



Tufts Grafton Campus Land Stewardship Plan

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Tufts University | Spring 2024

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Prepared for:

Tufts University Office of Sustainability



GRADUATE SCHOOL OF ARTS AND SCIENCES

Urban and Environmental
Policy and Planning

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REPORT SUMMARY

Introduction

This project identifies components of a land stewardship plan, ensuing steps in developing a plan, and ways to implement conservation practices on the Grafton Campus at Tufts University. The Grafton Campus is Tufts largest and most ecologically diverse campus. The approximately 600-acre area is located across Grafton and Westborough, Massachusetts, and is home to the Cummings School of Veterinary Medicine.

While a small portion of the campus is the Cummings School facilities and infrastructure, the majority of the property is made up of open space, including wetlands, forests, and agricultural land uses. With open space playing a crucial role in the research, teaching activities, and biodiversity associated with the Grafton Campus, on behalf of Tufts University, our Department of Urban and Environmental Policy and Planning (UEP) Field Project team compiles an initial suite of information needed to develop a comprehensive landscape stewardship plan. This plan will balance the ecological health of the open spaces with educational needs.

In alignment with the Campus Framework Plan report, this project develops an initial inventory of the Grafton Campus open space in order to provide baseline information and recommended actions that can guide long-term land stewardship planning and management on the Grafton Campus.

This project will assist Tufts University by developing a framework for land stewardship decision-making on the Grafton Campus that involves:

- An inventory of open space, assets, and baseline assessments;
- A review of relevant policies, plans, and practices;
- An analysis of opportunities, challenges, and threats;
- Preliminary recommendations for the management and use of open space on campus.

Our guiding research questions to address these components were:

1. What are the ecological features, resources, and constraints of the Grafton Campus associated with land management?
2. What current management practices are employed on the Grafton Campus for the following land uses and associated areas, and who is responsible for maintaining them?
 - a. Conservation Land
 - b. Agricultural Land
 - c. Other Land Uses
3. What are the relevant land use policies and plans pertaining to the Grafton Campus?

Research Methods

To answer our research questions and develop a framework for land stewardship decision making on the Grafton Campus, the team relied on primarily qualitative research methods, such as conversations with various stakeholders involved with the Grafton Campus. Interviews helped the team understand the educational and operational activities related to open space on the Grafton Campus and highlighted the perspectives

on participant priorities, challenges, and suggestions pertaining to the campus. The team utilized spatial data collection to identify the physical characteristics and spatial relations of the land and its features; such as wetland and woodland ecosystems, farmland, ecological aspects, and research areas.

This project also draws upon comparative analysis via academic literature and case studies to analyze and contrast the ecological and agricultural management at Tufts University to other institutions in order to aid the campus planning department in making informed decisions about land management. The procedures used to address the research questions and achieve the goals of the project are further discussed in detail throughout the report. All research procedures were carried out in compliance with Tufts University's Institutional Review Board (IRB) protocols. Our research is categorized into three asset groups outlined in the sections that follow.

Historical Background as an Important Cultural Asset

Before becoming the prominent location for veterinary training in the Northeast, the Grafton Campus site had a long history stretching from Indigenous stewardship to European seizure to state acquisition. The incorporated towns of Grafton and Westborough were once inhabited solely by the Hassanamisco Nipmuc people. A 2005 survey of the Hassanamesit Woods suggested that the land was used by native populations at least 8,000 years ago. Colonial contact in the early 17th century brought violence and land seizures to the Nipmuc people. By 1720, the decimation resulted in the Nipmuc people selling 7,500 acres of land to the English and the retainment of 500 acres for themselves. However, the money from the sale of this land was placed in a trust to which the Nipmuc people did not have access. In 1977, the "New Town Proposal" plan was developed with the goal for 500 acres of the

1,100 acre former state land to become a community for displaced Nipmuc people. The return and protection of culturally significant lands is critically important to the Nipmuc Nation. Concurrently, Tufts representatives lobbied State and Congressional leaders for endorsements and secured the land for what ultimately became the Cummings School of Veterinary Medicine. Despite the complex history on Grafton Campus, there is a lack of information on where and how the Nipmuc people lived. Currently in Massachusetts, there are approximately 600 state-recognized Hassanamisco Band of Nipmuc people and the Hassanamisco Reservation is a 3.5-acre parcel in Grafton (Background – Reclaiming Heritage, n.d.). Land reclamation is important and has defined much of Nipmuc Nation's work. They have partnered with entities like the Trust for Public Land, the Grafton Land Trust, the Town of Grafton, the state of Massachusetts, and the Fiske Center for Archaeological Research at the University of Massachusetts Boston to protect a 200-acre parcel of land in the Hassanamesit Woods in the town of Grafton (Hassanamesit Woods Protection Moves Forward (MA), 2004) (Mrozowski et al., 2015). The Nipmuc Nation is making efforts to negotiate with the Town of Grafton for the return of land to the reservation (Report of the Traditional Government of the Nipmuc Nation, 2020). The history of the Nipmuc people and their land stewardship on the Grafton Campus is an asset that needs to be understood and explored. Embracing the Indigenous people's connection to their ancestral homelands offers many benefits outside of correcting injustices. It establishes goodwill between institutions and the broader community, it provides positive public relations in the local community, enables institutions to lead by example amongst peer organizations, and meets goals of becoming anti-racist institutions, which are embedded in many of the missions and strategies of institutions.

Ecological Assets

On the Grafton Campus, a multitude of ecological aspects make up open space. The project team sought to understand the campus landscape through an investigation of these areas. In order to maintain and potentially enhance the biodiversity and ecological health of the Grafton Campus, it is important to understand key features of the landscape such as its geology, soil composition, wetlands, and woodlands.

Geology

The bedrock, which primarily consists of gneiss and amphibolite rocks, influence the mineral composition of the campus soil. Large outcrops of the gneiss can be found on the east and west of Willard Street and south of Westboro Road (Walsh, Aleinikoff, and Dorais, 2011), while amphibolite is more scattered on the campus. When weathered, mineral nutrients are released into the soil, which can support different plant communities. Understanding the bedrock of a place is needed in order to actively steward the long-term health of that particular ecological context.

Soil

Grafton Campus has 15 different soil types with the majority of it consisting of sandy loam, which is made up of more than 50% sand and 20% clay. Much of these soil types have been characterized by the USGS as land with optimal physical and chemical characteristics for crop production when mixed with proper farm management.

Woodlands

Grafton's historic forest cover consists of a mix of American Chestnut, Eastern Hemlock, and Eastern White Pine. Post deforestation for agriculture and grazing purposes, the woodland landscape has altered. Though an

estimated 34% of total acreage is forested land, there is a lack of inventory on the current tree species found on campus.

Wetlands

The Grafton Campus is covered by approximately 20-29% freshwater wetland areas. In accordance with the Massachusetts Wetland Protection Act and the Grafton Wetland Protection Bylaw, these wetlands are protected under specific regulations and rules. Wetlands are protected due to their importance as key ecological features that provide various ecosystem services.

Academic Assets

Understanding the interconnectedness of open space access and institutional activities is necessary for proper land management. The Cummings School programs are focused into four main centers: Tufts Wildlife Clinic, Center for Conservation Medicine, Center for Animals and Public Policy, and Cummings School Farm. Interviewees indicated students and faculty engage in varying research, ranging from veterinary medicine, to human and animal health, or conservation practices. While a lot of this research takes place in facility clinics and laboratories, much of the research is conducted through field work (Figure 6).

The project team highlighted the overlay between research and the open space. Our conversations with key stakeholders identified research activities such as the Campus Biodiversity Assessment 2016, the use of camera traps to capture campus wildlife data, and the course ENV 0121/UEP 294 Drones for Environmental Research (Fall 2024). Many students and faculty also engage with the Cummings Farm for teaching and research purposes. The activities pertaining to the 200-acre farm space are structured around species life cycles and crop rotation, allowing hands-on experience on animal and

land management. Respondents indicated that the campus is used for additional academic purposes such as courses, visits, and individual studies by student or faculty exist; however, access to this information is difficult for the team to access outside of interviews and personal communications.

Challenges

Through the process of bringing together information and identifying key aspects of Grafton Campus, the team identified challenges that Tufts University should address in order to facilitate a more comprehensive and cohesive approach to its planning and stewardship responsibilities.

Relationship with Original Stewards

- While there does not currently appear to be a formalized relationship or partnership with the Nipmuc people, there is room to build the capacity to establish and explore opportunities for a mutually beneficial relationship.

Lack of Woodland Species Identification

- Limitations with existing inventories. The Campus Biodiversity Assessment 2016 indicates that there are an abundance of forest species, but do not elaborate on their identification. This information is necessary to determine forest management.

Wetland Data Discrepancies

- A 2002 survey by Vanasse Hangen Brustlin, Inc. identified approximately 29% of the total Grafton Campus acreage as wetlands; however, a 2016 study conducted by Tufts affiliated members identified 20% of the campus to be wetlands.
- Vernal pool presence: The 2002 study states that there are no-certified vernal pools, but the 2016 study identified 6 Potential Vernal Pools (PVP) on the campus.
- Wetland buffers: The 2002 study mentioned

wetland buffers and emphasized that development should not take place within the 100-foot buffer zone or should at least have a minimum distance of 50 feet from wetlands. These zones were not mentioned in Tufts University Grafton Campus studies.

Wetland Evolution and Climate Change

- Due to climate change, weather events, wildlife interaction, and human disruption; the wetlands on campus have been subjected to frequent change. The most recent data on the impact of these factors was conducted in the 2002 study; therefore, there is a lack of comprehensive understanding of the wetlands.

Seasonal Floods and Agriculture

- The increase in seasonal flooding in conjunction with unclear farm management practices, has led to the disruption of crops. Specific areas of the fields receive extensive damage, creating issues around access and drainage. Compost rotation and distribution, land fertility, and crop production are all severely impacted.

Campus boundary discrepancies

- Competing boundary sources: The Town of Grafton GIS databases and the 2022 Amended Grafton Campus Master Plan display differing boundaries. The Grafton and Westborough GIS databases include additional land that is absent in the 2022 Master Plan. These differences create implications that impact land stewardship planning and development, resource allocation, and regulatory compliance.
- Hunting impact: There have been reports from Campus Police on instances of hunters accessing legal hunting areas by entering campus at the intersection of Discovery Drive and Westboro Road. The lack of campus boundary markers in these areas poses safety implications to students,

faculty, and staff especially given the close proximated research activity.

Cases and Opportunities

To highlight potential land stewardship opportunities on the Grafton Campus, the UEP Field Projects Team references case studies detailing how other institutions navigate some of the similar challenges outlined above. These studies detail specific actions Tufts University could take to address these issues. The case studies our team explored included:

- Case studies that showcase how institutions are building relationships or working with Indigenous tribes and people by examining and acknowledging institution's history with native peoples, granting Indigenous access to lands, creating land stewardship partnerships, collaborating on native-led projects, compensating Indigenous peoples for use of their lands, and returning land to Indigenous people.
- Land Management and ecological related case studies including biological or ecological inventory, repository of research and conservation activities, inclusionary decision-making, college or university land conservationist, conservation restriction, non-binding land use classifications and commitments, carbon sequestration, external partnerships, and integration of land protection framework with sustainability goals.
- Flooding and agriculture related case studies include integrated pest management, weed management, agricultural spaces for financial and community benefits, and livestock management for carbon sequestration.

Recommendations

The identification of these findings have led us to develop the following recommendations for Tufts University to consider moving forward.

Cultural

Timeframe: Long Term.

Suggested Parties: Tufts Leadership in concert with relevant Grafton Campus Researchers.

- **Seek and build a formal relationship with the Nipmuc Nation.** This must be a long and careful process that should amount to a mutually beneficial and collaborative association. Tufts should expand upon the archaeological survey conducted by the Fiske Memorial Center for Archaeological Research at UMass Boston in collaboration with the Nipmuc Nation. The survey was specific to the Hassanamesit Woods, leaving the Tufts Grafton Campus still relatively unknown from an archaeological perspective. In consultation with the tribe, Tufts should determine if resources should be dedicated to conducting an archeological survey on the Grafton site or whether some other type of partnership would be beneficial, like using Grafton land for specific purposes or collaborating on research or conservation projects. Engaging the Nipmuc Nation will provide a platform for collaboration between Indigenous and non-Indigenous scholars that advances critical research on campus. The following steps may be taken to start the process:
 - ▶ Initiate a dialogue the emphasizes a commitment to collaboration and mutual benefit.
 - ▶ Build trust with members of the Nipmuc Nation through open and transparent communication.
 - ▶ Facilitate joint planning and goal setting

for intended outcomes and benefits.

Academic

Timeframe: Short Term.

Suggested Parties: Interdepartmental steering committee with stakeholders from all three campuses.

- **Establish a centralized repository of current and future academic and research activities.** This repository would serve as a comprehensive resource to disseminate information about events, research projects, academic initiatives, and other campus activities, fostering greater communication among faculty members and students. Many researchers and students from all three Tufts campuses utilize areas of the Grafton Campus for their respective activities, thus a centralized repository would heighten exposure. Refer to Table 6 regarding the repository of research and conservation activities that Berry College created as an example. The repository at Berry College also included an interactive map as a visual to track all academic and research activities.
- **Establish a collaborative collaborative Conservation Task Force to harness the expertise and resources available at the Grafton Campus.** This task force would integrate students and faculty from the Tufts Wildlife Clinic, the Center for Conservation Medicine, and the Center for Animals and Public Policy, working in tandem with campus planning efforts to enhance conservation initiatives. Initial steps should include:
 - ▶ Identify conservation opportunities such as habitat restoration, wildlife surveying, and sustainable landscape management practices.
 - ▶ Integrate with Campus Planning

efforts by incorporating sustainability principles and best practices.

- ▶ Monitor and evaluate the effectiveness of conservation practices and initiative. Regularly review, solicit feedback, and adjust strategies as needed to ensure continuous improvement and success in achieving conservation goals.

Ecological

Timeframe: Long-term.

Suggested Parties: Relevant Tufts faculty and students, Tufts Campus Planning.

- **Evaluate wetlands and vernal pools located on the Grafton Campus.** Specifically, collecting data on extent of wetlands, quantity of vernal pools, and current standing of these ecosystems. Ideally, able to highlight opportunities and threats to the areas.
- **Complete a full biological inventory of the Grafton Campus to better understand what plant and animal species that are located the land and possible threats to the species communities.**
- **Identify biodiversity hotspots that urgently need further protection, map critical wildlife habitats, identify and possibly remove invasive species, identify and restore native plant species.**
 - ▶ Compile GIS data, aerial photographs, maps, and species lists from the full inventory that can be easily accessed.
 - ▶ Contact Marc Lapin the College Lands Conservationist and Associate Lab Professor in Environmental Studies for Middlebury College for guidance on biological inventories and conserving institutional lands.
- **Conduct an analysis of the ecosystem services of its open space lands and natural features,** including the carbon

storage; habitat; and water quality benefits through the capture of runoff and sediment and retention of nitrogen, phosphorus, and nutrients.

- **Create a Land Stewardship Framework based on the inventory and ecosystem service analysis that establishes the conservation ethic, strategies for management of lands, and future goals and plans for the open space land on the Grafton Campus.**

- ▶ The Land Protection Framework should complement the built aspects of the campus, ensuring that stormwater is managed effectively at present and under potential future circumstances of development.
- ▶ Tufts University should consider setting a goal for the reduction of impervious surfaces on the Grafton Campus.

Boundary

Timeframe: Short Term.

Suggested Parties: Tufts Legal Department, Worcester County Register of Deeds, Campus Police.

- **Engage Tufts Legal Department to reconcile the boundary that the Town of Grafton shows for the Tufts Grafton Campus.** If further clarity is required, the Worcester County Register of Deeds office should be approached. Once the deed and any corresponding plans are accounted for, Tufts can determine which boundary is correct.
- **Once the boundary discrepancies are addressed, clear markers must be strategically placed along the perimeter and at locations on campus where hunters have previously been noticed.** There are several discrete entrance points that hunters utilize and until they are

clearly marked, hunting will likely continue. Pertinent locations from Figure 5 are listed below:

- ▶ Intersection of Discovery Drive and Westboro Road.
- ▶ Intersection of Discovery Drive and Cornfield Lane.
- ▶ Turnaround Area.
- ▶ Dispersed along the Tufts Campus and Grafton Land Trust property lines.

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EXECUTIVE SUMMARY

The 600 acres of Tufts University's Grafton Campus is primarily composed of open space, with 550 acres of agricultural land, forests, and wetland habitats. For the purpose of this report, open space is referred to as any natural environment or unbuilt areas. Understanding that open space plays a crucial role in research and institutional activities, the Office of Sustainability has partnered with our UEP Field Projects Team to develop a framework for decision-making that utilizes land stewardship. This report highlights the assets of the Grafton Campus open space and the practices that should be taken into account for future planning.

To center our research for this project, our UEP Field Projects Team focused on creating an inventory of the various components that make up Grafton Campus open space, establishing an understanding of the current campus management and policies, analyzing the opportunities and challenges of those identified components, and providing recommended actions to guide long-term stewardship planning. These goals were explored through our research methods, which included a literature review that utilized a comparative lens between Tufts University's existing land stewardship practices and peer institutions' practices, several interviews and site visits with key participants with a wealth of knowledge on Grafton Campus facilities and open space, and spatial data collection performed through GIS mapping.

We organized our findings across three asset classes: cultural, ecological, and academic. Each asset class has corresponding challenges, opportunities, and recommendations throughout the report. These findings are

important considerations in land stewardship planning due to their interconnectedness and impact on land management strategies.

Following this research process, our team developed four main recommendations based on these findings. First, develop an ongoing relationship with the Nipmuc people to explore the possibility of a mutually beneficial partnership. In consultation with the tribe, Tufts should determine if resources should be dedicated to conducting an archeological survey on the Grafton site or whether some type of other partnership would be beneficial. Next, establish a centralized repository of current and future academic and research activities. This repository will enable Tufts to track research or activities that occur on Grafton Campus, along with providing a central location for easy access to information on projects. We also recommend creating a land protection framework based on an inventory and ecosystem service analysis. This framework would include the establishment of the conservation ethics, strategies for land management, and future planning for open space. Lastly, engage the Tufts Legal Department and Worcester County Register of Deeds in a process of boundary reconciliation. We recommend strategically placing postings at pertinent locations along the perimeter, such as road entry points to campus where campus police have spotted hunters, to address hunting impacts.

Through the identification of the challenges, opportunities, and recommendations associated with each asset class, we anticipate that this report will serve as a guiding resource for future land stewardship efforts and planning decisions on the Grafton Campus.



photo credits: Anna Miller

PROJECT BACKGROUND

Introduction

Open land is incredibly important for many reasons including but not limited to providing habitat for many important animal and plant communities, maintaining freshwater supply, carbon sequestration, air purification, preventing soil erosion, promoting soil health (Hanberry et al., 2020).

Although the importance of open, undeveloped space is undeniable, many institutions are still unsure of how to better manage and steward the lands and water that they are responsible for. The institutions that are currently responding to this need have developed frameworks, objectives, and departments to guide these efforts. Sustainable measures have gained popularity as they serve to mitigate impact, integrate human and environmental benefits, and support ecological health through long-term goal implementation. In addition to sustainability measures, institutions are also beginning to adopt conservation practices into their objectives and development plans.

Tufts University formerly conducted research on the Grafton Campus open space through a survey, Campus Biodiversity Assessment 2016, as well as an earlier study completed by Vanasse Hangen Brustlin Inc. (VHB) an environmental consulting group in 2002. Although this research was previously conducted, Tufts University acknowledges that supplementary research is necessary to provide a comprehensive understanding of the land for future management. Additionally, this is something the Cummings Veterinary School in Grafton is promoting in the 2030 Strategic Vision which commits to “recognizing, responding, and caring for the changing ecosystems and environments in our world”

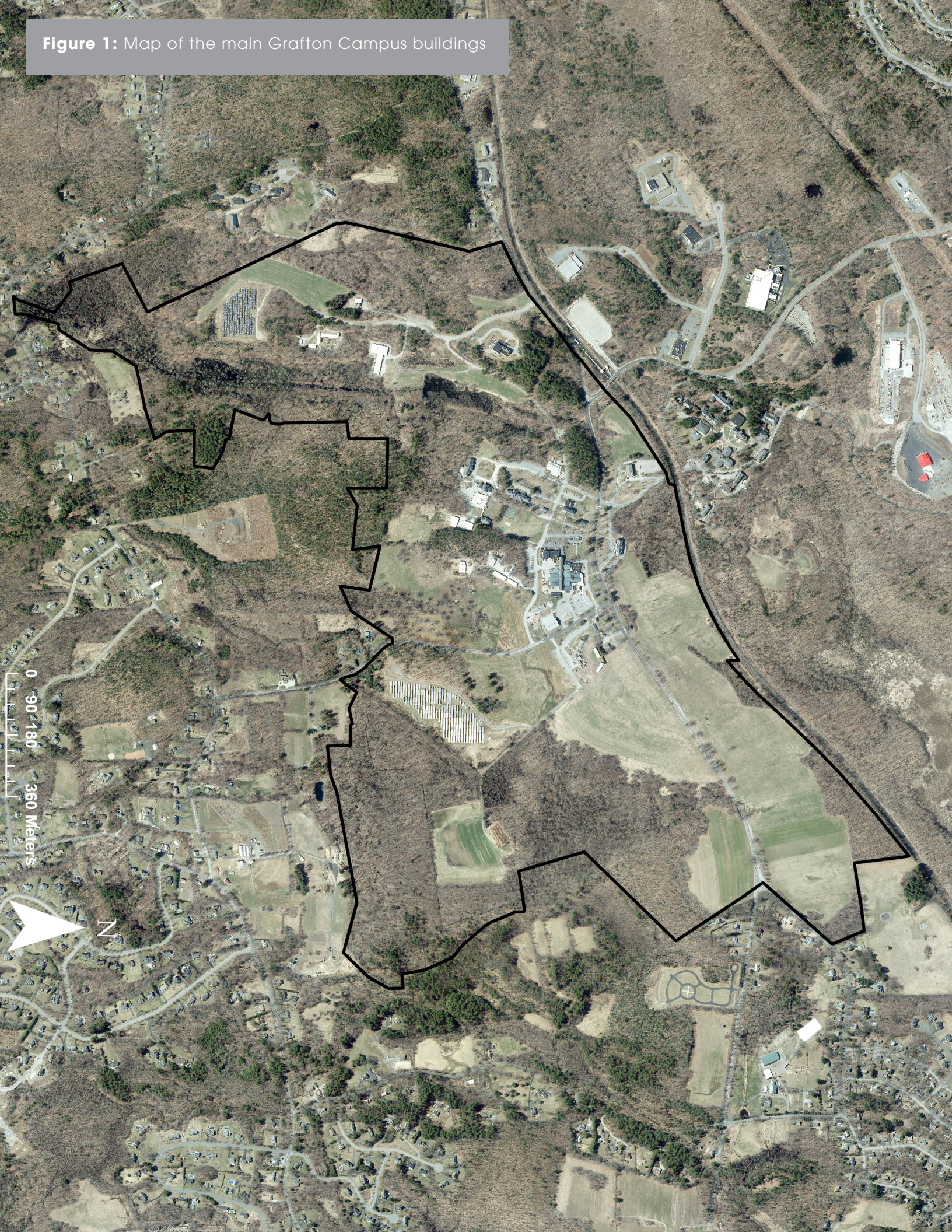
(Tufts University, Paragraph 2).

Project Overview

This Grafton Land Stewardship Plan is a collaborative project conducted by the Department of Urban and Environmental Policy and Planning (UEP) Field Project Team for Tufts University. In collaboration with the Tufts Office of Sustainability (OOS) and Campus Planning Department (CPD), this initiative considers the use of the Grafton Campus open space. The Grafton Campus is the largest by acreage of the four campuses that Tufts University operates, as well as the most ecologically diverse. Located across the towns of Grafton and Westborough in central Massachusetts, the approximately 600-acre property includes university buildings and lands primarily used by the Cummings School of Veterinary Medicine and its associated facilities. The Cummings School provides veterinary and graduate education by developing and delivering innovative care for domestic and wild animals to help achieve health and well-being for all species and by fostering a diverse, equitable, and inclusive community and profession.

The property is zoned as “Office/ Light Industry”, with the Town of Grafton establishing the “Campus Development Overlay (CDO)” district as a specific zoning that allows Tufts-owned land to be treated as one contiguous property despite the two town boundaries. This zoning’s intent is to provide design criteria and guidelines in accordance with master plans (Appendix B). As of now, no single comprehensive assessment or inventory of the land has yet to be conducted for Grafton Campus plans. This field project aims to fill that gap.

Figure 1: Map of the main Grafton Campus buildings



The Grafton Campus is comprised of two main areas: school facilities and open space. The 50 acres of campus facilities, areas such as buildings, parking lots, and solar fields, support education and research as well as central operations and services (Figure 1 Grafton Campus Map). The other 550 acres are primarily open space. Across these open space areas, 200 acres are allocated to agricultural use, and approximately 350 acres are identified as forests and wetland areas.

Open space plays a crucial role in the research, agriculture, teaching activities, and biodiversity associated with Grafton Campus. As a majority of the campus's acreage can be categorized as open space, the university seeks to develop a comprehensive landscape stewardship plan. Effective land stewardship planning balances the ecological health of a university campus with educational needs and those of the off-campus community. This integration of sustainable practices and educational services will strengthen Tufts University's larger environmental objectives. This project will develop an initial inventory of the components of the Grafton Campus open space in order to provide baseline information and an initial suite of recommended actions that can guide long-term land stewardship planning and management on the Grafton Campus.

Project Context

Tufts University is a private research institution with operations located in Medford/Somerville, Boston, and Grafton. Across its four campuses, the university houses an undergraduate college, seven graduate schools, and affiliations with several hospitals and research facilities. These programs enroll around 12,000 students and employ around 4,400 faculty and staff, resulting in a growing number of research initiatives. In pursuance of further supporting these initiatives, Tufts has engaged in master planning on the Grafton Campus.

The Grafton Campus development

plans are determined by Tufts University and Cummings School administration. Its development is influenced by the objectives of the Campus Framework Plan, whose proposal integrates development and renewal strategies to advance the Cummings Schools's Strategic Vision 2030 goals. The focus of the Campus Framework Plan centers around optimizing investments in new construction through targeted investments in capital renewal and supporting other goals that may be brought up during discussions (Grafton Master Planning Services, 2023). Tufts University's, and by extension the strategic objectives of Grafton Campus, are influenced by infrastructure renewable needs, decarbonization and sustainability goals, and funding opportunities (Office of Sustainability, n.d.). To learn more about the environmental management and initiatives Tufts University has implemented, please refer to Appendix D.

Project Goals and Questions

The UEP Field Projects Team developed a framework for land stewardship decision making that incorporates the following:

- An inventory of open space, assets, and baseline assessments;
- A review of relevant policies, plans, and practices;
- An analysis of opportunities and challenges;
- Recommendations for the management and use of open space on campus;

The following research questions will guide the work:

- What are the ecological features, resources, and constraints of the Grafton Campus associated with land management?
- What current management practices are employed on the Grafton Campus for the following land uses and associated areas, and who is responsible for

maintaining them?

- a. Conservation Land
- b. Agricultural Land
- c. Other Land Uses
- What are the relevant land use policies and plans pertaining to the Grafton Campus?

Methods

The team implemented several methods that address the research questions and achieve the goals of the project. We took a comparative approach with our literature review by identifying and comparing ecological and agricultural management planning between Tufts and other institutions. Our qualitative methods included gathering and analyzing data through in-depth interviews, site visits and spatial data collection. All research

procedures were carried out in compliance with Tufts University’s Institutional Review Board protocols.

Literature Review

The team reviewed literature to synthesize land management strategies used by comparable institutions to Tufts University. Utilizing accessible resources and peer-reviewed articles, we explored successful approaches in establishing land stewardship plans, expanding rural and agricultural development, and hazard mitigation. This information focused on the following:

- Site Background Research
 - a. Zoning
 - b. History
- Tufts Ecological Management
- Case Studies

Table 1. List of interviewed participants.

Name	Title	Areas Visited	Focus Points
Stephanie Bertrand, M.B.A.	Grafton Farm Manager	<ul style="list-style-type: none"> • All fields and pastures • Compost area 	<ul style="list-style-type: none"> • Field and pasture types • crops and animals raised • flooding impacts
Lt. David Nieves	Police Lieutenant, Tufts university Police Department-Grafton	<ul style="list-style-type: none"> • Discovery drive entrance • Solar field turnaround 	<ul style="list-style-type: none"> • Entrance point by hunters found on campus • Limited boundary postings
Dr. Alison Robbins, D.V.M.	Assistant Teaching Professor, Department of Infectious Disease and Global Health	<ul style="list-style-type: none"> • Bat research area • Beaver dam research area 	<ul style="list-style-type: none"> • Need for tracking and sharing research projects • Interest in re-establishing sweetgrass
Dr. Christopher Whittier, D.V.M., Ph.D.	Assistant Teaching Professor, Department of Infectious Disease and Global Health	<ul style="list-style-type: none"> • Southern Tufts boundary • General wildlife research • Areas and select camera trap locations 	<ul style="list-style-type: none"> • Research areas and camera trap locations • Provided access to location-based research data • Presence of hunters

- c. Ecological Management Practices
- d. Rural/Agricultural Development

The literature review explores land management practices from institutions, master plan documents, and local policies. The relevant literature draws useful parallels to Tufts for possible integration in its own land management efforts. The Tisch Library search engine was the primary database for initial research gathering. Search keywords included: “animal conservation,” “land management,” “agricultural management,” “institutional conservation,” “Tufts conservation,” and “Tufts sustainability.” Additionally, comparative research was generated directly from college and university websites, such as Middlebury College, the University of Florida, and Colgate College. Our project partners provided considerable gray literature in the form of Tufts internal planning documentation such as the Amended Grafton Master Plan, Hazard Mitigation Plan, and Campus Biodiversity Assessment 2016.

Key Participant Interviews and Site Visits

Relevant participants representing key groups such as faculty and operational staff were identified for interviews with input and referrals from our project partners (see Table 1). The goal was to meet with both faculty and staff who hold key expertise on educational and operational activities as they relate to open space on the Grafton Campus.

Interview questions focused on understanding participant priorities, challenges (Appendix A), and suggestions pertaining to the Grafton Campus. After our interviews with the key participants we walked through a variety of areas related to their research or operations which represent diverse land use types and ecosystems within the larger category of open space. Due to the varying educational and operational activities that take place on campus, it is important to

see the physical characteristics and dynamics of the campus landscapes. Each interview and area visited lasted between one and two hours. By understanding the work that is done in these areas, we were able to gather key inputs that helped build our inventory.

Spatial Data Collection

Spatial data collection, as a method for a land stewardship plan, involved gathering information about the physical characteristics and spatial relationships of the land and its features. This method plays a pivotal role in informing the land stewardship planning process outlined in this report. Synthesizing data from a variety of campus and open source portals, the team mapped land cover, valuable campus assets such as research zones and agricultural areas, as well as key points of contention, such as campus boundaries.

By leveraging data layers available on MassGIS and through data previously collected by some of the key stakeholders, we identify a variety of ecological aspects, wetland and woodland ecosystems, and research areas around campus. Farmland data collection efforts focused on mapping agricultural land use data and crop types provided by farm management. Through field surveys and interviews with farm management staff, we compiled a comprehensive inventory of farmland parcels and highlighted areas that are susceptible to flooding.

The spatial data collection method provides a robust foundation for land stewardship planning, enabling the identification of priority areas for conservation, the assessment of ecological resources, and the development of strategies to promote sustainable land use and management practices. By integrating spatial data from multiple sources, we generate actionable insights and inform evidence-based decision-making processes aimed at preserving and enhancing the ecological

integrity and productivity of the study area.

All spatial data is compiled into a comprehensive map shared with our project partners in a separate ArcGIS Pro project file. This map acted as a repository of geospatial information and all ensuing maps showcased pertinent layers that support our findings.

Case Studies

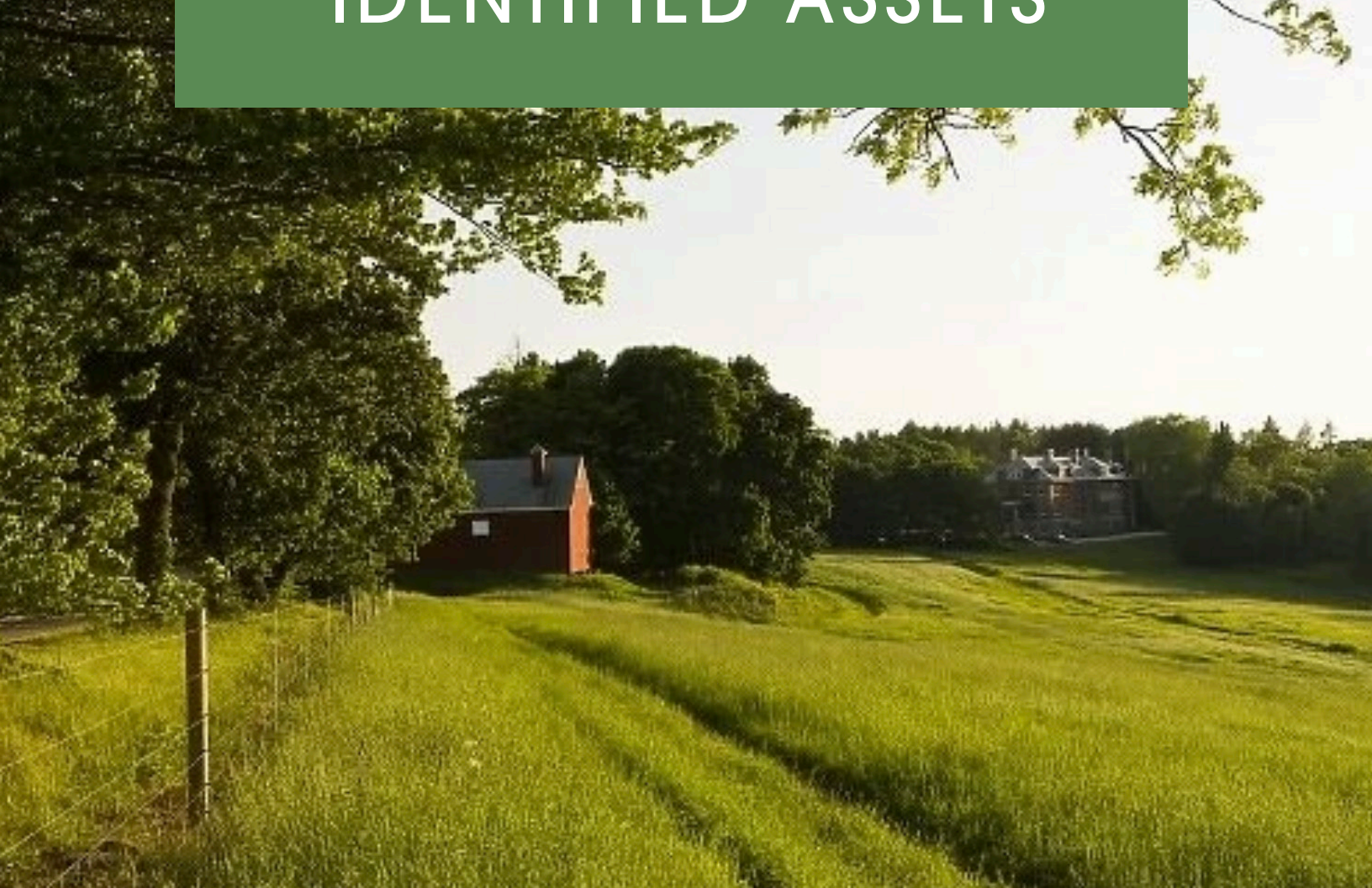
Given what we know about Tufts University and its goal of having an effective land stewardship plan that supports academic and sustainability objectives on the Grafton Campus, we explored relevant case studies and approaches from other institutions. These approaches supplement our recommendations for three overarching assets groups we identified on campus (Table 2): cultural, ecological, and academic.

Table 2. Identified assets of Grafton Campus.

Asset Type	Description
Cultural	Analysis of historical impacts on the Grafton Campus that inform future management practices
Ecological	Comprehensive environmental assessments and data analysis to inform strategic campus planning recommendations for sustainable management and conservation.
Academic	Evaluating current educational programs, faculty expertise, and research initiatives to inform strategic campus planning recommendations aimed at enhancing academic excellence and innovation on campus.



IDENTIFIED ASSETS





CULTURAL ASSETS

Introduction

Before Tufts University begins planning for the future uses of the Grafton Campus or continuing to realize its current uses, taking stock of its past uses and enduring cultural importance will help guide the management of this land. Studying the human interactions and connections to the site is just as valuable as studying its ecological composition. This section charts the history of the site based on publicly available information.

Historical Background

The Grafton Campus at Tufts University, now home to the Cummings School of Veterinary Medicine, has a long history of indigenous, colonial, and state use prior

to becoming the prominent location for veterinary training in the Northeast. The towns incorporated in Grafton and Westborough were once inhabited by the Hassanamisco Nipmuc people. The Hassanamesit Woods situated at the junction of the Quinsigamond and Blackstone Rivers made the area attractive for the Nipmuc Tribe due to the waterways and natural resources (Wickstrom, 2021). A 2005 survey of the Hassanamesit Woods suggested that the land was used by native populations as long as 8,000 years ago (Archaeological Survey, 2005).

While the Nipmucs moved with the seasons and tracked game and natural resources for their livelihood, evidence showed they often returned to the Hassanamesit Woods,

suggesting a sense of home or cultural significance (Wickstrom, 2021). The rich history of the Nipmuc people and their stewardship of the lands in and around the Grafton Campus is a unique cultural asset to the Tufts Grafton Campus. To understand the Nipmuc's deep connection to the land, both past and present, and to chart a future that honors their rights, it is important to understand their broader efforts to reclaim their homelands.

The first colonial contact occurred in the early 17th century when the English began to dispossess indigenous land across southern New England. Hassanemit, as it was referred to by the English, was known as a "praying Indian" town that served as a center for missionary activities in Central Massachusetts until the beginning of King Philip's War (Open Space and Recreation Plan, 2020). Contact with European settlers brought violence and land seizures to the Nipmuc people. Nipmucs were among those forcibly removed to Deer Island, an island by name only that is connected to the town of Winthrop, Massachusetts, by the English during King Philip's War in 1675. After the population of the Nipmucs in the Hassanamesit Woods region was decimated by disease and war in the 1720s, the remaining Nipmuc people in the region sold 7,500 acres of land to the English, retaining 500 acres for themselves (Wickstrom, 2021). However, the Nipmucs were not granted access to the money from the sale of land. Instead, it was put in a trust that the Nipmucs did not have access to and which the trustees squandered, impoverishing their community and contributing to the sale of more land.

Not much is known about the farms that existed on the Tufts Grafton Site before it became a mental hospital. In 1902, the nearby Worcester Insane Asylum had grown to be highly overcrowded and an expansion was needed according to the Massachusetts State Hospital System (Worcester Insane Asylum,

1902). Land was purchased in North Grafton and Westborough, and in 1903 an extension of the system later to be named the Grafton State Hospital was opened (Worcester Insane Asylum, 1902). Towns like Grafton were used for therapy and potential rehabilitation due to the pastoral setting, fresh air and sunlight. Patients farmed, tended gardens, maintained, and sometimes constructed additions to the property until the hospital shut its doors in 1973 (Health and Human Services, 2020). Online resources about the hospital are limited. Without further research into historical records, it is difficult to know how patients were treated in the Grafton State Hospital. The Grafton State Hospital was the first psychiatric hospital to close in Massachusetts as part of the state's process of deinstitutionalization ("The Desperate and the Dead Series: Mental Illness and Community Based Care," 2016). Upon closure of the Grafton State Hospital, the State of Massachusetts was tasked with proposing next steps for the land. Former state hospital supporters made a correlation between the closing of the state mental hospital and the need for a prison ("Grafton Prison Plan Still in Limbo", 1976). Governor Michael Dukakis wanted the former hospital to return to a more natural pastoral setting, and it to be used for public gardens (Kenney, 1975).

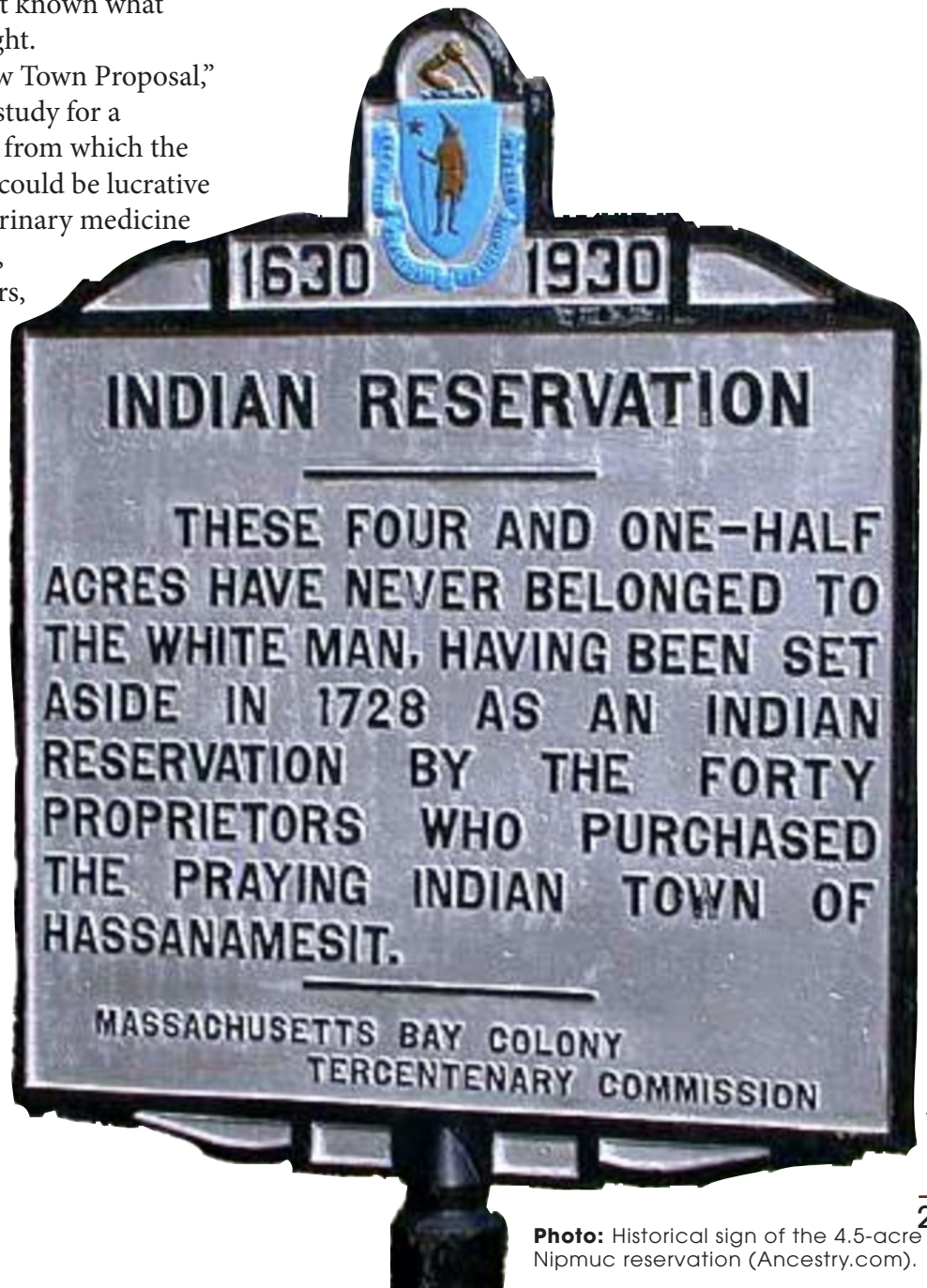
In 1977, Nipmuc sachem Zara Cisco Brough, a prominent member of the Nipmuc Tribe in Grafton who played an important role in founding the Massachusetts Commission on Indian Affairs in 1974 petitioned Governor Dukakis for the 500 acres of former Grafton State Hospital land (Regional Digest, 2009). Cisco Brough laid out her plans with the "New Town Proposal" which focused on stewardship and conservation. The goal was for the former State land to become a community for displaced Nipmuc people who would be able to live self-sufficiently (Summary Under the Criteria and Evidence for Final Determination

Against Federal Acknowledgement of the Nipmuc Nation, 2004). The return of land and the protection of culturally significant lands is critically important to the Nipmuc Nation and has driven much of the community's work in the past 50 years.

The New Town proposal to acquire 500 acres of the former state mental hospital lands is one of many. Wickstrom was unable to locate the original proposal Nipmuc sachem Zara Cisco Brough made for the land, and was only able to piece together the proposal from a secondary source. The petition was for the tribe to receive 500 acres of the 1,100 acre state hospital site back, but it is not known what segment of this site they sought.

In 1976, a year before "New Town Proposal," Tufts conducted a feasibility study for a potential veterinarian school from which the findings indicated that there could be lucrative results due to the lack of veterinary medicine in New England (Wickstrom, 2021). Over the next two years,

Tufts representatives lobbied State and Congressional leadership for endorsements and brokered a deal that helped secure the land for \$1 (Taylor, 1978). Since 1979, the Cummings School of Veterinary Medicine has graduated over 2,000 students and expanded into seven teaching hospitals and clinics that care for more than 100,000 animals annually (Cummings School of Veterinary Medicine, 2024). Today, Tufts is one of the largest employers in Grafton (Campus Master Plan 2020-2030, 2020).



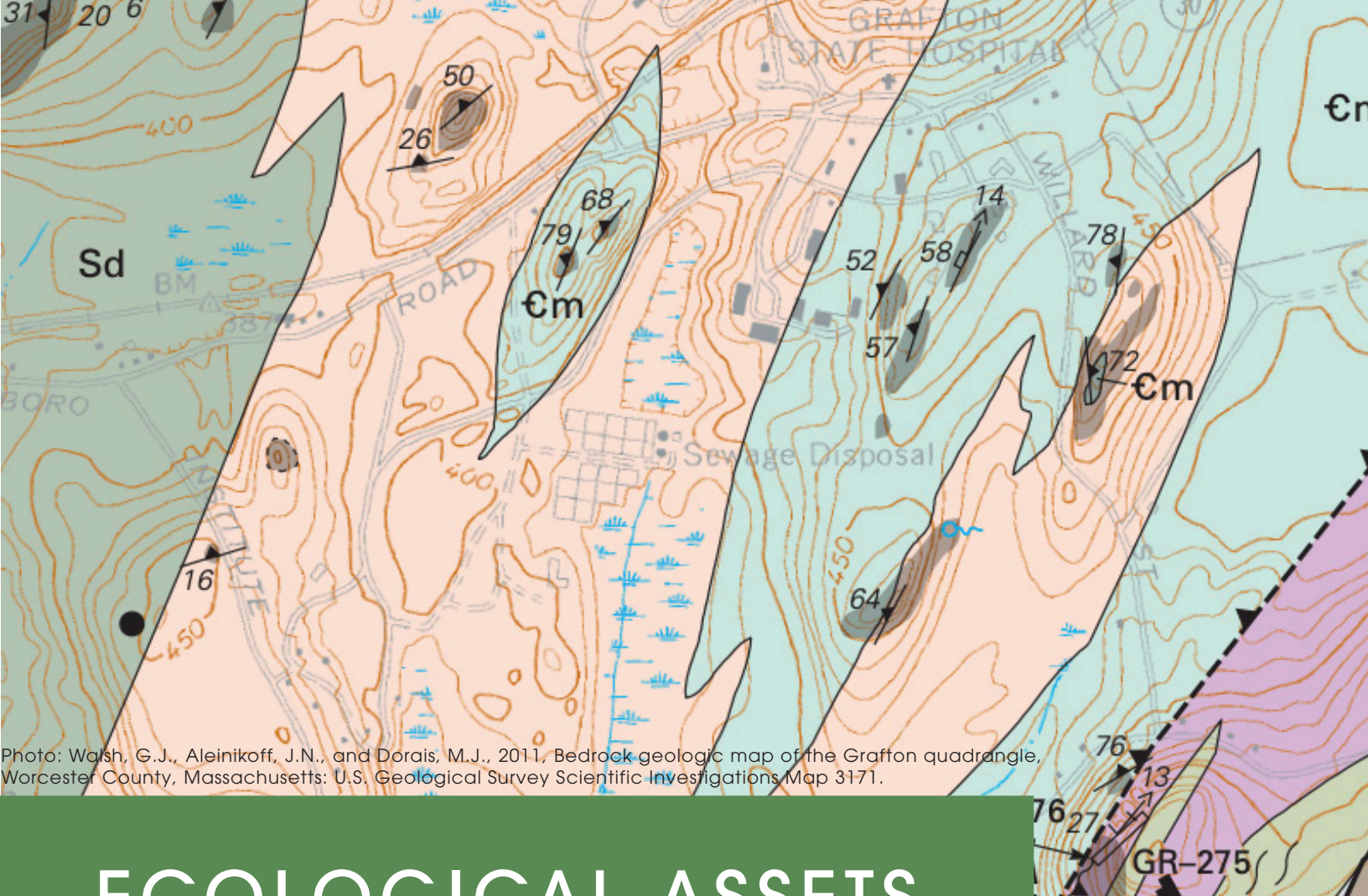


Photo: Walsh, G.J., Aleinikoff, J.N., and Dorais, M.J., 2011, Bedrock geologic map of the Grafton quadrangle, Worcester County, Massachusetts: U.S. Geological Survey Scientific Investigations Map 3171.

ECOLOGICAL ASSETS

Introduction

This section highlights the ecological assets associated with the Grafton Campus. These include geology, soil, woodlands, and wetlands. Each of these elements are unique and play a role in shaping the campus environment, influencing its biodiversity, agricultural potential, and ecological health, and are thus needed to be considered when creating a stewardship plan for the Grafton Campus.

Geology

The bedrock underneath the Grafton campus can influence the mineral composition of the campus soil. The bedrock is slowly weathered over time which regularly releases

mineral nutrients, and certain soils are favored by different plants. Therefore, understanding what the bedrock consists of is an important step towards producing fertile, well-drained soils.

The Grafton campus bedrock mainly consists of gneiss and amphibolite rocks. Grafton Gneiss is a type of biotite granite gneiss that is light-gray to light-pink in color, medium-grained, and well-foliated. Large outcrops of Grafton Gneiss can be found east and west of Willard Street and south of Westboro Road. (Walsh, Aleinikoff, and Dorais, 2011). Marlboro Formation, the second type of bedrock on campus, is a dark-green-to-black amphibolite type of gneiss. Both were formed under metamorphic

conditions. Together, these rocks are the parent materials for the campus soil. Granite and gneiss tend to form acidic soils while amphibolite soils are typically rich in minerals and nutrients (Plant & Soil Sciences eLibrary, n.d).

Soil

There are fifteen different soil types throughout the Grafton campus. These groups are further divided by slope and whether or not they are extremely stony (Figure 11). Most of the soil has a sandy loam or loamy sand texture, which consists of more than 50% sand and 20% clay. The Swine 1 Hayfield and Cornfield Road Pine Tree Hayfield are located on farmland of statewide importance (Figure 8). Furthermore, some parts of the Wildlife Hayfield, Wildlife Cornfield, Wildlife Summer Pasture, and Solar Park Pasture are considered to have statewide importance, which is defined by the USGS as “land that has the best combination of physical and chemical characteristics for economically producing sustained high yields of food, feed, forage, fiber, and oilseed crops, when treated and managed according to acceptable farming methods”

Additionally, with the exception of the campus wetlands, the campus soils are at least moderately drained throughout the year. However, most of the campus soil is less than eight centimeters from the water table, which increases the chance of having saturated soil. Sodium and other salt ions can easily flow through saturated soil zones, and topsoil that is too shallow a depth to the water table can increase salinity which further leads to poor crop health. For crops, North Dakota State University suggests an optimal depth to the water table of about three feet (91 centimeters), which is not present anywhere on campus (NDSU, n.d.).

More maps and soil parameters, such as pH, conductivity, and hydric rating, are available in the Appendix F.

Woodlands

Grafton’s original forest cover was a mix of American Chestnut (*Castanea dentata*), Eastern Hemlock (*Tsuga canadensis*), and Eastern White Pine (*Pinus strobus*). However, extensive logging and clearing for agriculture and grazing as well as the Chestnut Blight has drastically altered the woodland landscape of Grafton (Griffith et al., 2009). Despite these changes, the Grafton campus remains a distinctive blend of woodland, rural farmland, and formal grounds shaped by the establishment of the Grafton State Hospital. It is estimated that 34% of the total acreage of the Grafton Campus is forested, which reflects the enduring presence of wooded areas through evolving land use patterns (Grafton Biodiversity Survey, 2016).

Wetlands

Wetlands are a key ecological feature of the Grafton Campus. Due to their importance, they are protected under the Massachusetts Wetland Protection Act (Massachusetts General Laws (MGL) Chapter 131, Section 40). Grafton additionally protects its wetlands with the Grafton Wetland Protection Bylaw, which provides specific town regulations/ rules for the wetlands in Grafton. Wetlands are “areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season” (EPA, Paragraph 1). Wetlands are found in many different areas across vastly different landscapes. According to the Massachusetts Department of Environmental Protection, there are three main types of wetlands; freshwater wetlands, salt marshes, and coastal resources. In Massachusetts, wetlands cover approximately 14% of the state, with freshwater wetlands comprising 82% of these areas (Rhodes et al., 2019)..



Photo: Two woodchucks were spotted on campus using camera traps (Dr. Christopher Whittier).

Due to the location of Grafton, the campus has freshwater wetlands. Freshwater wetlands are non-tidal vegetated areas where water is near or on the surface of the ground during the majority of the growing season. Some different forms of freshwater wetlands are wooded swamps, shrub swamps, marshes, and bogs (Rhodes et al., 2019).. All of these types of freshwater wetlands are likely located on the Grafton Campus

ACADEMIC ASSETS



Introduction

In this section, we explore the academic assets within Tufts University's Grafton Campus, where the land stewardship intertwines with the pursuit of academic advancement. We introduce the Cummings School of Veterinary Medicine, a variety of past and present research activities, and the Cummings Farm. The section shows the importance that open space, farmland, and conservation land play in facilitating academic and research activities. These are integral components and considerations for land stewardship planning on the Grafton Campus.

Cummings School of Veterinary Medicine

Among Tufts's campus locations, the Grafton Campus is the main hub of Tufts conservation initiatives. The school includes four main centers for these practices: the Tufts Wildlife Clinic, the Center for Conservation

Medicine, the Center for Animals and Public Policy, and the Cummings School Farm. The Tufts Wildlife Clinic provides students the opportunity to work with around 1,600 wildlife patients annually ("Center for Conservation Medicine: Cummings School of Veterinary Medicine", n.d.). The Center for Conservation Medicine includes programs for wildlife medicine, international veterinary medicine, and conservation medicine. The Center for Animals and Public Policy centers more on developing human animal interactions through research, service, and discussion ("Center for Animals and Public Policy: Cummings School of Veterinary Medicine", n.d.). The center's online series "Animal Matters" is one way the school speaks on conservation through urban wildlife and animal protection. The Grafton Campus provides students the opportunity to not only improve the understanding of animal and human health, but to also develop

Table 3. Identified research activities: current and intended.

Research Activity	Purpose	Point of Contact	Research Output
Campus Biodiversity Assessment 2016	Initial inventory of wildlife species (emphasis on rare or endangered/threatened species) and their habitats on Grafton Campus. Data collection on presence via camera traps, field surveys, and GPS field data. Compiled research inventories on aggregate of animals for species classification and categorization for further assistance in student research.	<ul style="list-style-type: none"> • Carolyn Talmadge, GIS Specialist • Dr. Alison Robbins, D.V.M. 	<ul style="list-style-type: none"> • Tufts University Data Lab
Camera Traps	15 to 20 of 100 cameras deployed at a time in 190 locations around campus for research on wildlife species within the campus. Majority of deployment is located in the southernmost part of campus (forest and forested-wetlands). Data collection has thus far allocated over 1.7 million pictures, which are available for further application to student research.	<ul style="list-style-type: none"> • Dr. Christopher Whittier, D.V.M., Ph.D 	<ul style="list-style-type: none"> • N/A
ENV 0121/UEP 294 Drones for Environmental Research (Fall 2024)	Students will operate GNSS equipped drones from the Data Lab in the Tisch Library of the Medford Campus to collect data from 3 designated locations on Grafton Campus's open space. Research will include the studying of the dry abandoned beaver dam and the resulting associated biodiversity, along with tree categorization.	<ul style="list-style-type: none"> • Dr. Christopher Whittier, D.V.M., Ph.D • Jon Caris, Sr. Drone Data Scientist 	<ul style="list-style-type: none"> • Tufts University

environmentally conscious farming practices through teaching and research. With these centers existing on and surrounded by land with a multitude of ecological components, the programs often integrate conservation into institutional activities.

Research Activities

The Grafton Campus designates research as an integral part in the advancement of not only veterinary medicine, but also by extension “wildlife health and conservation, humane treatment of animals, protection of the nation’s food supply, and control of zoonotic disease” (“Student Research Training Programs”, n.d.). As such, the school offers various opportunities for DVM and other students to further their education via clinics, laboratories, or infield activities. From dialogues with Professor Robbins and Professor Whittier, the value that the open space of Grafton Campus brings to the Cummings School is further communicated.

As research offers a wealth of knowledge in relation to our inventory methods and our recommendations should keep future research prospects in mind as we need to continue the support for those activities, it is important to identify and consider the extent of research that takes place on the Grafton Campus.

In addition to the listed research activities in Table 3, the Grafton Campus hosts research projects through specific Cumming School program courses, visiting stakeholders or consultants or students from other Tufts University campuses, and individual activities via graduate students and professors. However, due to a lack of a central repository allowing access to information on projects and, or visits, the majority of information gathered on research activities is obtained via interviews, GIS reports from the Tufts University Data Lab, and personal communications.

Cummings School Farm

The majority of the information gathered about the Cummings School Farm comes from an interview and personal communications with Stephanie Bertrand, the farm manager at Tufts. Additional information comes from The Sustainability Tracking, Assessment & Rating System (STARS), a self-reporting system that colleges and universities use to measure sustainability performance. The Tufts STARS report used data from 2019 and 2022 (“Landscape Management | Tufts University | Scorecard | Institutions | STARS Reports,” n.d.). We have mapped the uses of the farmland, gathered the types of animal and crops that are raised, and highlighted aspects of the farm. Ensuing sections lay out our findings with accompanying challenges and opportunities.

Farm Findings

The farm operates, harvests, and cares for 200 acres of land. The land is used to raise beef cattle, sheep, dairy replacement heifers, laying hens, corn, legumes, and hay. According to Ms. Bertrand, the acreage is utilized as follows: 20 acres for corn, 150 acres for legumes, and about 30 acres for pasture. Pasture land is dependent on accessibility to shelter and fully enclosed fencing to keep animals both safe and contained. Figure 2 shows an overlay of field types and uses.

There is a degree of interchangeability with the farm uses, but pastures 6b - 10 are all grazing fields which will not serve any other purpose besides feeding the animals (Figure 2). Crop rotation is employed on the farm as a tool to build healthy soil and is a positive impact that contributes to the interchangeability of the land. The farm plans to continue crop rotation as much as possible, but production is paramount and long term rotation plans may fall secondary to securing seasonal crop yields. Because the farm

aims to be self-sufficient, it raises corn and several types of legumes and grasses almost exclusively for farm animal feed and bedding with a portion of production sold to the local community.

Most farm animals are raised for food and fiber production, certain species are used in teaching and research at the Cummings School (Cummings School Farm, 2024). Species, quantity and protocol number is shown in Table 4 Research Animal Inventory provided by Stephanie Bertrand. Each species is tied to research, which is tracked using protocol numbers.

The curriculum at the veterinary school is structured around the life cycles of different species, allowing students to learn about the care and management of healthy animals, not just diagnosing and treating illnesses. This approach helps students understand the fundamentals before delving into abnormalities. Hands-on experience at the farm is crucial for building rapport and

credibility for future veterinary students.

The farm also offers resources to the broader community, including opportunities like the Adventures in Veterinary Medicine program, which provides exposure to the veterinary profession for students of all ages (Becker, 2022). The collaborative environment at the farm fosters learning not only for students but also for staff, who appreciate the exchange

of knowledge and experiences. Overall, the Grafton Campus serves as an invaluable resource for education, research, and community outreach in veterinary medicine.

Table 4. Research animal inventory provided by Stephanie Bertrand.

Species	Quantity	Protocol Number
Sheep	129	Gray-Edwards G2021-47
Beef Cattle	5	Gray-Edwards G2021-47
Camelid	1	White G2022-221



Tufts Cummings School of Veterinary Medicine

Farm Fields

- 1a. Compost Hayfield
- 1b. Compost Pile
- 2. Southside Cornfield
- 3a. Dog Park
- 3b. Northside Dog Park Hayfield
- 3c. Northeast Dog Park Hayfield
- 3d. Northside Cornfield
- 4a. Northside Swale
- 4b. Northside Hillside
- 4c. Field 4c
- 4d. Northside Train Tracks
- 4e. Admin Field
- 5a. Wildlife Hayfield
- 5b. Wildlife Cornfield
- 6a. Wildlife Summer Pasture
- 6b. Solar Park Pasture
- 7. Sheep Pasture
- 8. Beef Steer Pasture/Holstein Pasture
- 9. Beef Cattle Pasture
- 10. Goat Barn 1 Pasture
- 11. Library Hayfield
- 12. Cornfield Road Pine Tree Hayfield
- 13. Swine 2 Hayfield
- 14. Swine 1 Hayfield
- 15. Route 30 Hayfield

Figure 2. Farm fields overlay.

CHALLENGES AND CASES

Introduction

Navigating the intersection of academia and indigenous relations, land stewardship, environmental sustainability, and institutional boundaries presents Tufts University with a multifaceted array of challenges. In this section, we raised the complexities faced by Tufts in engagement with the Nipmuc Nation, establishing a comprehensive land management and stewardship framework, mitigating environmental factors that impact academic activities, and reconciling discrepancies in campus boundaries from various sources. Through examination of pertinent case studies, we highlighted how other institutions navigate each challenge.

Cultural Challenges

Relationship with Nipmuc

The lack of a working relationship between Tufts University and the Nipmuc Nation is apparent. In order to plan for mutually beneficial future possibilities on the Grafton Campus, Tufts would first need to dedicate some institutional resources to establishing and exploring these opportunities in partnership with representatives from the Tribe.

In developing a working relationship with the tribal government of the Hassanamisco Band, Tufts University should be aware that there appears to be different organizations and entities that represent the Hassanamisco Band of the Nipmuc Nation and its people. In 2022, the Nipmuc Nation split into two organizations. The Hassanamisco Nipmuc Band Council broke off from the Nipmuc Nation Tribal Council, Inc. The Hassanamisco Nipmuc Band Council broke off from the Nipmuc Nation Tribal Council, Inc. (“Hassanamisco Nipmuc Band,” n.d.) (“Tribal Government of the Nipmuc Nation,” n.d.).

Without more information, it is difficult to determine which organization represents the Hassanamisco Band.

Peer Institution Indigenous Cases

Indigenous people across the United States have been pressing non-native colleges and universities to re-examine and acknowledge the founding origins of these institutions, which dispossessed Native people from their land, and to take action to form reparative relationships with tribes and tribal communities. The Morrill Act, signed by Abraham Lincoln, created the land-grant university system by funding universities and their endowments with the seizures of Indigenous lands (Lee et al., 2020). While Tufts is not a land grant university, it still holds land that was taken from the Nipmuc people.

Since a component of the injustice perpetrated against Indigenous peoples by settler colonialism is the confiscation of lands, much of the reparative actions stem from the actual return of land to Indigenous tribes. The specific actions that universities and colleges are taking to recognize and repair the harm they have caused are summarized in Table 5.

Ecological Challenges

Lack of Species Identification in Woodlands

A lack of identified forest species is a gap in prior research. Although a biological survey was completed in 2016, this was conducted at a very high level, without identifying many species (Tufts University, 2016). Having a full inventory of forest species would be beneficial to greater campus planning efforts. Therefore, providing information that would assist in the creation of a land management framework, conservation efforts, and enable the university and stakeholders to have a comprehensive understanding of the current risks and

Table 5. Case Studies: Examples of Non-Native Colleges and Universities’ Work with Indigenous Tribes and People.

Action	Examples of Non-Native Colleges and Universities
Examining and acknowledging institution’s history with native peoples	Native-led project, Towards Recognition and University-Tribal Healing (TRUTH), examined the University of Minnesota’s history with native peoples (“TRUTH Project,” n.d.). The report found that the Founding Board of Regents committed genocide and ethnic cleansing of Indigenous people (Mohs 2023).
Granting Indigenous access to lands	University of Washington maintains Memorandums of Understanding (MOUs) with indigenous groups to grow food and plants and farm on university lands (“Partnerships with Indigenous Tribes and Nations,” n.d.).
Creating land stewardship partnerships	Harvard Forest is collaborating with the Hassanamisco Band of Nipmuc on education, land stewardship, and research projects (“Harvard Forest Land Management,” n.d.). HF’s 2008 Land-Use Master Plan omitted the perspectives of the Nipmuc. To redress this, HF and the Hassanamisco Band of Nipmucs are writing a forest management plan for 1,000 acres of land that centers Nipmuc goals and values (“Harvard Forest Land Management,” n.d.).
Collaborating on Native-led projects	Utah State University (USU) worked with the Northwestern Band of the Shoshone Nation to restore the site of the Bear River Massacre, in which hundreds of Shoshone people were murdered by U.S. soldiers (Larsen 2022).
Compensating Indigenous peoples for use of their lands	USU earns millions a year from oil, gas, and minerals extraction and sales and leases for development from the lands taken from Indigenous tribes. USU offers full tuition for resident Native Americans (Banta 2024).
Returning land to Indigenous peoples	<p>The University of Minnesota will return 3,400 acres of land to Fond du Lac Band of Lake Superior Chippewa (which already within boundaries of tribe’s reservation) (“U of M Emphasizes Continued Focus on Tribal Relationships” 2023) (Kian 2024).</p> <p>Oakland University in Michigan became the first university in the U.S. to return land to Indigenous people by designating land as Anishinaabe heritage site in 2022 (Goral 2023) (“Gidinawemaaganinaanig: Endazhigiyang – Website for Land Matriation at Oakland University in Rochester, MI,” n.d.). Oakland University can no longer consider land for development (Goral 2023).</p>

opportunities that come with the identified species.

Based on a tree inventory conducted by the Grafton Land Trust on an adjacent parcel, species such as Elm, Red Maples, Oaks, Hickory, and Chestnut are likely to be found on the Grafton Campus. Additionally, this land may include species such as Gray Birch (*Betula populifolia*), Black Birch (*Betula lenta*), Northern Catalpa (*Catalpa speciosa*), Norway Spruce, (*Picea abies*), Staghorn Sumac (*Rhus typhina*), White Mulberry (*Morus alba*), Black Locust, (*Robinia pseudoacacia*), and Eastern Cottonwood (*Populus deltoides*), as these were identified tree species on Fisherville Mill site in Grafton (Bernat, 2015). The identification of woodland species is important for determining the best way to manage the forest on this campus, and therefore vital for decision making around the Grafton Campus. Not knowing what species are currently located on the campus is a significant challenge and risk to the school that needs to be addressed.

Inconsistent Wetland Data

In 2002, Vanasse Hangen Brustlin, Inc. conducted an updated survey of wetland delineation on the Grafton campus. This survey identified several intermittent streams, including Axtell Brook, which flows through campus. Additionally, the survey revealed that nearly 29% of the total campus area is classified as wetlands, with the largest contiguous wetlands situated in the southeast portion of the East Campus (SMMA, 2022). In 2016, a group of Tufts students and faculty conducted a biodiversity study, which also looked at wetlands. This study found that 20% of the campus was made up of wetlands. The reason for the discrepancy in these two estimates is unknown.

In addition to discrepancies regarding wetlands, there is also conflicting information about the number of vernal pools located on the Grafton campus. Vernal pools are

seasonal depressional wetlands categorized as small, shallow ponds lacking fish and sometimes experience dry spells (MA Division of Fisheries & Wildlife, 2009). Vernal pool habitats are incredibly important to a variety of species including various amphibians.

According to the 2002 Vanasse Hangen Brustlin survey, no vernal pools were identified on the Grafton campus. However, the Campus Biodiversity Assessment 2016 identified six Potential Vernal Pools (PVP) across the Grafton Campus. Of these, four were dried, and two had the presence of two reptiles, and four amphibian species (Tufts University, 2016).

Identifying Wetland Buffers

Wetland buffers were not emphasized in either of the campus studies references previously. They were mentioned in The Vanasse Hangen Brustlin, Inc. survey which stated that the Science Park would not build within the 100-foot buffer zone when possible, and when unavoidable in the buffer zone, a minimum distance of 50 feet from wetlands (SMMA, 2022), but beyond this has not been at the forefront of planning and research documents. This could pose challenges around safely and properly planning changes on campus. Additionally, pose threats to species in wetlands if buffer zones are not considered. Wetlands support various plant and animal communities, and also play a key role in flood control in rapidly changing climates (EPA, 2024). Wetlands are being lost at an alarming rate. From 2009-2019 roughly 670,000 Acres of vegetated wetlands had been lost, an amount equal to the land area of Rhode Island (U.S. Fish & Wildlife Services, 2024). This shows the importance of making these sensitive areas a potential focus for future stewardship planning on the Grafton Campus.

Updated Information

One challenge presented by the wetlands on Grafton's campus is that they are subject

to change. These changes are caused by climate change, weather events, storms, and interaction with wildlife, like beavers. This is currently impacting the Grafton campus as a beaver dam was built there this past year. These beavers have likely affected the wetlands on campus in some way. Wetlands are also affected by human disturbances like buildings, roads, and run-off. These factors were considered in the 2002 survey by Vanasse Hangen Brustlin, Inc., but have not been reviewed since, and have likely changed in the past 20 years (SMMA, 2022). Additionally, climate change poses significant threats to wetlands. Climate change is currently leading to shifts in precipitation and warmer climates which can alter the way wetlands function (Salimi et al., 2021).

Tufts University does not have a comprehensive understanding of the wetlands

due to the long stretch in between the last research of the campus wetlands. This is a challenge for Tufts as these wetlands have likely changed by both natural and human disturbances and are not being managed or protected, despite being such a vital ecosystem to many species in Grafton.

Peer Institution Land Management Cases

We reviewed the land management plans and practices for colleges and universities in the United States that had a stated purpose to protect the lands and/or natural features under their purview, which included Colgate College, Berry College, Harvard University, Middlebury College, Ithaca College, Smith College, Stanford University, the University of Florida, and the University of Central Florida. We used the term “land management plan or framework” to generalize and encapsulate all of the institutions’ plans rather than

Table 6. Case Studies: Examples of Colleges and Universities’ Land Management and Conservation Strategies

Strategy	Category	Description	Examples
Biological or ecological inventory	Knowledge Management	A comprehensive inventory and database of the biological characteristics of institution’s lands.	Middlebury commissioned a biological inventory of all its land-holdings, including those with agricultural uses. It was conducted through GPS-enabled field monitoring and then processed in a geographic information system. It remains a comprehensive database used to identify extraordinary biodiversity, warranting special protection.
Repository of research and conservation activities	Knowledge Management	Tracking and updating conservation and research activities taking place on campus lands in a central location serves an important organizational function.	Berry College created an interactive map of registered projects to track environmental conservation activities on the campus (“Berry College Educational Land Management,” n.d.). Duke University hosts a webpage with a list of all the available data they collect, including GIS data, aerial photographs, maps, and species lists (“Available Data,” n.d.).
Inclusionary decision-making	Structural	Democratize decision-making by including college community in land-related considerations.	Middlebury College has a Lands Advisory Committee composed of students, faculty, and staff that advises the College administration and Board of Trustees on land-related decisions (“Middlebury College Land Stewardship Initiative” 2008).

Table 6 (cont.).Case Studies: Examples of Colleges and Universities’ Land Management and Conservation Strategies

Strategy	Category	Description	Examples
College or university land conservationist	Structural	Employee(s) of institution whose job responsibilities include the conservation of the institution’s lands.	Small colleges have employees that serve dual roles as both staff and faculty. Middlebury has a college lands ecologist responsible for conservation of 6,000 acres of forest, wetland, and leased agricultural lands (“Franklin Environmental Center at Hillcrest,” n.d.). Smith College has a manager of the 250-acre MacLeish Field Station, which serves environmental research and outdoor education purposes (“Center for the Environment, Ecological Design & Sustainability (CEEDS),” n.d.).
Conservation restriction	Conservation Tool	Restrictions, like conservation easements, are the only way to assure permanent protection of lands.	Middlebury College, Ithaca College, University of Central Florida, and Smith College have all applied conservation easements to a portion of their lands.
Non-binding land use classifications and commitments	Conservation Tool	Institutions that are reluctant to permanently exclude lands from development set classifications or commitments to honor the ecological value of these lands; however, these measures are not enforceable.	University of Florida defines land parcels as “conservation areas” but this classification is non-binding and has been overridden by other land use decisions if priorities are in conflict with one another (“Conservation Area Land Management (CALM) Plans,” n.d.) (Ivanov 2021). Colgate University assigns parcels classifications according to the purpose of land use (Lin, n.d.-a). Skidmore College set a commitment to preserving 150 acres of an area called the North Woods until 2050 (Lin, n.d.-b).
External Partnerships	Process	Institutions partner with external entities like nonprofits and government agencies on conservation planning and targeted ecological management.	Stanford worked with USFWS and NOAA Fisheries on developing a Habitat Conservation Plan (“Sustainability Development Study: Stanford University” 2008). University of Florida partnered with the nonprofit Audubon International to become a pilot for their Cooperative Sanctuary Program for Universities or College (“Conservation Area Land Management (CALM) Plans,” n.d.). Middlebury partners with land trusts, the Nature Conservancy, and regional environmental nonprofit (Michaels, Fleming, and Gambill 2017). Berry College has partnered with The Nature Conservancy on plantings of Longleaf pines (“Pirelli Continues to Support the Longleaf Pine Project” 2023).
Integration of land protection framework with sustainability goals	Process	Land conservation planning exists within broader ecosystem of campus sustainability goals and plans. These should be horizontally integrated efforts, meaning if development will increase runoff, open space lands should both protected from these impacts and valued for the ecosystem services they provide.	The University of Pittsburgh set a goal to reduce 20% of impervious surfaces across its campus (“Water Systems Progress, 2018-22,” n.d.). Colgate College is using its forests as carbon sinks to meet the university’s own carbon neutrality goals (Lin, n.d.-a).

“land stewardship” because many of these institutions do not refer to their plans as such.

Through our findings, we conclude that there is no cohesive model, framework, or approach driving conservation or land management plans of the universities that were reviewed. Similarly, there is no consistent methodology for planning or enforcing land conservation on university campuses. Each institution started from or is starting from a different baseline understanding of the lands it manages and ecological characteristics. We analyzed the strategies used by colleges and universities to manage the conservation of their lands and highlighted what we believe to be the most important and applicable strategies that they applied in Table 6. Case

Studies: Examples of Colleges and Universities’ Land Management and Conservation Strategies.

Flooding on the Grafton Campus

Unclear farm management practices and increased seasonal flooding poses a consistent challenge to the Grafton Campus. The increased frequency of heavy rain over the past few years has impacted crop yield, hindering crop rotation and compost distribution across fields.

- 1. Impact on Production:** Significant areas such as fields 1a, 4d, 4e, 5b, and 12 have experienced the most damage, leading to concerns about access and drainage. These fields are highlighted in Figure 3 below. Between 2021-

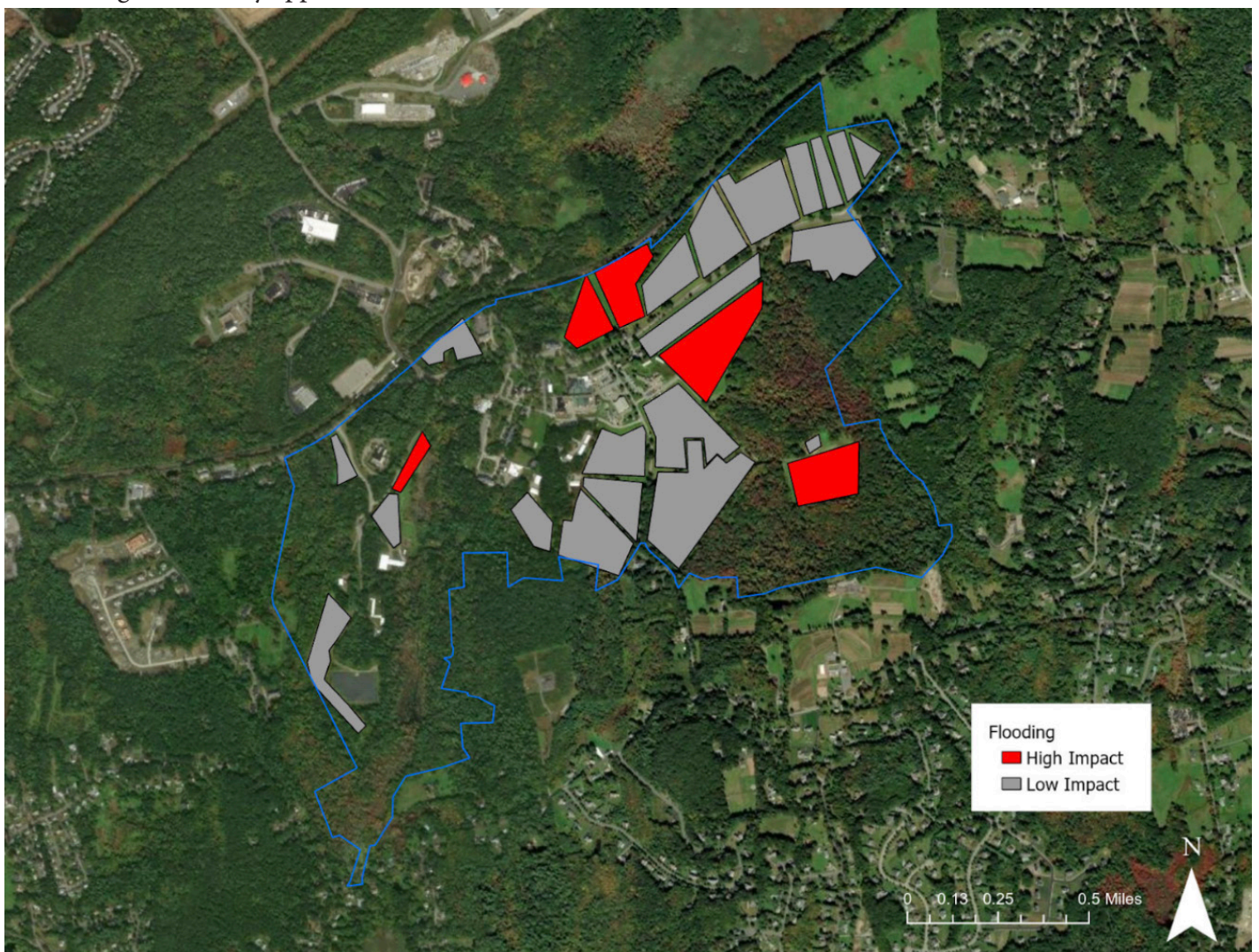


Figure 3. Cummings Farm Fields - Flooding Impact 2022-2024

2022, the Grafton Campus as a whole experienced a heightened degree of flooding which resulted in \$68,000 of damage as documented in the Hazard Mitigation Plan Update Draft (2024). The overall production has decreased by 5-8% over the last 2-3 years due to flooding, resulting in financial losses and necessitating a need for better monitoring and mitigation strategies.

2. **Composting Challenge:** While the farm extensively composts all waste, uneven distribution and rotation of compost columns across areas like 1a and 1b are evident. The lack of standardized practices and documentation, exacerbated by heavy rains, disrupts compost rotation and affects land fertility unevenly.

Agricultural Cases

We conducted a review of frameworks and practices created and used by other colleges

and universities to manage their lands for agricultural purposes. We specifically looked at the agricultural management plans of the University of Massachusetts - Amherst, Cornell University, Dartmouth College, and North Carolina State University. These colleges and universities all had impressive agriculture or veterinary programs that are comparable and applicable to the Grafton Campus due to factors such as size, area of study, and geographic location.

Through research we found that there was not a specific agricultural framework or management plan that was followed by colleges. Furthermore, due to the unique makeup of these programs, individual strategies and frameworks are implemented in each school around agriculture management. Table 7 outlines various farm management tools and practices, innovative livestock raising, and strategies for maximizing the benefits and yield from institutional farmland. These insights are invaluable for gaining a

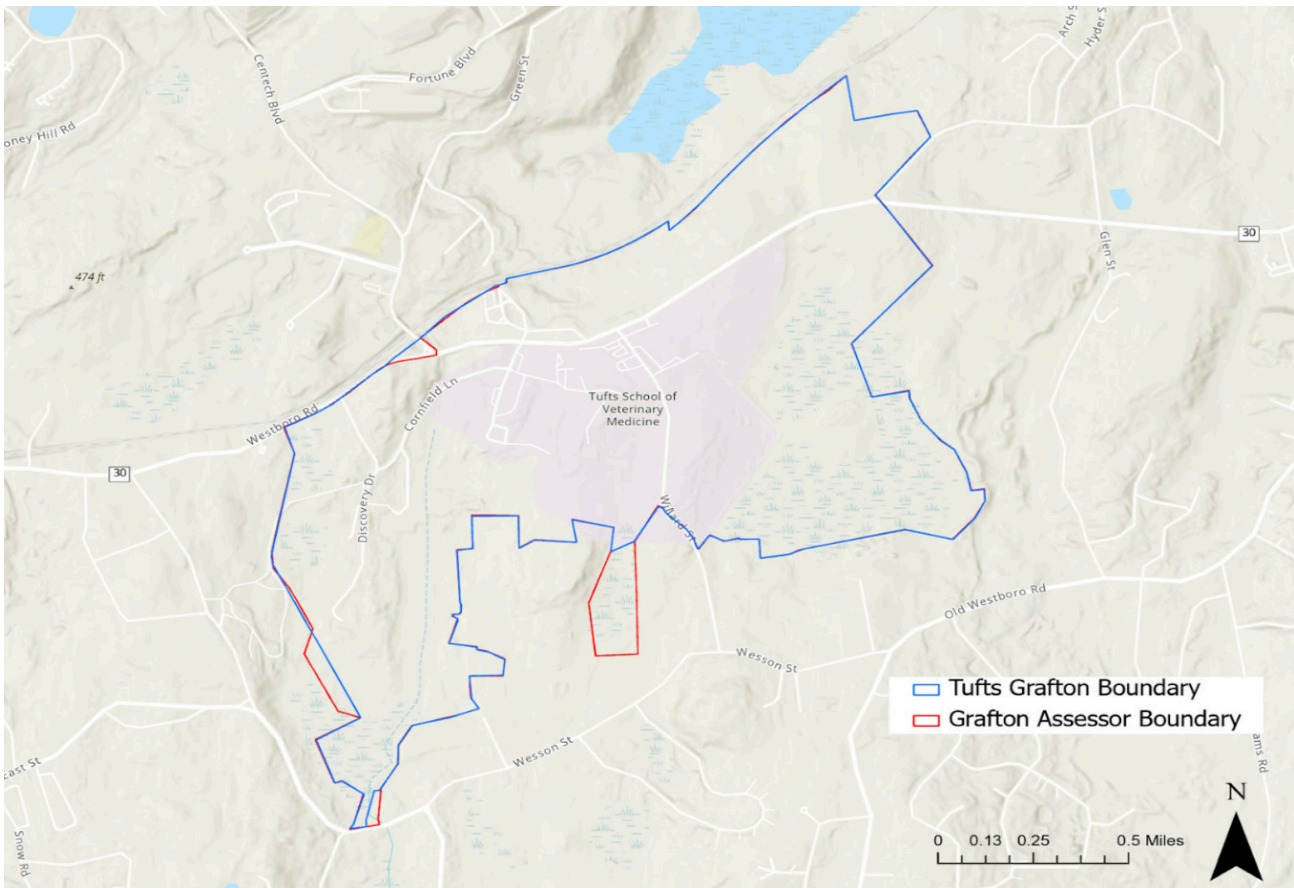


Figure 4. Town of Grafton Assessor Boundary vs Tufts Boundary.

Table 7. Case Studies: Examples of Colleges and Universities’ Agricultural Practices

Strategy	Category	Description	Examples
Integrated Pest Management	Farm Management Tool	A strategy and management plan used to decrease the impacts of pests on agricultural resources	UMass Amherst has been using IPM since 1978 and is now funded by a grant from the United States Department of Agriculture (USDA) and National Institute of Food and Agriculture (NIFA). (Whitehead, 2022) Dartmouth College has used IPM for the past 15 years. They also utilize “good” bugs for controlling pests, as well as physically removing pests through washing leaves and pruning. Additionally, pesticides are not used on what is grown in these agricultural farms
Weed Management	Farm Management Tool	Implementing strategies to be maintain and eliminate weeds for crop growth	North Carolina State University has a weed science research which aims to develop weed management systems for strawberries, oats, barley, wheat, and grain. (Weed Science Crop and Soil Sciences NC State University, n.d.)
Agricultural spaces for financial and community benefits	Maximizing Farmland Benefits	The use of agricultural land for not only student engagement but also for financial and community gain.	Dartmouth College has a fully functioning organic farm which produces 4000+ pounds of food each year. This food is sold to students in the form of prepared meals and also sold to Moosilauke Ravine Lodge for their daily meal service. 75% of the food is dedicated to supporting the community. The food is given to programs at Dartmouth Hospital as well as a non-profit Willing Hands (Dartmouth Organic Farm, n.d.) The Stockbridge School of Agriculture at University of Massachusetts Amherst has a 20 acres certified organic vegetable farm. The produce is then harvested and sold to local grocery stores like Big Y and at their farmers market. The proceeds from this project are reinvested into the program to support the work of future students. (Stockbridge School of Agriculture, n.d.).
Livestock management for carbon sequestration	Alternate Livestock Management practice	Raising livestock in a particular way in to sequester carbon, having carbon reduction abilities	UMass raises their sheep within a silvopasture system that consists of livestock grazing under tree canopy. This project began as a pilot program in collaboration with the UMass Carbon Farming Initiative which aims to bring awareness to practices that can support the drawdown of carbon from the atmosphere to soil. (Stockbridge School of Agriculture, n.d.).

deeper understanding of agricultural practices among peer institutions and igniting creativity in enhancing land utilization.

Boundary Challenges

Defining Campus Boundaries

Boundary research involved a review and comparison between both Grafton and Westborough GIS databases which show the town assessor's parcel data which include additional land from what is found in the 2022 Amended Grafton Campus Master Plan. The additional land in question is outlined in Figure 4. The master plan was conducted by an outside consultant contracted by Tufts University. This comparative analysis aimed to identify any inconsistencies or discrepancies in the delineation of the campus boundary.

The observed disparity in campus boundary mapping between the town of Grafton GIS database and the Grafton Campus Master Plan raises questions regarding the accuracy and consistency of spatial data management practices. Discrepancies of this nature can have

significant implications for land stewardship planning, resource allocation, and regulatory compliance on the campus.

1. **Planning and Development:**

Inaccurate mapping of campus boundaries may lead to misinformed decisions in land use planning and development projects. Without a clear understanding of the campus extent, planning initiatives may inadvertently encroach upon neighboring properties or fail to utilize available campus resources effectively.

2. **Resource Allocation:**

Precise mapping of campus boundaries is essential for effective resource allocation, including budgeting for maintenance, infrastructure development, and environmental conservation initiatives. Inaccurate boundary data may lead to inefficient resource utilization and suboptimal management practices.

3. **Regulatory Compliance:**

Discrepancies in boundary mapping could pose

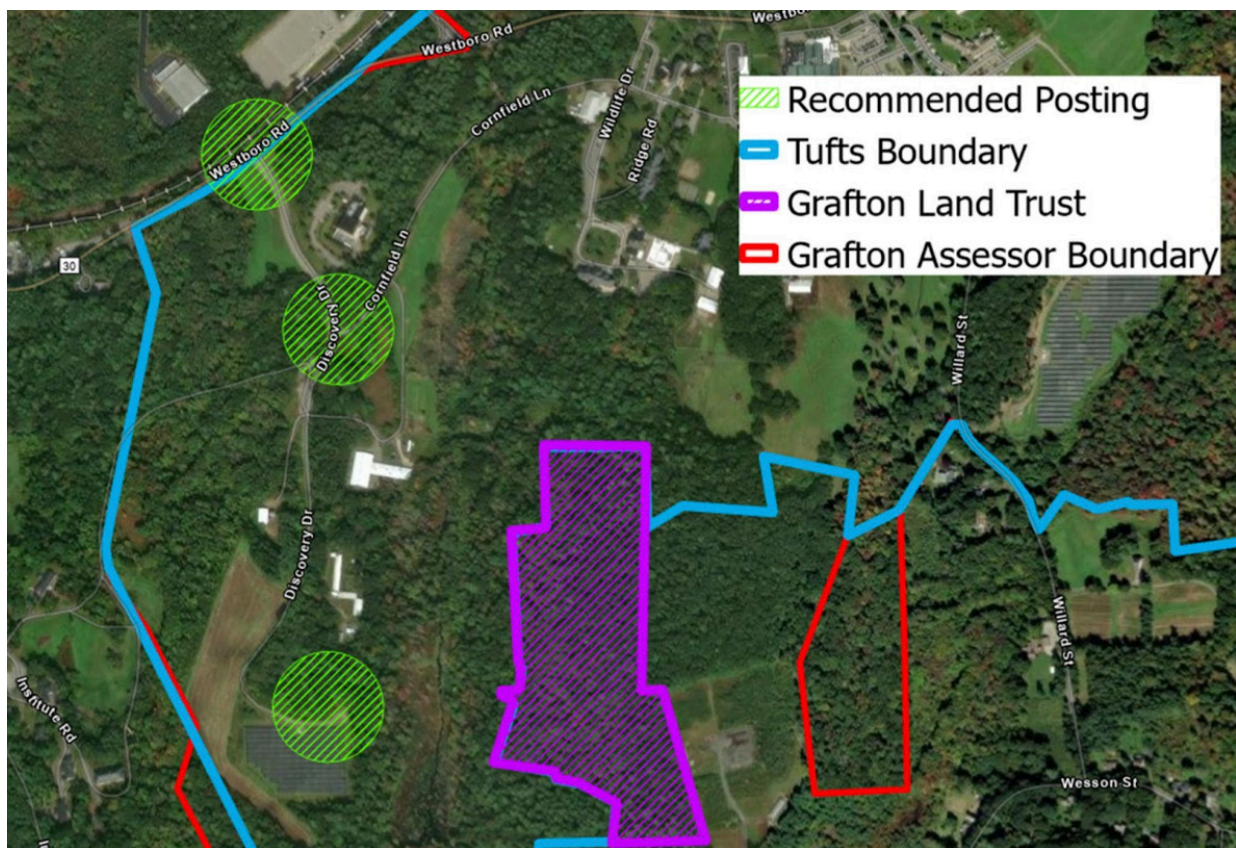


Figure 5. Discover Drive Entry and Abutting Grafton Land Trust Parcel

challenges in complying with local zoning regulations and land-use ordinances. Incorrect delineation of the campus boundary may result in violations or disputes with regulatory authorities, potentially hindering campus operations and research efforts.

Hunting Impact and Nearby Research

According to Campus police instances of hunters accessing legal hunting areas such as the abutting Grafton Land Trust, parcel were prevalent and have been addressed as they occur (Grafton Land Trust Hunting Policy 2013, 5). However, more preventative action must be taken in order to ensure the safety of all members of the Tufts' community. Hunters access the abutting Grafton Land Trust parcel by entering campus at the

intersection of Discovery Drive and Westboro Road. This access point avoids the main core of campus. Figure 5 shows the proximity from the Discovery Drive entry point to the Grafton Land Trust hunting area. There are opportunities for postings or signage at the intersection of Discovery Drive and Westboro Road as well as at the turnaround area to deter hunters from using Discovery Drive Grafton Land Trust access.

The presence of unmarked campus boundaries poses significant implications for both the safety of Tufts' students, faculty, and staff and the integrity of surrounding natural areas, as exemplified in the case of Tufts University and the Grafton Land Trust. In areas where campus boundaries were not clearly delineated, hunters inadvertently entered university grounds while pursuing

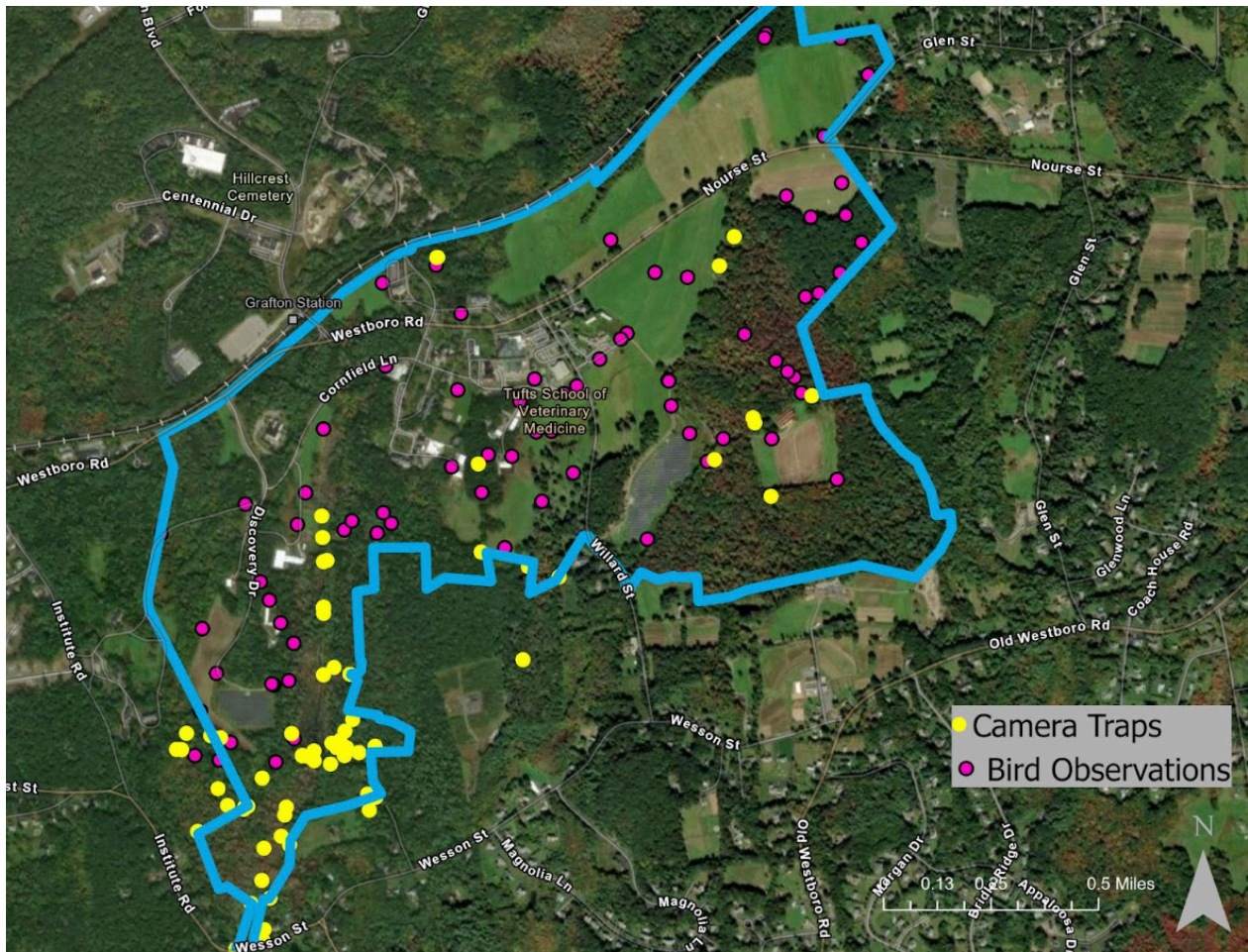


Figure 6. Research areas on the Grafton Campus.

legal hunting activities. This poses a direct risk to individuals who may encounter hunters unaware of the campus boundaries, potentially leading to dangerous situations. The presence of hunters in close proximity to academic and research areas raises concerns about the disruption of scholarly pursuits. The presence of hunters, even in legally designated areas, can create a distracting or uncomfortable environment for those engaging in academic activities nearby, affecting their ability to focus and perform effectively. Figure 6 Research Areas on the Grafton Campus shows the density of research conducted in the woodlands near the turnaround area.

Moreover, the lack of clear demarcation between the university campus and adjacent natural spaces, such as the Grafton Land Trust, increased the likelihood of hunters unintentionally straying into the Grafton Campus where research is heavily conducted. The discrepancy raises concerns and underscores the importance of precise spatial data management in campus planning endeavors.

OPPORTUNITIES AND RECOMMENDATIONS

Introduction

In this recommendations section, we present several suggestions to inform future campus planning on the Grafton Campus. These recommendations are structured around key thematic pillars: cultural, ecological, and academic considerations. Each set of recommendations offers targeted strategies to enhance cultural relationships, promote ecological sustainability, and bolster academic excellence. Furthermore, we address the importance of reconciling boundary discrepancies to ensure clarity and coherence in spatial delineations.

Cultural

Timeframe: Long Term.

Suggested Parties: Tufts Leadership in concert with relevant Grafton Campus researchers.

- **Seek and build a formal relationship with the Nipmuc Nation.** This must be a long and careful process that should amount to a mutually beneficial and collaborative association. Tufts should expand upon the archaeological survey conducted by the Fiske Memorial Center for Archaeological Research at UMass Boston in collaboration with the Nipmuc Nation. The survey was specific to the Hassanamesit Woods, leaving the Tufts Grafton Campus still relatively unknown from an archaeological perspective. Engaging the Nipmuc Nation will provide a platform for collaboration between Indigenous and non-Indigenous scholars that advances critical research on campus. The following steps may be taken to start the process:

- ▶ Initiate a dialogue that emphasizes a commitment to collaboration and mutual benefit.
- ▶ Building trust with members of the Nipmuc Nation through open and transparent communication.
- ▶ Facilitate joint planning and goal setting for intended outcomes and benefits.

Academic

Timeframe: Short Term.

Suggested Parties: Interdepartmental steering committee with stakeholders from all three campuses.

- **Establish a centralized repository of current and future academic and research activities.** This repository would serve as a comprehensive resource to disseminate information about events, research projects, academic initiatives, and other campus activities, fostering greater communication among faculty members and students. Many researchers and students from all three Tufts campuses utilize areas of the Grafton Campus for their respective activities, thus a centralized repository would heighten exposure. Refer to Table 6 regarding the repository of research and conservation activities that Berry College created as an example. The repository at Berry College also included an interactive map as a visual to track all academic and research activities.
- **Establish a collaborative collaborative Conservation Task Force to harness the expertise and resources available at the Grafton Campus.** This task force would integrate students and faculty from

the Tufts Wildlife Clinic, the Center for Conservation Medicine, and the Center for Animals and Public Policy, working in tandem with campus planning efforts to enhance conservation initiatives. Initial steps could include:

- ▶ Identify conservation opportunities such as habitat restoration, wildlife surveying, and sustainable landscape management practices.
- ▶ Integrate with Campus Planning efforts by incorporating sustainability principles and best practices.
- ▶ Monitor and evaluate the effectiveness of conservation practices and initiative. Regularly review, solicit feedback, and adjust strategies as needed to ensure continuous improvement and success in achieving conservation goals.

Ecological

Timeframe: Long-term.

Suggested Parties: Relevant Tufts faculty and students, Campus Planning.

- **Evaluate wetlands and vernal pools located on the Grafton Campus.** Specifically, collecting data on extent of wetlands, quantity of vernal pools, and current standing of these ecosystems. Ideally, able to highlight opportunities and threats to the areas.
- **Complete a full biological inventory of the Grafton Campus to better understand what plant and animal species that are located the land and possible threats to the species communities.**
- **Identify biodiversity hotspots that urgently need further protection, map critical wildlife habitats, identify and possibly remove invasive species, identify and restore native plant species.**

- ▶ Compile GIS data, aerial photographs, maps, and species lists from the full inventory that can be easily accessed.
- ▶ Contact Marc Lapin the College Lands Conservationist and Associate Lab Professor in Environmental Studies for Middlebury College for guidance on biological inventories and conserving institutional lands.

- **Conduct an analysis of the ecosystem services of its open space lands and natural features,** including the carbon storage; habitat; and water quality benefits through the capture of runoff and sediment and retention of nitrogen, phosphorus, and nutrients.
- **Create a Land Stewardship Framework based on the inventory and ecosystem service analysis that establishes the conservation ethic, strategies for management of lands, and future goals and plans for the open space land on the Grafton Campus.**

- ▶ The Land Protection Framework should complement the built aspects of the campus, ensuring that stormwater is managed effectively at present and under potential future circumstances of development.

Boundary

Timeframe: Short Term.

Suggested Parties: Tufts Legal Department, Worcester County Register of Deeds, Campus Police.

- **Engage Tufts Legal Department to reconcile the boundary that the Town of Grafton shows for the Tufts Grafton Campus.** If further clarity is required, the Worcester County Register of Deeds office should be approached. Once the deed and any corresponding plans are accounted for, Tufts can determine which boundary is

correct.

- **Once the boundary discrepancies are addressed, clear markers must be strategically placed along the perimeter and at locations on campus where hunters have previously been noticed.**

There are several discrete entrance points that hunters utilize and until they are clearly marked, hunting will likely continue. Pertinent locations are listed below:

- ▶ Intersection of Discovery Drive and Cornfield Lane.
- ▶ Turnaround Area
- ▶ Dispersed along the Tufts Campus and Grafton Land Trust property lines.

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APPENDIX A: INTERVIEW QUESTIONS

1. What is your role at the Cummings School/Grafton Campus?
2. How long have you been in this role?
3. How do you interact/use the land on the campus?
4. What sort of ecological resources are you aware of, if any? (I.E. the land, the forest, the stream <name>, habitat?)
5. Are there current or future threats to the spaces that you use or value? For example impacts from climate change, invasive species, predators, abutters.
6. If applicable, where do these threats exist on campus?
7. Are you seeing any impacts of climate change on the land?
8. What type of research is conducted on campus?
9. What management practices if any exist on the farm?
10. What pesticides if any are used?
11. What types of animals, crops, grasses, and feed are raised on the farm?
12. Are there animals, crops, grasses, or feed that cannot be raised on the farm but are needed for a certain purpose?
13. Do you have any other data sources, information, or contacts that would help further our project?

APPENDIX B: ZONING

The Grafton Campus is a 594-acre property located in Grafton, Massachusetts and, with a small portion of the property being located in Westborough, Massachusetts. Although the parcel of land is primarily zoned as “Office/ Light Industry”, the Town of Grafton has established a specific zoning district known as the “Campus Development Overlay (CDO)” district. Its intent is to provide design criteria and guidelines in accordance with master plans. This allows the Tufts-owned land to be treated as one contiguous property located in Grafton even though 149 acres of the Grafton Campus is within the Town of Westborough boundaries. Tufts does not have to acknowledge any municipal boundaries

within the CDO. However, Tufts has the right to create separate sections or parcels within the district as necessary, such as leasing a portion of the land for financial reasons (Grafton Zoning By-Law, 2018).

Purposes

- Permit the establishment of rural campus park developments through the use of master plans, provided that they are compatible with nearby developments;
- Encourage economic growth in the Town of Grafton by providing high-quality mixed-use developments;
- Establish zoning regulations that set guidelines to minimize the adverse impact of development on the natural features of the property;
- Protect the Town’s general water resources;
- Encourage mixed-use development by providing research, manufacturing, and commercial development opportunities near the existing school of veterinary medicine.

Permitted Uses

- Any educational use by non-profit educational institutions, such as classrooms, dormitories, and athletic facilities;
- Research and development in various life science fields, such as biotechnology, environmental science, toxicology, and nutrition;
- Research and development in alternative and renewable energy;
- Research and development in computer technology, including light construction of devices for field research, internet service providers, and electronic data storage centers;
- Commercial facilities including animal hospitals, restaurants, libraries, conference facilities, and daycare;
- Accessory facilities such as roads and parking lots;
- Independent marijuana testing laboratories, marijuana standards laboratories, and marijuana research facilities.

APPENDIX C: GIS LAYERS UTILIZED FOR MAPS AND ANALYSIS

- Aerial Imagery Research
- Hunting Identification
- Soils: Special Features
- Saturated Hydraulic Conductivity
- Hydrologic Soil Group
- Depth to Water Table
- 500-year and 100-year floodplains from FEMA
- Slope by Category
- Surficial Geology
- Lidar Elevation and Shaded Relief
- Wetland Boundaries
- Cultural (New Town Proposal Boundary and potential locations for Sweetgrass growth)
- Research Overlays
- pH
- Slope by Percentage
- Prime Farmland Soils
- Hydric Rating by Map Units
- Corrosion of Concrete
- USA Forest Type
- Land Use
- Dwellings with Basements
- Septic Tank Absorption Fields
- Drainage Class
- Risks

APPENDIX D: TUFTS ENVIRONMENTAL MANAGEMENT AND INITIATIVES

1. In 1990, the then university president, Jean Meyer, created the Tufts Environmental Policy which affirmed the university's responsibility to positively engage with the natural environment, in both "local action and global thinking" (Meyer, 1990).
2. The prioritization of mitigating human impact on the environment has been a focal point of the university since 1996 ("Tufts Institute of the Environment", n.d.).
3. Tufts president Lawrence Bacow renewed this commitment in 2003 by adopting the New England Governors and Eastern Canadian Premiers Climate Change Action Plan goals. The plan involved reaching the 1990 greenhouse gas emission levels by 2010 and a continued 10% reduction of those levels by 2020.
4. As of 2020, Tufts University is 23% below its 1990 levels, and the university aims to meet a reduction target of between 75-85% below 2001 levels by 2050 (Office of Sustainability, 2020).
5. As of current management, Tufts University implements planning and development mandates throughout Tufts campuses and surrounding communities in accordance with the sustainable operations as laid out by the Tufts Office of Sustainability. These operations focus on four categories ("Tufts Climate Initiative", n.d.):
 - a. Carbon Emission Reductions
 - b. Research and Monitoring
 - c. Education
 - d. Outreach and Events

APPENDIX E: MAPS

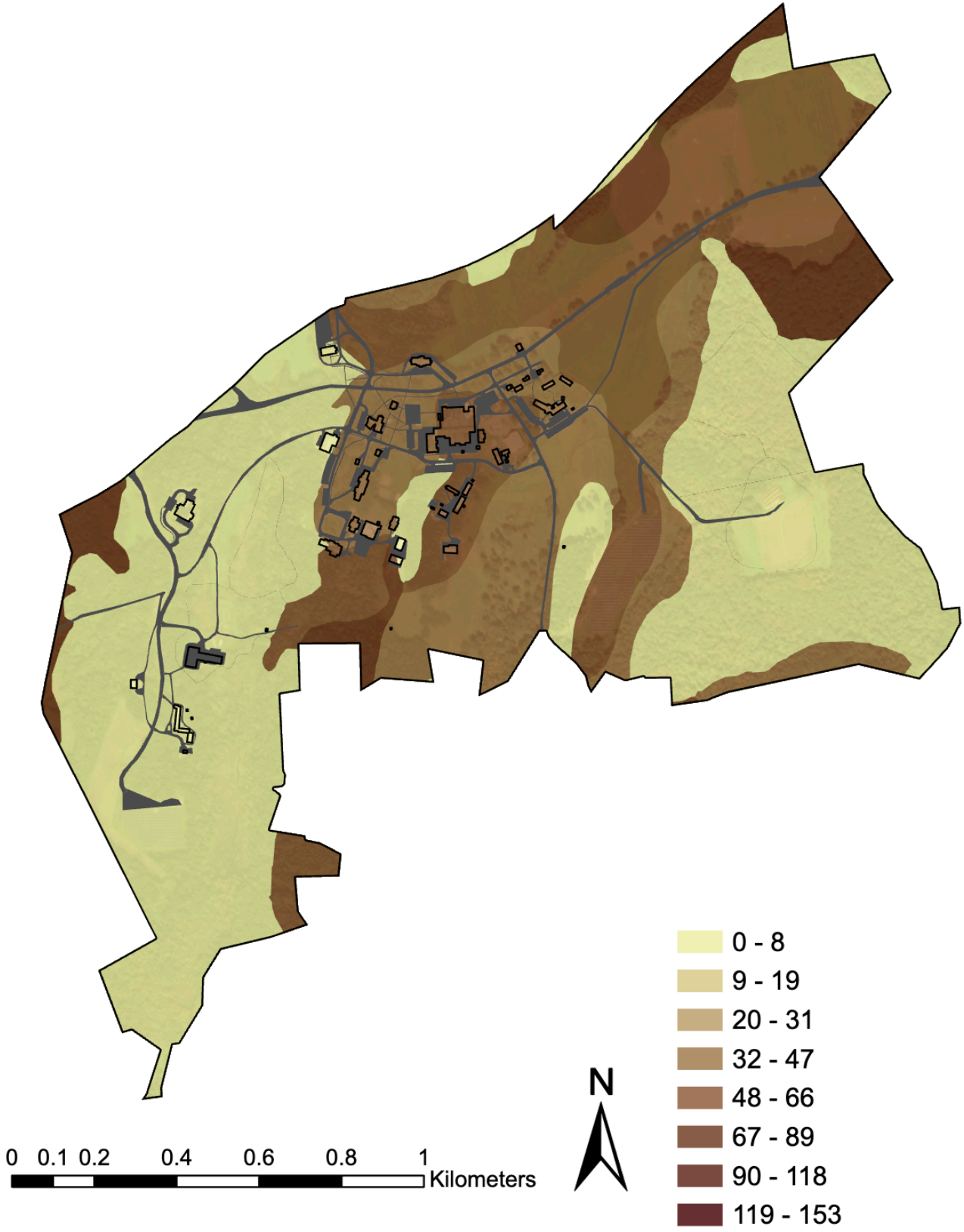


Figure 7. Depth to water table in centimeters.



Figure 8. USDS-designated areas of prime farmland and statewide importance.

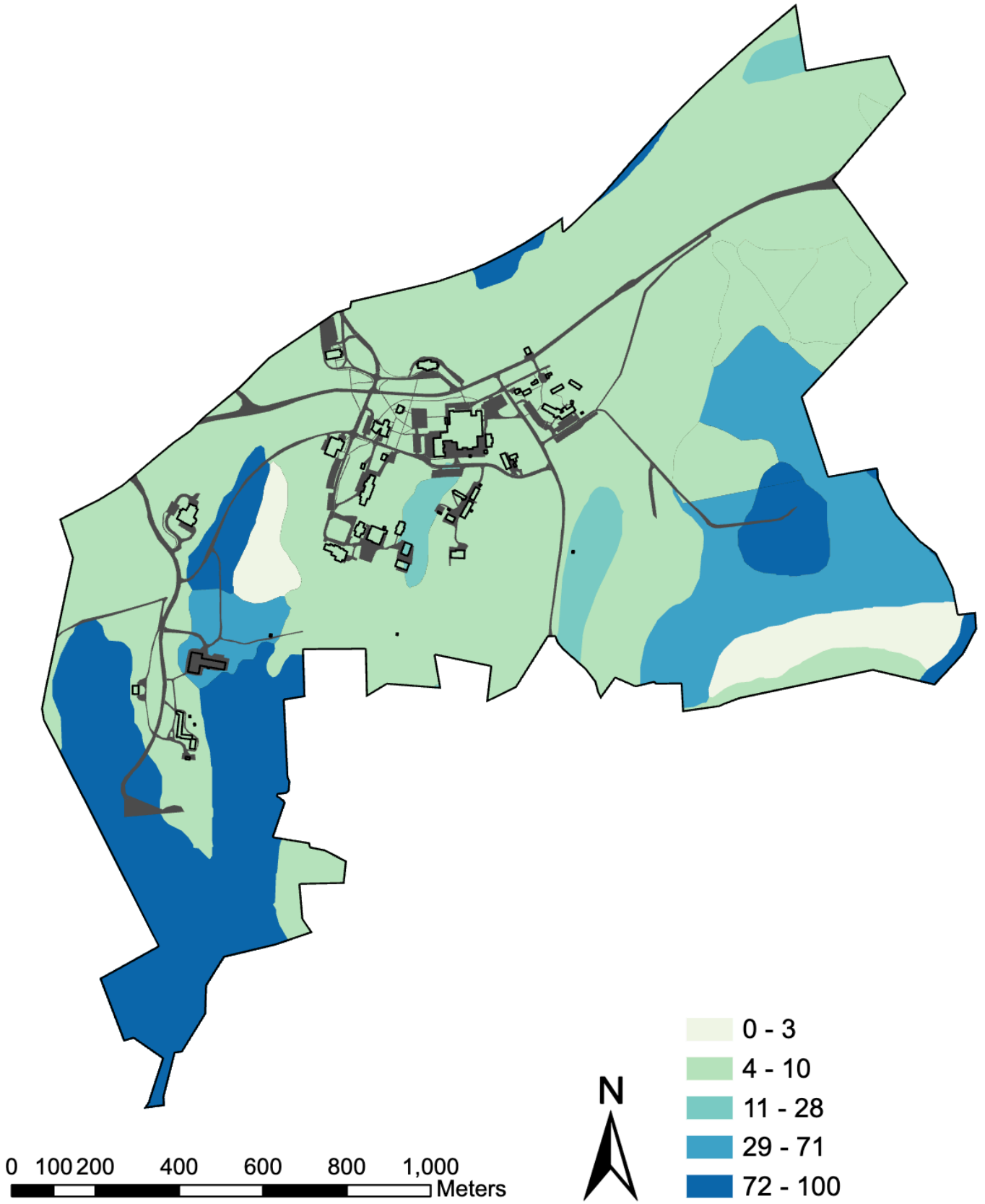


Figure 9. Soil conductivity.

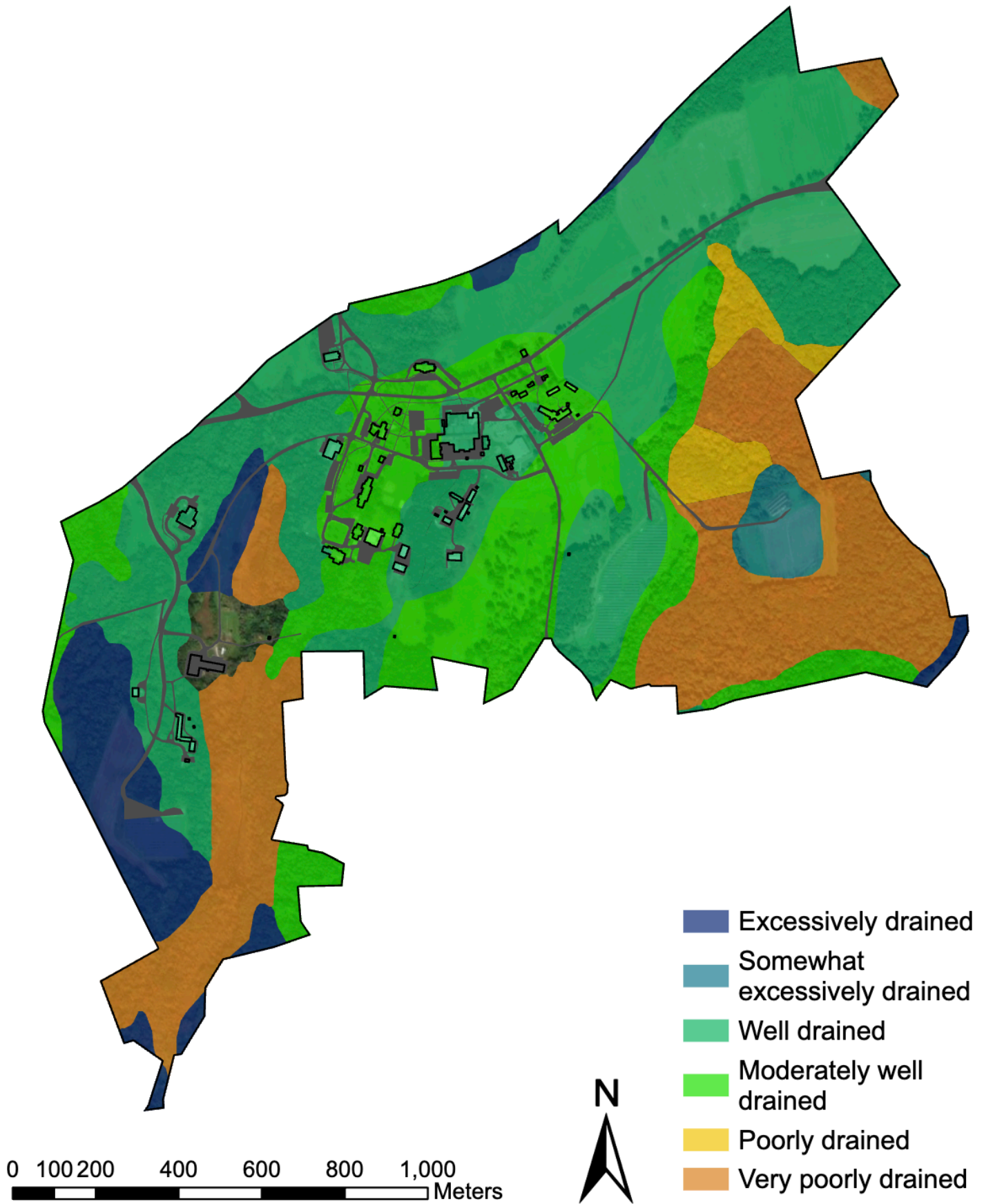


Figure 10. Soil drainage status.

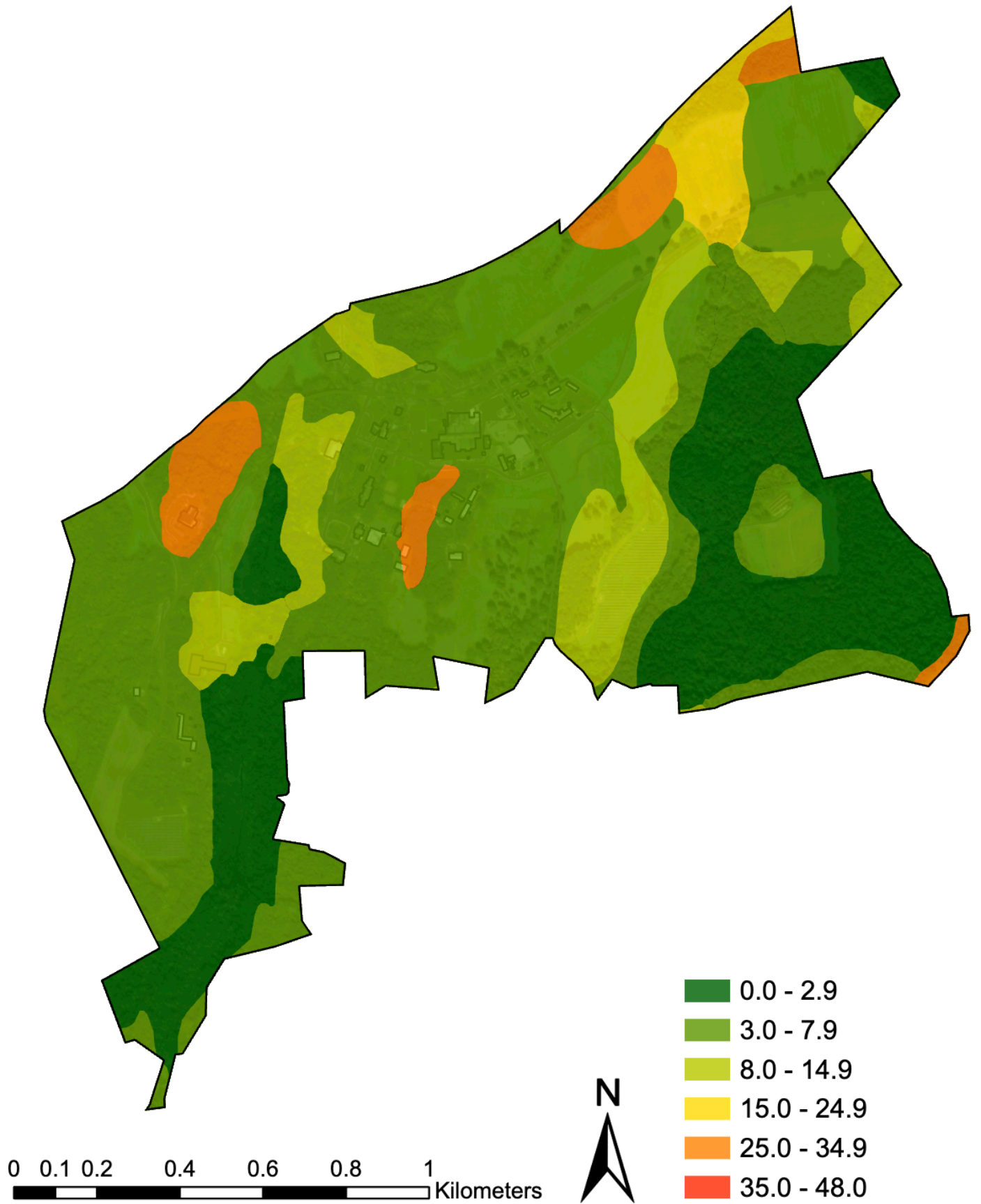


Figure 11. Slope by percentage.