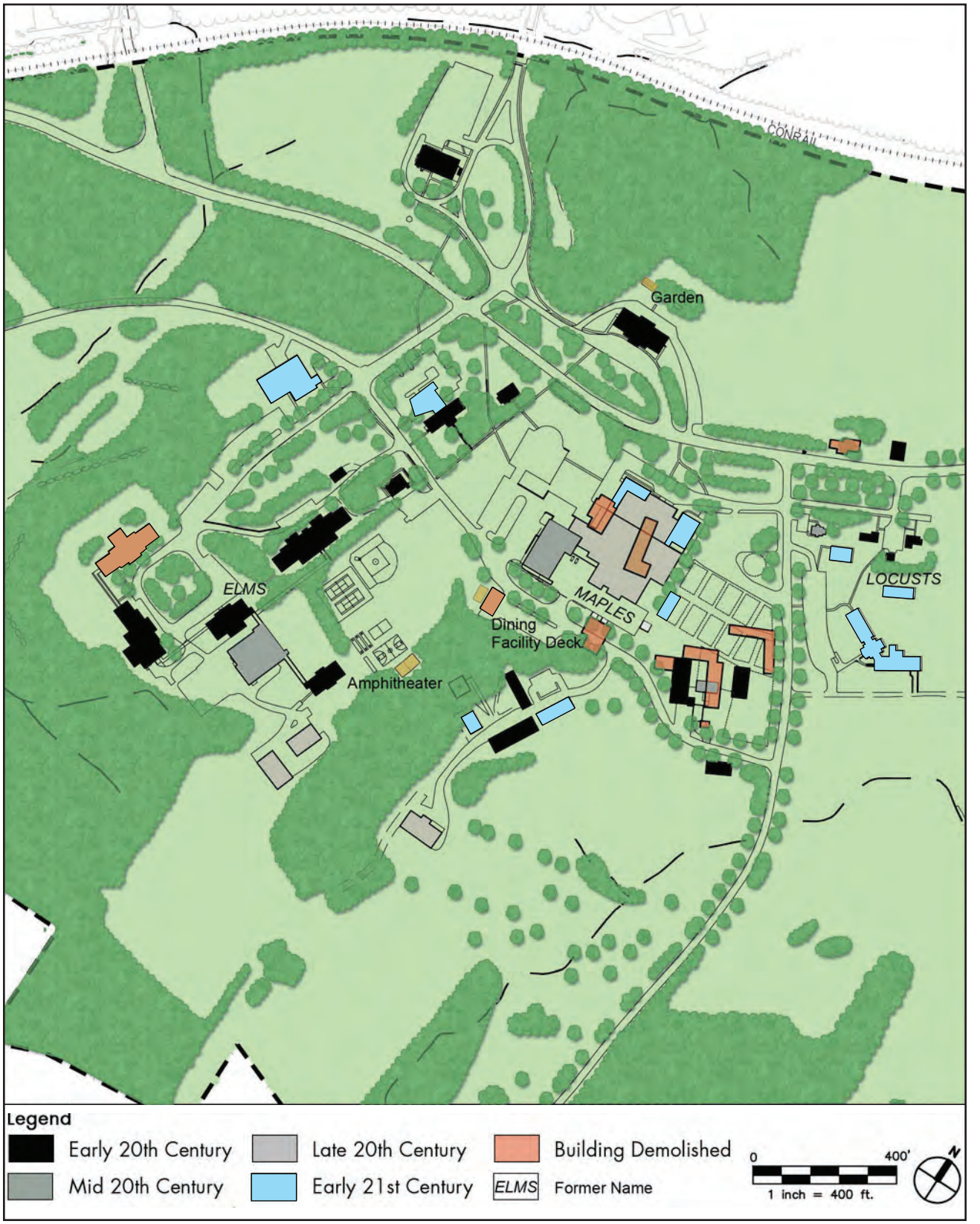
Willard Street: View to North

Central Green: View to Agnes Varis Campus Center

School Green: Jean Mayer Administration Building

Upper Green: East Campus Entrance at Willard Street

Figure 10: Landscape Antecedent – Core Campus



The south quadrangle is the most formal campus space, defined on three sides by research buildings and separated from west lawn by a dense grove of trees. Mature plantings adjacent to the buildings and adjoining woodland frame the space; more recent plantings are located in the quadrangle lawn.

Three landscape features located in the campus center provide smaller scale outdoor spaces. The extant garden located north of the Administration Building contains a shelter and ornamental shrubs from earlier twentieth century plantings.

The dining facility terrace at the Agnes Varis Campus Center located south of the hospital is the most frequented public outdoor space. The terrace overlooks the east lawn field, parking lots and building service area.

An amphitheater located on the east lawn edge opposite Building 18 provides an overview of the most expansive space on campus that is now Phelps Field.

The Massachusetts Register of Historic Places lists the west lawn adjacent to Building 18, the east lawn adjacent to Building 16, the south quadrangle and the green east of the Loew Academic Center as spaces of 'critical' importance.

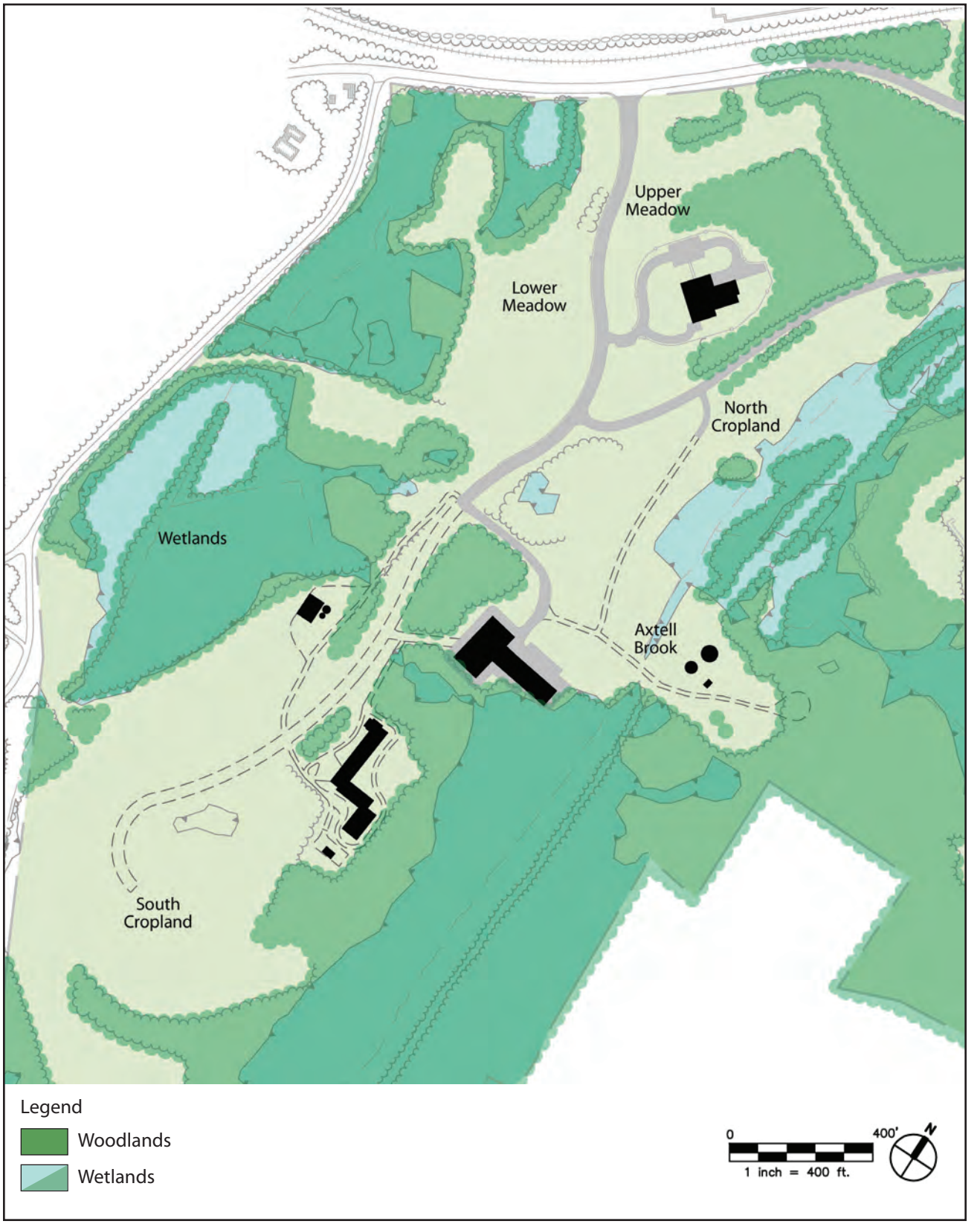
West Lawn: View to Building 17

East Lawn: View West along Jumbo's Path

East Lawn: Phelps Field and Amphitheater

East Lawn: View West to Bldgs. 18 and 17

Figure 11: Open Space – West Campus



Open Space: West Campus and Grafton Science Park

Two meadows border Route 30 on the West Campus. The lower meadow opens up onto Route 30. The upper meadow is more self-contained, separated from the lower meadow by a row of coniferous trees. The two meadows are bordered to the west by a red maple wetland and to the east by a knoll on which the NE-RBL is now located. These elements delimit the area of developable land, which extends along a north/south axis defined by these meadows. Additional sites in Grafton Science Park are planned to be developed in this area.

Two open areas south of Cornfield Road are now in agricultural use. The North Cropland is planted with corn, and the South Cropland is currently used for hay and composting. Two swine unit facilities, a silo, and a grain mixing facility comprise other agricultural uses. One swine unit and the silo are in forest clearings and the other swine unit is at the south of the North Cropland.

To the west of the Tufts' property, a group of former Grafton State Hospital buildings known as the 'Willows' dominate the high land. These buildings are still owned by the state and some are vacant.

Figure 11 illustrates these open spaces.

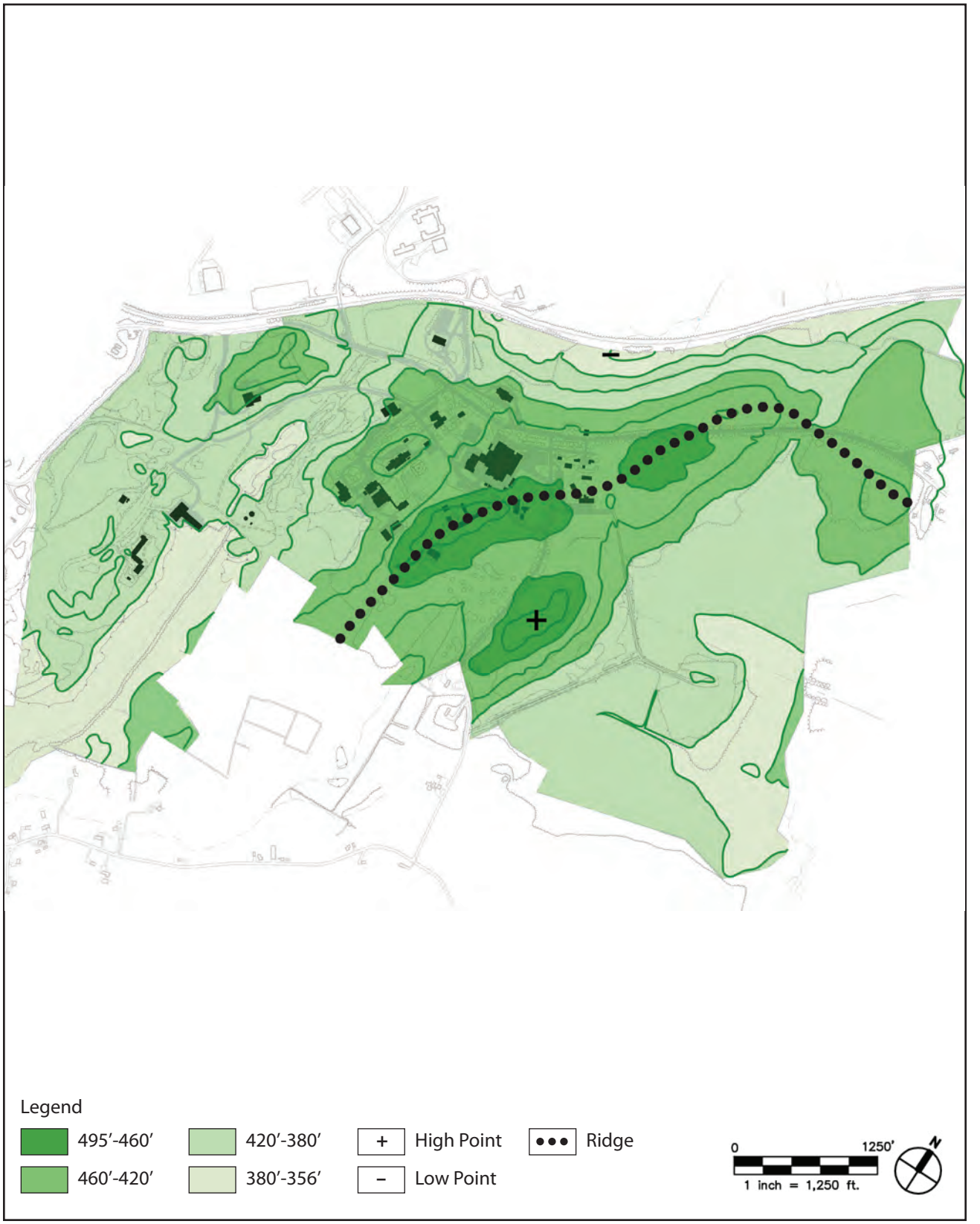
Upper Meadow: View Northwest to Route 30

North Cropland: View North to NE-RBL

Lower Meadow: View to NE-RBL from Route 30

South Cropland: View from South

Figure 12: Physiography



SITE ASSESSMENT

Physiography

The campus is located in the Massachusetts Eastern Plateau, a physiographic division for land 200' to 700' above sea level. The site, distinguished by great topographic variety, ranges from a high point elevation of 495' on the prominent campus knoll south of the hospital to a low point of 356' adjoining the rail line on the north campus bound. (See Figure 12.) The highest knoll on campus is part of a ridge that extends from the east campus bound on Route 30 to the pasture land south of the research quadrangle. Most campus buildings are sited on the ridge or to the north on northwesterly oriented terraces and knolls between elevations 460' to 420'.

Slope

Land with slopes that constrain future development covers approximately 76 acres or 13% of the total site. Most of the steepest slopes (greater than 10%) occur north of Route 30 and east of Willard Street. See Figures 13 and 14 for western and core campus slope physiography.

Figure 13: Slope – Core Campus

Figure 14: Slope – West Campus

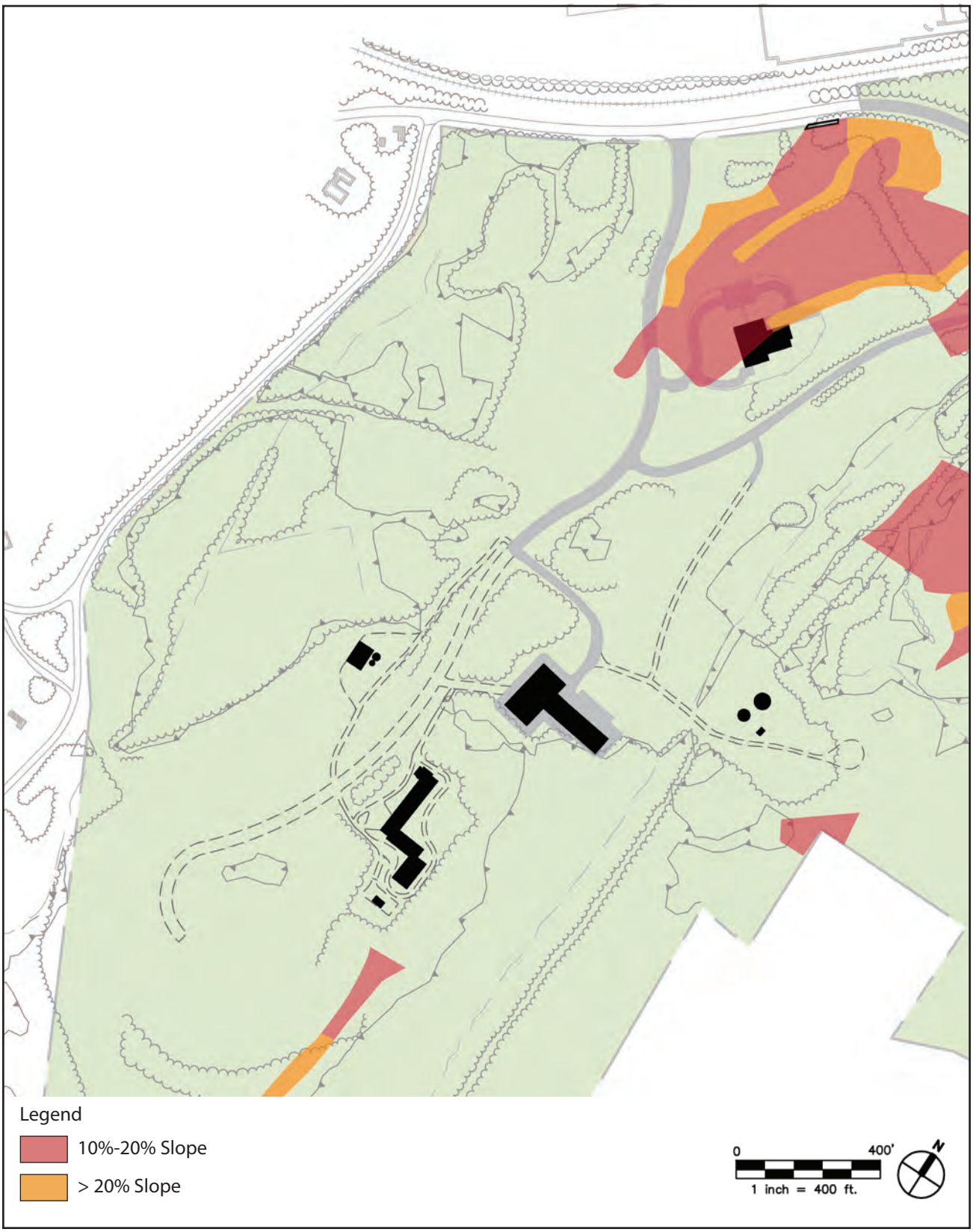
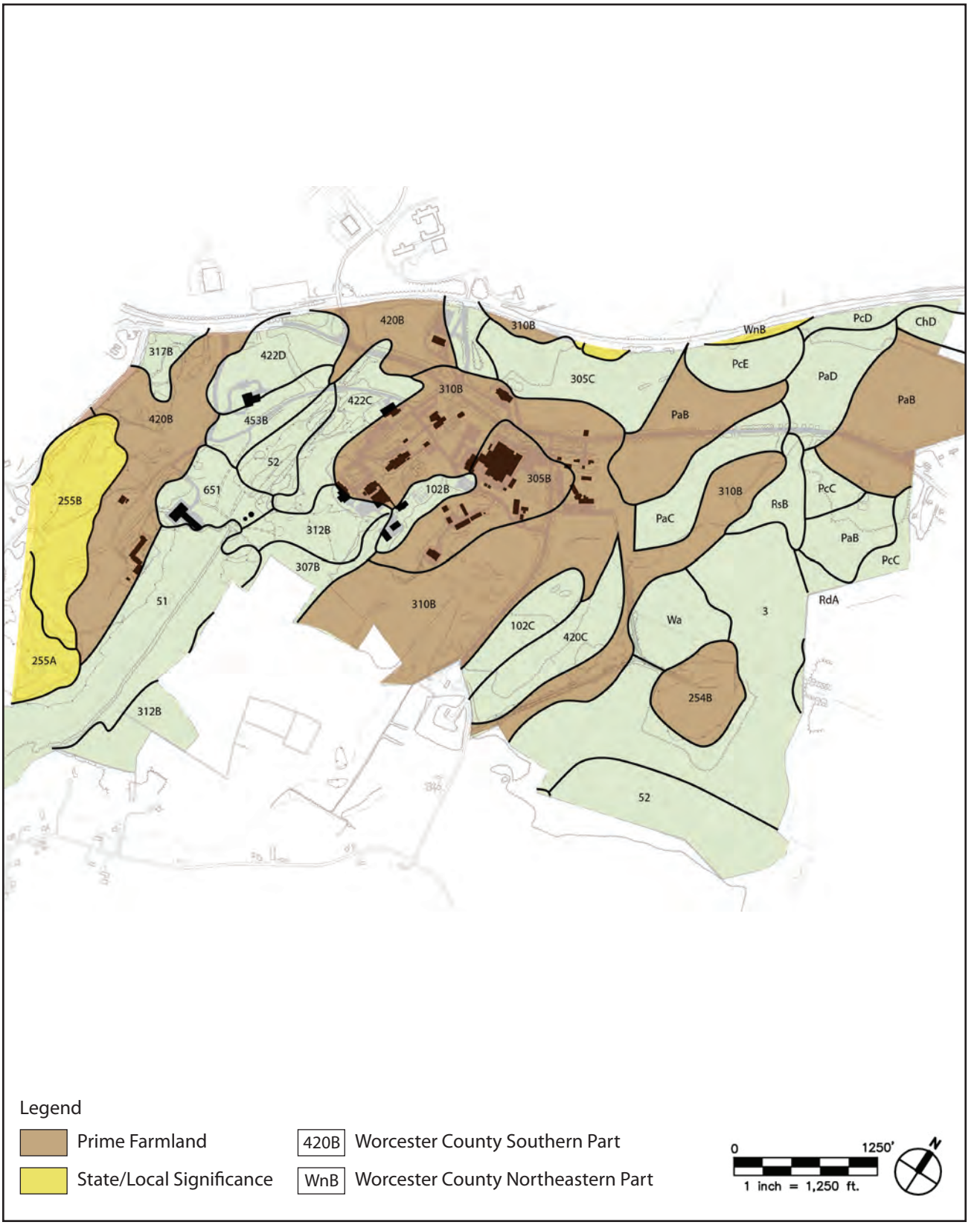


Figure 15: Soil



Soil

Most soils on the campus are in the Paxton-Woodbridge-Canton group, characterized by well- to moderately-drained upland soils. Most campus buildings are located on the Woodbridge and Paxton fine sandy loam soils.

Prime farmland soils comprise 253 acres, 43% of the total site. Another 29 acres, 5% of the campus, is classified as having statewide or local importance. A majority of the prime or significant soils are located on or adjoining the ridge that traverses the core and east campuses.

Hydric soils, characterized as poorly drained soils with water table close to the surface, comprise 137 acres, 23% of the total campus. A majority of hydric soils are located in the southeast and west campus and classified as wetland.

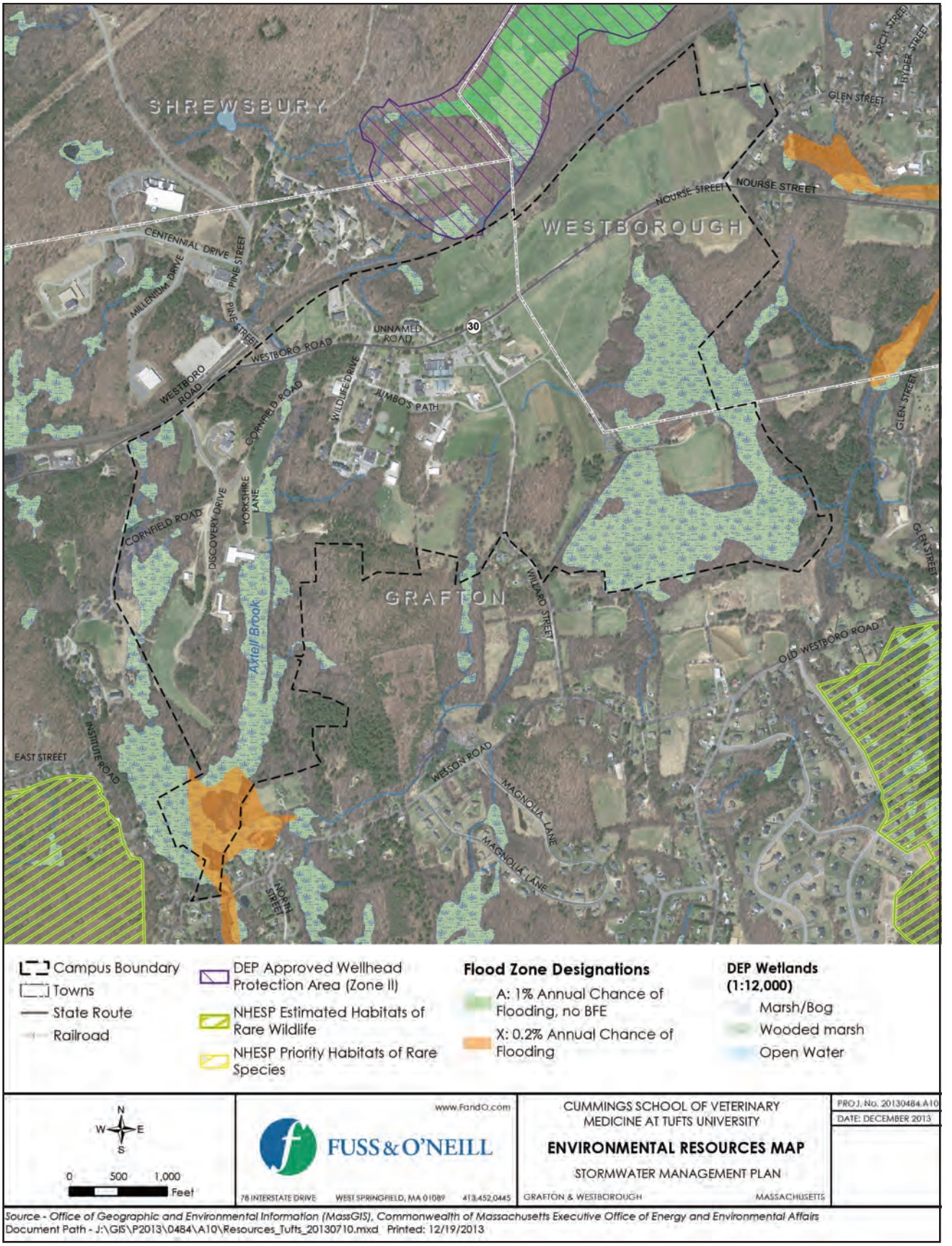
Table 2.3 identifies soil types and provides a key to accompany Figure 15, which locates the soil types on the campus. Hydrologic soil groups on campus are also described in Appendix B, Conceptual Stormwater Management Plan and its Figure 2-1.

Table 2.3: Soil Index

MAP KEY	SOIL TYPE	
420B	Canton fine sandy loam*	3-8% slope
420C	Canton fine sandy loam	3-15% slope
422B	Canton fine sandy loam	3-8% slope, extremely stony
422C	Canton fine sandy loam	3-15% slope, extremely stony
422D	Canton fine sandy loam	15-20% slope
102D	Chatfield-Hollis rock outcrop	3-15% slope
ChD	Chatfield-Hollis rock outcrop	15-25% slope
52	Freetown muck	
253B	Hinckley sandy loam	3-8% slope
MeB/254B	Merrimac fine sandy loam*	3-8% slope
PaB/305B	Paxton fine sandy loam*	3-8% slope
PaC/305C	Paxton fine sandy loam**	8-15% slope
PaD	Paxton fine sandy loam	15-25% slope
PcB/307B	Paxton fine sandy loam	3-8% slope, extremely stony
PcC	Paxton fine sandy loam	3-15% slope, extremely stony
PcD	Paxton fine sandy loam	15-25% slope, extremely stony
PcE	Paxton fine sandy loam	25-35% slope, extremely stony
RdA	Ridgebury fine sandy loam	0-3% slope
RsB	Ridgebury fine sandy loam	3-8% slope, extremely stony
Sc	Scarboro mucky fine sandy loam	
317B	Scituate fine sandy loam	3-8% slope, extremely stony
51	Swansea muck	
Wa	Walpole fine sandy loam	Walpole and Scarboro fine sandy loam
Wh/3	Whitman loam	extremely stony
255A	Windsor loamy fine sand**	0-3% slope
WnB/255B	Windsor loamy fine sand**	3-8% slope
WrB/310B	Woodbridge fine sandy loam*	3-8% slope
312B	Woodbridge fine sandy loam	3-8% slope, extremely stony
651	Udorthents, smoothed	

*Prime farmland **State/Local Significance

Figure 16: Environmental Resources Map



Hydrology

Wetlands

Wetland resource areas subject to the Massachusetts Wetlands Protection Act ("WPA"), M.G.L. 131 and the Grafton Wetlands Bylaw were flagged and mapped in 1998 to create a campus-wide wetland delineation plan. The delineation was updated by Vanasse Hangen Brustlin, Inc.("VHB") in 2002 and subsequently approved by the Grafton Conservation Commission. Wetlands were also delineated in the vicinity of the proposed solar arrays in 2013 in support of the local permitting and approval process. Campus wetlands consist of several intermittent streams, including Axtell Brook, which flows in a southerly direction bisecting the campus, and Bordering Vegetated Wetlands ("BVW") subject to state, local and/or federal jurisdiction. As documented in the 2006 Stormwater Management Plan (SMMA), Axtell Brook is considered an intermittent stream based on field documentation provided by VHB in 2002. Under the WPA, intermittent streams have a 100-foot buffer zone but do not have an associated 200-foot Riverfront Area.

Axtell Brook flows generally south through the campus and creates a separation between the main campus and Grafton Science Park. The brook receives discharges of stormwater from a stormwater basin constructed for the Grafton Science Park as well as overland flow from the main campus. Axtell Brook and two unnamed tributaries converge near a culvert under Wesson Street south of the TCSVM property boundary.

Wetland areas, primarily forested wetlands, account for approximately 169 acres (29%) of the total campus, with the largest contiguous wetland located in the southeastern portion of the East Campus. Wetlands comprise approximately 47 acres of the West Campus and approximately 15 acres of the core campus, primarily located south of the veterinary school research facilities and associated with Atwell Brook. Wetlands are also located in the west campus along the unnamed tributary to Axtell Brook in the vicinity of the Grafton Science Park.

Field-delineated wetlands on the TCSVM campus are shown on the existing and proposed conditions site plans (Figures 1 and 24). Wetlands mapped by the Massachusetts Department of Environmental Protection are depicted on the environmental resources map. See Figure 16.

Table 2.4A: Wetland Distribution

LOCATION	ACRES		% OF	
	Total	Wetland	Area	Campus
Core Campus	173	15	9%	3%
East Campus	270	107	40%	18%
West Campus	151	47	31%	8%
TOTAL	**594**	**169**		**29%**

Floodplains

Floodplains, which are areas that would be impacted by floodwaters of some depth, are delineated by the Federal Emergency Management Agency ("FEMA"). The entire campus is located outside of the regulated 100-year floodplain, and the majority of the campus is located outside of the 500-year floodplain (i.e., regulatory flood zones). According to the FEMA Flood Insurance Rate Map Panel 25027C0831E, revised in 2011, a 500-year flood zone associated with Axtell Brook is located in the southwestern corner of the TCSVM campus property near the Wesson Street culvert. The FEMA flood study indicates that areas along the southwest portion of the Tufts property near the Wesson Street culvert will be subject to flooding in extreme storm events. See Figure 16.

Threatened and Endangered Species

Information on Massachusetts endangered, threatened, and special concern plant and animal species is maintained by the Massachusetts Natural Heritage and Endangered Species Program ("NHESP"), a part of the Massachusetts Division of Fisheries and Wildlife. The Massachusetts Natural Heritage Atlas mapping identifies habitat areas for known occurrences of state- and federally-listed endangered, threatened and special concern species. According to the most recently published edition of the Massachusetts Natural Heritage Atlas (13th Edition, October 1, 2008), no priority habitats of rare species, estimated habitats of rare wildlife, or certified vernal pools occur within the campus boundaries. Mapped areas of NHESP Estimated Habitats of Rare Wildlife are located to the southeast and southwest of the campus (Figure 16).

Watersheds and Water Supply

The TCSVM campus straddles the boundary between the Blackstone River and SuAsCo (Sudbury-Assabet-Concord) River Basins. Approximately the western half of the campus is within the Quinsigamond River subwatershed in the Blackstone River Basin and the eastern half is within the Assabet River subwatershed within the SuAsCo (formerly referred to as the Concord River Basin) River Basin, as shown in Figure 17. Section 3 of Appendix B, Conceptual Stormwater Management Plan includes a description of the existing campus drainage and site hydrology.

Pursuant to the Massachusetts Surface Water Quality Standards (314 CMR 4.00), Outstanding Resource Water ("ORW") include public water supplies and their tributaries, including wetlands. No ORWs or tributaries to ORWs are located on or in the vicinity of the campus. Based on the Town of Grafton's Zoning Map (October 2012), the western portion of the campus surrounding Axtell Brook is located within a Water Supply Protection Overlay District.

Water Quality Impaired Waters

According to the Massachusetts Year 2012 Integrated List of Waters (March, 2013), Axtell Brook is not an assessed waterbody, and there are no other named waterbodies on campus. Axtell Brook discharges to Lake Ripple, which discharges to the Quinsigamond River, and eventually to the Blackstone River, all of which are impaired (i.e., do not meet water quality standards) for various designated uses (see Table 2.4B). The eastern portion of campus discharges to an unnamed brook which eventually discharges to the Assabet River Reservoir and Assabet River, which are both impaired for various designated uses (Table 2.4B). Figure 17 shows the impaired water bodies in the vicinity of the TCSVM campus.

Water Supply Protection Overlay District

The portion of the Town of Grafton's Water Supply Protection Overlay District that parallels Axtell Brook covers 126 acres, 21 % of the total campus (see Figure 18). Present veterinary school activities within the aquifer protection district are located in two areas: two swine unit operations on west campus farmland, and one research/general education building in the core campus.

Table 2.4B: Water Quality Impairment

WATERBODY	IMPAIRMENT CAUSE	CATEGORY
Blackstone River Basin (Upper Blackstone River Watershed)		
Lake Ripple (MA51135; 47 acres)	Non-Native Aquatic Plants* Aquatic Plants (Macrophytes)	5 (Impaired – TMDL required)
Quinsigamond River (MA51-09; 5.2 miles)	Eurasian Water Milfoil, Myriophyllum spicatum* Non-Native Aquatic Plants*	4C (Impairment not caused by a pollutant)
Blackstone River (MA51-04 - Fisherville Dam, Grafton to outlet Rice City Pond, Uxbridge; 8.8 miles)	Other flow regime alterations* Physical substrate habitat alterations* Aquatic Macroinvertebrate Bioassessments Cadmium Copper DDT Escherichia coli Excess Algal Growth Fishes Bioassessments Lead Nutrient/Eutrophication Biological Indicators PCB in Fish Tissue Total Phosphorus Sedimentation/Siltation Taste and Odor Turbidity	5 (Impaired – TMDL required)
SuAsCo (formerly Concord) River Basin		
Assabet River Reservoir (MA82004; 338 acres)	Eurasian Water Milfoil, Myriophyllum spicatum* Dissolved oxygen saturation Excess Algal Growth Mercury in Fish Tissue Dissolved Oxygen Turbidity	5 (Impaired - TMDL required) TMDLs for Dissolved oxygen saturation, Mercury in Fish Tissue, and Dissolved Oxygen have been completed
Assabet River (MA82B-01 - Outlet of the Assabet River Reservoir, Westborough to the Westborough WWTP discharge, Westborough; 1.25 miles)	Low flow alterations* Aquatic Macroinvertebrate Bioassessments Fecal Coliform Total Phosphorus	5 (Impaired - TMDL required) TMDL for Total Phosphorus has been completed

* Total Maximum Daily Load ("TMDL") not required (Non-pollutant)

Figure 17: Watershed Map

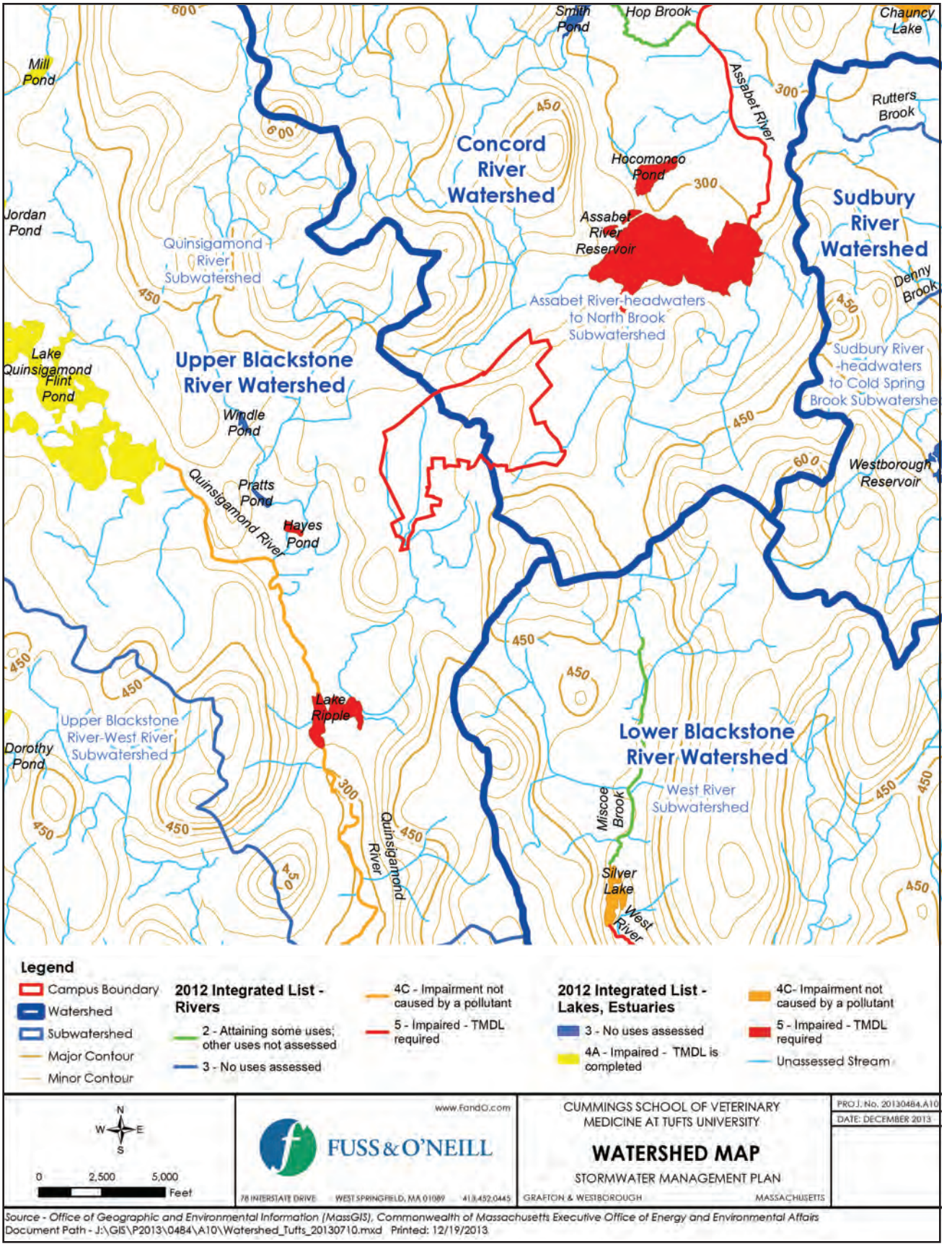
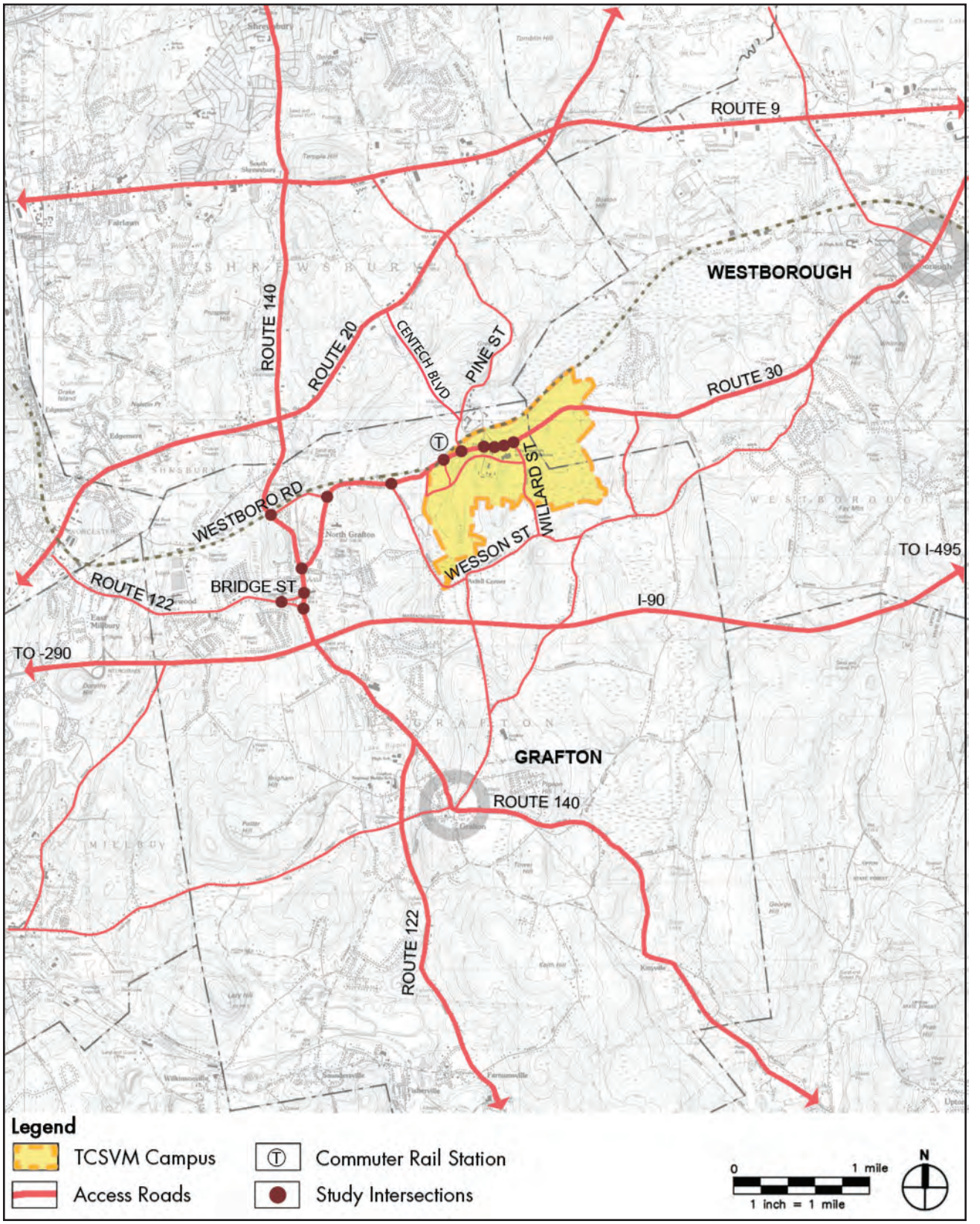


Figure 18: Watershed Supply Protection Overlay District

Figure 19: Local Highway & Transit



TRANSPORTATION

Highway Access

Regional highway access to the veterinary School is provided by Interstate 90-Massachusetts Turnpike, which links I-495 to the east and I-290 to the west to state and local roads that serve the campus. Route 30 traverses the campus and connects the school to the town centers of Grafton and Westborough. (In Grafton, Route 30 is a state-designated route but is under local jurisdiction). Route 30 connects with State Route 140, which provides access to communities to the north and south of the site, and State Route 9, which provides east-west access. See Figure 19.

In addition to Route 30 – a two-lane urban collector road – two local public ways pass through the campus in Grafton: Willard Street and Pine Street. Route 30 is known as Westboro Road as it crosses the site in Grafton and as Nourse Street in Westborough. These public ways join Institute Road to the west, Wesson Street to the south and Glen Street to the east to form the local highway network. Pine Street also now joins with Centech Boulevard to the north, improving north-south access between Routes 20 and 30.

Rail Access

The site is bounded on the north by railroad tracks now owned by the Massachusetts Bay Transportation Authority (MBTA). These tracks provide MBTA commuter and Amtrak passenger service, as well as CSX freight service. The MBTA's purple line commuter station, located 1/4 mile northwest of the campus core (on the north side of the railroad tracks), links the campus to Boston-South Station and Worcester.

Off-Site Traffic

A Traffic Impact and Access Study, prepared as part of the 2006 Amended Grafton Campus Master Plan, established traffic volumes for critical roadways. These are shown in Table 2.5.

Table 2.5: Traffic Volumes

LOCATION	PEAK VEHICLES/HR		VEHICLES/ DAY
	AM	PM	TOTAL
Route 30 West of Willard St.	533	577	5,690
Route 140 North of Waterville Road	1,167	1,189	14,240
Route 122 W of Bridge St	1,559	1,763	20,545
Pine Street N of Route 30	334	228	1,280

The study confirmed that, with some limitations, intersections in the traffic study area operated at satisfactory levels of service.[3]

[3]The "Traffic Impact and Access Study," prepared by Vanasse & Associates, Inc., January 2006, noted the intersection of Route 122 at Bridge Street operated at capacity or under constrained conditions during weekday morning and evening peak periods and recommended, independent of the development proposed in this Master Plan or the 2006 Master Plan, that various improvements be made (or monitoring occur) at this intersection and at Route 30 at Willard Street, Route 30 at Institute Road, Route 30 at Westboro Road, Route 140 at Westboro Road, Route 140 at Route 30 and East Street, and Route 140 at Bridge Street.

Figure 20: Vehicular Circulation

Campus Vehicle Circulation

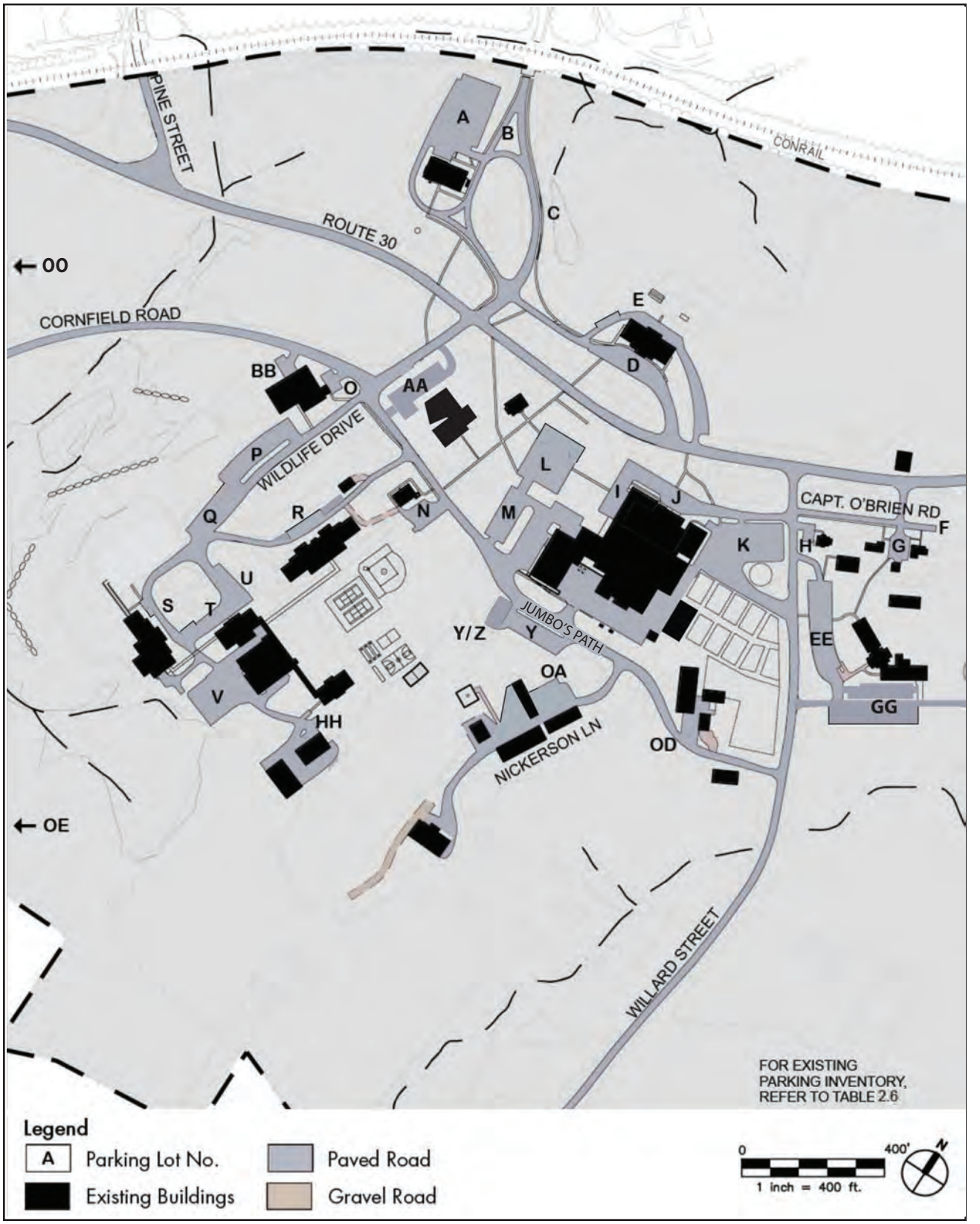
Route 30 is the primary road linking all campus ways. Off Route 30 to the north are two one-way roads that provide access to the Administration Building and its parking and egress plus a two-way entrance road to the Franklin Loew Education Center. Internal education center roads are one-way.

Willard Street and two internal campus roads serve the south campus. The principal internal campus road, called Jumbo's Path, provides two-way east campus access from both Route 30 and Willard Street. Another campus road, called Captain W. O'Brien Road provides access to Willard Street, which provides access to hospital visitor arrival and parking. Wildlife Drive, another two-way internal road, is the major entrance to the research and general education area on the core campus. Wildlife Drive and the entrance road to the Loew Education Center form a four-way intersection with Route 30.

Jumbo's Path runs from Willard Street to another campus road, Cornfield Road, which continues to the school's Axtell Brook agriculture operations. These roads provide access to a majority of the parking lots and building service areas. Lower Valley Road also provides access to facilities east of Willard Street and unnamed gravel ways to the vale west of the core campus.

The portion of Discovery Drive located in the Science Park's Phase I was completed in 2006 and subsequently accepted as a public way. It also intersects with Cornfield Road to create access to the Science Park-Phase I from both Route 30 and the campus.

Figure 21: Parking – Core Campus



Parking

Current parking areas provide capacity for 883 cars. The majority of the parking supply (854 spaces) serves the core campus. Lots are located adjacent to all major buildings including the Loew Education Center, hospital, administration building, cafeteria, and research buildings. Large lots also border the east and west lawns. The present supply of parking meets Zoning Bylaw requirements.

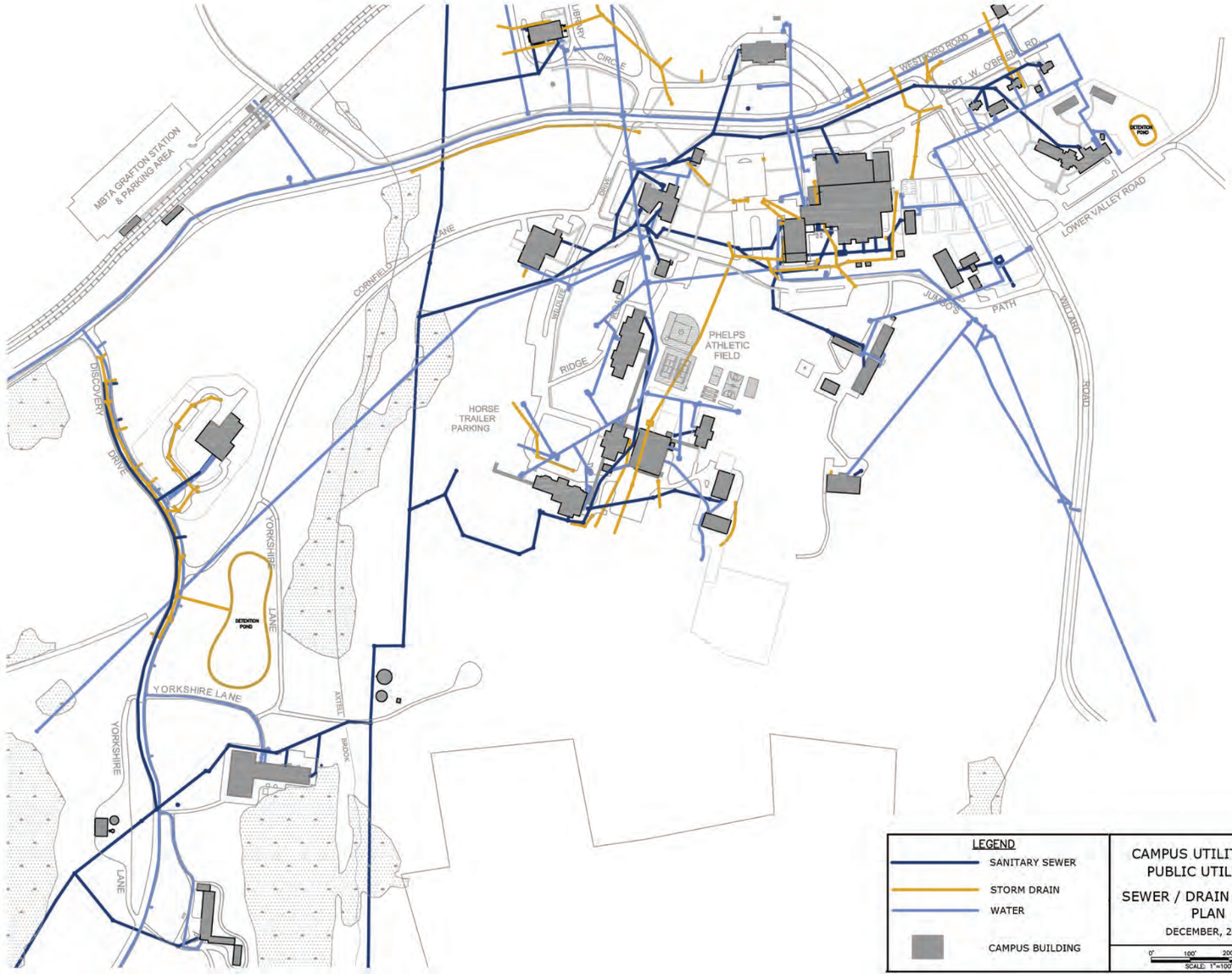
Table 2.6 identifies the existing parking space inventory. The table also provides keys to the accompanying maps of Vehicular Circulation and Parking on the core campus (Figures 20 and 21).

Table 2.6: Existing Parking

Map Key	Lot Location	No. of Spaces
NORTH OF ROUTE 30		**227**
A	Loew Education Center	90
B	West Commons	4
C	West Commons	51
D	Administration	38
E	Administration	44
EAST OF WILLARD STREET		**164**
F	Development (Advancement) Office	3
G	Development (Advancement) Office	13
H	Fraternity	4
EE	Wildlife Center	55
GG	South Wildlife Center	74
--	Wildlife Center Driveway (reserve)	3
--	On Capt. O'Brien Driveway (reserve)	12
HOSPITAL ACCESS DRIVE		**72**
J	Entrance	33
K	East Lot	39
CAMPUS LAWNS		**236**
L	East Lawn	54
M	East Lawn: Varis Campus Center	58
N	East Lawn	7
O/BB	West Lawn: McGrath	9
P	West Lawn	42
Q	West Lawn	20
R	West Lawn	26
AA	West Lawn: Varis Campus Center	20
SOUTH QUADRANGLE		**86**
S	Building 20	8
T	Building 21	7
U	Building 21	19
V	Peabody Research	46
X/HH	Animal Barns Area	6
ACADEMIC CORE*		**69**
Y	South Large Animal Hospital*	31
Z	South Large Animal Hospital*	14
OA	Herdsman	20
OD	Teaching Barn	4
OUTLYING CAMPUS		**29**
OE	Swine 2	8
OO	NE-RBL	19
--	NE-RBLGenerator area (reserve)	2
TOTAL EXISTING PARKING		**883**

*now Includes lots formerly adjacent to old cafeteria

Figure 22: Public Utilities



UTILITIES
Public Utilities: Sewer and Water

Sewer

An internal system of sanitary sewer lines serves the existing facilities on the campus. Over the years, these lines have been upgraded as necessary and have the capacity to accept the modest additional growth to the core campus.

The internal system connects to a 15-18" sewer trunk line (the Axtell Brook Interceptor) that traverses the campus in a north/south direction approximately parallel to Axtell brook. The capacity (instantaneous flow maximum) of this line is estimated at 1,800,000 gallons per day (GPD). The approximate current average daily wastewater discharge from TCSVM is about 29,800 GPD.

The main upgradient sources of wastewater to the interceptor from offsite are CenTech Park and the Job Corps. Average daily flows from the Job Corps are approximately 32,000 GPD. The estimated wastewater generation at full build out of CenTech Park is 640,000 GPD.

Based on these estimated flows, the available sewer capacity in the interceptor is approximately 699,500 (based on average daily flows).

The Axtell Brook Interceptor is eventually tributary to the Grafton Wastewater Treatment Plant. The plant is currently permitted for 2.4 MGD, with average daily flows of 1.9 MGD. Remaining capacity under the current permit is .5 MGD.[4]

Water

Water service to the entire campus, including the Science Park, is provided via a 10" main in Westboro Road (Route 30). This main has been upgraded and re-lined from Pine Street to 86 Westboro Road.

As part of the Science Park development, a new 12" main was constructed in Discovery Drive. This main extends the full length of the roadway (Phases I and II) and extends to the adjacent DCAM property to the west. It connects to the DCAM system approximately 300 feet east of Institute Road. While the water supply and fire flow were improved by the Town's installation of a new main between Institute Road and Snow Road in 2005, the need for an 8" water main loop – from Westboro Road at Willard Street to connect to the main terminating at the Willard Clock Museum – has been identified to improve water quality, fire flows and reliability to the Core Campus.

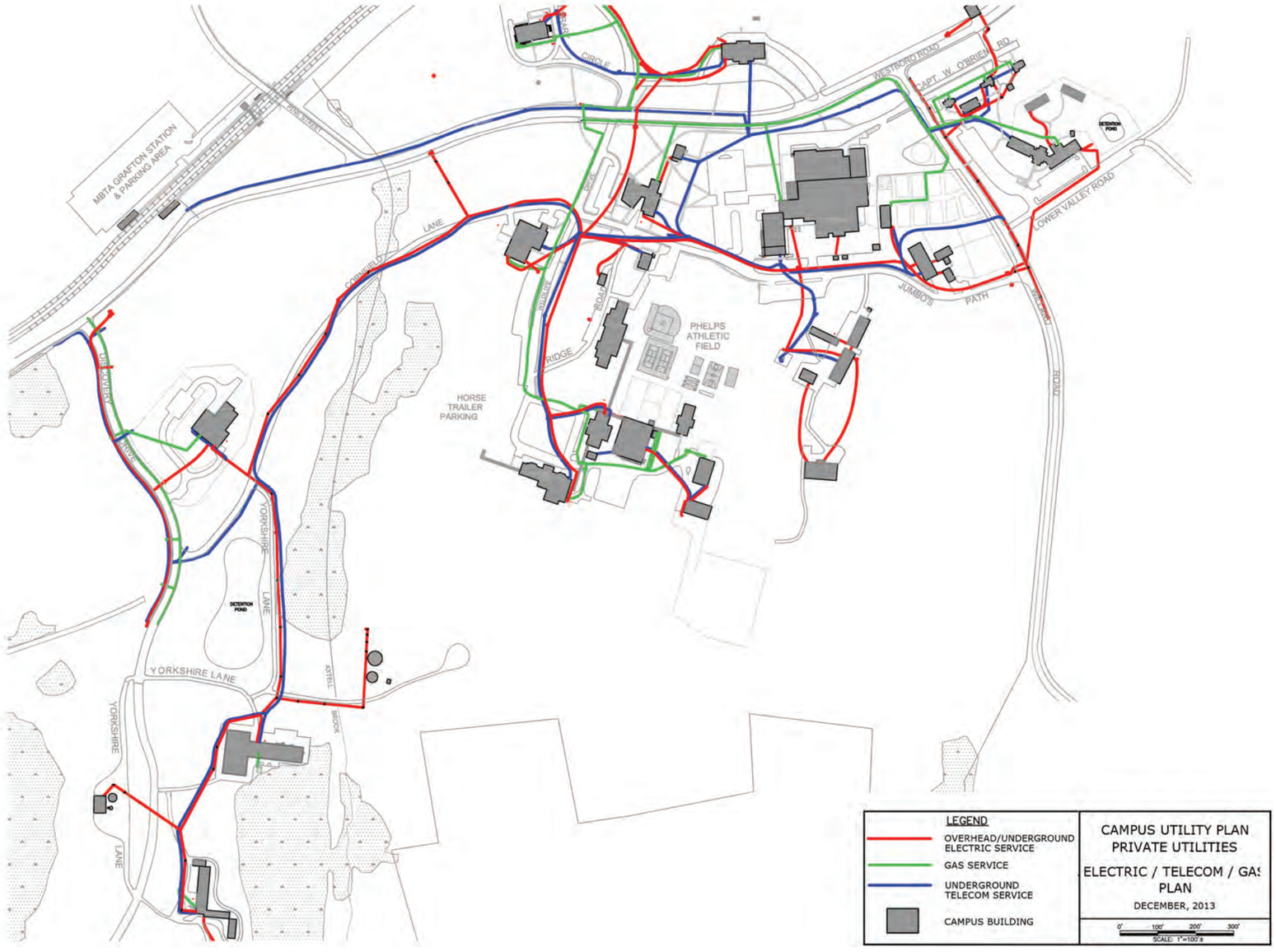
Water supply in the Grafton Water District system is not nearing capacity. The maximum permitted capacity in the system is 3.2 MGD. The average daily demand is 1.2 MGD. The maximum single day demand in 2012 was 1.850 MGD.[5]

Figure 22 locates the water and sewer distribution systems, along with the campus storm drain system.

[4]Email communication with Paul Cournoyer, WWTP Superintendent, 10/1/2013.

[5]Email communication with Matthew Pearson, Grafton Water District Manager, 10/2/2013.

Figure 23: Private Utilities



Private Utilities: Power and Telecommunications

Power

The campus is currently served by a 13.8 Kilovolt (kV) system from Willard Street. The NE-RBL is also connected to a 13.8 kV back-up system from Route 30. National Grid (NGrid) delivers both as primary metered services. The school owns all its service transformers and primary distribution beyond the demarcation points where services are metered by NGrid. The existing Willard Street 13.8 kV line serves all of the campus. On the Core Campus, the system is entirely underground, switching to an overhead system at Cornfield Lane on its way to the NE-RBL and Swine Units.

New development in the Core Campus would be served by an extension of the existing 13.8 kV underground system. The NE-RBL is served by both an overhead extension of the existing 13.8 kV system and, as a second power supply, by the 13.8 kV system from Route 30 that runs underground in conduit along Discovery Drive. The NE-RBL normally operates with half of the building on Route 30 power and half on Willard St power. Any other major development on the western portion of the campus likely will be served by the separate underground system constructed in Phase I of the Science Park and connected to the Route 30 13.8 kV system.

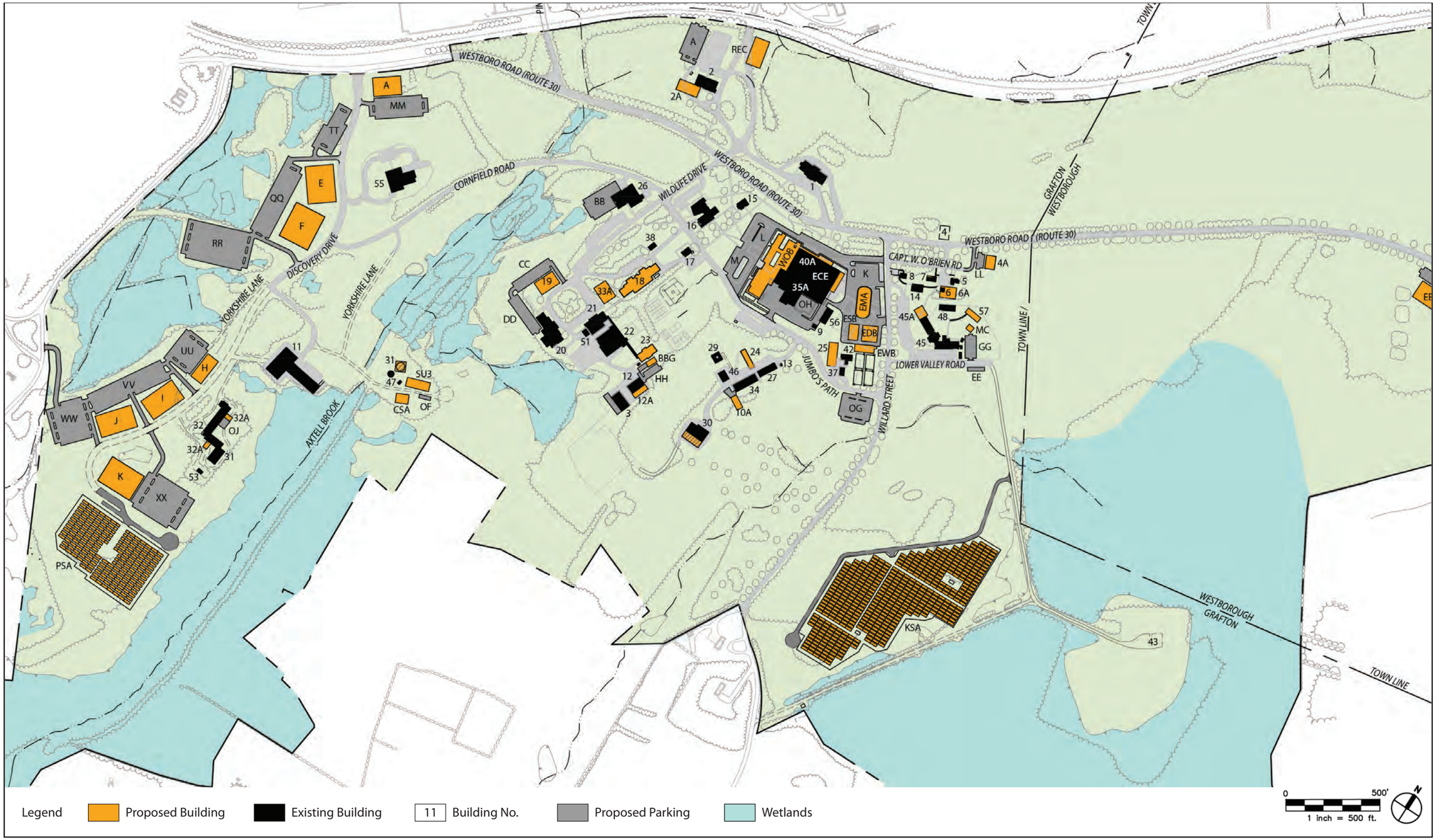
Telecommunications

Telephone service from Verizon and CATV service from Charter Communications are delivered to the Core Campus through underground conduits. A university-owned telecommunications system, also underground, links all the Core Campus buildings. This can be readily extended to any new development in the Core Campus.

Linkage between the Core Campus and Science Park can be made either by overhead lines on the existing poles on Cornfield Lane or by linking directly from the underground conduit in Discovery Drive to existing Verizon telecommunications lines in Route 30.

Figure 23 locates these private utilities as well the NStar's natural gas distribution system on campus.

Figure 24: Illustrative Master Plan



SECTION THREE: THE DEVELOPMENT PLAN

TCSVM proposes continued growth of its clinical, academic and research facilities and continued development of the Science Park on the school's West Campus. This section specifies proposed development, and describes how the proposed development conforms to the requirements of the Grafton Zoning By-law. The plan respects the school's status as a Massachusetts historic site; proposed layouts and building designs maintain the site's pastoral context. The proposed development is, in most respects, similar in scope and scale to that outlined in the 1998 and 2006 Master Plans. As a result, utility and traffic impacts of the proposed development and potential costs, revenues and benefits to the Town of Grafton are anticipated to be consistent with those described in detail in the 2006 Master Plan.

THE VETERINARY SCHOOL AND CLINICAL FACILITIES

Since 1998, TCSVM has constructed 129,398 square feet of facilities and removed eight support buildings totaling 39,070 square feet. The David McGrath Veterinary Teaching Laboratory, the Bernice Barbour Wildlife Medicine Building, a significant expansion and renovation to the Swine II facility, the Agnes Varis Campus Center, and the NE-RBL were completed, along with three hospital expansions, including a Magnetic Resonance Imaging (MRI) addition and the Large Animal Isolation Facility. Several animal housing facilities were also completed.

Projects with near term priority now include the Avian Rehabilitation Cage, two sites on which commercially-owned photovoltaic solar arrays will be constructed, and phased expansion and renovation of the Foster Hospital for Small Animals, comprised initially of a small animal hospital lobby renovation and addition.

Later phases of the veterinary hospital complex expansion under consideration include a small animal hospital west office wing addition; radiology, surgery and ward expansions; and an east clinical oncology service expansion. Equine functions now housed in the large animal hospital would be located in four separate new facilities as another component of the veterinary hospital complex expansion, renovation and re-purposing. Other future projects under consideration include expansion to the Center for Animals and expansion of the Swine I facility.

Projects that are planned for the long term development of the campus include relocation and reuse of goat housing for a laboratory; a Simulation Center and spay lab expansion into hospital basement space; a mid-size lecture hall, conference rooms and offices added to the existing Franklin M. Loew Veterinary Medical Education Center; and an addition to the Barbour building. Relocation of the basement wet lab to one of the goat barns is also contemplated.

This Master Plan also identifies a series of more speculative building projects, the construction of which will depend on future need, and, as yet, unplanned fund-raising. We include these in this Master Plan to illustrate the kinds of buildings that may be built in the future. Potential projects in this category include relocation and repurposing of the Locust Barn; additional animal housing; renovation or demolition/reconstruction of the one remaining vacant brick building, 18, and reconstruction of Building 19 that was razed in 2012 for research/general education; construction of a new research/general education building on the south research quadrangle; construction of a recreation facility for use by the campus community; relocation of the buildings and grounds operation; and a new storage building for buildings and grounds.

The school also proposes to construct an equine exercise training center in either Westborough or Grafton within the east campus Valley Farm Area.

All planned school development, with the exception of the solar arrays, equine training center, some animal housing, and the storage building will occur on the current core campus. The intent is to enhance existing major spaces and improve the spatial qualities of an already effective and pleasant campus. For example, the recreation facility proposed to be built north of

Route 30 will complete a campus green east of the existing Loew building. The proposed re-construction of Building 19 and construction of a second research/ general education building will complete the existing south quadrangle. The new swine unit will be contiguous with the current swine units on the west campus.

Three facilities proposed in earlier master plans - the Progressive Swine Barn on the east campus, Large Animal Shelter to replace the razed Bull Barn and Telecommunications Backup Building - are no longer programmatically required and have been removed from the list of the proposed projects in this Master Plan.

Potential Site: Solar Array on East Campus Knoll

The Program

Each DVM class at the veterinary school has an enrollment of 90 to 100 students and the course of study for each class is four years. Currently, all classes are taught on the Grafton campus, including classes for combined degree candidates and masters' program candidates.

The most critical and immediate challenge for the Cummings School is to redesign, renovate and appropriately size its 1980s vintage small and large animal teaching hospitals to deliver 21st century clinical care and leading-edge, quality clinical learning environments. Improvements are necessary because of expansion in the DVM class size in recent years; the increasingly competitive environment for the best students, faculty and clinical referrals; and the need to provide clinicians with operationally efficient and effective space for translational and other types of collaborative research opportunities.

The proposed veterinary school development program is outlined in Table 3.1 and depicted on Figures 24 and 25. Notes accompanying each project listed explain the rationale for each of the proposed facilities.

Figure 25: Proposed Development – Veterinary School Core Campus

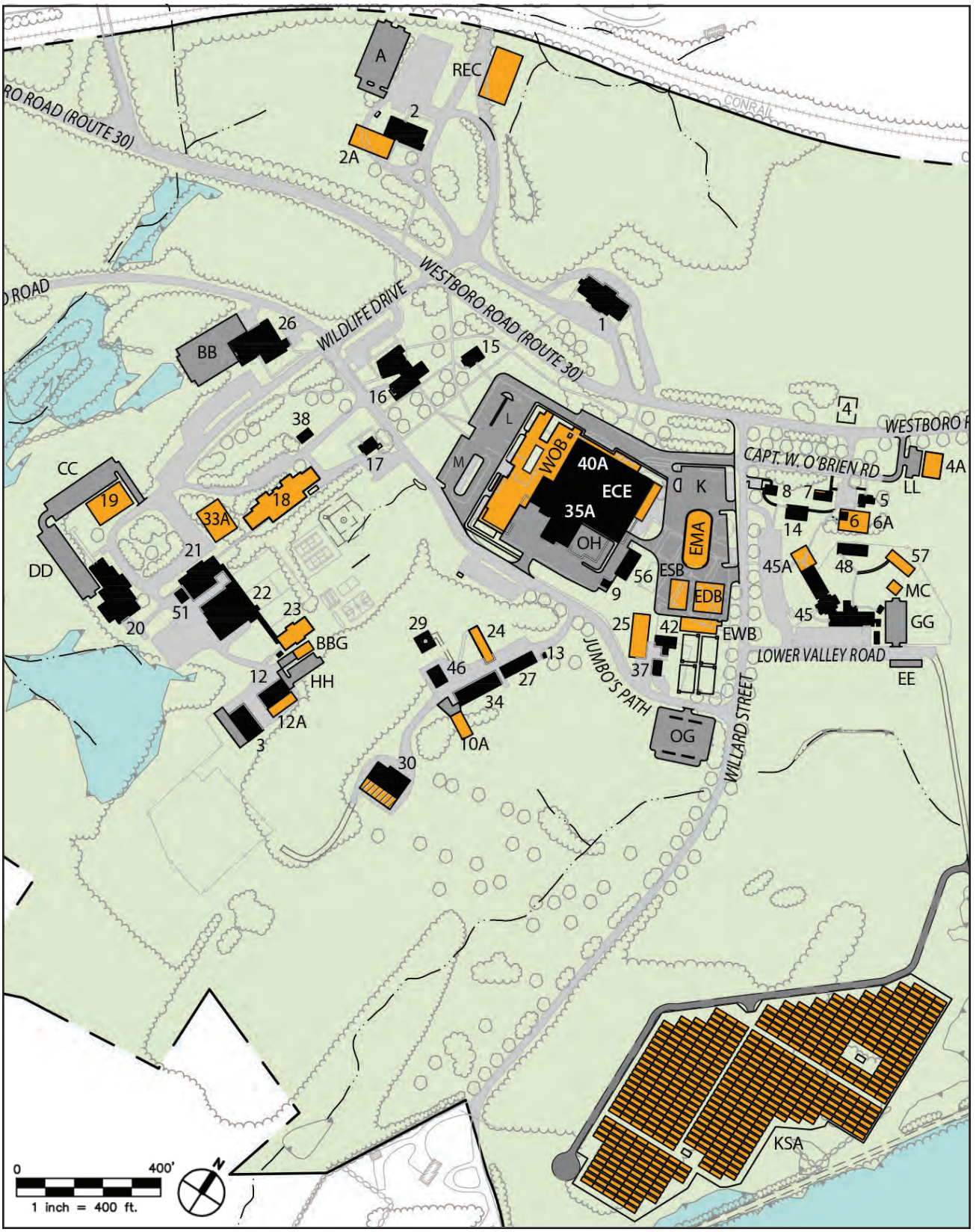


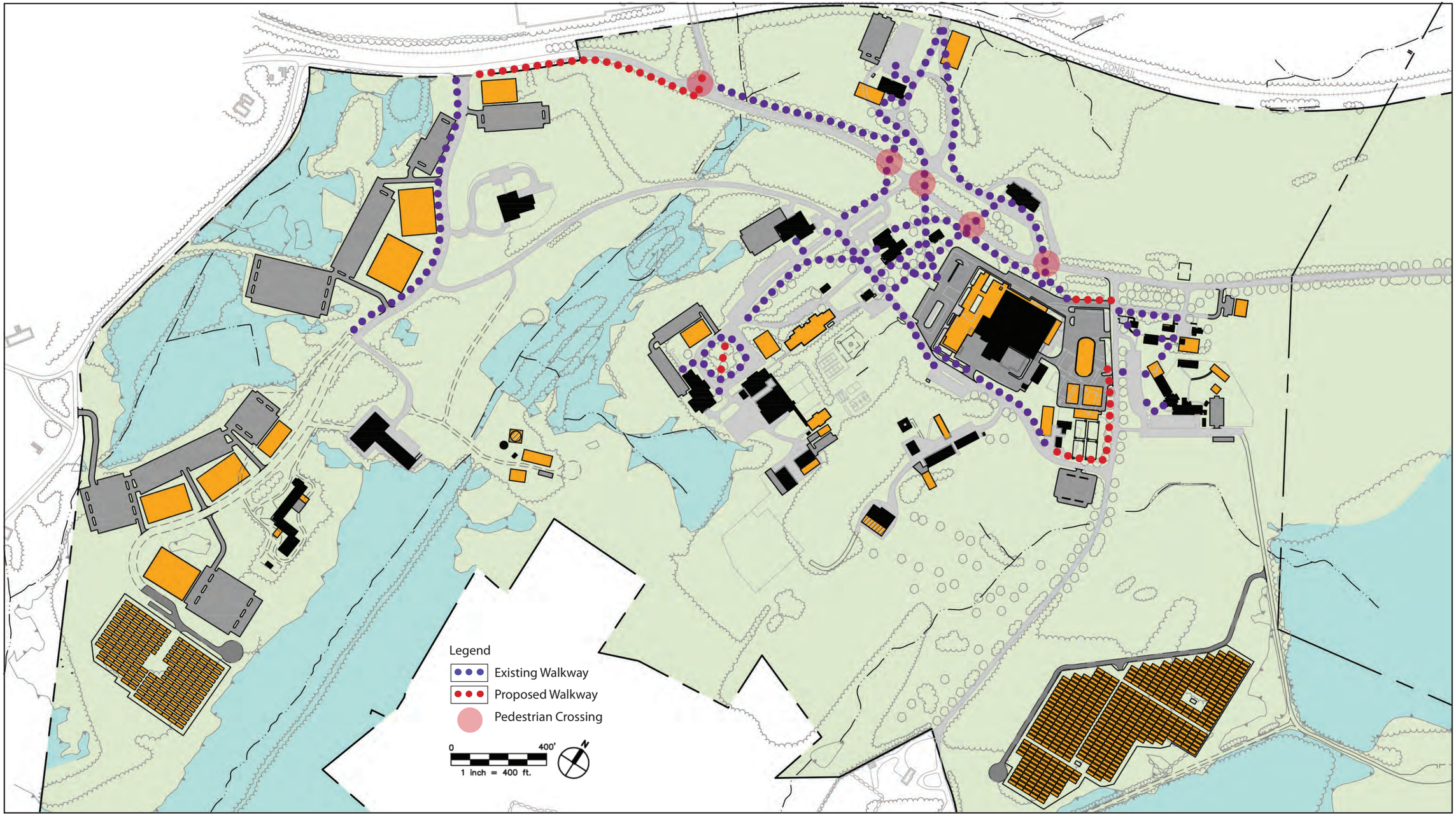
Table 3.1: Veterinary School Campus Program

Bldg Key	Program & Building	GSF Completed through 2013 and Proposed through 2020	GSF Completed 1998 to 2006	GSF Completed 2007 to 2013	Year Completed	Renovated	Explanded	New Construction	Demo	Development Accomodation
	ACADEMIC	**17,400**								
2A	Library Renovation or Expansion	7,000					7,000			Medium lecture hall for 30-50 seats; offices, conference rooms, classrooms
6A	Center for Animals	5,000						5,000		Tear down Bldg 6 / Build new in same location
45A	Barbour Building Addition	3,000					3,000			Office space
12A	Goat Barn Renovation and Expansion	2,400				4,388	2,400			Renovation of existing 4,833 SF and expansion for relocation of HLA basement wet lab
	HOSPITAL	**66,200**								
40A	Small Animal Lobby Addition/Renovation	2,336						2,336		
WOB	Small Animal West Office Addition/Surgery & Ward Expansions	29,993						29,993		
ECE	Small Animal East Clinical/Oncology Expansions	3,518						3,518		
EDB	Equne Diagnostic Building	6,970						6,970		
ESB	Equine Surgical Building	4,420						4,420		
EWB	Equine Ward Building	4,400						4,400		
EMA	Equine Sports Medicine Arena	11,250						11,250		
35A	Large Animal Hospital Partial Demo	-7,330							-7,330	
40	MRI Suite	2,128		2,128	2007		2,128			Addition for diagnostic equipment
56	Large Animal Isolation Facilty	3,432		3,432	2009		3,432			Equine isolation
40	Hospital Expansion	5,083	5,083		2002					Expansion to Small Animal Hospital.
	ANIMALS	**31,994**								Housing of expanding animal population.
3	Goat Reproduction Center							*		Add paving at rear about 3500 SF
13	Sheep Equipment Storage	153	153		2000			153		Added storage building
30	Beef/Cattle Barn Addition	538	538		2001					Addition to existing animal housing
30A	Beef/Cattle Barn Canopy Addition	4,000						4,000		Add additional 4,000 gsf canopy in rear in 2013 MP
42	Equine Housing	432	432		2000					Addition to existing animal housing
46	Large Animal Housing Unit	2,136	2,136		2001					
11	Swine Unit 2 Expansion @ Bldg. 11	13,815		13,815	2007	9,000	13,815			Renovation of existing and approximately 14,000 SF addition for MGH research
27	Sheep Barn New Facility	3,000		3,000	2013			3,000		Replacement of existing barn
24	Poultry Barn	-				2,898				Partial use as frozen meats storage; include possible future demo/remodel
25	Equine Reproduction - Mare	-				3,100				Renovation for partial use as farrier function
32A	Swine I Farrowing Addition(s)	1,920					1,920			Add two 960 SF wings if swine sales increase
SU3	Swine Unit 3	6,000						6,000		
	SPECIAL PROJECTS	**40,996**								
45	Wildlife Clinic	11,200	11,200		2001			11,200		
48	Eagle Flight Cage	3,591	3,591		2002			3,591		SF total includes 2 small cages and shed, along with large cage
10A	Hay Barn	2,520						2,520		2,520 GSF proposed in 2013 MP in former 10A location
31A	Sewer Tank Cover	3,025								Add 55' by 55' roof covering for winter manure storage in 2013 MP
53	Feed Storage	540	540		2006			540		
EEF	Equine Exercise Facility	16,000						16,000		In Westboro (Includes Outdoor Ring); may be relocated to Grafton
57	Birds of Prey Flight/Avian Rehabilitation Cage	3,120						3,120		Permitted in 2013 (but not yet built), increased from 1,500 SF
MC	Mammals Cage	1,000						1,000		
	RESEARCH/GENERAL EDUCATION	**117,132**								**Complete 'Research Quadrangle'.**
18	Building 18 Renovation	39,070				39,070				
19	Building 19 New Construction	12,900						12,900		
26	McGrath Lab Building and 2nd floor addition	13,339	12,610	729	2000 & 2013	12,610	729			Second floor mechanical room added in 2013
51	Building 28 Office Module Replacement	752	752		2006			752		Modular office space
33A	New Research Quad Building	12,000						12,000		
55	New England Regional Biosafety Laboratory	39,071		39,071	2009			39,071		Located at Grafton Science Park
	STUDENT LIFE	**24,862**								
8	Alpha Psi Addition	125	125		2002		125			Wheelchair access added ADA compliance in 2002; repurposing for offices/international faculty extended stay housing

Table 3.1: Veterinary School Campus Program (continued)

Bldg Key	Program & Building	GSF Completed through 2013 and Proposed through 2020	GSF Completed 1998 to 2006	GSF Completed 2007 to 2013	Year Completed	Renovated	Explanded	New Construction	Demo	Development Accomodation
	STUDENT LIFE *continued*									
16	Agnes Varis Campus Center Renovation and Additon	24,737		24,737	2008-2009	15,750	8,987			Campus Center, Auditorium, Café and Faculty Offices
	RECREATION	**21,678**								
4A	Relocate Locust Barn/Visitor Center	3,678				3,678				Existing barn relocation and renovation; with extension of Capt. O'Brien Road
REC	Recreation Facility	18,000						18,000		Gym/health club for campus community
	BUILDING & GROUNDS	**13,010**								
23	Building 23 Renovation	8,010				8,010				Uses: offices, shops, storage.
BBG	Building and Grounds Garage	1,600						1,600		
CSA	Unheated Storage Building	3,400						3,400		Storage based on anticipated need
	ADMINISTRATION	**2,994**								**Administration expansion.**
14	Clinical Faculty Office Building	2,013	2,013		2001					
7A	Development Porch Rebuild	200						200		Rebuild porch (additional 100 sf) in 2013 MP for 2 additional offices
15	Administrative Services Porch /Ramp Addition	781	781		2006		781			New porch and ramp for ADA compliance
	SUPPORT FACILITIES	**2,532**								
PSA	Grafton Science Park Solar Array									5.1 acres+
KSA	Knoll Solar Array									10.5 acres+
45SR	Wildlife Cage Storage	416	416		2002			416		
45SS1	Wildlife Equipment Storage	160	160		2005			160		
45SS2	Wildlife Equipment Storage	160		160	2013			160		
45SS3	Wildlife Equipment Storage	160		160	2013			160		
47	Sewer Pump House	206	206		2000	206				
49	Hospital Waste Storage	96	96		2002			96		
50	Hospital Feed Storage	208	208		2002			208		
7SR	Advancement Records Storage	80		80	2013			80		
41A	Dining Service Storage	96	96		2002			96		
40SS	FHSA Storage Shed	160	160		2001			160		
18SR	TFS Equipment Storage	630		630	2012			630		
23SS	Universal Waste Accumulation Shed	160		160	2013					
	DEMOLITION	**-42,918**								
6	Building and Grounds Equipment Storage Demoliton	-400							-400	
10	Grain Storage	-2,520							-2,520	Relocation of 3,300 GSF (including #39)
26	Teaching Barn Demolition	-3,000	-3,000		2002				-3,000	
28	Lab Module Demolition	-450	-450		2002				-450	
29	Bull Barn Demolition	-900	-900		2006				-900	
33	Residence Demolition	-2,370	-2,370		2003				-2,370	
36	Horse Shelter Demolition	-1,150	-1,150		2003				-1,150	
39	Corn Bin Demolition	-828							-828	Demolition proposed after new feed storage (10A) completed
7	Advancement Building Porch Demoliiton	-100							-100	Demolition proposed
19	Building 19 Demolition	-25,800		-25,800	2012				-25,800	Demo'd due to roof collapse
27	Sheep Barn Demolition	-3,000		-3,000	2012				-3,000	
41	Dining Facilty Demolition	-2,400		-2,400	2009				-2,400	
	OTHER INTERIOR RENOVATIONS									
35	Hibernaculum	NA								
35	Simulation Center	NA								
35	Spay Clinic Expansion	NA								
8	Alpha Psi	NA								
34	Poultry Barn	NA								
	GRAND TOTAL	**295,880**	**41,296**			**98,710**	**44,317**	**209,100**	**-50,248**	
	GRAFTON DEVELOPMENT	240,809	41,296	88,102						Does not include the Equine Exercise Facility proposed for East Campus in Westboro
	Total Grafton Development to Date			129,398						
	Total Grafton Demolition to Date			-39,070						
	Net Development to Date			90,328						

Figure 26: Landscape Areas and Pedestrian Circulation – Core Campus



The Plan

Core Campus Plan

Additional pedestrian circulation improvements will join the new school facilities to existing hospital and academic buildings, support functions and new parking lots. Formal planting on part of the east side of the space is proposed to infill and complement the existing mature trees framing a majority of the lawn.

Development of the Veterinary School Core Campus will occur in four areas defined by the predominant landscapes: east lawn, west lawn, school green and agricultural areas. Figure 26 illustrates major landscaped areas and pedestrian circulation.

East Lawn and Paddock Areas

The east lawn, from the Administration Building to the stand of trees at the Peabody Pavilion, will be the primary campus open space with phased renovation and expansion of the combined small and large animal hospitals. These improvements will continue the hospital frontage along Route 30, providing, in the near-term, an enhanced small animal hospital entrance lobby and client service area. Over the longer term, small animal specialty clinical areas, office and teaching areas and animal wards will be expanded. The improvements also serve to link the hospitals functionally to the Agnes Varis Campus Center, the main student space, and to the east, permit more operationally efficient, discrete large animal hospital facilities in the current paddock area. Additional details on TCVSM's Hospital Master Plan are provided in Appendix A.

Table 3.2 provides an inventory of proposed east lawn and paddock area improvements.

Table 3.2: East Lawn and Paddock Areas

Bldg Key	Program/Site Improvement	Notes
12A	Goat Barn	3
40A	Small Animal Lobby	3
WOB	Small Animal West Offices /Surgery & Ward	3
ECE	Small Animal East Clinical/Oncology Expansions	3
EDB	Equine Diagnostic Building	1
ESB	Equine Surgical Building	1
EWB	Equine Ward Building	1
EMA	Equine Sports Medicine Arena	1
35A	Large Animal Hospital	4
3	Goat Reproduction Center	5
30A	Beef/Cattle Barn Canopy Addition	1
23	Building 23 Renovation	2
BBG	Building and Grounds Garage	1
24	Poultry Barn	6
25	Equine Reproduction - Mare	6
10A	Hay Barn	1

Key refers to Figure 25
NOTES: TYPES OF IMPROVEMENTS
1 – New construction
2 – Renovation of building not in use
3 – Renovation and addition
4 – Partial demolition
5 – Adjacent paving added
6 – Partial renovation/ use change

West Lawn

West lawn improvements, if they occur, will complete the Research/General Education campus by demolishing or renovating the one remaining unused building, 18, and re-building 19. Use of Building 19, located within the Water Supply Protection District, will be restricted to research offices and other permitted uses. Corporate and academic collaborations in research and development are possible in these buildings as well, particularly Building 18.

Office/General Education uses are also proposed in a new building on the north side of the quadrangle, 33A, which will intensify use of the area and require additional (and relocated parking) in Lots S, T and U.

Walks are proposed to link new west campus parking lots to the greater campus. Planting improvements include formal trees on the western lawn edge adjacent

to the new building 33A and a thinning of the dense tree enclosure physically separating the enclosed research quadrangle from the more open west lawn.

Table 3.3: West Lawn, South Quad and School Green

Bldg Key	Program/Site Improvement	Notes
12A	Goat Barn	3
2A	Library Renovation or Expansion	3
18	Building 18 Renovation	2
19	Building 19 New Construction	1
33A	Research Quad Building	1
BBG	Building and Grounds Garage	1
REC	Recreation Facility	1

Key refers to Figure 25
NOTES: TYPES OF IMPROVEMENTS
1 – New construction
2 – Renovation of building not in use or demolition/rebuild
3 – Renovation and addition

School Green

An expansion of the Loew Library Education Center is proposed, along with a new recreation facility. The potential new recreation facility, north of the education center and school green, frames the open space and complements existing public activities and services at the West Campus entrance. Administration, student and recreation activities will all be located within 500 feet of the school green, the most public campus open space. Table 3.3 lists west lawn and school green improvements.

Agricultural Areas

Two photo-voltaic solar array projects are proposed. The first is located on the knoll – pasture and crop land east of Willard Street – and the second is in Phase II of Grafton Science Park, south of the swine units on the West Campus. Access to these sites will be on existing gravel ways. Table 3.4 shows these improvements.

Table 3.4: Agricultural Areas

Bldg Key	Program/Site Improvement	Notes
PSA	Grafton Science Park Solar Array	1
KSA	Knoll Solar Array	1

Key refers to Figures 24 and 25
NOTES: TYPES OF IMPROVEMENTS
1 New construction

Wildlife Clinic Area

A proposed new avian rehabilitation cage, wildlife clinic addition and mammal cage on the Core Campus east of Willard Street will help define the eastern corner of the campus. Paralleling Route 30 in this area, new offices for the Center for Animals and Public Policy, and expansion of the Advancement building's porch are also planned. Relocating the Locust Barn to the south side of Route 30 is also proposed for farm use, which would allow - with a reconfigured Capt. O'Brien Road - for its increased setback from Route 30.

Outlying Campus Plan

Two major program elements are proposed for the outlying campus. One is an equine training facility, to be located either in Westborough, or in the former Valley Farm area, an area of crop land encircled by wetlands. A new swine unit, farrowing additions to the existing Swine I facility, and an unheated storage building are also proposed in Grafton on the West Campus.

Equine Exercise Facility

An equine exercise and training building is proposed south of Route 30-Nourse Road on crop land in Westborough at the eastern campus bounds. The exercise facility would be located on the most level land; adjacent horse barns and shelters will separate parking and van storage from the site. Mature trees lining Route 30 will be preserved. The alternative

location for this facility is the former Valley Farm area located east of the knoll solar project.

Swine Units

In the western area of the campus, additions to the swine unit housing are proposed: an expansion to Swine Unit 1 and a new Swine Unit 3 located east of the existing Swine Unit 2. This swine unit is sited to provide adequate setback from wetlands north and south of the unit. An unheated storage facility could also be located in this area of campus.

Table 3.5: East Campus

Bldg Key	Program/Site Improvement	Notes
EEF	Equine Exercise Facility	1
45A	Barbour Building Addition	1
6A	Center for Animals	3
4A	Relocate Locust Barn/Visitor Center	2
57	Avian Rehabilitation Cage	1
MC	Mammals Cage	1
7A	Development Porch Rebuild	3

Key refers to Figure 25
NOTES: TYPES OF IMPROVEMENTS
1 – New construction
2 – Renovation of building and change in use
3 – Demolition and rebuild/expand

Table 3.6: West Campus

Bldg Key	Program/Site Improvement	Notes
32A	Swine I Farrowing Addition(s)	1
SU3	Swine Unit 3	1
31A	Sewer Tank Cover	1
CSA	Unheated Storage Building	1

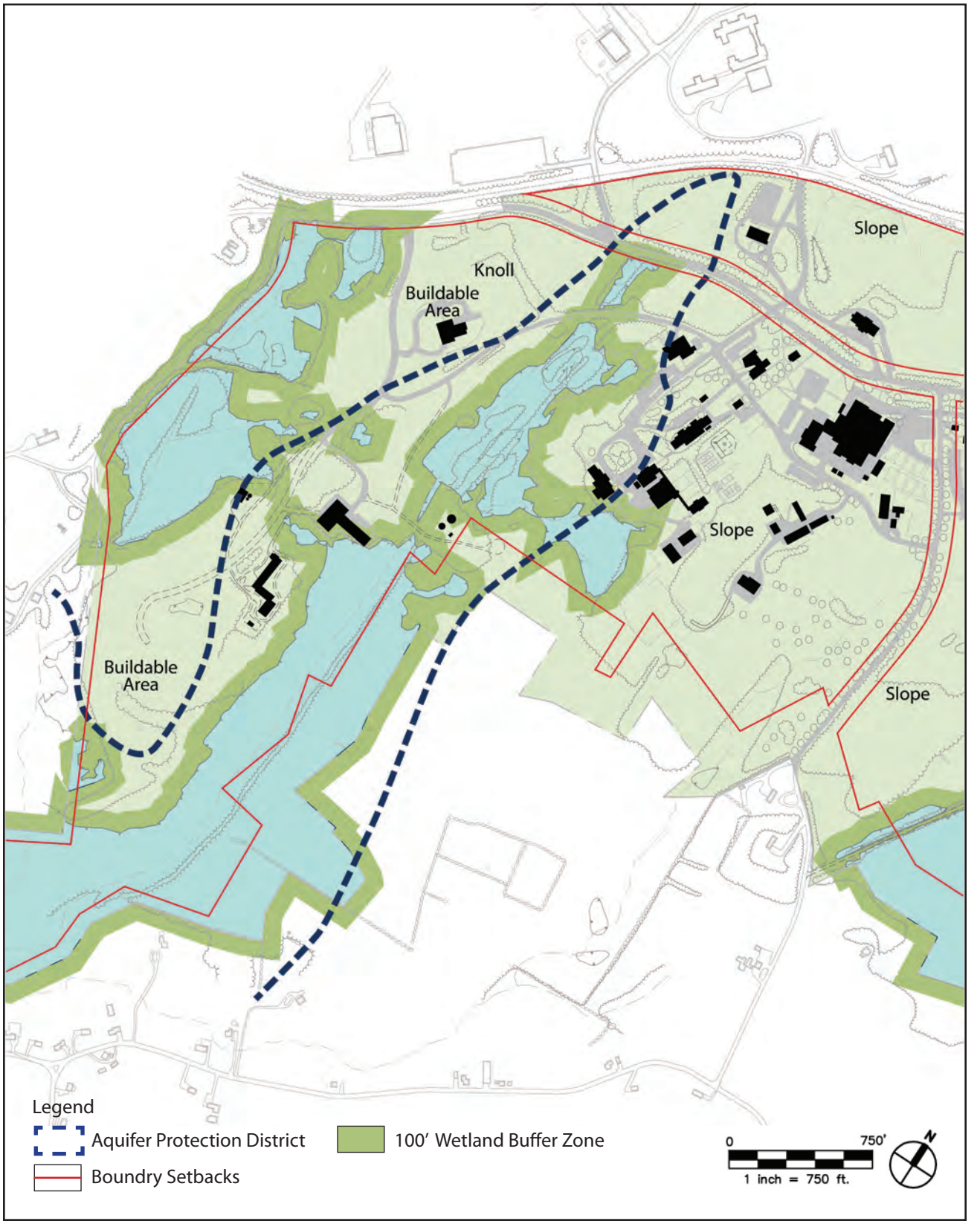
Key refers to Figure 25
NOTES: TYPES OF IMPROVEMENTS
1 – New construction

View to South: Knoll Solar Array Location

View to North from Knoll Solar Array Location

View to Northeast: Locust Barn Current Location

Figure 27: Site Constraints – West and Core Campus



GRAFTON SCIENCE PARK

An important part of the school's mission and that of its faculty is research aimed at curing and preventing animal and human diseases. This research is also essential to the education of the Cummings School's veterinary and graduate students. Traditionally, the federal government sponsors much of this research. But an important part of the school's current research and economic development activity involves collaborative efforts with biotechnology, pharmaceutical, and medical device companies. These companies bring their research, and occasionally, their real estate needs to TCSVM because of Tufts' unique combination of expertise, facilities, and research capabilities.

The desire of health science and high tech companies, including those in the alternative and renewable energy sectors, to have facilities near their university collaborators, as well as the prospects for continuing industry growth in these sectors, led Tufts to plan the Science Park. The proposed development would be located on the western edge of the TCSVM campus, in an area bounded by Route 30 on the north, Axtell Brook on the east, and a state-owned access road on the west. While a specific area has been delineated and approved under a 43D designation, the approximate boundaries within the West Campus on which the Science Park will be developed, as well as the actual time frames for development, may change as demand and market conditions dictate.

The Program

The Science Park will provide office, laboratory, and animal housing areas for biomedical, pharmaceutical, medical device and other high tech companies that have expressed interest in locating on the TCSVM campus. Upon completion, the Science Park could house as much as 662,929 GSF of space devoted to research and development, pilot manufacturing, and other activities related to biotechnology, medical, and pharmaceutical, alternative and renewable energy industries as well as the physical, biological, behavioral and environmental sciences. It may also contain such support uses as offices, food, administrative, and conference facilities as permitted uses by the Campus Development Overlay District zoning.

To maintain market flexibility, only broad space type estimates are provided at this point. This flexibility will allow a specific program to unfold over time in response to a dynamic market.

Development will occur in two phases. Phase I was begun with the NE-RBL that was completed in 2009 and is expected to continue over the next ten-year period, pending market demand for Greenfield, build-to-suit science or high technology facility construction west of I-495. It will total a maximum of 348,000 GSF at build-out. Phase II would be built out over the subsequent ten years and could add another 354,000 GSF. Table 3.7 outlines an updated proposed development program. The various building floorplates shown illustrate different potential building types. Total gross square feet (GSF) for each phase would depend on the market for health sciences and high tech development on the campus over the proposed build-out periods.

Overall Policies

The overriding principle in planning the Science Park has been to create building opportunities that competitively address market needs while maintaining elements of the rural and agricultural characteristics of this part of the campus. This goal is achieved by respecting – and responding to – the environmental restraints of the West Campus.[6]

Hydrological and natural features on the Tufts campus both constrain development and offer important opportunities. Figure 27 illustrates these important site constraints. To protect the natural and environmentally sensitive qualities of this unique site, the development plan for the Science Park reflects the following policies:

- Protection of wetlands by not building within the 100 foot buffer zone wherever possible. If construction is unavoidable in the buffer zone, minimum distance from wetlands is to be held at 50 feet.
- Protection of wetlands by locating all parking areas and other hard surfaces at least 25 feet from wetland boundaries.
- Limiting development within the Water Supply Protection Overlay District to office and other permitted uses.

[6]Figure 31 in Section 4, Impacts and Mitigation, shows the relationship of development to hydrological and historical features.

Figure 28: Proposed Development – West Campus and Grafton Science Park

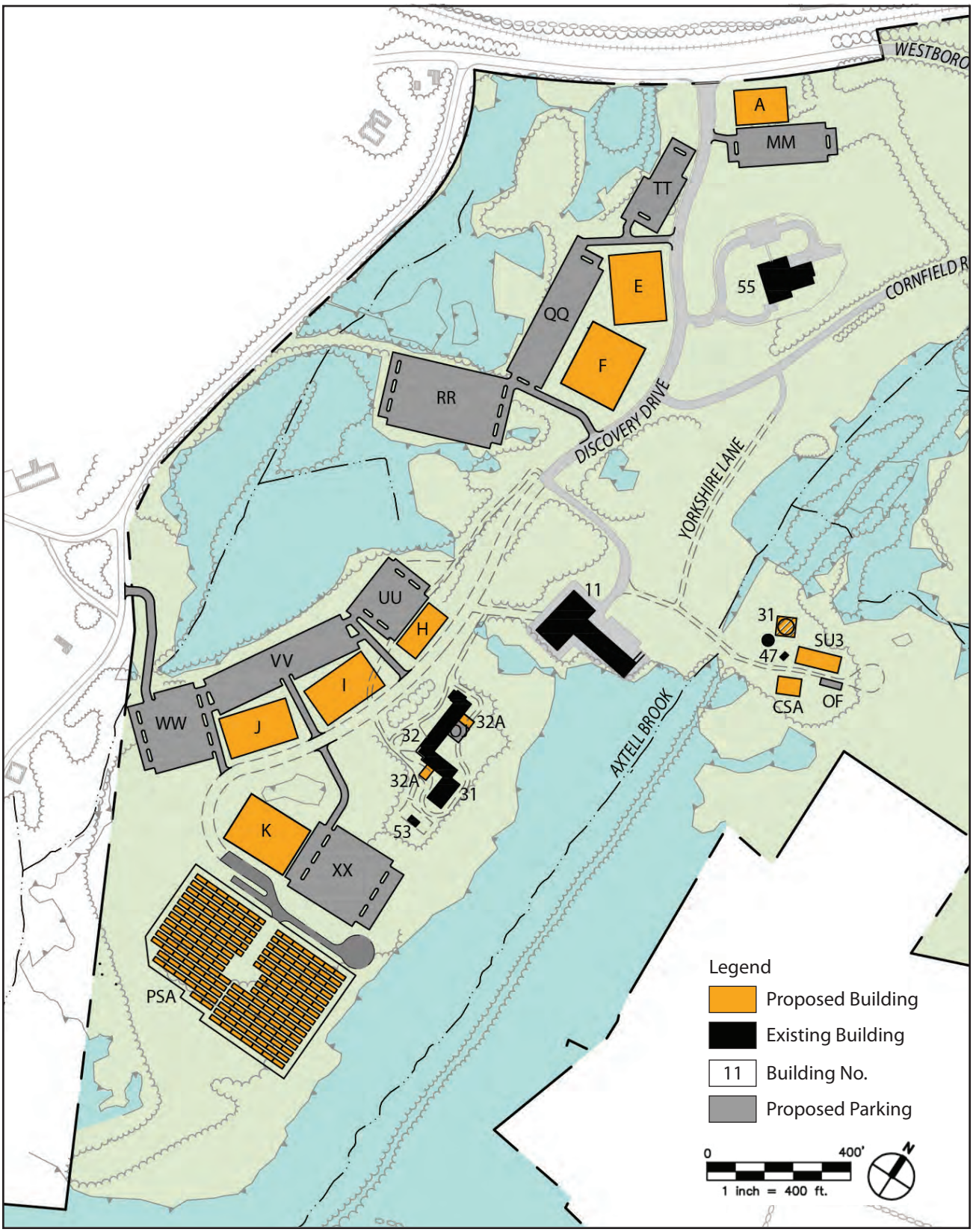


Table 3.7: Grafton Science Park Program

	Notes	Phase & Building Reference	Floorplate Dimensions	Floorplate Area (GSF)	Building Area (GSF)
PHASE I					
	1,3	Building A	150'X100'	15,050	60,200
	1,3	Building E	150'X200'	30,075	120,300
	1,3	Building F	160'X200'	32,107	128,429
	1,3	NE-RBL			39,071
				Subtotal	**348,000**
PHASE II					
	2,3	Building H	150'X70'	10,500	42,000
	2,3	Building I	200'X120'	24,000	96,000
	2,3	Building J	200'X120'	24,000	96,000
	2,3	Building K	200'X150'	30,000	120,000
				Subtotal	**354,000**
				GRAND TOTAL	**702,000**

Notes:
1 – Buildings C,D and G from the 1998 Master Plan were reallocated into A.E, F in 2006.
2 – Buildings L and M from the 1998 and 2006 Master Plan Amendment have been reallocated into I, J and K.
3 – All buildings assumed to contain 4 floors including basement

Phase I

Phase I represents near-term development, to occur, market willing, during the next 10 years. For planning purposes, we show the actual GSF of the NE-RBL and the remaining 308,900 GSF configured in three buildings of 60,200 to over 128,400 GSF each. The Phase I portion of Discovery Drive leads south, approximately following the line of existing meadows and creating a 'village green' that defines this phase of the development. Buildings will line the roadway; most parking lots are located between the buildings and the surrounding forest cover. The knoll to the east, on which the NE-RBL is located, and wetlands to the west define the developable area.

Aerial View of New England Regional Biosafety Laboratory (NE-RBL)

Phase I: View Southeast from Route 30

Phase II

Phase II represents long-term development planning, estimated to occur over the subsequent 10 years. In Phase II, Discovery Drive will be continued south, generally aligned with the existing open cropland areas. A connection would be made between this road and the road system of the state (DCAM) owned land to the west. While state permission has been secured for this connection and an easement survey completed, Tufts has not yet finalized the easement agreement.

Development is restricted to the northwest and southeast of the access road and, as in Phase I, parking is generally located between the buildings and the surrounding forest cover. In the current plan, a 5.1 acre accessory photo-voltaic solar project is also located in Phase II to the south of Swine I.

This arrangement allows the existing Cummings School animal housing and some corn fields to be kept and will present a unique opportunity to develop this phase of the Science Park with an agricultural ambiance. Over the longer term, existing silo storage will be relocated. Because some of the corporate occupants are expected to use the Tufts animal laboratories, housing and other resources, this juxtaposition of uses could also have a practical value.

One building in Phase II - Building H - is within the Water Supply Protection Overlay District thus precluding 'wet laboratory' biomedical uses. Use of this building will be restricted to biomedical office or other permitted uses.

Phase II: View North to Phase I and NE-RBL

TRANSPORTATION

Vehicle Circulation

Core Campus

The primary change to campus ways in the Core Campus will be the upgrades to Lower Valley Road off Willard Street to serve the proposed knoll photo-voltaic solar array and possible equine training center, if it is located in the Valley Farm area.

Potential realignment of hospital parking and access ways to the veterinary hospital complex would also occur as part of the longer-term expansion of the Small Animal Hospital and re-configuration of the Large Animal Hospital.

Grafton Science Park

Discovery Drive in the Science Park currently connects in Phase I to the existing paved internal campus way, Cornfield Road, serving the main campus. This connection allows two means of access for emergency vehicles to Phase I. Discovery Drive was designed to meet the appropriate Grafton subdivision design standards for roadways and, in the future, may include appropriate turning lanes at its junction with Route 30 (as identified in the 2006 Traffic Impact and Access Study). Cornfield Road is proposed to be widened to 24'. STOP signs, as appropriate, will be installed on internal roads. Improvements to Cornfield Road are expected to be completed at build-out of Phase I.

If permitted, Tufts will connect the planned continuation of Discovery Drive to the state-owned road that runs along the western boundary of the campus. This will provide a second means of access for emergency vehicles serving Phase II of the development. The remaining portion of the access road is within the 500' maximum length prescribed for dead-end roads. See Figure 29.

Parking Program

Parking for the development program conforms to the parking ratios required by the Zoning Bylaw. Parking lots are located on the periphery of the main campus quadrangles, preserving these quadrangles as a pedestrian environment. In keeping with this approach, the school may relocate some existing parking, now in the research quad area, to the new peripheral lots.

Expansion of the small animal hospital and reconfiguring large animal hospital spaces may displace parking adjacent to the hospital. This Master Plan locates a new parking lot near the hospital, preserving a majority of paddock for short-term animal use and preserving the visual screen of parking by the paddock fence. Over the longer term, a second parking lot could be located south of Jumbo's Path, also near the hospital complex.

Tables 3.8 and 3.9 on the following pages identify the demand and supply of parking by the veterinary school and the Science Park. Parking lot designations shown in these tables correspond to new lots proposed, which are shown in Figure 29.

Figure 29: Vehicle Circulation and Proposed Parking

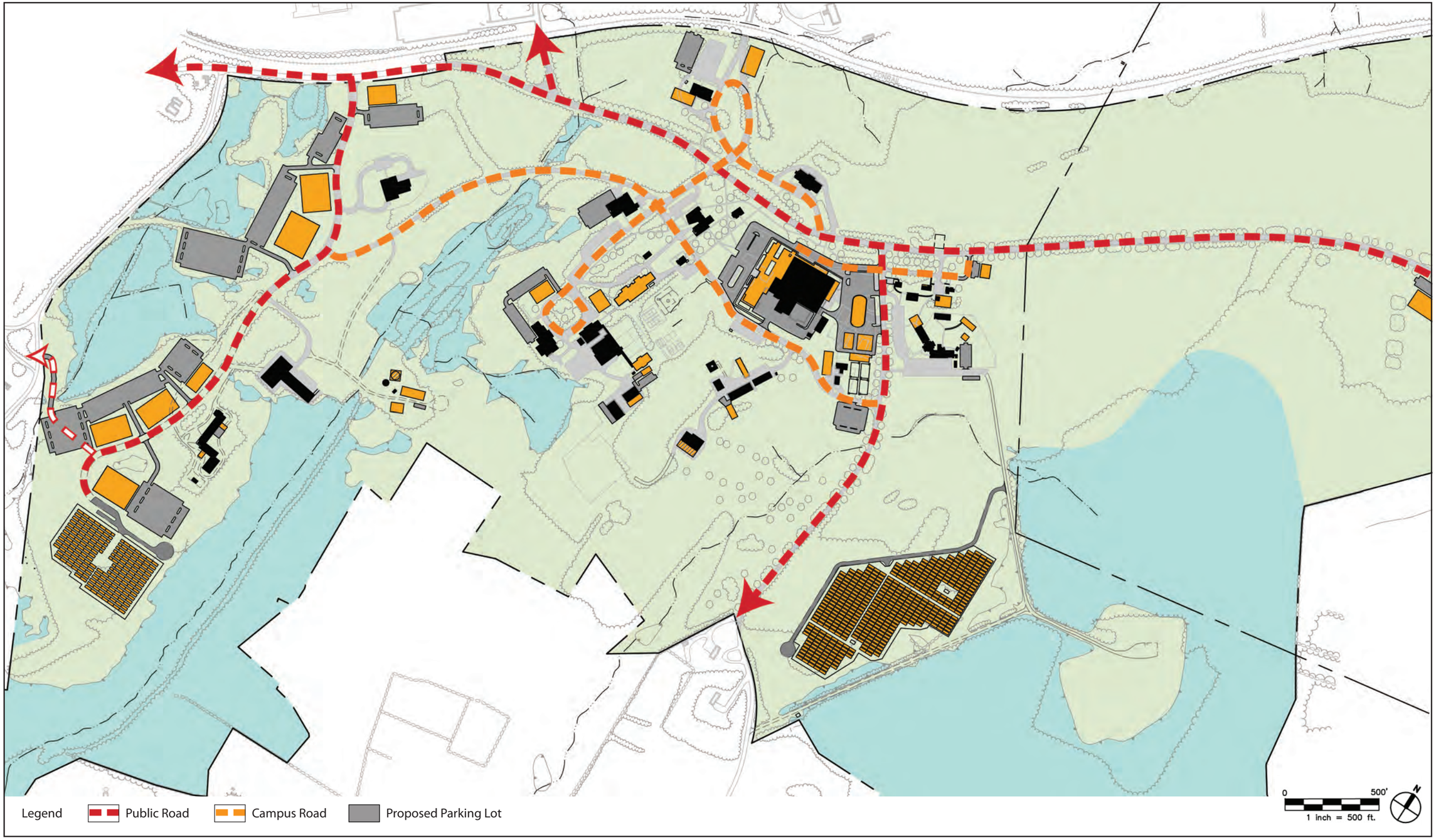


Table 3.8: Parking Supply and Demand – Veterinary School

NOTES	STATUS	BUILDING REFERENCE or LOT	BUILDING	BUILDING AREA (GSF)	NEW PARKING SPACES AS PER CODE	TOTAL REQUIRED PARKING SPACES	LOT	NUMBER OF SPACES	LINEAR FEET @ 8.5 FT/ SPACE
	DEMAND						**SUPPLY**		
	Loss	Lot S				7			
	Loss	Lot T				6			
	Loss	Lot U				19			
	Loss	part Lot K				4			
					Sub-Total	**36**			
1	Need	2A	Educational Center-Loew Library Expansion	7,000	14	14	Lot A expansion	80	680
4	Need	4A	Relocate Locust Barn/Visitor Center	3,678	10	10	Lot LL	10	85
1	Need	6A	Center for Animals	5,000	10	10	Lot EE expansion	10	85
2	Need	10A	Hay Barn	2,520	2	2			
1	Need	12A	Goat Barn II Expansion	2,400	5	5			
1	Need	18	Building 18 Renovation (Potential Educ./Comm. Development)	39,070	78	78	Lot BB	83	705.5
1	Need	19	Building 19 New Construction	12,900	26	26	Lot CC	68	578
1	Need	23	Building 23 Renovation	8,010	16	16	Lot DD	68	578
5	Need	24	Poultry Barn Demo/Remodel	2,898	0	0	Lot HH expansion	16	136
4	Need	25	Equine Reproduction - Mare	6,293	10	10			
		30A	Beef Cattle Barn Canopy Addition	N/A	0	0			
		31A	Sewage Treatment Area Roof Canopy	N/A	0	0			
4	Need	32A	Swine I Farrowing Additions	1,920	2	2	Lot OJ	4	34
1	Need	33A	Research Quad Building	12,000	24	24			
		35A	Large Animal Hospital Partial Demo	-7,330	-14	-14	Lot OG	70	595
3	Need	40A	Small Animal Lobby Addition/Renovation	2,336	5	5			
3	Need	WOB	Small Animal West Office Addition/Surgery & Ward Expansions	29,993	60	60	Lot GG expansion	29	246.5
3	Need	ECE	Small Animal East Clinical/Oncology Expansions	3,518	7	7	Lot OH	39	331.5
3	Need	EDB	Equine Diagnostic Building	6,970	14	14	Lot K expansion	17	144.5
3	Need	ESB	Equine Surgical Building	4,420	9	9			
3	Need	EWB	Equine Ward Building	4,400	9	9			
3	Need	EMA	Equine Sports Medicine Arena	11,250	23	23			
1	Need	45A	Barbour Building Addition	3,000	6	6			
6	Need	SU3	Swine Unit 3	6,000	5	5	Lot OF	5	42.5
5	Need	BBG	Buildings and Grounds Garage	1,600	0	0			
7	Need	EEF	Equine Exercise Facility	16,000	48	48	Lot JJ	48	408
5	Need	REC	Recreation Facilty	18,000	0	0			
		MC	Mammals Cage	1,000	0	0			
		PSA	Grafton Science Park Solar Array	5.1 acres+	0	0			
		KSA	Knoll Solar Array	10.5 acres+	0	0			
4	Need	CSA	Unheated Storage Building	3,400	2	2			
TOTALS					**370**	**406**		**547**	

Notes:

1 – Education/Research Use. Assume code requirement of 2 parking spaces per 1,000 GSF. While education use requires a population-based parking space calculation, for planning purposes, research use parking requirements were used because population projections are uncertain.

2 – Office/Maintenance Facility uses. Parking requirements derived from estimates of staff and visitors.

3 – Hospital/Research use. Assume code requirement of 2 parking spaces per 1,000 GSF. Lot OH would only be constructed if portion of HLA (35A) is demolished.

4 – Based on anticipated demand

5 – No additional parking since facilty would serve existing campus population.

6 – Animal housing facilities. Assume nominal parking of 5 spaces for each building for visitors and staff.

7 – 48 spaces for visitors are shown in Figure 29 as Lot JJ in Westborough, as part of Equine Exercise Ring area; however they may be constructed in Grafton as a Lot OH expansion if the facility is located in Grafton instead.

Table 3.9: Parking Supply and Demand - Grafton Science Park

Notes	Status	Building	Building Area (GSF)	New Parking Spaces as Per Code	Lot	No. of Spaces	LF @ 8.5'/ Space
	DEMAND				**SUPPLY**		
	PHASE I						
1,2	Need	Building A	60,200	120	Lot MM	140	1,190
1,2	Need	Building E	120,300	241	Lot TT	84	714
1,2	Need	Building F	128,429	257	Lot QQ	200	1,700
4		NE-RBL			Lot RR	217	1,845
	Subtotal		308,929	617		641	5,449
	PHASE II						
1,3	Need	Building H	42,000	84	Lot UU	124	1,054
1,3	Need	Building I	96,000	192	Lot VV	200	1,700
1,3	Need	Building J	96,000	192	Lot WW	160	1,360
1,3	Need	Building K	120,000	240	Lot XX	240	2,040
	Subtotal		354,000	708		724	6,154
	TOTALS		**662,929**	**1,325**		**1,365**	

Notes:

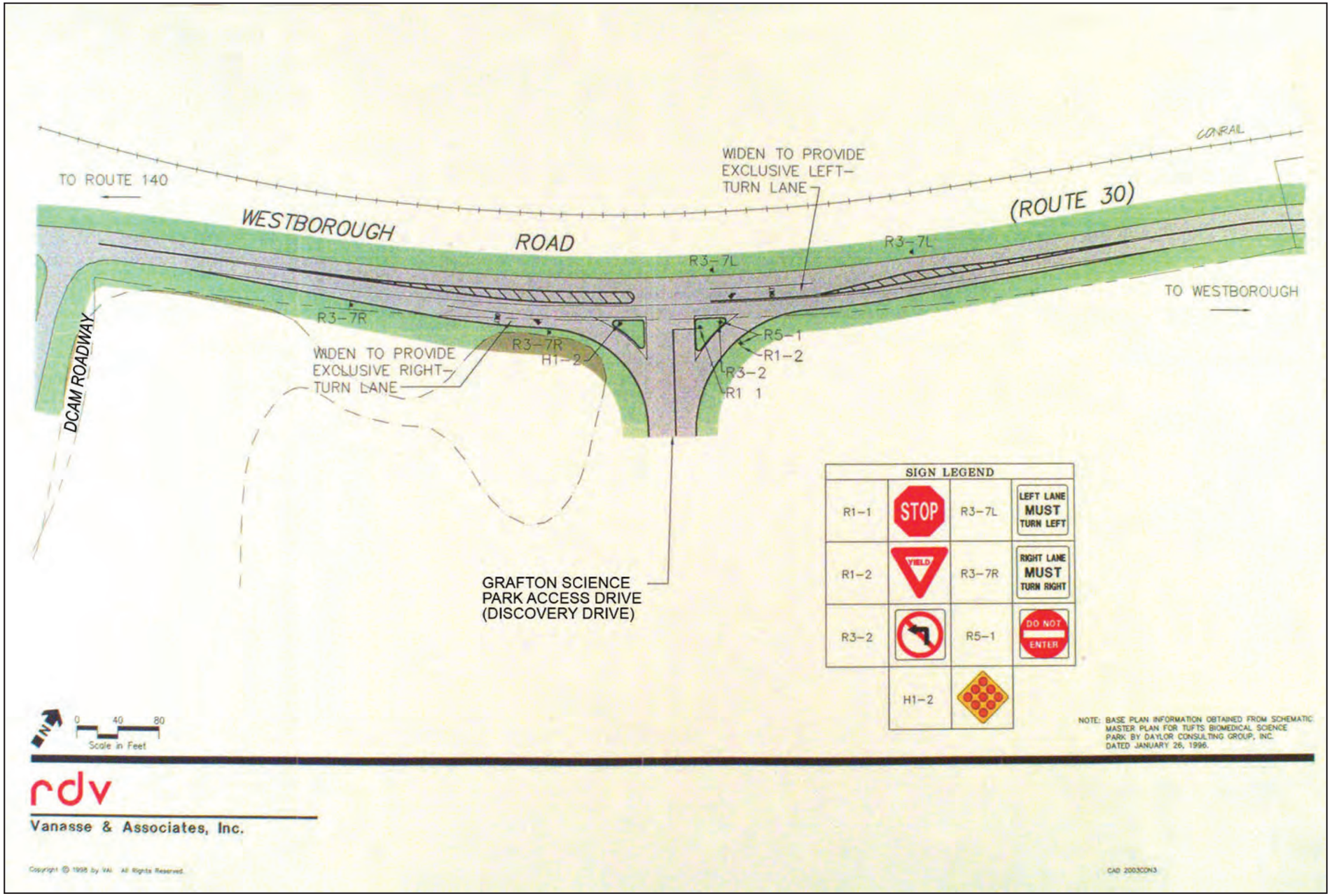
1 – Parking spaces as per code: 2 spaces per 1,000 GSF

2 – Buildings C,D and G from the 1998 Master Plan were reallocated into A.E, F in 2006.

3 – Buildings L and M from the 1998 and 2006 Master Plan Amendment have been reallocated into I, J and K.

4 – The New England Regional Biosafety Laboratory's (NE-RBL) 19 parking space in Lot OO and 2 reserve spaces are included in Table 2.6: Existing Parking Inventory

Figure 30: Park Entrance at Route 30



SECTION FOUR:
DEVELOPMENT IMPACTS AND MITIGATION

TRAFFIC STUDY

Vanasse & Associates, Inc. (VAI) conducted a Traffic Impact and Access Study (TIAS) as part of an update to the 2006 Amended Campus Master Plan. The full TIAS was included as Appendix B of that report; its scope and key findings are summarized below:

Scope and Key Findings

Study Area

The study area assessed in 2006 was consistent with that evaluated in conjunction with the 1998 Master Plan. It included Westboro Road (Route 30), between Willard Street and Route 140, and Route 140, between the Shrewsbury Town Line and Route 122. The study area also included thirteen intersections located along these roadways within the Towns of Grafton and Westborough (see Figure 19).

With some limitations, the study area intersections operated at satisfactory levels of services.[7]

The development program was expected be phased over approximately 20 years, with Phase I[8] commencing in 2006 and ending in 2011. Phase II was anticipated to begin in 2011 and be complete by 2026. In order to assess traffic impacts, traffic volumes in the study area were projected to the years 2011 and 2026, to reflect traffic conditions at the expected completion of each phase of the development program.

[7]The study noted the intersection of Route 122 at Bridge Street operated at capacity or under constrained conditions during weekday morning and evening peak periods and recommended, independent of the development proposed in this and the 2006 Master Plan, that various improvements be made (or monitoring occur) at this intersection and at: Route 30 at Willard Street, Route 30 at Institute Road, Route 30 at Westboro Road, Route 140 at Westboro Road, Route 140 at Route 30 and East Street, and Route 140 at Bridge Street.

[8]This first phase included 348,000 sf of Science Park development and 104,400 sf of academic projects. VAI also assumed 152,390 sf of academic projects would be constructed in the second phase, along with Phase II (356,000 sf) of the Science Park. Between 2006 and 2013, 39,071 sf in the Science Park (the NE-RBL) and 49,031 sf of other academic projects were actually completed.

Traffic Volumes

Phase I was expected to generate approximately 2,994 vehicle trips on an average weekday (1,497 entering and 1,497 exiting), with 434 vehicle trips (356 entering and 78 exiting) during the weekday morning peak hour and 391 vehicle trips (73 entering and 318 exiting) during the weekday evening peak hour.

Phase II of the campus development program was expected to generate approximately 3,488 additional vehicle trips on an average weekday (1,744 entering and 1,744 exiting) over the Phase I development program, with 616 additional vehicle trips (495 entering and 121 exiting) during the weekday morning peak hour and 572 additional vehicle trips (132 entering and 440 exiting) during the weekday evening peak hour.

Trip Distribution and Assignment

The directional distribution of generated trips to and from the campus was consistent with the trip distribution pattern presented in the 1998 Master Plan. In general, 24 percent of project related traffic was assigned to/from the east on Route 30, with 24 percent assigned to/from the west on Route 122; 22 percent to/from the north on Route 140; 12 percent to/from the south on Route 140; 9 percent to/from the south on Snow Road; 5 percent to/from the north on Pine Street; 3 percent to/from the south on Willard Street; and 1 percent to/from the south on Institute Road.

Future Traffic Volumes - Build Condition

The development as envisioned in this and the 2006 Master Plan was shown to result in traffic-volume increases in the vicinity of the campus relative to 2011 No-Build conditions ranging from 2.2 to 26.5 percent, with vehicle increases ranging from 12 to 105 vehicles. Relative to 2026 No-Build conditions, the proposed development was shown to result in traffic-volume increases ranging from 4.3 to 56.8 percent, with vehicle increases ranging from 48 to 252 vehicles.

Traffic Operations Analysis

This analysis indicated that, in general, the proposed development would not result in a significant change in traffic operations or vehicle queuing at the study intersections over anticipated future conditions without the project (No-Build conditions), with significant improvements shown to occur with the implementation of suggested improvements (discussed below). The majority of the movements at the study intersections were shown to operate at a level of service (LOS) D or better during the peak periods under all analysis conditions (Existing, No-Build and Build).

Recommendations

Recommendations for both site access and off-site roadway improvements were identified with the corresponding development phase:

Phase I

Science Park Access

Access to the Science Park will be provided via Discovery Drive, which intersects the south side of Route 30, between Pine Street and the DCAM roadway. Additional access is provided via the internal campus roadway network. It was recommended that Discovery Drive continue to accommodate a single entering travel lane and two exiting travel lanes (separate left and right turn lanes) approaching Route 30, with vehicles exiting onto Route 30 under STOP sign control. Double-yellow centerline pavement markings should be provided along Discovery Drive in order to separate the directions of travel. Any signs or landscaping adjacent to the intersection of Route 30 at Discovery Drive will be designed and maintained so as not to restrict lines of sight to or from the intersection. No additional improvements appear to be required at this location to accommodate Phase I of the campus expansion.

It should be noted that the intersection of Route 30 at Discovery Drive has been constructed with the necessary traffic signal conduit and pull boxes to

accommodate the potential future installation of a traffic control signal, if and when warranted.

Internal Roadway Connection

An internal connection between the science park and the main campus has been incorporated into the Master Plan, which will reduce overall traffic impacts on Route 30. The roadway will be a minimum of 24 feet wide, with STOP-sign control provided at appropriate internal locations. Signs and landscaping will be designed and maintained so as not to restrict lines of sight to or from the roadway network.

Off-Site Roadway Improvements

Route 122 at Bridge Street –The installation of a traffic control signal in order to improve operating conditions at the intersection may be warranted under 2005 Existing conditions, independent of the proposed project. With the installation of a traffic control signal at the intersection, overall operating conditions were shown to improve to LOS B during the weekday morning and evening peak hours under 2011 Build with Mitigation conditions.

Route 140 at Route 30 and East Street – An analysis of traffic operations at this signalized intersection indicated that overall operating conditions may become constrained (LOS F) during the weekday morning and evening peak hours under 2011 No-Build conditions, independent of the proposed project. In order to improve traffic operations at this intersection, it was suggested that the traffic signal timing and phasing be optimized.

With implementation of these improvements, overall operating conditions at the Route 140 at Route 30 and East Street intersection were shown to improve to LOS D during the weekday morning peak hour and to remain operating at LOS F during the weekday evening peak hour, with increased intersection capacity (improved volume-to-capacity ratio), under 2011 Build with Mitigation conditions.

Route 140 at Bridge Street – An analysis of traffic operations at this signalized intersection indicated that overall operating conditions may be at capacity (LOS E) during the weekday morning and evening peak hours under 2011 Build conditions, with the addition of Phase I project-related traffic. In order to improve traffic operations at this intersection, it was suggested that the traffic signal timing and phasing be optimized.

With implementation of these improvements, overall operating conditions at the Route 140 at Bridge Street intersection were shown to improve to LOS D during the weekday morning peak hour and to remain operating at LOS E during the weekday evening peak hour, with an overall reduction in motorist delays and vehicle queuing, under 2011 Build with Mitigation conditions.

Phase II

Science Park Access

As the Phase II development program proceeds, the intersection of Route 30 at Discovery Drive will be monitored periodically for the installation of a traffic control signal (See Figure 30).

Access Alternatives

In order to alleviate congestion at the intersection of Route 30 at Discovery Drive, alternative access via a potential connection to the existing DCAM roadway has been reviewed and will be pursued, if warranted.

Off-Site Roadway Improvements

Due to the long range planning horizon of the study (2026), it was impractical to make definitive roadway improvement recommendations due to the variable nature of the factors utilized in developing the future traffic volume projections. However, the following suggestions were offered relative to potential transportation improvements and should be reviewed for application in the future should the need arise.

It was recommended that the following intersections be monitored periodically at the completion of the

Phase I development program and reviewed for future traffic signal control:

- Route 30 at Pine Street
- Route 30 at Westboro Road
- Route 140 at Westboro Road
- Route 122 at Bridge Street

The review of these intersections should be undertaken in an overall context of a Route 30/ Route 140 corridor study incorporating both existing and future development potential along these roadways.[9]

Science Park Traffic Reduction Recommendations

In order to reduce the overall number of new vehicle trips in the area as a result of the Science Park, a pedestrian connection to the MBTA's Grafton station – a sidewalk along Route 30, between Pine Street and Discovery Drive – is anticipated to be constructed as a part of Phase I of the Science Park development. In addition, the study's recommended transportation demand management strategies have been implemented, including ridesharing, alternative work schedules, the use of public transportation and the provision of bicycle facilities.

In summary, the 2006 VAI study concluded that the proposed campus development program could be constructed without appreciably impacting the study area roadways. The phased nature of development proposal would allow for monitoring of traffic conditions within the study area to identify deficiencies and for implementation of corrective actions where necessary, and as required.

[9]In order to establish baseline conditions at these intersections, a 12-hour (7:00 AM to 7:00 PM) manual turning movement count will be conducted at each of the above intersections at the completion of the Phase I development program and a detailed Traffic Signal Warrants Analysis (TSWA) will be completed in accordance with the methodology and procedures outlined in the Manual on Uniform Traffic Control Devices (MUTCD), Federal Highway Administration, 2003 as amended. The results of the baseline TSWA will be provided to the Town of Grafton.

UTILITIES

Public Utilities: Water and Sewer

Water

Water service to the campus is provided via a 10" water main in Westboro Road (Route 30). This main has been upgraded and re-lined from Pine Street to 86 Westboro Road.

As part of the Science Park development, a new 12" main was constructed in Discovery Drive. This main extends the full length of the roadway (Phases I and II) and extends to the DCAM property to the west. It connects to the DCAM system approximately 300' east of Institute Road. Water supply and fire flow to the park were further improved by the Town's installation of a new main on East Street between Institute Road and Snow Road in 2005.

However, TCSVM has identified the need for an 8" water main loop – from Westboro Road at Willard Street to connect to the main terminating at the Willard Clock Museum – to improve water quality, fire flows and reliability to the Core Campus.

Future water demands for the school expansion and the Science Park are estimated as follows.

Consistent with the methodology used in the MEPA filings for the campus (EOEA 11715), the Science Park estimates are very conservative. The methodology was based on an analysis of biomedical facilities at the Massachusetts Biomedical Research Park in Worcester. To arrive at a conservative estimate, the peak daily flows were further increased by 10% to establish an estimated maximum daily demand of 250 gpd/1000 gsf.

The projected increased flow for TCSVM's building expansion program is negligible. Many of the planned program spaces are administrative and academic, and the school's population is only expected to increase about 11% over the next seven years. Therefore, consistent with Title 5 loading guidelines for wastewater (and water) projections, significant increased water demand is not anticipated. Animal housing spaces will also result in small increases in water demand.

Table 4.1: 20-Year Water Demand

	GSF	WATER DEMAND (GPD)	
EXISTING			
TCSVM	454,971	33,159	actual daily average (2010-2012)
PLANNED			
TCSVM	240,809	5,509	estimated 11% population increase*
SCIENCE PARK			
Phase I**	308,929	77,232	250 gpd per 1000 GSF
Phase II	354,000	88,500	250 gpd per 1000 GSF
TOTAL GPD:		204,400	

*50 gpd/person

** NE-RBL included in Existing TCSVM actual daily average

Table 4.2: 20-Year Wastewater Projections

	GSF	WASTEWATER LOADING (GPD)	
EXISTING			
TCSVM	454,971	29,843	estimated based on 90% of water demand
PLANNED			
TCSVM	240,809	4,958	estimated 11% population increase
SCIENCE PARK			
Phase I**	308,929	69,509	225 gpd per 1000 GSF
Phase II	354,000	79,650	225 gpd per 1000 GSF
TOTAL GPD:		183,960	

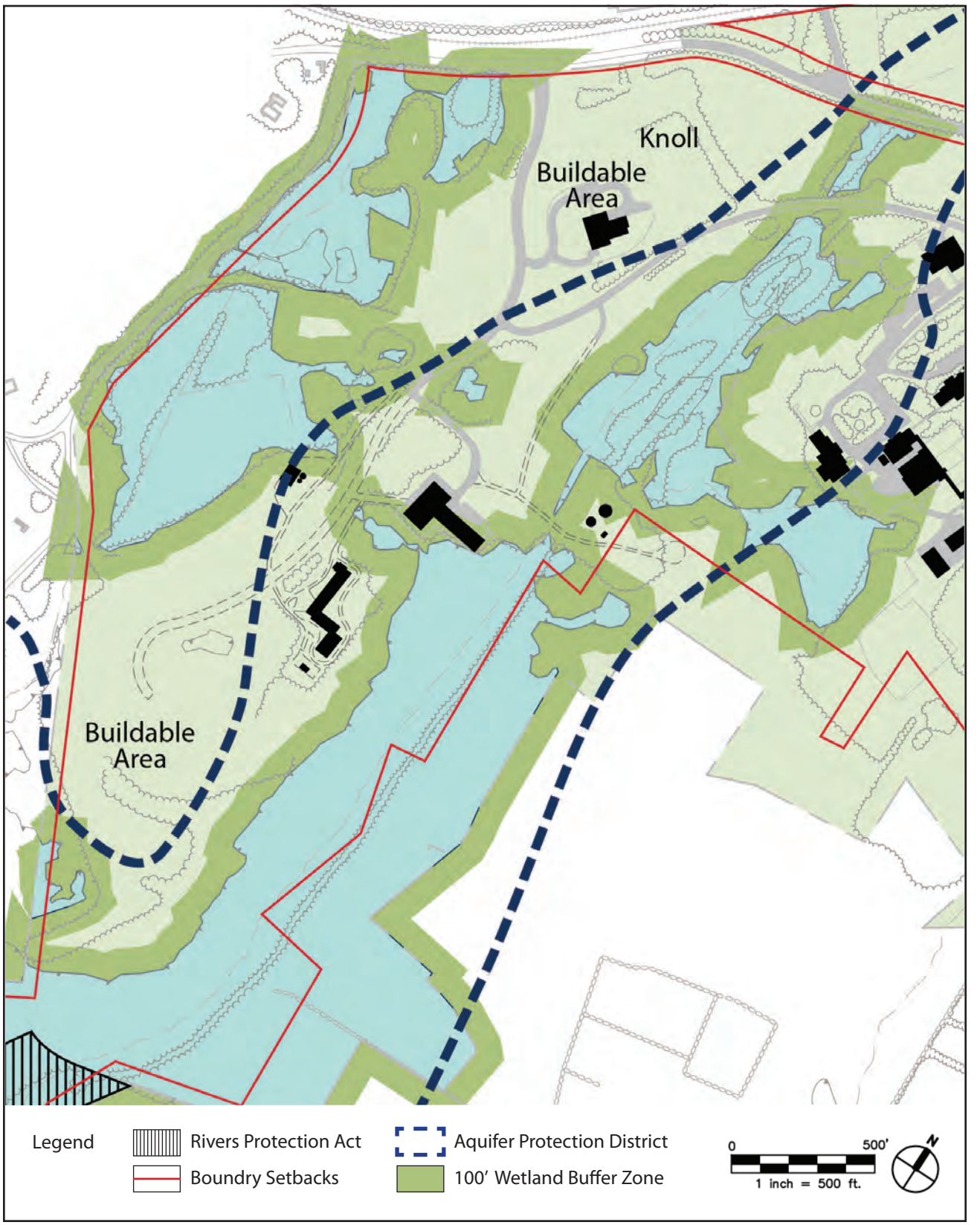
As shown above, the projected wastewater generation is estimated to be approximately 0.18 MGD at full build-out, well within the remaining capacity of .5 MGD under the current permit.

Sewer

The sewer network is tributary to the Grafton Wastewater Treatment Plant via the Axtell Brook Interceptor that flows south through the TCSVM campus. The Grafton Sewer Department owns and operates the pipeline within an easement. There is available capacity within the piping network and treatment system to accommodate the proposed Master Plan expansion. As previously noted, the plant, is currently permitted for 2.4 MGD, with average daily flows of 1.9 MGD.

Again, consistent with the MEPA filing for the Science Park, wastewater projections are very conservative and based on analysis of peak daily flows at the Massachusetts Biotechnology Research Park. There is no significant planned increase in wastewater flows at the TCSVM campus given that the campus population will not significantly increase under this Master Plan.

Figure 31: Environmental Compliance Map



Private Utilities: Power and Telecommunications

Approximately 5 to 7 MW of electric power demand is estimated at full build-out of both the school and Science Park. Both power and telecommunications for the Science Park development can link directly into the existing line in Route 30.

Development in the Core Campus would link into the existing Willard Street system as well.

Two solar (photo-voltaic array) projects in planning would also connect to the existing NGrid system (one into the Route 30 and one into the Willard Street system). The solar project located in the Science Park would be net metered and the one located at the East Campus knoll site would be directly connected to the campus distribution system. Together, they would generate an estimated 3.9 MW to offset Core Campus demand.

As development plans progress, TCSVM will work closely with National Grid, in its long-term capacity planning, as well as with Verizon and Charter Communications. NGrid is currently looking at the feasibility of upgrading its Waterville Street substation to increase local capacity.

ENVIRONMENTAL MITIGATION

A number of measures have been incorporated into the Master Plan design to mitigate the development's effects on water resources and open space, historic and archeological resources, and the ecology of the area.

Wetlands and Natural Features

Activity within the 100 foot buffer zone of the Bordering Vegetated Wetlands includes construction of roadway, driveways, parking lots and portions of buildings as well as construction of vegetated stormwater management basins. Both state and local wetlands regulations will be followed.

To protect these wetlands, the layout of each building site has been designed to minimize impact on vegetation, wetlands, and surface runoff given the building program. Proposed grades in paved areas and for building first floor elevations are to be as close to existing grade as feasible to minimize side slopes and hence the extent and impact of work that occurs within the buffer zone. All temporarily disturbed areas of open space will be loamed and seeded to re-establish vegetative cover.

The stormwater design will also protect wetland values. These protective measures will include specific site construction techniques and a stormwater management system, described in the following section, meeting DEP's Stormwater Quality Performance Standards. No bordering vegetative wetlands, bank or land under water are altered by the stormwater management plan.

The site design also preserves campus topography to the greatest extent feasible in locating new structures and parking lots.

Historic and Archeological Resources

The entire campus is listed in the Massachusetts Register of Historic Places. To protect the site's special qualities, the Master Plan:

- preserves historic features and specimen trees by proposing the renovation and reuse of existing vacant campus structures; and
- will maintain compatibility with the rural and historically distinctive nature of the entire campus, characterized as 'Victorian Gothic', by the use of appropriate design guidelines and architectural standards.

Based on consultation with the Massachusetts Historical Commission, no prehistoric or archeological sites exist on the campus.

Ecological Effects

No state-listed plant or vertebrate species, or vernal pool habitats have been identified in the areas of proposed development.[10] The Natural Heritage and Endangered Species Program has confirmed that there are no known rare plants, animals or exemplary natural communities in the development areas. An agricultural field of about 4.5 acres will be altered in Phase II development, and about 13 acres of woodlands will be developed.

Water Quality and Quantity

New buildings and new paved areas with new grading will change the drainage patterns. The storm water management plan recommendations are intended to effectively mitigate the potential impacts of campus development on the peak discharge rate, volume and quality of stormwater run-off.

The projects proposed in this Master Plan will not discharge wastewater into ground or surface waters, and stormwater will be managed during and after construction following all the requirements of the General National Pollutant Discharge Elimination System permit for construction activities, the Grafton Stormwater Management Bylaw, and the Massachusetts Stormwater Management Standards.

Waste and Hazardous Materials

Standard laboratory use generates, and will continue to generate, biological hazardous and non-hazardous waste. The university has disposal protocols and programs already in place, which are directed by the university's head of Environmental Health and Safety in accordance with local, state and federal regulations.[11]

Noise

Temporary increases in noise levels in the immediate area will occur only during the construction. Typical noise control measures will be employed, such as the use of heavy mufflers on equipment, construction hour restrictions and other noise mitigation. Noise should not be noticeable beyond the immediate area due to significant tree cover and open space around the campus, which will buffer distant residential abutters.

[10]Fuss & O'Neill review of Massachusetts Natural Heritage Atlas, (13th ed., 2008).

[11]Disposal guidelines are specified in Tufts University's "Chemical Hygiene Plan," May 2013 at http://publicsafety.tufts.edu/ehs/files/CHP2013Final.pdf and "Hazardous Waste Management Plan," November 2010 at http://publicsafety.tufts.edu/ehs/files/HazardousChemicalWasteManagementPlan11-2010.pdf

STORMWATER MANAGEMENT PLAN

A Stormwater Management Plan was prepared for the TCSVM campus in support of this Master Plan approval process. The Stormwater Management Plan, which is an update of the previous 2006 Stormwater Management Plan, evaluates existing development and proposed development on the Tufts campus over the next 20 years as envisioned in this Master Plan. The plan identifies stormwater management recommendations and stormwater quality and quantity criteria for future campus development projects, consistent with the Grafton Stormwater Management Bylaw and Regulations, and the Massachusetts Stormwater Management Standards. The Stormwater Management Plan is provided in Appendix B.

Hydrologic Analysis

A hydrologic model was developed for the Tufts campus to assess the potential stormwater-related impacts of future campus development and to inform stormwater management recommendations for future campus projects. The model was used to evaluate peak runoff rates, runoff volumes, and runoff timing for existing and proposed campus development. The hydrologic model is based on a similar model that was prepared for the 2006 Stormwater Management Plan. The 2006 hydrologic model was updated to reflect campus development and watershed land use changes that have occurred since 2006, hydrologic analysis requirements of the Grafton Stormwater Management Regulations, and this Master Plan development program.

Three major subwatersheds and design points were modeled, corresponding to the locations at or near the campus property boundary where runoff leaves the site: (1) the Axtell Brook subwatershed, (2) the subwatershed associated with the wetlands located on the southeast portion of the campus (which eventually drain to Assabet River Reservoir and the Assabet River), and (3) the subwatershed associated with the northeast portion of campus, which is also located within the Assabet River subwatershed. The Axtell Brook subwatershed includes the majority of the existing and proposed development on the Tufts campus including the core campus and west campus/ Grafton Science Park. The Axtell Brook subwatershed was further subdivided into smaller catchment areas to evaluate the potential stormwater-related impacts of the 2014 Master Plan development program to the on-site wetlands and Axtell Brook flowing through the campus.

Axtell Brook Subwatershed

Total impervious cover within the Axtell Brook watershed is anticipated to increase by 2.9% at full build-out. Peak flow rates in Axtell Brook near the downstream campus property line are predicted to remain the same or decrease slightly as a result of the detention provided by the existing and proposed Science Park stormwater basins. Low Impact development ("LID") measures recommended for the future Science Park developments, as well as LID and peak flow attenuation recommended for 2014 Master Plan projects proposed within the core campus are expected to further reduce peak flows and runoff volumes to Axtell Brook. The highly permeable soils in the Science Park are conducive to the use of infiltration-based LID techniques.

Development within the Core Campus is expected to result in a modest increase in peak runoff rates (2% to 7%) and runoff volumes (2% to 6%) to the central portion of Axtell Brook and the adjacent wetlands. Peak flow attenuation is recommended for future projects in this area that would add significant new impervious cover, such as the Tufts Veterinary Medical Center expansion, construction of several new buildings and parking around the south quadrangle and Research Quad area, expanded parking at the Teaching Barn, the library expansion, and construction of Swine Unit III.

Southeast Wetlands Subwatershed

This Master Plan proposes several projects within the southeast portion of the campus, including a new Equine Exercise Facility along Route 30 in Westborough, new Cummings School facilities along Lower Valley Road, and a commercial solar array located on a knoll southeast of the central campus. No measurable changes to peak runoff rates or volumes are predicted for this subwatershed due to the minor overall increase in impervious cover (less than 1%) within this subwatershed under this Master Plan full build-out. The use of LID and runoff reduction measures (environmentally sensitive site design, infiltration of stormwater, etc.), water quality treatment, and peak flow attenuation are recommended for several of the proposed projects in this subwatershed.

Minimal peak flow attenuation is anticipated to be necessary for both the Knoll and Science Park Solar Arrays, given the proposed design of the arrays, which incorporate the use of environmentally sensitive site design measures to maintain pre-development runoff patterns and infiltration conditions to the maximum extent practicable, as well as the relatively permeable soils on both sites.

Assabet River Subwatershed

Several relatively minor projects are proposed within the Assabet River subwatershed including relocation of the Locust Barn/Visitor Center across Route 30, a new recreational facility for the campus community near the campus library, new or expanded school facilities in the vicinity of Captian W. O'Brien Road, and new or expanded Animal Hospital facilities. These projects would result in an increase in subwatershed impervious cover of less than 1%. Peak flow rates and runoff volumes are predicted to remain essentially unchanged from existing conditions under this Master Plan build-out scenario. The use of LID and runoff reduction measures (environmentally sensitive site design, infiltration of stormwater, etc.) and water quality treatment are recommended for the proposed recreational facility and the new or expanded Veterinary School and Animal Hospital facilities.

Other Plan Recommendations

Environmentally sensitive site design and the proper selection, design, construction, and maintenance of campus stormwater management systems can effectively mitigate the potential impacts of campus development on the peak discharge rate, volume, and quality of stormwater runoff. The Stormwater Management Plan identifies recommendations for implementation of this Master Plan to mitigate potential stormwater-related impacts. The plan recommendations are intended to ensure that future campus development occurs in a manner that conserves and protects wetlands and water resources and addresses existing drainage conditions on the campus.

Guiding principles related to stormwater management for Master Plan projects on the Tufts campus include:

1. Reduce existing impervious cover, runoff volume, and soil disturbance to the extent practical through effective site planning and environmentally sensitive site design. The following site planning and design techniques are recommended for Master Plan projects on the Tufts campus:
    - Reducing impervious surfaces to the extent practical
    - Disconnecting impervious surfaces from the storm drainage system by directing runoff to pervious areas (i.e., lawns, filter strips, vegetated swales, etc.) or structural stormwater Best Management Practices ("BMPs") such as bioretention systems, drywells, and other infiltration or vegetation based practices
    - Minimizing site disturbance including grading and clearing
    - Avoiding compaction of porous soils and disturbance of erodible soils
    - Lengthening flow paths and promoting overland flow

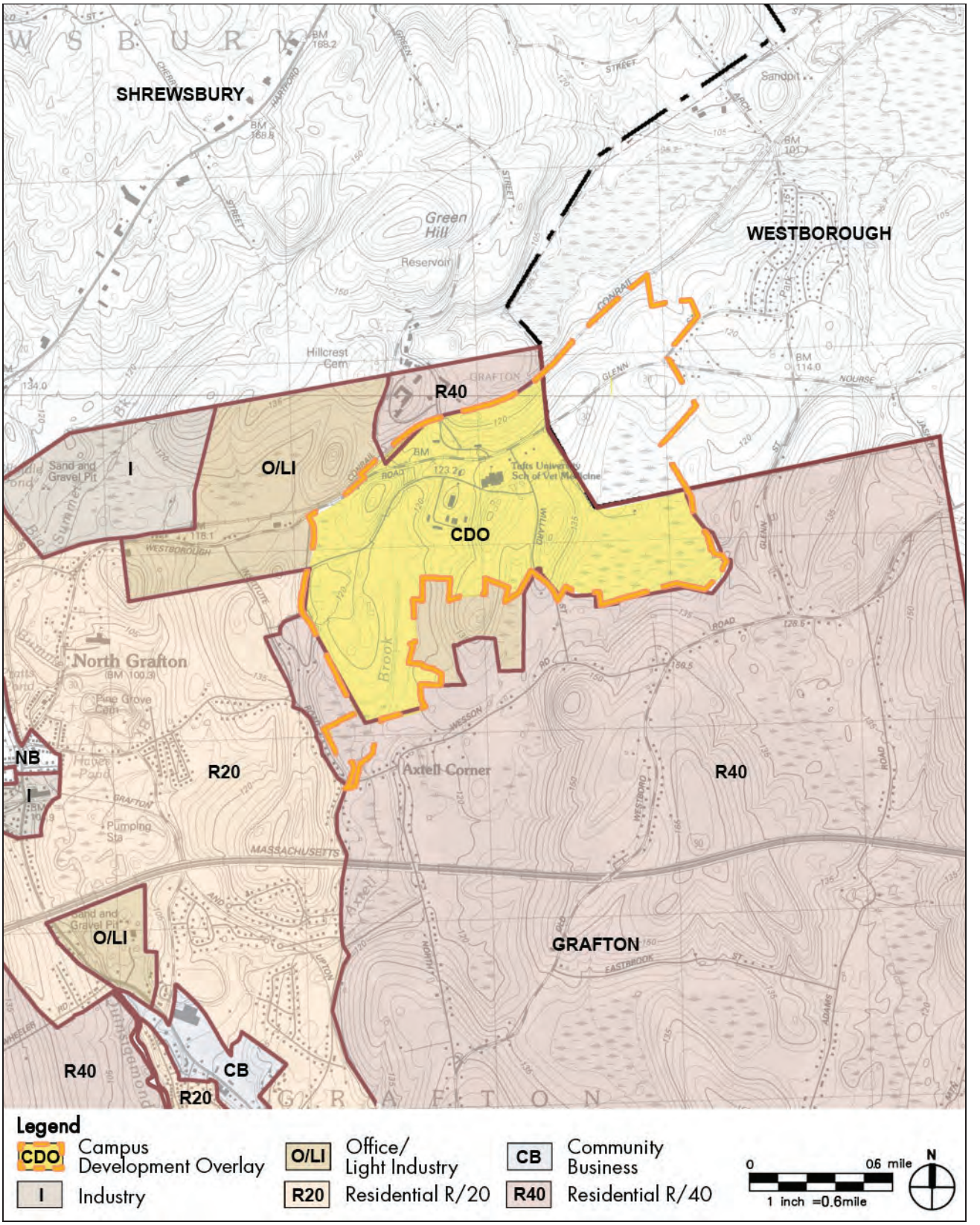
- Preservation of sensitive natural areas
- Preservation of riparian buffers and floodplains

2. Use structural stormwater BMPs to collect, store, infiltrate and treat stormwater runoff after first applying effective site planning and environmentally sensitive site design techniques. LID and other structural BMPs are recommended for consideration in campus projects, including rainwater harvesting (e.g., rain barrels, cisterns) for landscape irrigation and gray water reuse; bioretention systems including rain gardens; drywells and subsurface infiltration systems (decentralized, small-scale practices distributed throughout the site); permeable pavement; vegetated filter strips; vegetated swales/channels; and larger structural BMPs where necessary to provide additional peak runoff attenuation and/or water quality treatment (e.g., infiltration basins, stormwater basins, underground detention, constructed and gravel wetlands, proprietary BMPs, etc.)

3. Implement source controls and pollution prevention practices to reduce the generation of runoff pollutants. Source control and pollution prevention practices (e.g., sweeping of parking lots and driveways, minimizing the use of road sand and salt to the extent feasible based on safety considerations, drainage system inspection and maintenance including catch basin cleaning and sediment removal from structural BMPs, turf management, landscape waste management) should continue to be implemented after construction of campus projects and as part of routine campus operations to reduce or eliminate the exposure of pollutants to rainfall and runoff.

Detailed plan recommendations for specific subwatersheds, catchment areas, and master plan projects are contained in Appendix B.

Figure 32: Zoning – Town of Grafton



MUNICIPAL CONTEXT

Zoning

This Master Plan complies with the Town of Grafton Zoning By-Law, Section 9 - Campus Development Overlay (CDO), as amended at the October 2013 Annual Town Meeting. Compliance with zoning code requirements is summarized in the following reference list.

9.1 District

The entire Grafton site is in the CDO District.

9.2 Applicability

Relevant Zoning Bylaw conditions which underlie the CDO have been identified as Section 7 - Water Supply Protection. Wetland and River Protection boundaries are identified in Section II - Site Assessment.

9.3 Purposes

This Master Plan supports the expansion of a well-designed rural campus which integrates educational and health sciences and high technology activities with natural areas and nearby residential and commercial development.

9.4 Permitted Uses

All uses proposed are permitted in Section 9.4. Uses permitted by Section 9.4.A include all educational uses by non-profit educational institutions, including classrooms, hospital facilities, clinics, laboratories, research centers, auditoriums, study halls, libraries, dormitories, housing for students, faculty and staff, fraternities and sororities, campus centers, book stores, athletic facilities, farming facilities, animal husbandry facilities, executive and administrative offices, staff offices, maintenance and service facilities, and all other elements and features associated with educational institutions. Uses permitted by Section 9.4.B include (i) research, development and manufacturing in the fields of: biotechnology, medical, pharmaceutical, physical, biological, and behavioral sciences and technology; environmental sciences, toxicology, wildlife medicine, and genetic engineering, comparative medicine, bioengineering, cell biology, human and animal nutrition, and veterinary medicine, and (ii) research and development in the fields of Alternative energy and Renewable Energy, including production of equipment, apparatus, machines and other devices for research, development, manufacturing and advance and practical application in any such field or area described in clauses (i) and (ii), and including offices, administrative and support facilities related to any of the foregoing activities. Uses permitted by Section 9.4.C include research and development in the field of computer technology, including the light manufacture, assembly and production of equipment apparatus, machines and other devices for such field, and also including internet service providers, electronic data storage centers and similar back office operations, and including offices, administrative and support facilities related to any of the foregoing activities.

Uses permitted by Section 9.4.D include commercial facilities reasonably required in connection with and in furtherance of any of the uses permitted under the preceding paragraphs A, B and C, including, without limitation, animal and veterinary hospitals and clinics, restaurant and other food service facilities (but excluding establishments selling food prepared for immediate consumption which is distributed to customers in whole or in part by means of automobile drive-up windows, counters or by prohibited [sic]), conference and convention facilities, hotel, motel and other housing accommodations, library, information and telecommunication services, and facilities for banking, postal and delivery services, day care and recreation. Uses permitted by Section 9.4.E include facilities accessory to any of the foregoing, including water sewage disposal, drainage, electric, telephone, Alternative Energy, Renewable Energy and other utility services; roads, walks, paths, parking areas and structures, and lighting, directional signage and vehicular services therefore; grounds maintenance, snow plowing and open space protection; and all structures, equipment and facilities necessary to any thereof.

Figure 33: Ground Coverage and Buffer Zones

This Master Plan is a long-term development proposal. Although the overall development areas will not exceed the density shown, the plan must be responsive to changing market conditions over time, and so development may include any or all of the permitted uses identified above.

9.5 CDO Design Criteria and Guidelines

This Master Plan provides for the following:

A Site design unity with a campus-wide development incorporating landscape improvements with parking, sidewalk and building siting guidelines.

B Use of natural, open space and agricultural land resources to direct the siting of future campus improvements. Care has been taken to integrate and preserve environmentally significant features in the plan.

C Use of best management practices in the storm water and drainage system design. Space is reserved between parking areas and wetlands for the detention or retention of storm water. (See Appendix B, Conceptual Stormwater Management Plan).

D Location of all new utility lines below ground.

E Compliance with all dimensional regulations.

F Mitigation of adverse environmental impacts. (See Section 4, Traffic Study and Environmental Mitigation, and Appendix B).

G Compatibility of the plan with abutting property by the retention of generous forested buffer strips.

H/I Net benefits to the Town of Grafton (see Section 4, Municipal Costs, Revenues and Benefits, which includes discussion of benefits as well as the impact of the development on public services).

J Facilities for meeting transportation needs, and planning for control and reduction of vehicle trips by means of ride-sharing, car-pooling, use of campus vans, and MBTA facilities. (Mitigation of transportation impacts. (See Appendix C, Annual Report to the Planning Board.)

K Organizational and managerial arrangements and documents pursuant to which the Master Plan will be implemented and common facilities maintained including provisions for architectural review and control, enforcement of applicable restrictions, and the transportation planning with respect to transportation and parking certification are described in Section 4, Management Plan and Appendix C, Annual Parking and Demand Management Report/ Campus Stormwater Maintenance Plan Certification.

9.6 CDO Special Regulations

9.6.1 *Planning Procedures*

9.6.1.1 The Master Plan has been prepared for the entire campus of approximately 594 acres to indicate the anticipated scope and intensity of layout, location of structures, impact on environment and the effect upon municipal costs, revenues, and benefits.

9.6.1.4 The Master Plan's time frame is up to twenty years. Extensions and/or amendments may be filed or submitted to the Town of Grafton at the end of each seven-year period if necessary.

9.6.2 *Dimensional and Design Regulations*

9.6.2.1 *Lot Dimensions*

The land is considered a single parcel of land as defined in Section 9.2, paragraph B of the Zoning Bylaw. The FAR for the total existing and proposed development within the Town of Grafton is .07 (see Table 4.3), which is well within the maximum average allowable FAR of .35.

9.6.2.2 *Height*

No building proposed in this Master Plan exceeds the 60' height limit.

9.6.2.3 *Setback; Separation; Access*

A. All proposed new buildings and structures meet or exceed the following setbacks. (See Figure 33: Ground Coverage and Buffer Zones.)

- North Bound: Consolidated Rail Corporation (MBTA): 15'.
- Southwest and Southeast Bound: 200'.
- West Bound: Adjacent to Commonwealth of Massachusetts: 50'.
- South Bound: Not adjacent to residentially used lands: 50'.
- Route 30/Willard Street: Public street or way: 50'.

B. Minimum 20' distance between free standing buildings.

9.6.2.4 *Ground Coverage*

No proposed project, in consideration of existing building and paved impervious surfaces, exceeds 60% site coverage as defined by the application of the 1000' radius. See Figure 33 and Table 4.4.

9.6.2.5 *Buffers/Landscaping*

Setbacks will be maintained as open space land use, and new buildings and parking site selection will be organized to reduce the visual impact of existing parking areas and to buffer future parking lots. In general, 30% site coverage as defined by the application of the 1000' radius will be landscaped or retained in forest or agricultural use.

9.6.3 *Ways/Parking/Loading/Drainage*

All proposed new ways are intended to comply with applicable provisions of the subdivision rules and regulations and will be designed in accordance with these standards. The proposed parking program, layout, access roads, loading and drainage are prepared in accordance with Zoning Bylaw categories of use.

9.6.4 *Signs*

It is intended that all development within the CDO will comply with the provisions of this Zoning Bylaw.

Table 4.3: Floor Area Ratios

DEVELOPMENT ELEMENT	AREA	
GRAFTON SCIENCE PARK	662,929	GSF
EXISTING TCSVM	454,971	GSF
PLANNED TCSVM (Grafton)	240,809	GSF
TOTAL DEVELOPMENT	1,358,709	GSF
Total Campus Area	594	Acres
Grafton Portion of Campus	445	Acres
or Grafton Portion in GSF	19,384,200	GSF
FAR (Grafton Only)	**0.0700936**	

Table 4.4: Ground Coverage

1000' Radius Circle	Area Circle within CDO (SF)*	Ground Coverage (SF)	% Ground Coverage
1	2,199,400	333,940	15%
2	2,764,960	479,285	17%
3	3,142,000	955,395	30%

* See Figure 33, Ground Coverage and Buffer Zones

Ground coverage was calculated by Fuss & O'Neill using AutoCad

Municipal Costs, Revenues & Benefits

Grafton Science Park Private Investment

TCSVM continues to anticipate substantial investment by private firms in the Science Park. Research and development operations that will locate there are expected to spend in the range of $250-$450 per square foot to build and equip their facilities.[12]

Based on this building cost estimate range, Table 4.5 outlines expected capital investment in Phase I of the Science Park.

At full build-out (348,000 GSF) of Phase I, we estimate overall capital investment ranging from $108.2 to $170 million. Assuming a property tax rate of $15.26 per thousand, annual property tax revenues for Grafton can be projected at between $1.6 million and $2.6 million.[13] Over the long term, Phase II will potentially add an additional 354,000 GSF. At full build-out of both phases, a total capital investment of $196.7 to $329.3 million is predicted, with $3.0 to $5.0 million in annual tax revenues.

Job Creation

Biotechnology research and development laboratories and manufacturing facilities are assumed to operate with an average workforce of about three people per 1,000 square feet for offices/labs and 2 per 1,000 square feet for manufacturing and animal housing facilities. Thus, at projected build-out in the first five years, we expect up to 443 jobs[14] to be created; with an additional 302 jobs projected at build-out of Phase I, and 1,577 jobs at total combined build-out of Phases I and II. (See Table 4.6, Tenant Build-out Schedule and Table 4.7, Job Creation Potential).

[12]Specialized spaces in such facilities can cost up to $1,000/SF.
[13]$1,661,132 to $2,594,200 in annual tax revenues. This calculation is based on the FY2014 tax rate as reported by the Grafton Town Administrator. The calculation assumes no inflation in either the tax rate or construction costs over the ten-year build-out period.
[14]These figures assume that 35% of the space will be office/ R& D labs, 35% will be manufacturing and 30% animal housing.

Biomedical development will provide job opportunities to people of a range of education and income levels. Jobs in biotechnology research and product development are typically well-paying, with good benefits. Table 4.8 provides a sampling of job titles and salaries in discovery and pre-clinical research, as well as clinical research in product development. We anticipate that a number of these jobs, particularly the most numerous – laboratory and facilities support staff categories – will most directly benefit area residents of low and moderate income.[15]

These jobs are expected to have a multiplier effect in the local economy. A study by Nexus Associates, performed for TCVSM in 2006, suggested that the school's expenditures, and planned investment in the Science Park, would contribute more than 946 jobs annually (exclusive of the jobs of Science Park tenants), generate $459 million in output and $195 million in disposable personal income over a seven year period.[16]

Tufts Cummings School of Veterinary Medicine

The Nexus study highlighted the contributions the school and the Science Park were expected to make to the state and local economy. The analysis looked at two kinds of economic impacts —the direct, and indirect and induced effects of budgetary expenditures and planned capital investment from 2006 – 2012. Its other major findings were that the school and Science Park:

- Will be responsible for annual employment of over 1,360 in the Commonwealth, exclusive of jobs brought by park tenants.
- Will be responsible for creating over $782 million in output, $450 million in gross state product, and $293 million in personal income.
- Are projected to generate a total of $33 million in net state revenues over the next seven years.

[15]These categories, titles and salaries levels were found at www.salary.com on January 2014.
[16]Nexus Associates, Inc., "Economic Impact of the Cummings School of Veterinary Medicine at Tufts University," February 2006.

In 1997, TCSVM began leasing space in Building #21, its business incubator facility, to biotechnology companies and the school began paying property taxes on this commercial use. In 2014, this building and other commercial tenants on the campus continued to generate property taxes.

Table 4.5: Projected Investment by Private Firms

Phase I Corporate Tenant or Bldg.*	Bldg. Area (GSF)	Maximum Investment ($ Million)	Cumulative Investment ($ Million)
55 (NE-RBL)	39,071	31	
A	60,200	15-27.1	46-58.1
E	120,300	30.1-54.1	76-112.2
F	128,429	32.1-57.8	108.2-170

* Building number/letters refer to Figure 28

Table 4.6: Tenant Build-out Schedule

Year	Bldg. Key	Maximum GSF	Cumulative GSF
PHASE I			
2009	55 (NE-RBL)	39,071	
1 - 2 (2016-2017)	A	60,200	99,271
3 - 4 (2017-2018)	E	120,300	219,571
5-10 (2019-2023)	F	128,429	348,000
PHASE II			
11-20 (2024-2032)	H-K	354,000	702,000

* Building number/letters refer to Figure 28

Table 4.7: Job Creation Potential

Year	Bldg. Key	Maximum Jobs	Cumulative Jobs
PHASE I			
2009	55 (NE-RBL)	19	
1 - 2 (2016-2017)	A	141	160
3 - 4 (2017-2018)	E	283	443
5-10 (2019-2023)	F	302	745
PHASE II			
11-20 (2024-2032)	H-K	832	1,577

* Building number/letters refer to Figure 28

Source: Occupancy ratios (persons/SF) were taken from ULI's Development Impact Assessment Handbook, 1997, p. 110 and Centech Park's EDA application (Exhibit IVA-3c(4)).

Table 4.8: Job Categories

JOB TITLE	SALARY
Research Group/Discovery/Pre-Clinical	
Scientific Director	$95,704 - $240,664
Senior Scientist	$106,300 - $157,509
Senior Research Associate	$50,128 - $67,577
Junior Research Associate	$34,888 - $52,546
Laboratory Technician	$31,200 - $49,472
Clinical Research/Regulatory Affairs/Drug Information	
Medical Director	$179,139 - $319,908
Senior Biostatistician	$102,947 - $162,733
Senior Clinical Data Associate	$57,504 - $89,323

Source: http://www.salary.com, 1/1/2014

Ranges represent 10%-90% for each job title in the Boston area.

Urban Design Impacts/Benefits

Tufts has located the Science Park at the northwestern edge of its campus, adjacent to CenTech Park and the MBTA station. The co-location of these uses is intended to reinforce this area as a health and high tech science center. Similarly, this location may enhance the commercial development potential of the remaining undeveloped parcels – in CenTech or in public ownership – on the northern side of Route 30.

Costs

TCSVM successfully partnered with the town to secure state PWED and CDAG grants to construct the first phase of the Science Park's infrastructure and important off site infrastructure that benefits the whole neighborhood. To help finance and complete the infrastructure, TCSVM will request that the town join it, or its designated private developer, in applying for appropriate state and/or federal infrastructure grants.

Tufts expects ongoing town operating costs related to the Science Park to be minimal. The town and the school currently have cooperative arrangements for public safety services. Tufts' police provide on-site security services and call upon town police and fire services as needed. In the last five years, the campus police department has requested assistance that averaged less than ten calls annually. On-campus Tufts police are in turn auxiliary town police officers and provide back-up support to Grafton police.

The school, its subsidiary or designated private developer will provide grounds maintenance, security, and property management services including parking management, to Science Park tenants. Services to the proposed on-campus expansions would be covered under these same arrangements.

MANAGEMENT PLAN

The dean of the veterinary school, through the executive associate dean, will oversee implementation of this Master Plan. This oversight will be linked to other internal reviews. For example, Tufts' Board of Trustees, advised by the university's vice president of operations and a buildings and grounds advisory committee, will approve any project plans prior to their submittal to the town.

Two groups at the veterinary school will manage implementation of the Master Plan's separate components. Tufts Facilities Services (TFS) department, headquartered in Medford, MA, will provide policy and operational oversight to the campus portion of the plan and advisory oversight for the Science Park's development. Policy decisions related to the Science Park component will be made by JM Holdings Corporation, a subsidiary of the university established to develop the Science Park.

The school's on-site Facilities Director, a member of JM Holdings management advisory committee, will manage overall implementation of the Master Plan. JM Holdings will manage implementation of the Science Park development component, providing a single point of contact for community outreach, coordination of external development specialists (or, if selected, the designated private developer) and internal coordination.

Tufts anticipates that common facilities in the campus portion of the master plan will be maintained by the TFS department and Science Park facilities by outside service providers. Any Master Plan policies or restrictions will be followed and enforced primarily by the TFS department, the on-site Tufts police detail (particularly with respect to traffic monitoring, parking certifications and controls), and campus planning staff.

TCSVM will adhere to standards that provide harmony and consistency with the school's existing architectural styles and materials. TCSVM will follow existing university design review procedures; it has already established a design review board that includes JM Holdings' board members.