Rowan University

Stormwater Management & Landscape Master Plan

DECEMBER 2014

ACKNOWLEDGMENTS

Rowan University would like to thank the following individuals (their associated departments and groups) for their input on this stormwater management and landscape master plan.

CONTRIBUTORS

Dr. Ali A Houshmand, President, Rowan University

Facilities Committee of the Rowan University Board of Trustees

Donald E. Moore, Senior Vice President - Facilities, Planning & Operations

Joseph Monahan, Assistant Vice President - Campus Planning & Construction

Arijit De, Senior Director of Campus Planning

Edward Thompson, Director of Facilities & Landscape Management, Environmental Planning

Merrie Winston, Senior Project Manager at Rowan University

Jim Lovegrove, Assistant Vice President - Operations & Maintenance

Kevin Muldoon, Chief of Facilities- Building & Grounds Operations

Richard Jones, Vice President of Student Life and Dean of Students

Travis W. Douglas, Assistant Vice President - Residential Learning and Inclusion Programs

Joe Daraio, Assistant Professor of Water Resources Engineering

John Hasse, Department Chair of Geography and Environment

Skeffington Thomas, Art Professor in the College of Communication & Creative Arts and Chair of the Campus Aesthetic & Environmental Committee

Jamilynn T. Kisthardt, Student Government Association

THE CONSULTANT TEAM

Biohabitats Inc.
Ted Brown, PE; Jennifer Dowdell, ASLA; Nick Lindow, PE; Meghan Gloyd, PE; Jean Wisenbaugh; Bryn Freeman

Ayers Saint Gross
Amelle Schultz, PLA; Sarah Rumbaugh; Jonathan Ceci, PLA

Urban Engineers
Bill McGarrigel, PE; Brad Tombs, PE

Because planning is an ongoing process, this stormwater management and landscape master plan is a framework which will guide the administration as it continues to make decisions concerning the campus landscape and stormwater management. As issues arise, each decision must be weighed within the context of the master plan framework set forth and the spirit of its recommendations.

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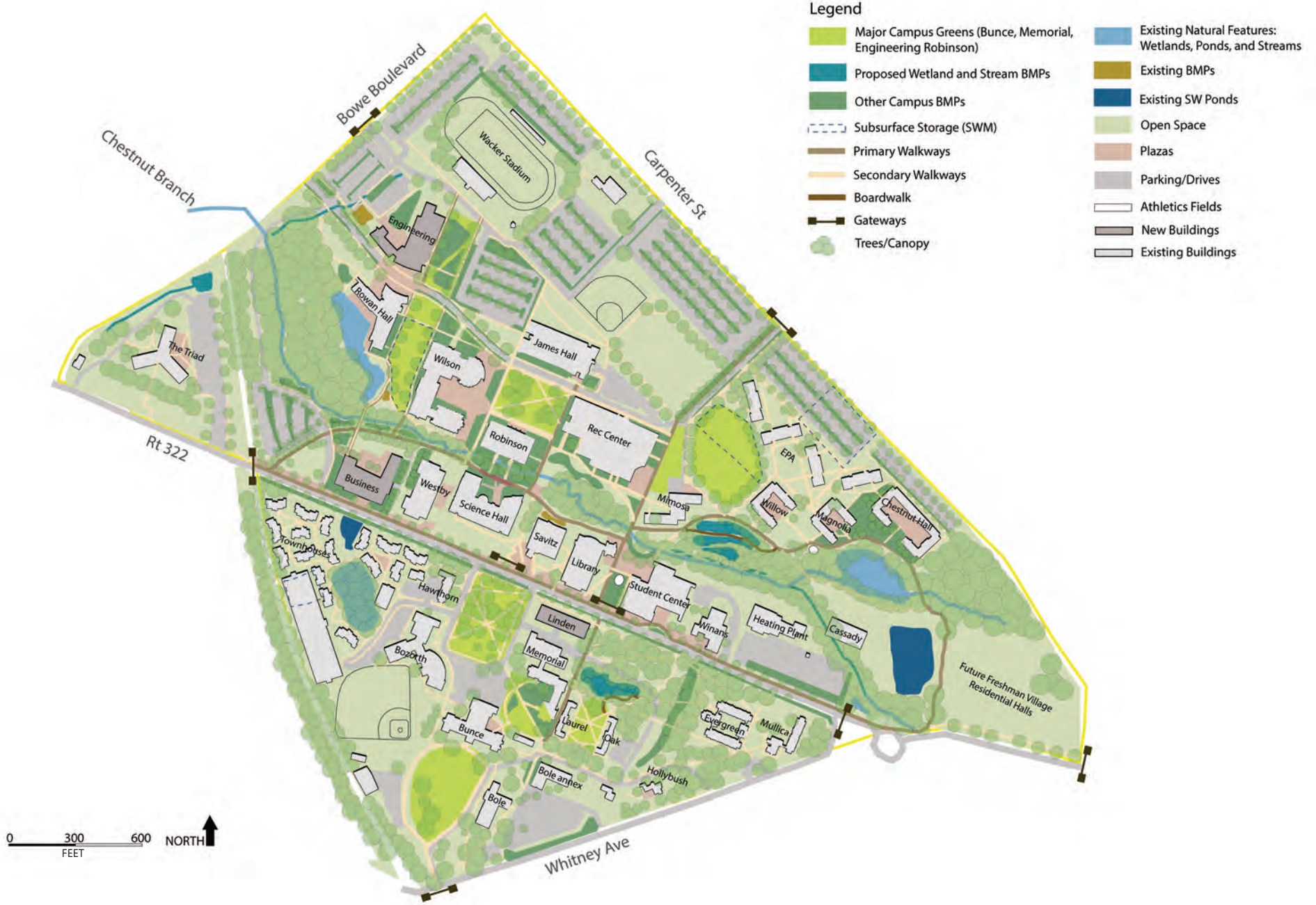
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1-INTRODUCTION

WHY A STORMWATER MANAGEMENT AND LANDSCAPE MASTER PLAN?

Photo courtesy of Rowan University

Bunce Hall is an icon of Rowan University.

Over the coming decade, the Glassboro campus of Rowan University will be fundamentally transformed as a result of current growth projections. Rowan's Stormwater Management and Landscape Master Plan (the Plan) provides the foundation for a successful and sustainable transformation by devoting critical attention to the environmental performance and character of the future campus landscape. The Plan provides a holistic strategy for campus development—accommodating building expansion outlined in the 2013 Rowan University Facilities Master Plan within a network of thriving campus landscapes and high-performing ecological infrastructure. It also aims to increase the overall available green space on the portion of campus north of Rt. 322. Thoughtful planning and design today are critical for ensuring a successful campus tomorrow.

The Plan provides a blueprint for the cohesive implementation of innovative methods to treat and manage stormwater runoff, renewal of a unique sense of place and campus identity, and the enhanced ecological function of the Chestnut Branch Stream, which runs through the heart of the campus. It presents a consistent series of landscape and open space typologies that integrate stormwater management, addressing existing and potential future campus-wide hydrologic challenges and providing guidance for a high level of water quality and quantity controls.

The Plan promotes the widespread integration of stormwater and landscape features throughout the campus; reflects the University's potential regional leadership role in planning and implementation of holistic green infrastructure practices and sustainability; shows the water quality and quantity benefits of the various techniques and practices that will be applied to the sites; provides a phased manner in which the campus improvements will be implemented; and provides representative photographs and schematic plans that show the types of aesthetic and multifunctional landscapes that will renew Rowan's sense of place.

The planning principles, design guidelines, and landscape typologies developed herein can also be extended to Rowan's other campuses, including West Campus, Camden, and Stratford.

Clockwise from above: The existing campus; current stormwater management; and issues with aging stormwater infrastructure.

A Green Infrastructure Approach

Green infrastructure makes stormwater management functional and beautiful.

Inherent in the stormwater management and landscape master planning approach is the need to protect, enhance, and create functional landscapes that demonstrate and embrace the manner in which water serves as a resource. These landscapes also provide important habitat, microclimate, and aesthetic benefits that will be consistent with their specific locations on campus. For example, in redevelopment and new development situations it is important to target opportunities to incorporate ecology and water into active landscapes such as courtyards, plazas, walkways, parking areas and adjacent to building foundations.

Developing a strong and resilient green infrastructure network involves examining, interpreting and building upon the inherent patterns in the landscape, to build a site's capacity for regeneration. This approach involves a strong focus on connectivity, and designing for benefits at multiple scales with an appreciation for historic function but an understanding that in urbanized areas, where natural function may not return in its original form, a new functional living system with natural characteristics can be introduced.

Creating regenerative functional landscapes means transitioning from practices that degrade the environment toward working landscapes that perform important ecological functions.

Some of the functions and benefits of this approach include:

- Receiving, retaining, and filtering stormwater runoff close to the source;
- Restoring natural habitat in diverse ecosystems, creating integrated landscapes that have multiple functions;
- Restoring potential ecological linkages and providing restored or enhanced habitat areas that connect to Chestnut Branch
- Providing educational, stewardship and research opportunities;
- Providing natural areas for passive recreation and respite and opportunities to take advantage of the therapeutic benefits of natural areas;
- Providing relief from the effects of urban heat islands and other microclimates common in developed areas;
- Providing noise and aesthetic buffers;
- Providing ecological stepping stones for wildlife; and
- Reducing the overall operation and maintenance burden for campus staff, balancing initial costs with long-term benefits, and reducing potential infrastructure upgrade costs.

Photo courtesy of Rowan University

From top: Functional landscapes include green roofs like the one at the Medical School building on campus and bioretention in parking lots.

The Planning Process

Site visits in winter and spring provided oppotunities to see the stormwater and landscape conditions in different seasons.

The Plan is based on a combination of scientific and expert analysis of existing and proposed conditions. This analysis encompasses the review of existing data, mapping and plans; in-depth on-site field investigations (site analysis); and modeling of future hydrologic conditions under different design scenarios.

A set of leading questions guided the analysis:

- *Regional setting and characteristics*—How is the campus landscape defined by geography, population, climate, topography, geology, soils, watersheds, natural areas, and land use?
- *Planning history and past efforts*—How can past planning efforts be carried forward for future conditions analysis?
- *Campus ecological context*—Based on desktop and field analysis, what is the ecological characterization and assessment (woodland, stream, wetland)?
- *Campus landscape context*—Based on field analysis and subsequent characterization of existing conditions, what is the character of the landscape defined by programming, materials, space-making, etc.? What are the prominent pedestrian and vehicular flows?
- *Stormwater conditions and regulatory context*—Based on field and desktop analysis, what are the existing and historic conditions? What are the subwatershed and catchment drainage patterns? What are the regulatory requirements associated with these campus landscapes? What are the offsite impacts?
- *Stakeholder concerns, observations and maintenance issues*—What are the challenges faced on campus? What are the needs?

Working sessions with members of the campus community were a key component of the observations phase. Staff, faculty, and students—all of whom are daily users of the campus and therefore much more aware of the nuances of its unique story of place—were valuable assets during this phase, providing important details related to maintenance, current issues with flooding or nuisance stormwater, programming needs (eg. applied research), and the successes/failures of current landscape maintenance and management standards. The institutional knowledge that long-term staff and faculty were able to share was key to the project, helping team members become aware of past planning successes and challenges, as well as newer projects under construction and/or in planning. These individuals worked with the master plan team to formulate a set of planning principles. The planning principles provide the basis for an approach to planning that advocates for the implementation of functional natural landscapes, or green infrastructure.

Stormwater modeling was performed to better understand the behavior of water in the landscape and the potential practices that could be employed on campus to improve water quality and effectively manage water quantity.

This approach provides a holistic integration of stormwater management practices and ecological restoration and enhancement. It also addresses the creation of safe and attractive routes for circulation and connectivity through the campus.

Students, faculty, and staff participated in feedback and interview sessions.

Campus Conditions

LANDSCAPE ECOLOGY

By examining historic ecological and hydrological patterns on campus, current conditions and new opportunities become apparent. In this aerial photo from 1931, the patterns of woodland, stream and wetland have been interpreted.

Rowan's location in Southern New Jersey means that it sits close to both the Delaware River and Delaware Bay/Estuary, as well as the Atlantic Coastal Plain. Southern New Jersey is home to a diverse selection of wildlife habitat, including large pine barren forests, Atlantic cedar swamps, and estuarine and tidal marshes.

The Atlantic Inner and Outer Coastal Plains share a handful of ecological communities including: southern mixed oak forest, upland pine forest, upland oak forest, red maple sweetgum forest, Virginia pine successional forest, pitch pine lowland forest, and pine barrens savanna. These historic ecotypes are good references for ecological restoration and enhancement on campus.

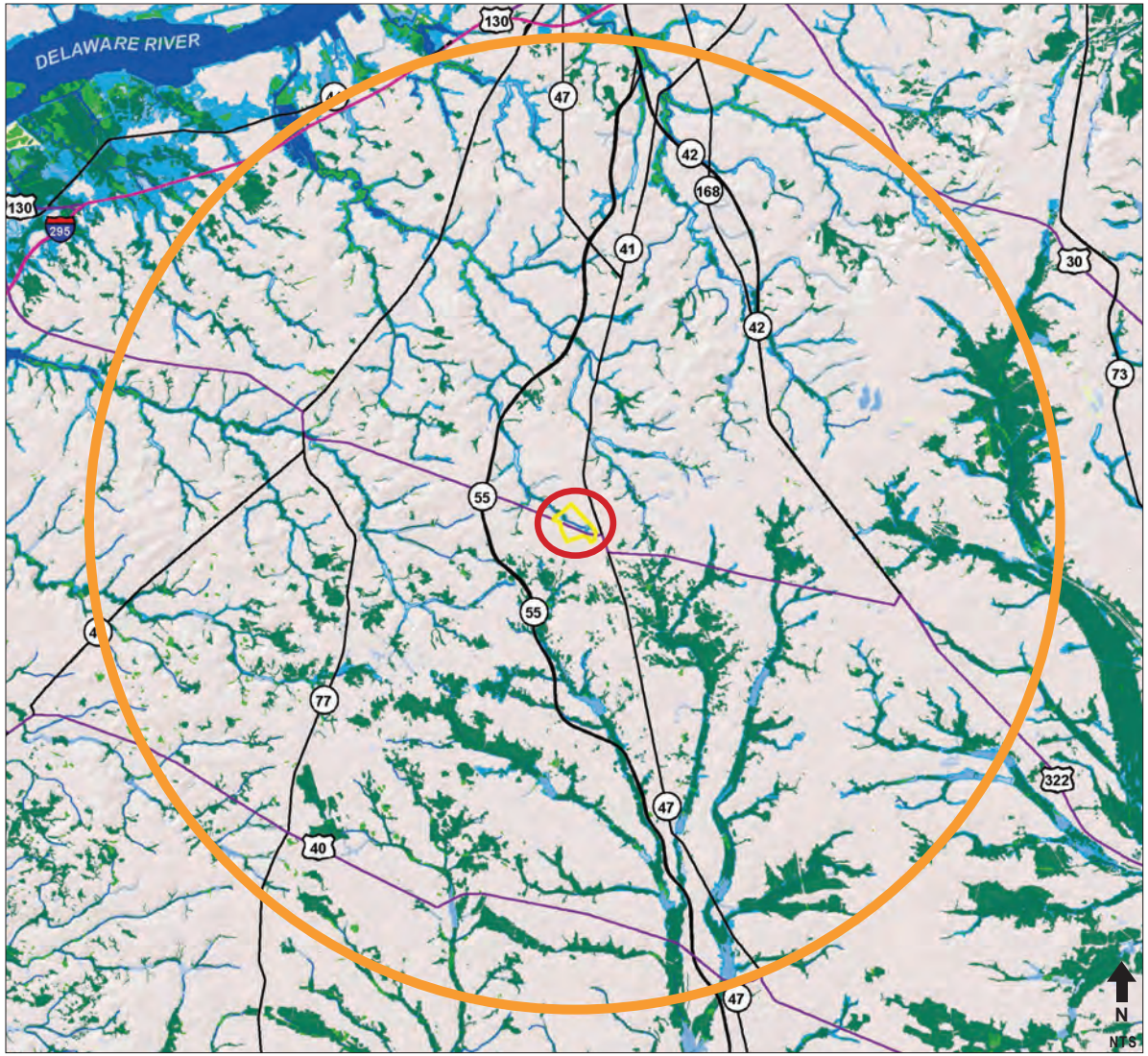
Historic aerials of the campus show a wooded and wetland-dominated stream system surrounded by a combination of agricultural lands, orchards, and urban development.

Most intriguing are the patterns that can be seen on today's North Campus, where there is a matrix of wetlands and small tributaries that feed Chestnut Branch.

When the interpretation of the historic vegetation and hydrology is overlaid on today's conditions, it offers a clearer understanding of where there may be opportunities to explore stream daylighting, vegetated surface treatment of stormwater conveyance with native plantings, and increased tree canopy to improve overall ecological function and have the campus landscape aesthetic better reflect its historic roots.

More detail on the ecological conditions can be found in *Appendix III.*

HYDROLOGY



Rowan University (shown here in the red circle) is located along Chestnut Branch, a tributary of Mantua Creek, which eventually flows to the Delaware River (a ten mile area radius from campus is shown in orange, to provide a sense of the scale of surrounding context). All changes made to the function and health of the stream on campus can have positive effects in the broader watershed.

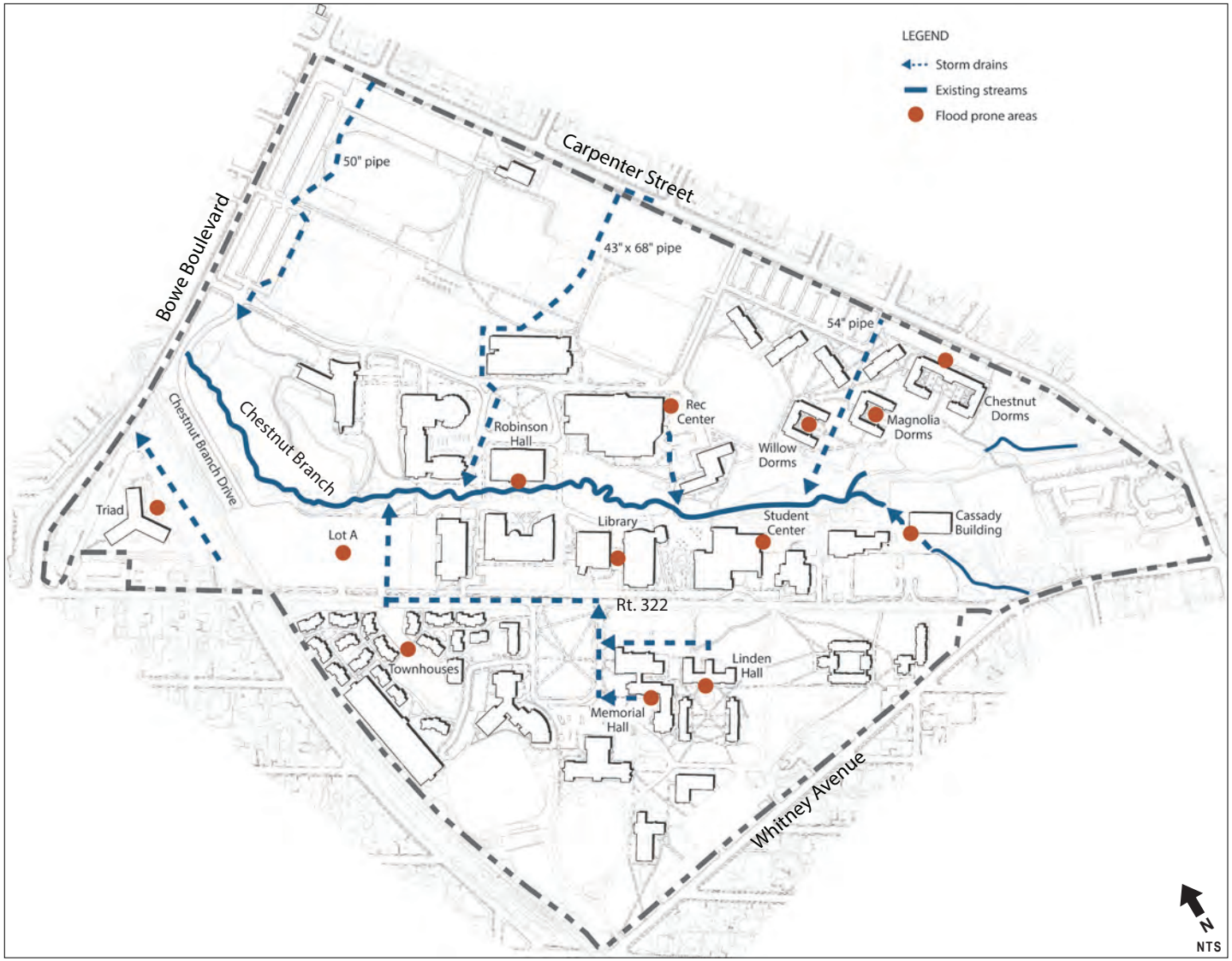
Rowan sits at the headwaters of Chestnut Branch, a tributary to Mantua Creek. Mantua Creek, which eventually empties into the Delaware River, drains over 50 square miles of Gloucester County and is characterized by gently rolling, wood terrain dotted by small lakes.

Chestnut Branch bisects the Rowan Campus. It enters on the eastern edge at Main Street, and then Bowe Boulevard acts as the downstream-most boundary. Over the past 80 years, the campus and surrounding City of Glassboro have transitioned from a predominantly rural landscape of farms and peach orchards to mixed, medium density (suburban) development and urban land. This transition has increased the volume and rate of stormwater runoff from the watershed, due to an increase in impervious surfaces and improved drainage infrastructure.

Acreages of watersheds that drain to Chestnut Branch through the Rowan Campus.

In fact the majority of the water being received by Chestnut Branch within the bounds of the campus is coming from areas beyond the campus *(see watersheds figure on this page)*. Of the 677 acres of land that drain to Chestnut Branch below Bowe Boulevard, only 207 acres are comprised of Rowan University (31%). The remaining 69% of the watershed is made up of mixed residential, commercial, and other built-up, urban land within the City of Glassboro.

Historically, the campus and surrounding landscape characterized by numerous tributaries to Chestnut Branch, riparian forests, and bottomland hardwood wetlands that assisted in intercepting rainfall, infiltrating runoff, and slowing down the rate of rainwater flowing into Chestnut Branch. The small tributaries and wetland areas around Chestnut Branch have been buried in storm drain pipes or filled in for development. Where natural channels have the ability to dissipate energy in a natural floodplain, stormdrain networks create increases in velocity and energy of water- which can in turn result in flooding, erosion and degradation of the stream.



Stormwater issues and hot spots as identified in the text.

There are six storm drain systems that convey offsite runoff through campus to Chestnut Branch. The principal drainage pipes include a 54-inch corrugated metal pipe that outfalls east of the tennis courts, an elliptical 43- by 68-inch pipe that outfalls west of Robinson Hall, and a 50-inch pipe that outfalls west of the Engineering Building. All of these storm drains convey runoff from the northern off-campus drainage areas.

Examples of where historic stream conversion has occurred on campus include the Town Houses, the Library, the Student Center, the Recreation Center, and the Cassady Facilities Building *(see figure on this page)*. Therefore it is not surprising that there has been documented flood damage at these locations. Over time, the storm drain infrastructure has aged and been stressed by further urbanization, both on and off campus. The subwatersheds that drain to Chestnut Branch include a large percentage of impervious surfaces, such as parking lots, buildings, and roadways, that contribute a greater percentage of the overall runoff volume *(see figure on previous page)*.

Much of North Campus is within the historic floodplain for Chestnut Branch, which has led to flooding at the stream outlet at Bowe Boulevard, where the existing berm and culvert configuration has been in place for approximately 45 years. During major storm events, the berm embankment and floodplain of Chestnut Branch act as a retention pond, restricting the discharge and temporarily storing water on campus. This behavior has caused significant damage to infrastructure and property on campus, flooding Robinson Hall and vehicles in parking Lot A, as well as preventing safe ingress/egress along the Chestnut Branch Drive.

South Campus represents more upland areas, older development, and many iconic landscapes, including the Oak Grove. However, the drainage from South Campus flows across Rt. 322 and down through North Campus on its way to Chestnut Branch. The buildings along the north side of Rt. 322 have been subject to localized flooding, ie. at the loading dock behind the Student Center. This area also serves as a storage area for campus maintenance and is therefore considered a hotspot for poor water quality, both from the uncovered storage areas and from the dumpsters.

Hydrologic modeling of the existing campus watershed indicates that several stormdrain networks are undersized and incapable of adequately accommodating larger storm events, such as the networks by Triad, Linden Hall, Memorial Hall, and Magnolia, Willow, and Chestnut Dormitories. For more information on the existing conditions hydrologic model, see *Appendix 4*.

Clockwise from top left: Twin 54-inch pipes at Bowe Boulevard; the stream crossing at Robinson Hall; the upper reach of Chestnut Branch; and the flood prone area at Linden Hall.

There are a few existing stormwater management practices on campus, in the form of wet ponds, underground storage, and more recently, bio-infiltration swales. By incorporating stormwater management into the landscape, runoff can be mitigated in the upland areas prior to discharging to Chestnut Branch. The existing natural resources on campus can be enhanced to improve the ecosystem services provided, which include stormwater management.

After leaving the campus Chestnut Branch flows approximately 1.5 miles before passing the Lapiri Landfill, a Superfund site, and eventually flows into Alcyon Lake. Actions to improve stormwater management on Rowan University must also consider downstream impacts.

There are a number of locations on campus where there is a need to improve built stormwater infrastructure to improve stream health and function.

OPEN SPACE AND CIRCULATION

Photo courtesy of Rowan University

Walkability and a cohesive circulation through campus provide for a heightened sense of place.

One of the key elements in creating a sense of place within the campus context is the development of a robust framework of open spaces defined by vegetation and other landscape elements. The use of scale and spatial definition in the design of the spaces is crucial for creating a comfortable and welcoming environment. The experience of traversing the campus helps to define the landscape for the user, so well-defined entries and circulation routes that serve both pedestrian and vehicular movement are important.

Walkability is an important asset of the Rowan Campus, which is fairly compact. From the centerpoint of campus, it is only a 5-minute walk to the majority of buildings, and a 10-minute walk to the edges of campus (*see figure on the following page*). While this would seem to make for a very walkable campus, it is clear from student and faculty feedback that there is still a heavy reliance on cars and on campus parking and that the campus has the feel of inaccessiblity from one end to other.

Through improved circulation, organization of spaces, and further enhancement and cohesion of the landscape aesthetic, as well as a limitation on vehicles through the heart of campus, the sense of walkability and safety can be enhanced campuswide.

As noted in the 2009 Facilities Master Plan, Rowan University's growth from a small teachers' college to a major state university has resulted in a highly varied campus landscape and open space framework. The original teachers' college, south of Rt. 322, featured a signature open space fronting Bunce Hall and surrounded by hardwood shade trees. Despite the functional reversal of the campus frontage along Rt. 322 south campus is still a highly valued landscape with mature specimen trees and the tradition-linked open space south of Bunce Hall (University Green). The south campus also hosts the Oak Grove, characterized by mature canopy of Oak trees, and Hollybush Mansion, with its own historically resonant landscape design.

The relatively recent expansion of the University to the north of Rt. 322 has not benefited from a strong or cohesive open space plan, nor has it had the time for the maturation of landscape plantings outside of the stream corridor. The area's one natural feature, Chestnut Branch, provides much potential as a unifying feature. As noted in the stormwater and ecology sections of this chapter the stream has issues with flooding, erosion and nonnative invasive plant species. Campus faculty and students also noted that the stream is ignored rather than celebrated in the campus landscape, except for when there are flooding issues. While quads, plazas and open space areas exist across North Campus, (like Robinson Circle, the plaza in front of Science Hall, and the Green next to Rowan Hall) there lacks an aesthetic cohesion or hierarchy of spaces and an overall lack of green space.

Campus walkability

ONGOING LANDSCAPE AND STORMWATER PROJECTS AND CAMPUS INITIATIVES

The Triad (above) and the new Engineering building across from Rowan Hall (below) are two of the ongoing campus initiatives.

There are a number of ongoing projects, with separate timelines, that this master plan touches on briefly—mainly in the Campus Wide Recommendations chapter. While this master plan may not address these projects specifically, the concepts and considerations of these areas have taken into account the potential for change with the understanding that there may be adjustments to design solutions that will occur based on the specific project timelines and requirements.

These include:

- The New Engineering Building
- The New College of Business Building
- A Campus Wide Parking Study
- Potential Future Connections to Public Transit
- Freshman Village Residential Halls
- Memorial and Linden Halls
- Parking Lots and the Rec Center

There is also the planned relocation of most of the athletics programming to West Campus. With that move, there will be more available land on the main campus for either future buildings or more flexible open space that accommodates active and passive recreation for students. This is important, as some of the existing active spaces, like the basketball courts near Mimosa Hall, are envisioned to evolve into a wetland amenity that treats stormwater and creates a new experiential space along Meditation Walk. Another important campus initiative involves the integration of small ornamental donor and alumni gardens across campus, described in further detail in *Chapter 2* and *Appendix VI.*

Guiding Principles

Photo courtesy of Rowan University

Integrated stormwater management is a part of a network of high performing open spaces.

The Stormwater Management and Landscape Master Plan ensures that the campus successfully:

- Performs critical ecological services including stormwater management,
- Provides a network of high-performing open spaces that serve Rowan's learning communities, provide a sense of place, and strengthen the campus residential community
- Supports Rowan's academic mission with the campus serving as a living laboratory—encouraging academic collaboration and research integration
- Respects and enhances local and regional natural systems,
- Promotes sustainable and regenerative landscape practices, and
- Connects with the adjacent communities by highlighting a variety of access options, including bicycle trails through the campus, enhanced gateways, cultural corridor connections, and accommodations for campus transit and the future light rail stop. See Bike Circulation overlay in *Chapter 2* and standards for bicycle and skateboard stands in *Appendix II*.

Goals and Objectives

Photos courtesy of Rowan University

Science Hall (top) and Hollybush (bottom) show the diversity of architectural styles on campus, but through landscape enhancements a sense of cohesion can be achieved on campus.

During the master planning process Rowan students, faculty and staff came together to express their desires for the University campus landscape, associated with stormwater issues, aesthetics, open space use, circulation, and connectivity.

The feedback revolved around three main themes: Chestnut Branch (both the flooding issues and the fact that it was an overlooked natural resource amenity on campus); the need for more cohesion and connectivity across the campus for a holistic sense of place; and the need for landscapes that can provide multiple functions, from the social and recreational to the treatment of stormwater.

One of the greatest challenges is unifying the eclectic and diverse architectural styles represented on campus. A cohesive landscape aesthetic could create a sense of harmony among all of these different architectural styles.

With the input of the Rowan Facilities staff three goals were created to address these themes:

- Restore and enhance the Chestnut Branch stream corridor and campus natural areas for improved function and aesthetics.
- Create a strong identity for the Rowan campus through improved landscape quality, enhanced connections and continuity between spaces.
- Create integrated multifunctional landscapes that support ecological and hydrologic function while enhancing the campus experience.

For each goal a succinct set of pragmatic but forward-thinking objectives were developed. These goals and objectives, presented on the following pages, provided the basis for the development of the stormwwater and landscape master plan.

GOAL 1

Restore and enhance the Chestnut Branch stream corridor and campus natural areas for improved hydrologic function and aesthetics.

OBJECTIVES

- Restore a more natural hydrology to Chestnut Branch, by reducing "flashiness" of discharge through upland stormwater management.
- Enhance and maintain the vegetative buffer of the stream with native plants, increasing vegetative diversity and structure within the buffer (groundcover, understory, and canopy).
- Plant transitional landscapes between the natural vegetative buffer and formal campus open space areas with native plants.
- Remove and control all invasive nonnative vegetation along stream buffer.
- Create strategic access and enhanced viewsheds along the stream corridor without impacting ecological function.
- Stabilize banks along Chestnut Branch.

GOAL 2

Create a strong identity for the Rowan campus through improved landscape quality, enhanced connections and continuity between spaces.

OBJECTIVES

- Create a variety of collegiate landscapes that serve as gathering and social spaces for the campus community.
- Develop and enhance strong connections campus-wide.
- Create gateways that provide a clear sense of arrival and identity, and prepare for future growth of the campus.
- Strengthen and extend the walkway/trail connections along Chestnut Branch/Meditation Walk to run the entire length of campus, connecting to Rowan Boulevard and Triad.
- Create walkable and safe experiences along all major pedestrian corridors within and along the edges of the campus (adhering to ADA accessibility guidelines).
- Support a residential campus experience with landscapes that support active and passive recreation.
- Promote internal pedestrian and bicycle connections by reducing non-essential vehicular access internal to campus.

GOAL 3

Create integrated multifunctional landscapes that support ecological and hydrologic function while enhancing the campus experience.

OBJECTIVES

- Create landscapes that capture and filter runoff from sidewalks, rooftops, parking lots, and roads close to where the water falls.
- Develop spaces that serve as research and learning opportunities, including flexible spaces for outdoor learning and teaching.
- Develop a plant palette that is responsive to the native ecology (creating habitat, filtering stormwater and promoting ecological function) and creates beautiful landscapes.
- Create planted buffers between hardscape areas and ecological zones.
- Reduce overall operations and maintenance costs through low maintenance landscape alternatives and integrated stormwater management.
- Assure water quality treatment for all new development or redevelopment on campus.

Note to the Reader

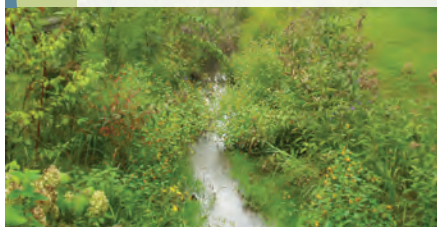
There are 11 campus typologies defined for Rowan University's campus. This set of standard campus landscape types helps to create a sense of identity, and is responsive to existing conditions and potential for innovation and change.

This document uses iconography to highlight the campus typologies chosen to bring consistency and cohesion to the Rowan campus landscape. These standard icons appear throughout this document, as different landscape types are referenced.

More detail and full descriptions of these campus typologies can be found in *Appendix I* of this document.

PEDESTRIAN WALKWAY

STREAM ENHANCEMENTS



CAMPUS GATEWAY

CAMPUS GREEN

POND EDGE

STREETSCAPES

COLLEGE PLAZA

STORMWATER MANAGEMENT

PARKING

RESIDENTIAL COURTS

OUTDOOR LEARNING

2-THE MASTER PLAN

Photos courtesy of Rowan University

Two different campus landscapes that define Rowan University: The University Green in front of Bunce Hall (top) and the plaza in front of the Student Center (right) looking toward the Library.

The Stormwater and Landscape Master Plan for the Rowan University campus *(see the following page)* incorporates functional landscapes into the campus context, focusing on the components of integrated stormwater management, landscape cohesion and connectivity, and ecological preservation and enhancement of the Chestnut Branch stream corridor. Together these provide a framework for the future management and planning of the campus, while defining a renewed sense of natural function, social interaction, and spatial definition.

Two of the main goals that the University set forth at the beginning of the planning process were to provide corrective measures to address the existing hydrologic issues and to enhance visual cohesion as well as connectivity across the campus.

Inherent in this master plan is the goal to protect, enhance, and create functional or "working" landscapes that demonstrate and embrace the manner in which water serves as a resource, while also providing a myriad of other benefits: habitat, microclimate, aesthetics, recreation and respite, social spaces, and learning landscapes.

This plan provides a holistic strategy for campus development, in that it accommodates significant building space expansion within a network of thriving campus landscapes and high performing ecological infrastructure. The Plan serves to invoke the University's potential regional leadership role in the planning and implementation of holistic green infrastructure practices and sustainability. Some of the major gestures made by this plan include: an enhanced and restored Chestnut Branch stream corridor; improved connectivity across the campus and between North and South Campuses (spanning Rt. 322); improved campus greens and plazas at Robinson, Wilson, the Student Center, and outside of the Engineering building; and new wetlands that double as open space amenities near Mimosa and Linden Halls.


Legend
Major Campus Greens (Bunce, Memorial, Engineering Robinson)
Proposed Wetland and Stream BMPs
Other Campus BMPs
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Primary Walkways
Secondary Walkways
Boardwalk
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Trees/Canopy
Existing Natural Features: Wetlands, Ponds, and Streams
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Chestnut Hall
Townhouses
Savitz
Library
Hawthorn
Rt. 322
Student Center
Linden
Winans
Heating Plant
Cassady
Bozorth
Memorial
Future Freshman Village Residential Halls
Bunce
Laurel
Oak
Evergreen
Mullica
Bole annex
Hollybush
Bole
Whitney Ave
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Examining the Layers of the Plan

Photo courtesy of Rowan University

Considerations for this master plan include existing stormwater management issues as well as cultural and ecological landscapes.

This master plan is informed by multiple layers associated with landscape cohesion and functionality. On the following pages the key layers are parsed out to provide an even greater understanding of how each contributes to the whole. The layers describe the natural and cultural foundation for the campus, with layers associated with the preservation of natural resources areas on campus; cultural, historical, artistic and garden locations; and then layers begin to explore the built landscape with a focus on improved circulation of pedestrians and vehicular traffic; gateways to the campus; impervious area; stormwater management; campus open space; and outdoor classrooms, gathering spaces and opportunities for living laboratories.

The 2013 Facilities Master Plan was continually referenced during the development of this master plan - although in some cases actions were suggested that conflict with the previous planning efforts. A more detailed discussion of the comparisons and contrasts between the two plans is included in *Appendix VII*.

NATURAL RESOURCE PRESERVATION AREAS–EXISTING CONDITIONS

One of the main natural resource assets on campus is the Chestnut Branch stream corridor. The stream provides a unique opportunity at the heart of the campus, where students can enjoy the peace and solitude of a walk along the wooded edges or enjoy the sound of the flowing water as it parallels Meditation Walk.

Other existing natural resources of note on campus include: the wooded areas on the west and east ends of Chestnut Branch within the campus; Abbotts Pond on north Campus; a wetland tucked into the Townhouses on south campus; and the Oak Grove on south campus, which is a campus icon characterized by mature oaks.

Currently the stream corridor is barely noticed by passing students and considered a bit of a nuisance by faculty and facilities staff, because of historic flooding issues and the lack of a robust vegetation

CAMPUS TYPOLOGIES

Stream Enhancement

Pond Edge

NATURAL RESOURCE PRESERVATION AREAS–PROPOSED CONDITIONS

management plan.
With the implementation of this master plan there is an opportunity to enhance the stream corridor with a broader swath of native plantings, improve the stream function with the implementation of integrated stormwater practices in upland locations that convey small amounts of water to the stream at any given time, and expand natural resource connections across the campus through integrated green infrastructure practices like stormwater wetland features, expanded plantings in the Oak Grove, and further adaptive management of the existing woodlands and wetlands in the expanded conservation and enhancement zones.

Further detail about these opportunities and the associated typologies is found in *Chapter 3* and *Appendix I*.

PEDESTRIAN CIRCULATION–EXISTING CONDITIONS

In the 2013 Facilities Master Plan walkability and vitality were identified as key components in supporting a pedestrian-oriented campus with a strong residential community, where new buildings were set within a framework of pedestrian pathways and open space.

Existing walkways include a diversity of widths and materials. Some paths have legacy alignments that may not work as well today as they once did.

Improvements to circulation across the campus focus on developing a stronger east/west corridor along Meditation Walk, which engages with the stream corridor and connects to Rowan Boulevard and the new residential development at the eastern edge of the campus. Mullica Hill Road (Rt. 322) is also an important east/west corridor for pedestrians. Any improvements for walkways will respect current ADA requirements.

Pedestrian Walkway

PEDESTRIAN CIRCULATION–PROPOSED CONDITIONS

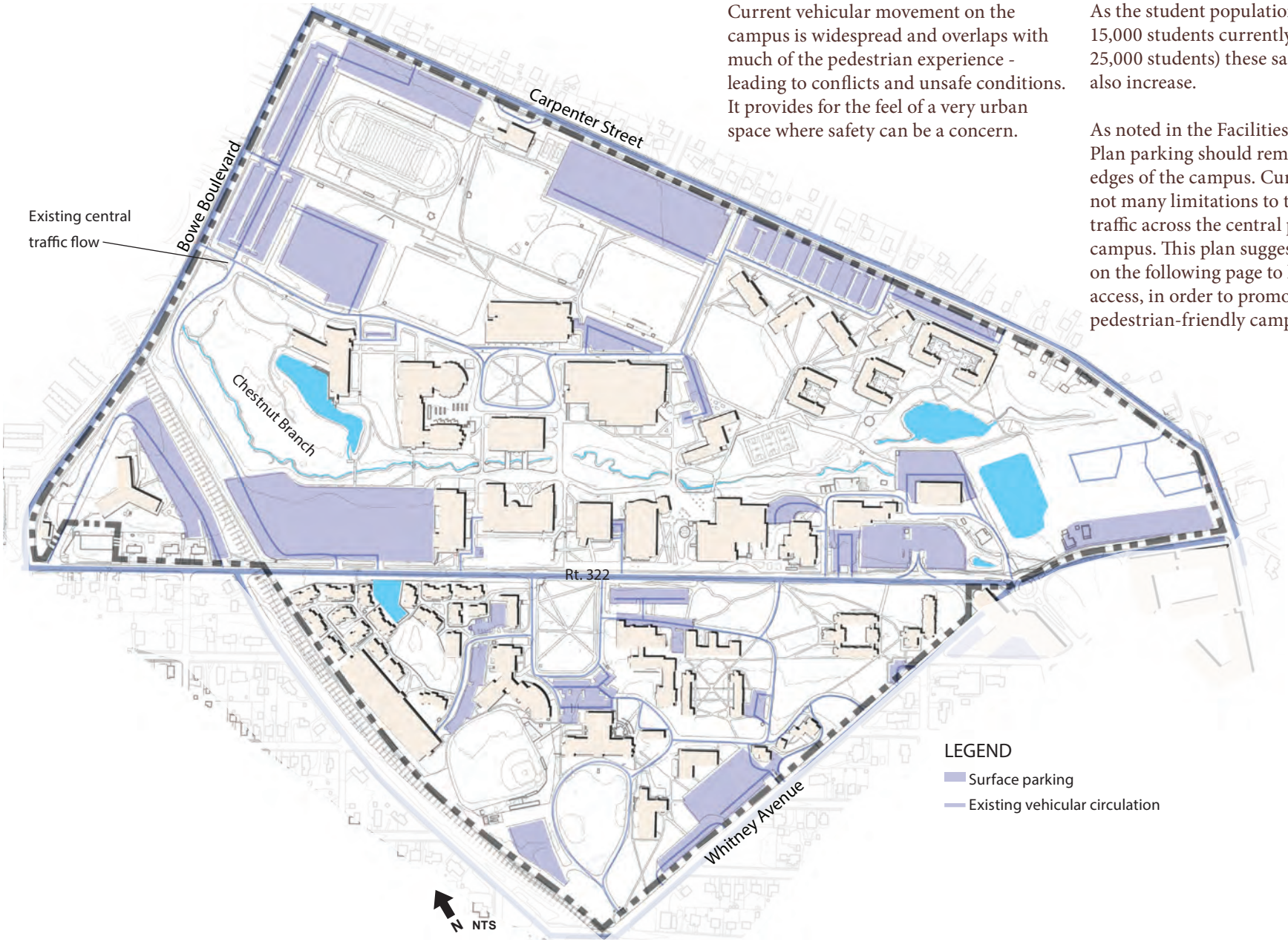
The circulation within the campus is also strengthened with more well-defined primary walkways that connect north and south campus, strengthening intercampus connections. Meditation Walk is enhanced as a primary walkway that connects the campus from east to west.

A hierarchy of secondary and tertiary paths is suggested with narrowing widths. Further detail on the pathway hierarchy is included in *Appendix II*. Pedestrian pathways are also defined by their relationship with the surrounding landscape and architectural features. The experience of the pedestrian can be improved by the addition of new plantings along walkways and campus greens, to better define open spaces and create a sense of movement through the landscape.

Further detail about these opportunities is found in *Chapter 3*, the associated typologies in *Appendix I,* and design standards in *Appendix II*.

Proposed conditions provide for a slightly simplified path system across the campus, with some paths being removed to create stronger connections on other pathways. Green infrastructure infiltration gardens help manage stormwater while creating a more walkable and welcoming experience for pedestrians.

VEHICULAR CIRCULATION–EXISTING CONDITIONS



Current vehicular movement on the campus is widespread and overlaps with much of the pedestrian experience - leading to conflicts and unsafe conditions. It provides for the feel of a very urban space where safety can be a concern.

As the student population increases (from 15,000 students currently, to upwards of 25,000 students) these safety issues will also increase.

As noted in the Facilities 2013 Master Plan parking should remain along the edges of the campus. Currently there are not many limitations to the vehicular traffic across the central portion of campus. This plan suggests some changes on the following page to limit vehicular access, in order to promote a more pedestrian-friendly campus.

CAMPUS TYPOLOGIES

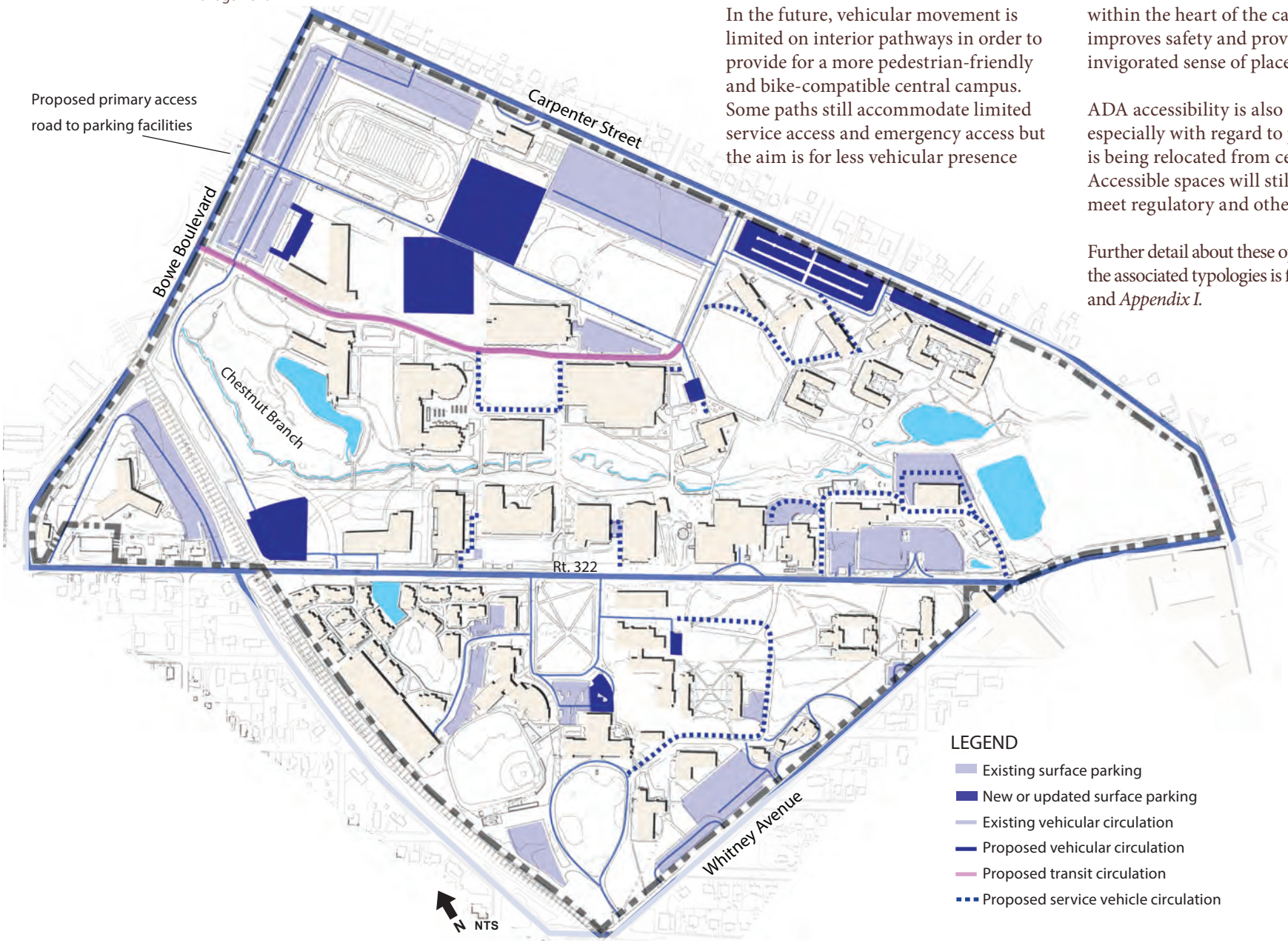
Parking | Streetscapes | Stormwater Management

VEHICULAR CIRCULATION–PROPOSED CONDITIONS

In the future, vehicular movement is limited on interior pathways in order to provide for a more pedestrian-friendly and bike-compatible central campus. Some paths still accommodate limited service access and emergency access but the aim is for less vehicular presence within the heart of the campus. This improves safety and provides for an invigorated sense of place.

ADA accessibility is also a consideration, especially with regard to parking that is being relocated from central campus. Accessible spaces will still be provided to meet regulatory and other requirements.

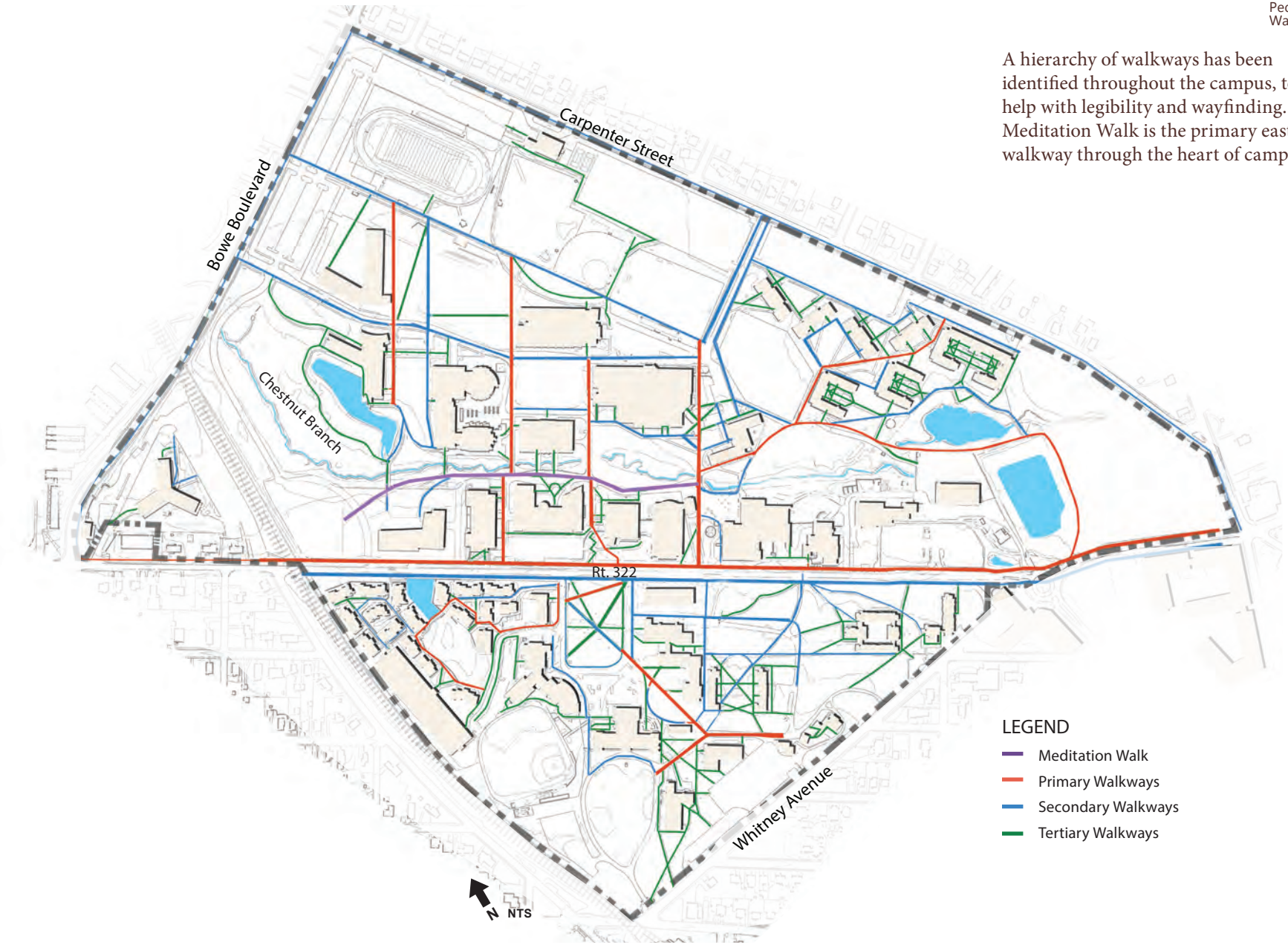
Further detail about these opportunities and the associated typologies is found in *Chapter 3* and *Appendix I.*



CIRCULATION HIERARCHY–PROPOSED CONDITIONS

Pedestrian Walkway

A hierarchy of walkways has been identified throughout the campus, to help with legibility and wayfinding. Meditation Walk is the primary east-west walkway through the heart of campus.

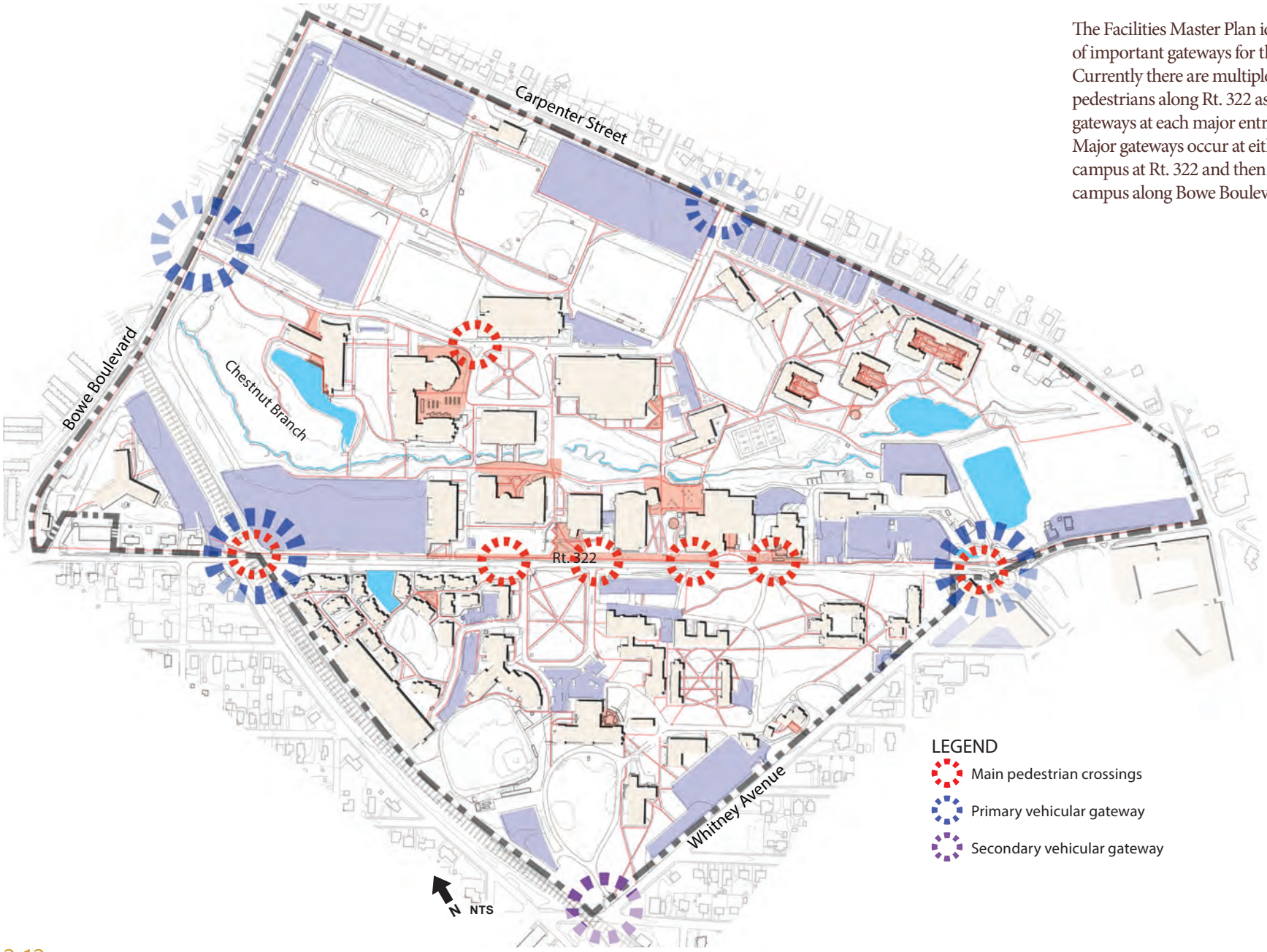


BIKE AND SKATEBOARD CIRCULATION–PROPOSED CONDITIONS

Bicycle and skateboard usage is encouraged on select paths. This helps provide better connections across the campus but also promotes certain routes solely for pedestrians.

GATEWAYS–EXISTING CONDITIONS

The Facilities Master Plan identified a number of important gateways for the campus. Currently there are multiple gateways for pedestrians along Rt. 322 as well as vehicular gateways at each major entry to the campus. Major gateways occur at either end of the campus at Rt. 322 and then at the entry to the campus along Bowe Boulevard.



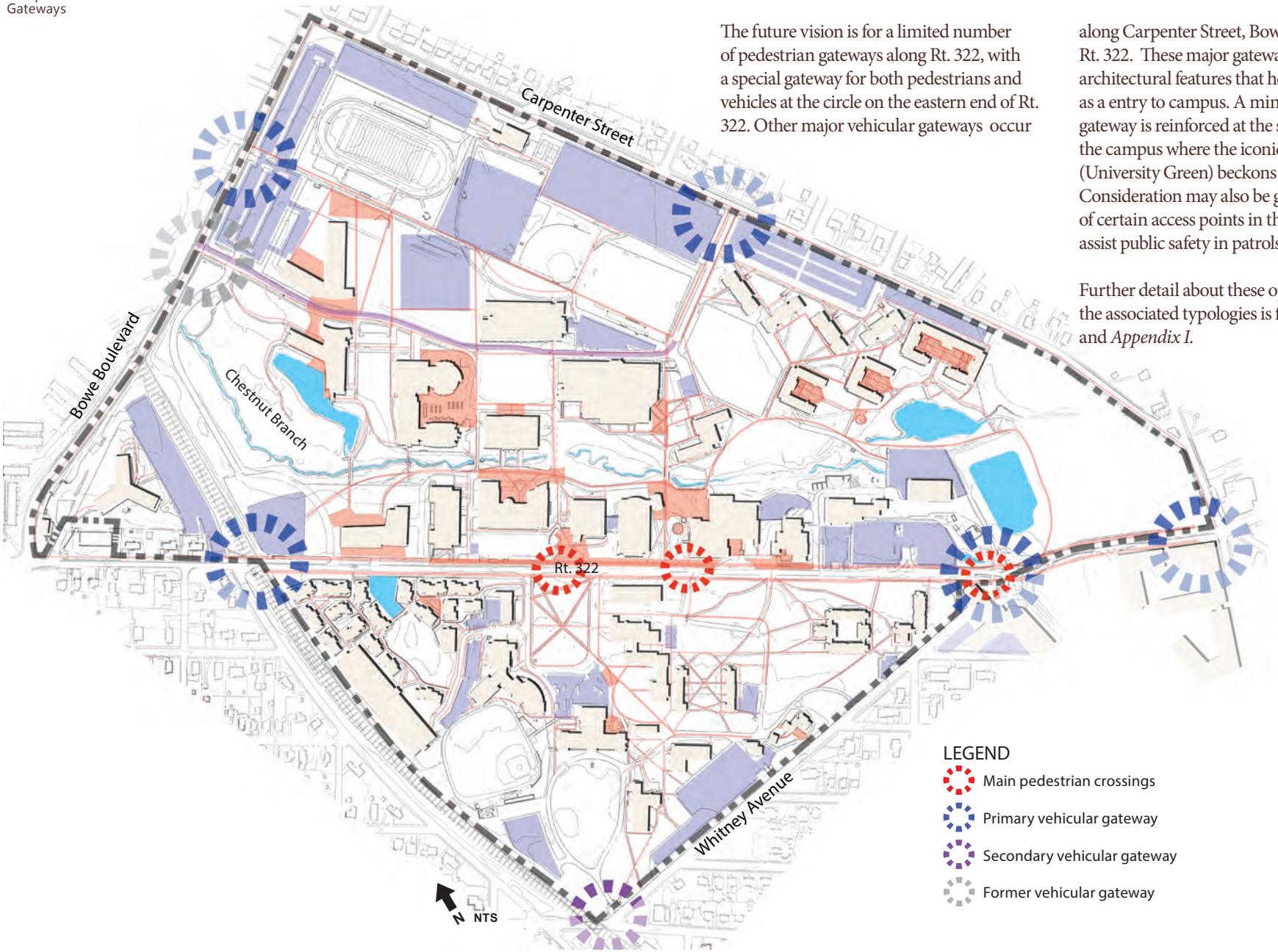
CAMPUS TYPOLOGIES

Campus Gateways

GATEWAYS–PROPOSED CONDITIONS

The future vision is for a limited number of pedestrian gateways along Rt. 322, with a special gateway for both pedestrians and vehicles at the circle on the eastern end of Rt. 322. Other major vehicular gateways occur along Carpenter Street, Bowe Boulevard, and Rt. 322. These major gateways may include architectural features that help denote them as a entry to campus. A minor, but important, gateway is reinforced at the southern tip of the campus where the iconic Bunce Oval (University Green) beckons to passing cars. Consideration may also be given to the control of certain access points in the evenings, to assist public safety in patrols.

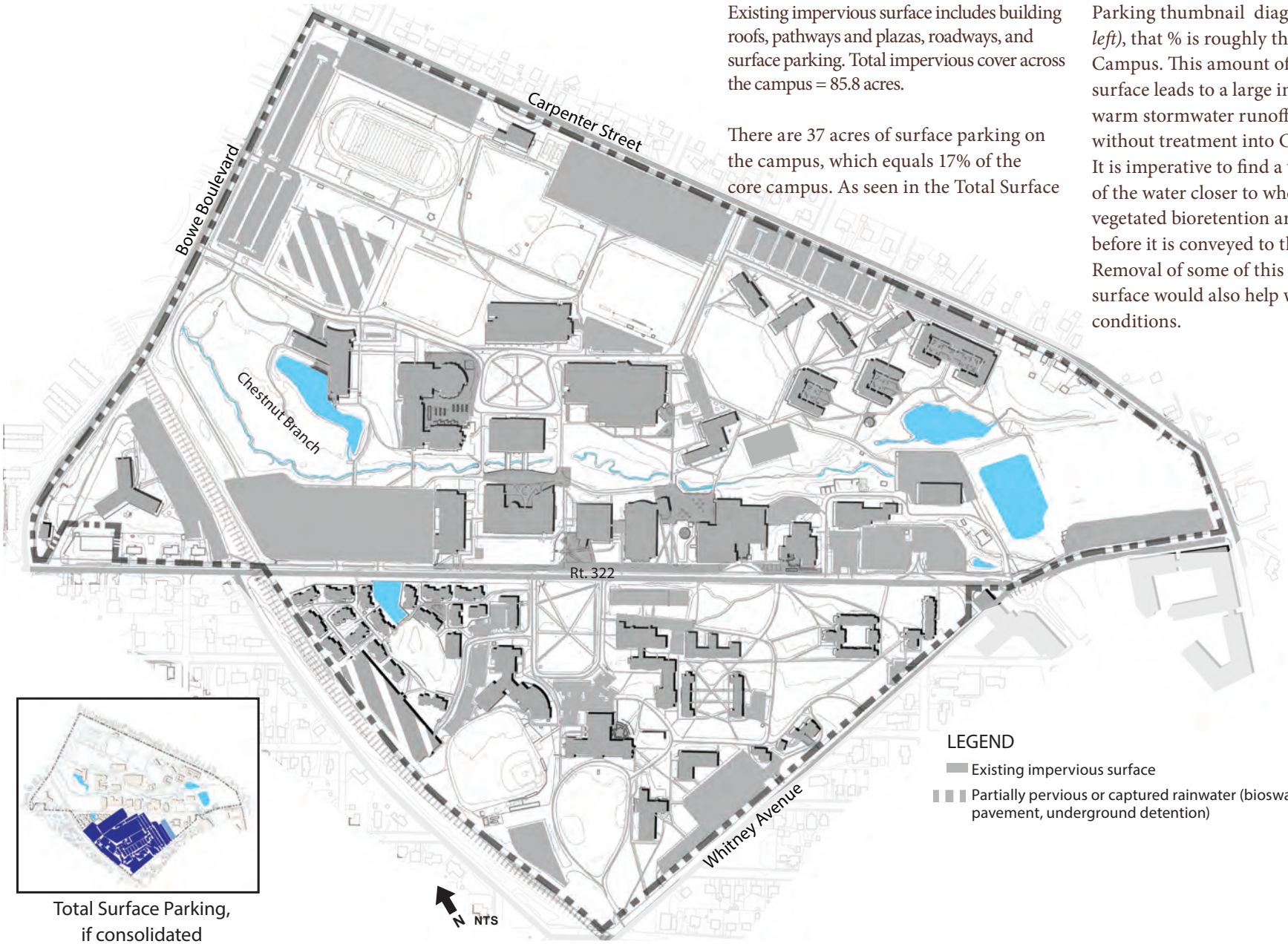
Further detail about these opportunities and the associated typologies is found in *Chapter 3* and *Appendix I*.



IMPERVIOUS SURFACE–EXISTING CONDITIONS

Existing impervious surface includes building roofs, pathways and plazas, roadways, and surface parking. Total impervious cover across the campus = 85.8 acres.

There are 37 acres of surface parking on the campus, which equals 17% of the core campus. As seen in the Total Surface Parking thumbnail diagram *(bottom left)*, that % is roughly the size of South Campus. This amount of impervious surface leads to a large influx of dirty, warm stormwater runoff being conveyed without treatment into Chestnut Branch. It is imperative to find a way to treat more of the water closer to where it falls, in vegetated bioretention areas and swales, before it is conveyed to the stream. Removal of some of this impervious surface would also help with water quality conditions.



Total Surface Parking, if consolidated

CAMPUS TYPOLOGIES

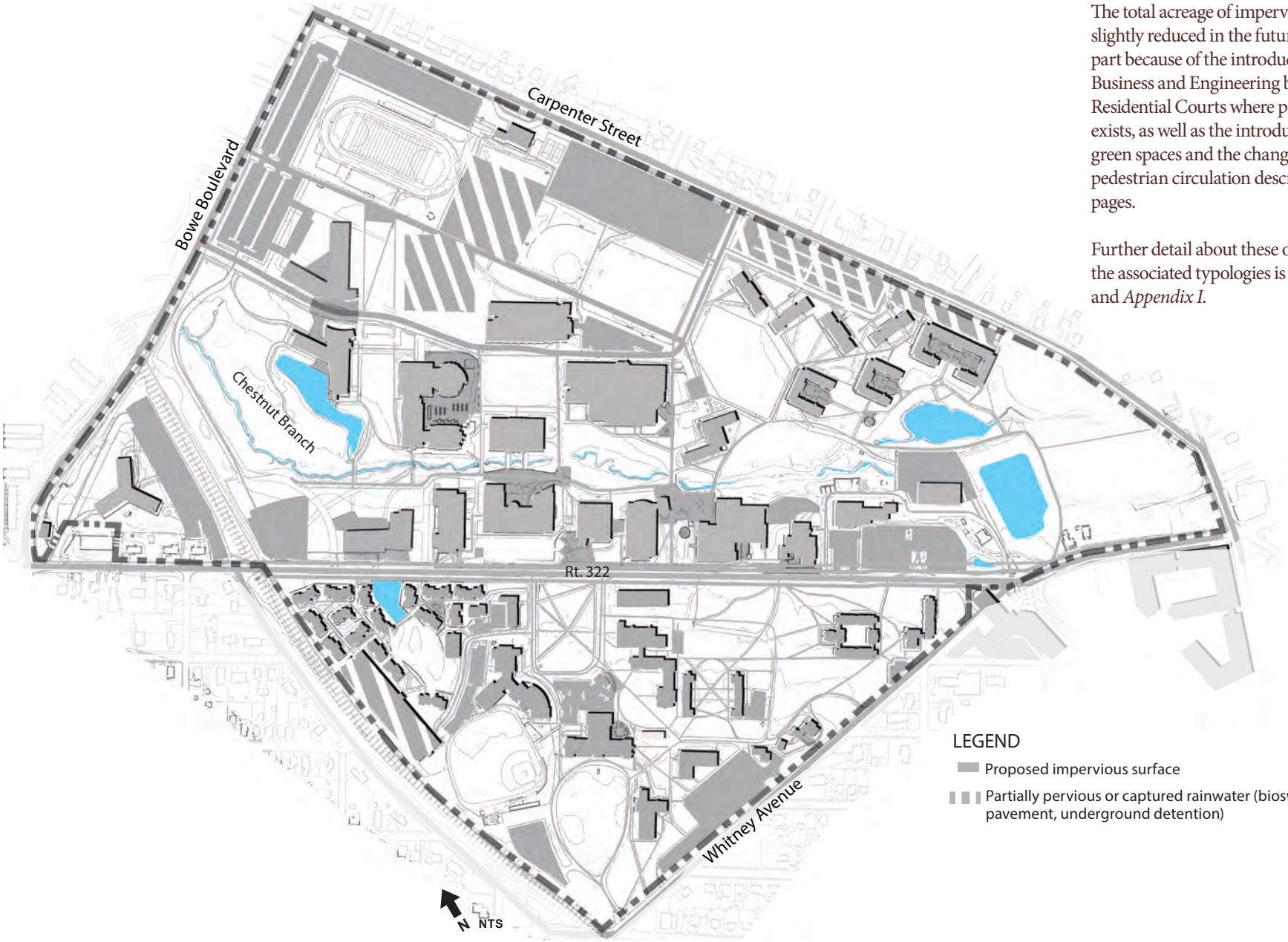
Parking

Stormwater Management

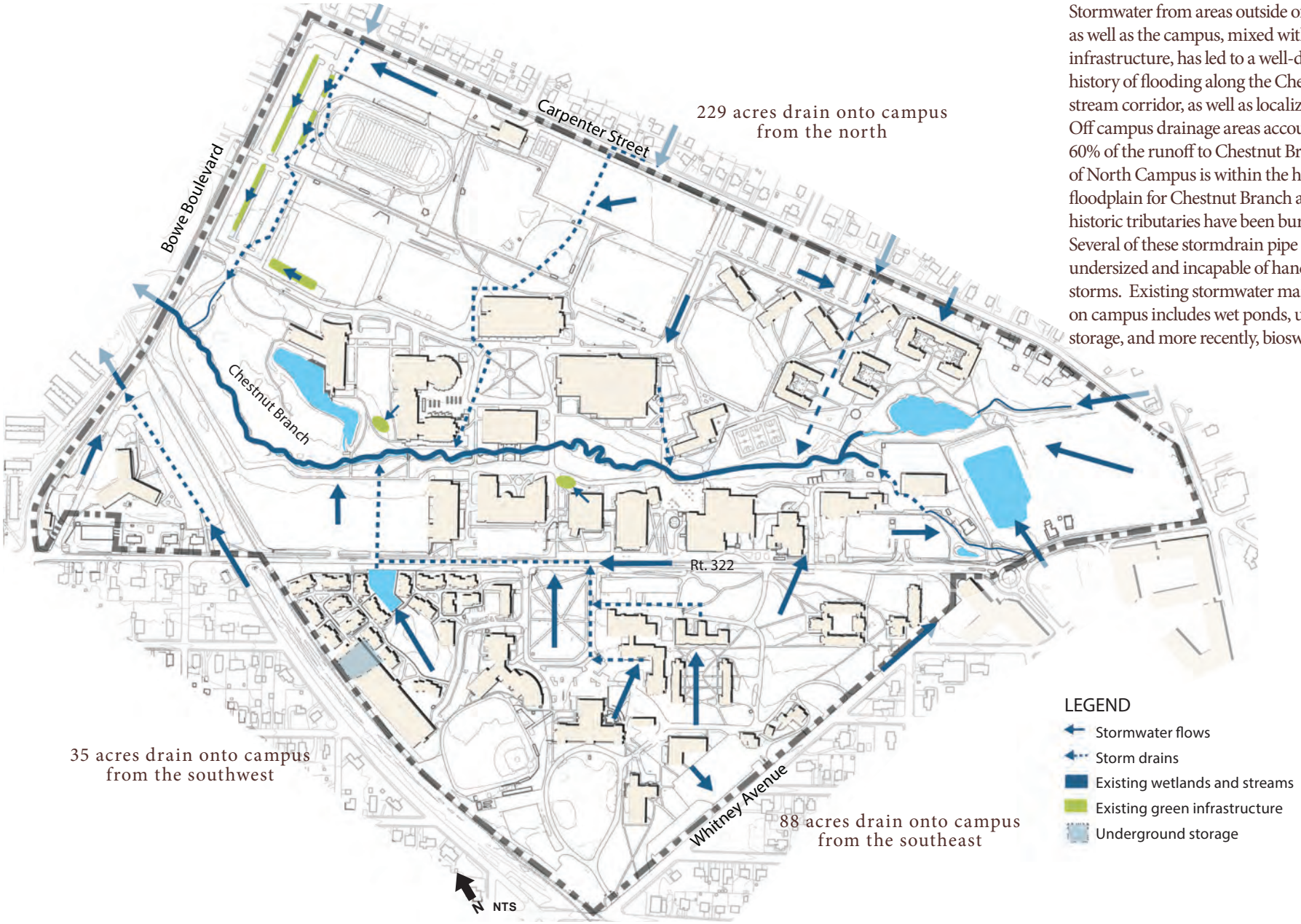
IMPERVIOUS SURFACE–PROPOSED CONDITIONS

The total acreage of impervious surface is slightly reduced in the future. This occurs in part because of the introduction of the new Business and Engineering buildings, the Residential Courts where parking currently exists, as well as the introduction of new green spaces and the changes in vehicular and pedestrian circulation described on previous pages.

Further detail about these opportunities and the associated typologies is found in *Chapter 3* and *Appendix I*.



STORMWATER –EXISTING CONDITIONS



Stormwater from areas outside of the campus as well as the campus, mixed with aging infrastructure, has led to a well-documented history of flooding along the Chestnut Branch stream corridor, as well as localized flooding. Off campus drainage areas account for over 60% of the runoff to Chestnut Branch. Much of North Campus is within the historic floodplain for Chestnut Branch and many historic tributaries have been buried in pipes. Several of these stormdrain pipe networks are undersized and incapable of handling larger storms. Existing stormwater management on campus includes wet ponds, underground storage, and more recently, bioswales.

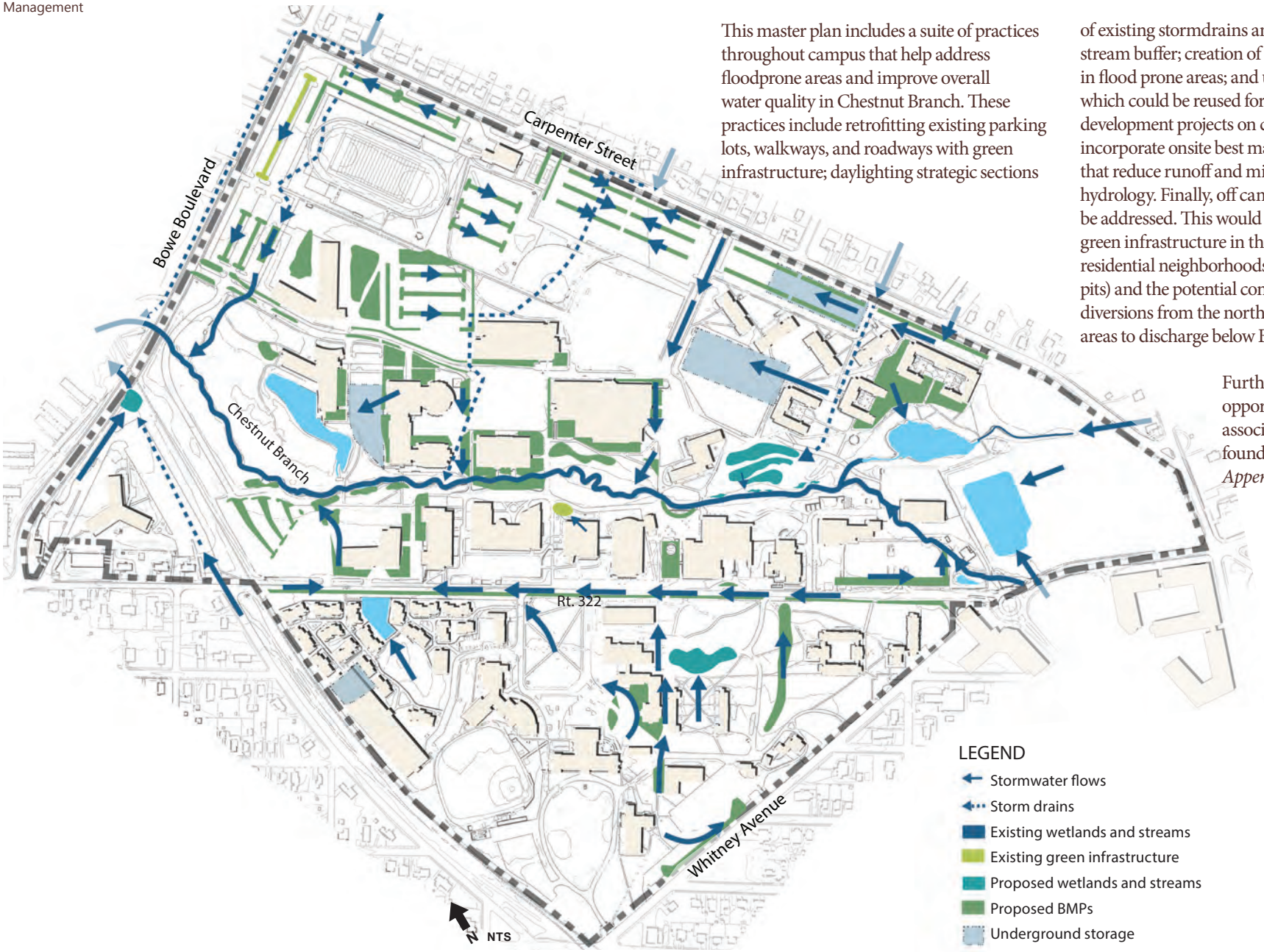
CAMPUS TYPOLOGIES

Stormwater Management

STORMWATER –PROPOSED CONDITIONS

This master plan includes a suite of practices throughout campus that help address floodprone areas and improve overall water quality in Chestnut Branch. These practices include retrofitting existing parking lots, walkways, and roadways with green infrastructure; daylighting strategic sections of existing stormdrains and restoration of the stream buffer; creation of stormwater wetlands in flood prone areas; and underground storage which could be reused for irrigation. All future development projects on campus should incorporate onsite best management practices that reduce runoff and mimic natural hydrology. Finally, off campus drainage must be addressed. This would include integrated green infrastructure in the surrounding residential neighborhoods (swales and tree pits) and the potential construction of bypass diversions from the northern subwatershed areas to discharge below Bowe Boulevard.

Further detail about these opportunities and the associated typologies is found in *Chapter 3* and *Appendix I.*



OPEN SPACE–EXISTING CONDITIONS

The primary goals of the open space plan presented in the Facilities Master Plan include: the protection of significant existing natural and man-made landscapes on campus, the reinforcement of a pedestrian-oriented campus through the creation of attractive walkways and defined landscape spaces, and the heightening of the campus identity through the landscape treatment of campus edges and gateways.

There is currently a lack of cohesion amongst the campus open space areas. They are comprised of a collection of campus greens scattered amongst the buildings, along with the existing natural resource areas characterized mainly by the presence of tree canopy. Plazas and hardscapes provide further gathering and social spaces in the heart of the academic core and near some of the residential areas.

CAMPUS TYPOLOGIES

Campus Green | College Plaza | Residential Court

OPEN SPACE–PROPOSED CONDITIONS

The future open space network on campus features stronger connections through enhanced campus greens and more cohesive landscape designs of residential courts, walkways, and plazas (described in more detail in *Appendix I*).

This accommodates the projected increase in residential students and their need for active and passive recreation in flexible spaces.

On north campus the new Engineering and Business buildings are organized along an elongated open space axis that connects to the Chestnut Branch stream corridor. Campus greens at Robinson Circle and between the Rec Center and Mimosa Hall are enhanced with tree plantings, water features, and new gathering spaces for students. On south campus an expanded campus green at Laurel and Oak Halls terminates at a new wetland amenity and the Oak Grove.

Further detail about these opportunities and the associated typologies is found in *Chapter 3* and *Appendix I*.

OUTDOOR CLASSROOMS, GATHERING, AND STUDY LOCATIONS–EXISTING CONDITIONS

Faculty and students identified a number of locations that are frequently used for gathering or study on campus. Students were also observed using some of these spaces to conduct experiments or other projects for classes. Students also noted that some of these existing spaces are not necessarily meeting their highest potential for use. University Green (a significant historic landmark for current students and alumni) was noted as a favorite space but one that is fairly distant from the campus core. The students also noted that they would like to see more spaces like University Green and the Oak Grove available on north campus.

CAMPUS TYPOLOGIES

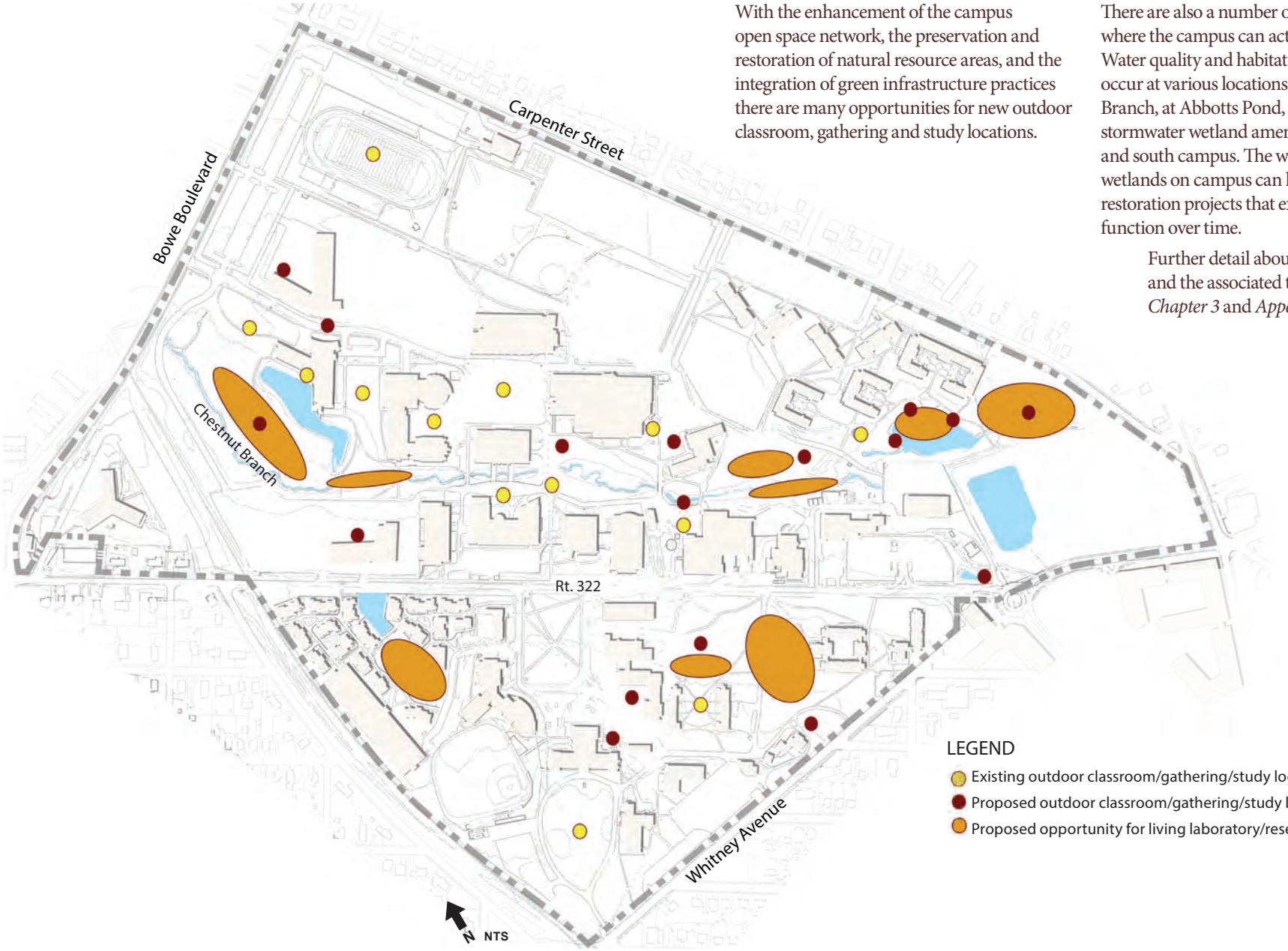
Aa
Outdoor Learning

OUTDOOR CLASSROOMS, GATHERING, AND STUDY LOCATIONS–PROPOSED CONDITIONS

With the enhancement of the campus open space network, the preservation and restoration of natural resource areas, and the integration of green infrastructure practices there are many opportunities for new outdoor classroom, gathering and study locations.

There are also a number of opportunities where the campus can act as living laboratory. Water quality and habitat monitoring can occur at various locations along Chestnut Branch, at Abbotts Pond, as well as the new stormwater wetland amenities on north and south campus. The woodlands and wetlands on campus can host monitoring and restoration projects that examine ecological function over time.

Further detail about these opportunities and the associated typologies is found in *Chapter 3* and *Appendix I.*



CULTURAL/HISTORICAL AREAS–EXISTING CONDITIONS

South campus is home to several important cultural landscapes that often serve as the public image of Rowan. These include University Green, the Oak Grove, Hollybush Mansion and Memorial Circle. There are also a number of sculptural pieces and small garden areas scattered across both campuses.

The challenge is to continue to maintain these unique and historic landscape elements in a way that lends to a sense of cohesion. This can be met through the use of a universal planting palette that is applied to the various gardens and around sculptures and works of art, as well as the introduction when appropriate of standard campus furnishings. The contrast of the new campus landscapes to the north and the older spaces to the south also provides an opportunity to consider how art, garden spaces, and other social and gathering spaces can help create a sense of community and identity that spans the campus as a whole.

CAMPUS TYPOLOGIES

Campus Green

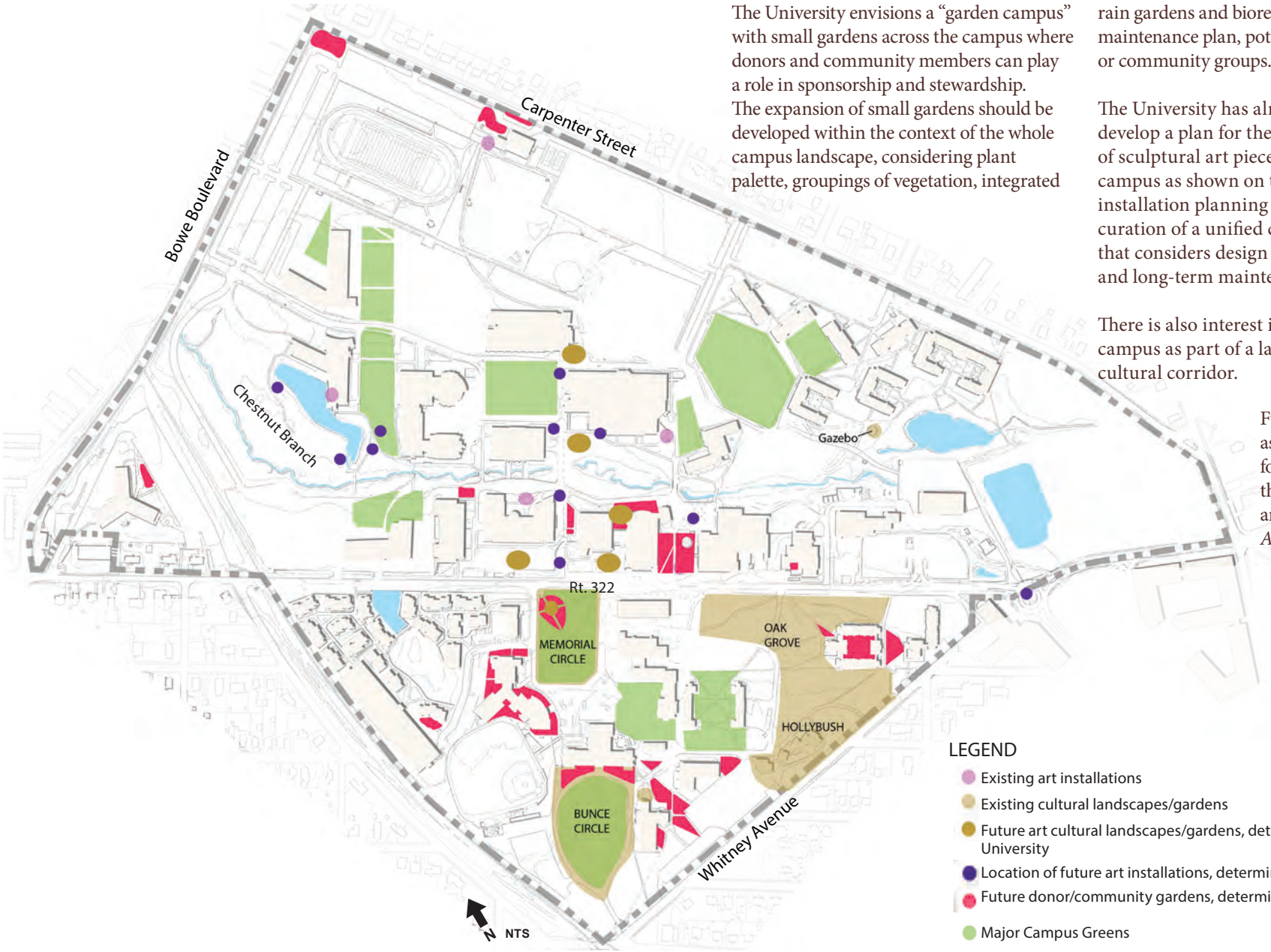
CULTURAL/HISTORICAL AREAS–PROPOSED CONDITIONS

The University envisions a "garden campus" with small gardens across the campus where donors and community members can play a role in sponsorship and stewardship. The expansion of small gardens should be developed within the context of the whole campus landscape, considering plant palette, groupings of vegetation, integrated rain gardens and bioretention, and a maintenance plan, potentially with donor or community groups.

The University has already begun to develop a plan for the further integration of sculptural art pieces throughout the campus as shown on the figure. Art installation planning should consider curation of a unified campus art collection that considers design review for all pieces and long-term maintenance.

There is also interest in integrating Rowan campus as part of a larger contiguous cultural corridor.

Further detail about the associated typologies is found *Appendix I* and the gardens initiative and cultural corridor in *Appendix VI.*



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3-CAMPUS FOCUS AREAS

Identifying three focus areas on campus opens up the opportunity to explore design considerations for integrating stormwater management, enhancing ecological function, and creating a more cohesive landscape that provides a strong sense of place and a connection to the University's mission.

Three locations on campus were determined to be representative of the campus stormwater and landscape master plan as a whole, for a deeper examination of design considerations. These three focus areas provide the opportunity to drill down and explore the way in which the campus landscape is reinvigorated and re-envisioned with this plan.

The three focus areas are:

1. West Side Quad Connections: Robinson Circle, Wilson Hall Plaza, and the Engineering expansion
2. North South Corridor from the Rec Center to Memorial Hall
3. Chestnut Branch Corridor/ Meditation Walk

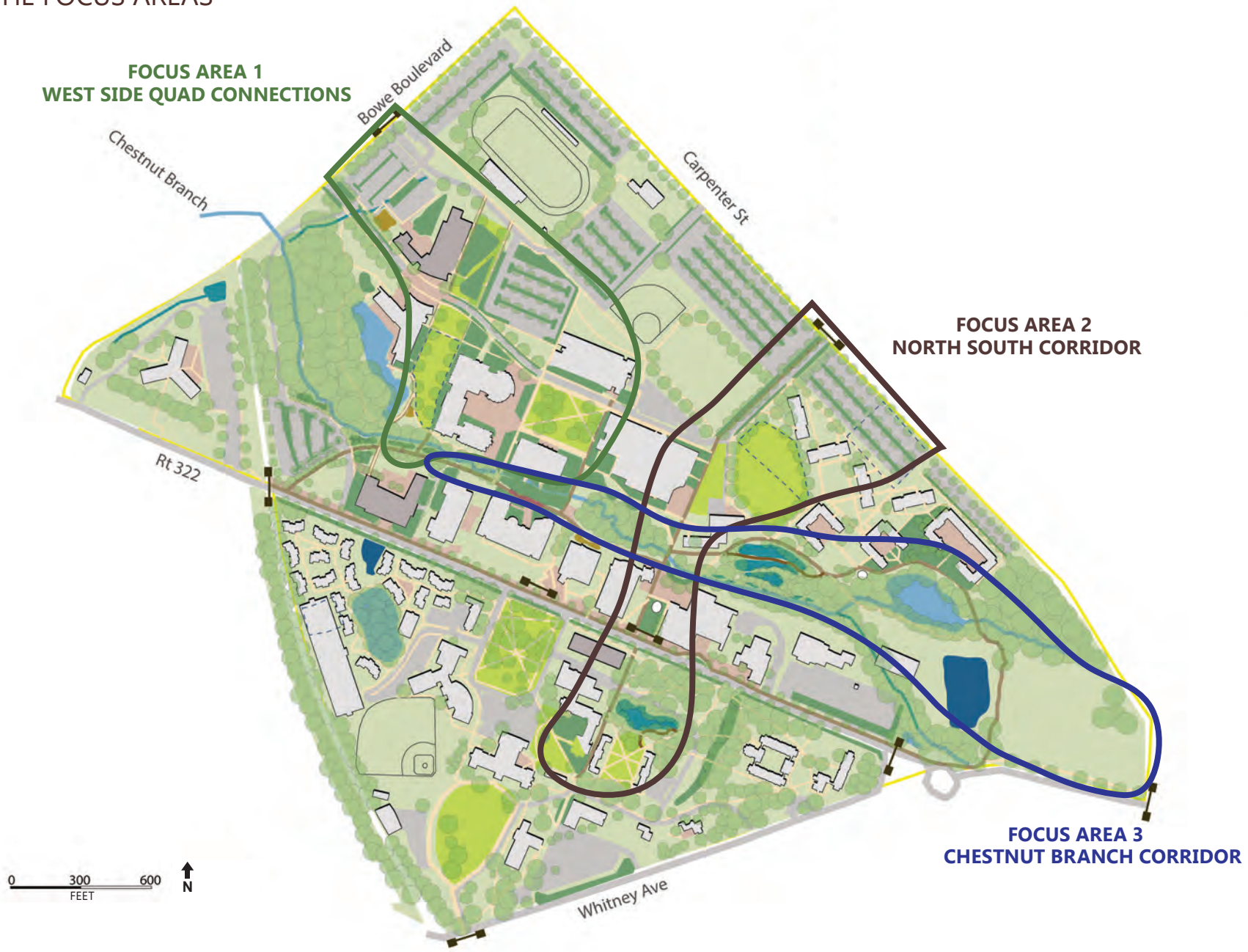
Three focus areas discussions in this chapter provide preliminary concepts that present the application of stormwater and landscape management practices conforming to the design principles established for this master plan. They have been developed based on both subwatershed and precinct-scale level analyses.

The concepts presented:

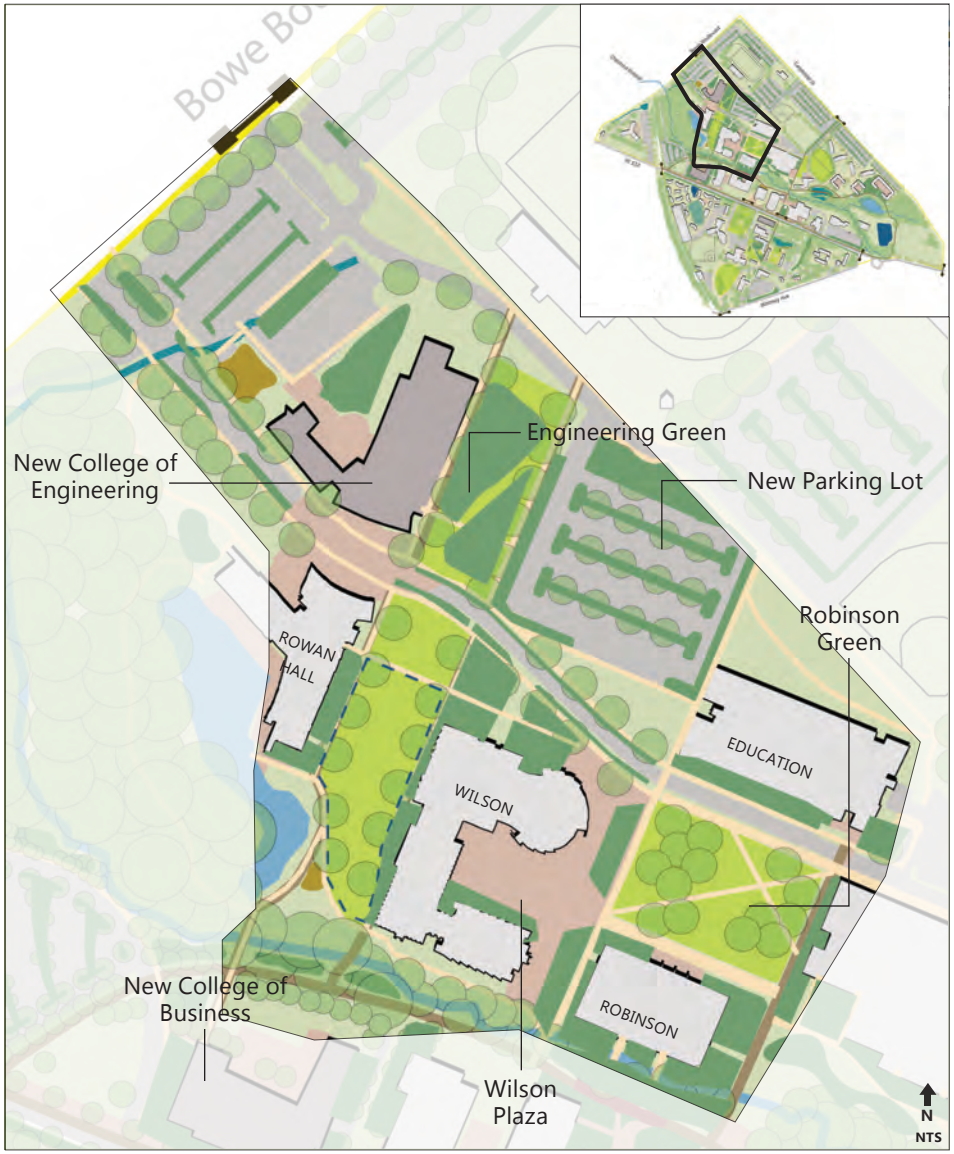
- Replicate natural hydrological cycles, where practical, optimizing infiltration, filtering, and evapotranspiration through non-structural biological processes.
- Seamlessly integrate ecological, cultural, and aesthetic features throughout the campus, allowing form to follow function.
- Protect and enhance the character and image of the campus as a research institution and residential campus
- And meet and exceed all federal, state, and local regulations.

This chapter also presents the various campus landscape typologies in each Focus Area, when they are applicable, along with a planning-level design approach for each location. More information about the specific typologies is found in *Appendix I*.

THE FOCUS AREAS



Focus Area 1–West Side Quad Connections



The western edge of North Campus has recently experienced significant change as the campus and the curriculum continue to expand. Rowan Hall defines the western edge, overlooking the pond and woodland along the edge of Chestnut Branch.

The future vision of this portion of campus includes the addition of a new College of Business (south of Chestnut Branch) and the new College of Engineering (north of Rowan Hall). With these two significant additions, the character of the campus continues to evolve.

Landscape design plays an important role in helping to create cohesion among these new structures. Not only does the western end of campus host prominent academic departments, it also serves as the face of Rowan. The Education School and the Wilson Arts Center both host members of the community for various events and activities, making the entrance from Bowe Boulevard an important gateway for many members of the wider community. There is an unprecedented opportunity to strengthen campus identity and renew a sense of place within Focus Area 1.

A prominent campus green will stretch all the way from the football stadium to the College of Business. This becomes an iconic open space that is flexible, accommodating many different programming needs and providing the wide open green space frequently enjoyed on larger, residential university campuses.

More intimate collegiate spaces are enhanced and enlivened in the concepts developed for Robinson Green and the Wilson Hall Plaza. There is a seamless combination of hardscape design with integrated stormwater management practices and a peaceful inviting canopied green that links the Education Building to Robinson Hall.

The concepts highlighted in this focus area serve to connect and enliven the existing campus spaces, in a way that reflects and celebrates the growing profile of the University.

CAMPUS TYPOLOGIES IN THIS LOCATION

Campus Green | Streetscapes | Stormwater Management | Parking

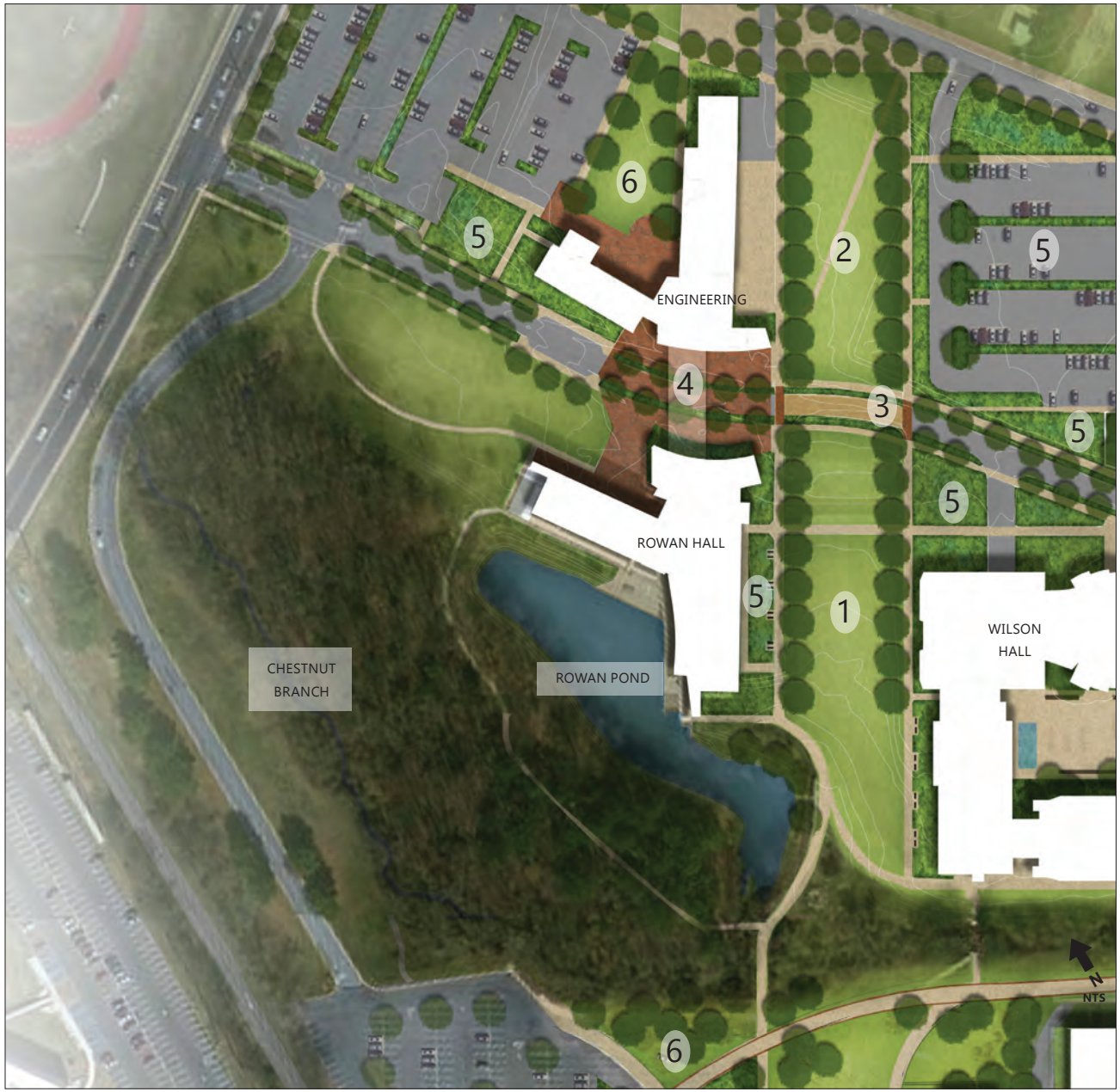
ENGINEERING QUAD

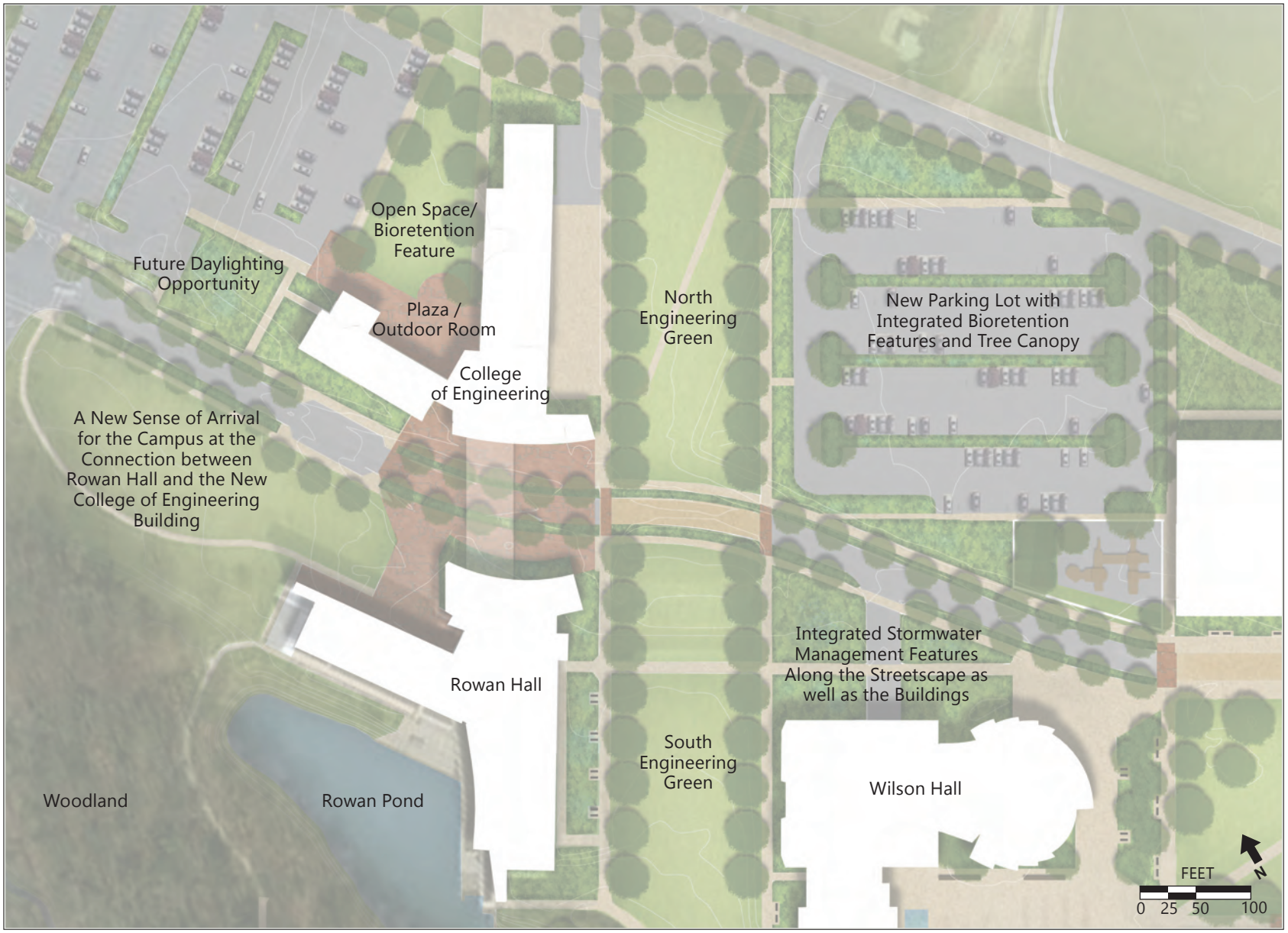
The open space alongside Rowan Hall has been recognized as very valuable and well-utilized. From scientific experiments spilling out of Rowan Hall, music practice and dance rehearsals, to study and respite, this North-South open space corridor has a variety of important uses (1).

The intent of this concept is to build on that success, with the enhancement and enlargement of the open space northward, extending this collegiate landscape to the new College of Engineering building and associated campus green (2). Increased tree canopy along both edges helps extend the views and frame the space. With the expansion of this new college green a spatial dialogue is established with the stream and the green space surrounding the College of Business.

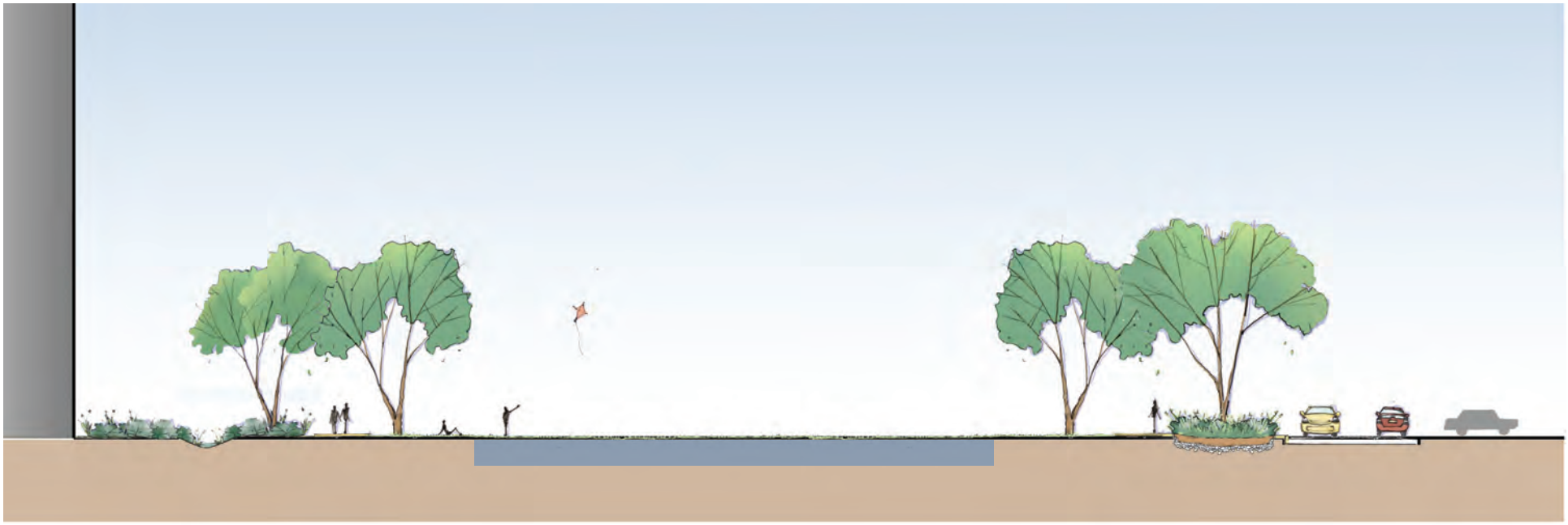
As the campus drive is considered for rerouting in the future, less vehicular traffic is allowed into the campus core along this route; the crossing from the south green to the north green takes on a new character and creates a stronger pedestrian corridor. The streetscape is lined with canopy trees and stormwater treatment swales (3). A special paving pattern and a vegetation-lined crossing links Rowan Hall to the Engineering building, creating a sense of arrival (4).

Bioretention areas are suggested along Rowan Hall, as well as within and along the edges of parking lots (5). Other bioretention areas associated with the new buildings are designed as landscape amenities that respond to both the architectural design and the ecological context of Chestnut Branch (6).





Major elements of the concept.



The integration of rain gardens and subsurface storage areas (shown in dark blue) provides space for stormwater treatment in a way that enhances the landscape experience. A wide, open green is framed by canopy trees.

The vision for the Engineering Green includes enhanced walkways, integrated stormwater management practices in vegetated areas along these walkways, and a streetscape treatment that promotes a sense of arrival. Further information on these campus landscape typologies is found in *Appendix I.*

Examples of enhanced walkways at University of Georgia and Penn State University

When surface parking is desired close to the campus core, there is the risk that the collegiate greens may be dwarfed by these large expanses of asphalt. With the help of integrated stormwater management practices and increased vegetation through the expanses of parking stalls, the lot becomes a much more comfortable space that complements the campus landscape at a human scale.

Use of tree canopy throughout helps provide shade and vertical structure in what would otherwise be a very flat and hot landscape. Edge plantings also help provide screening.

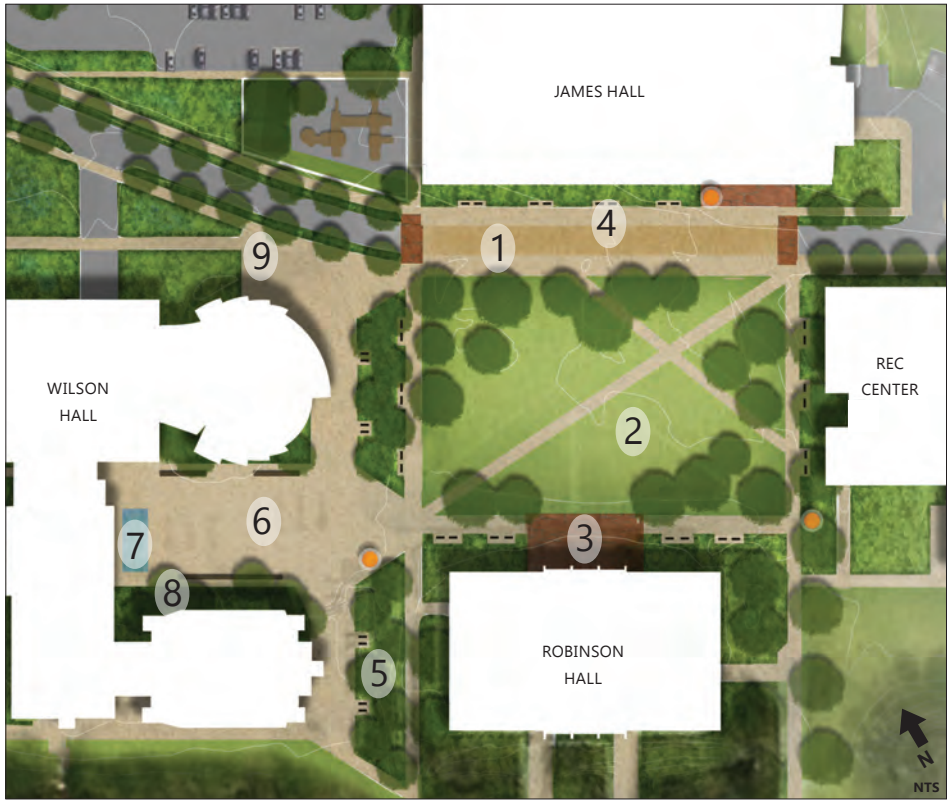
Examples of integrated tree canopy and vegetation along and within parking lots

A typical cross section of a parking lot edged with bioretention/bioswales that also accommodates pedestrian access and the potential for subsurface storage of stormwater.

ROBINSON GREEN AND WILSON PLAZA

CAMPUS TYPOLOGIES IN THIS LOCATION

Campus Green | College Plaza | Pedestrian Walkway | Stormwater Management

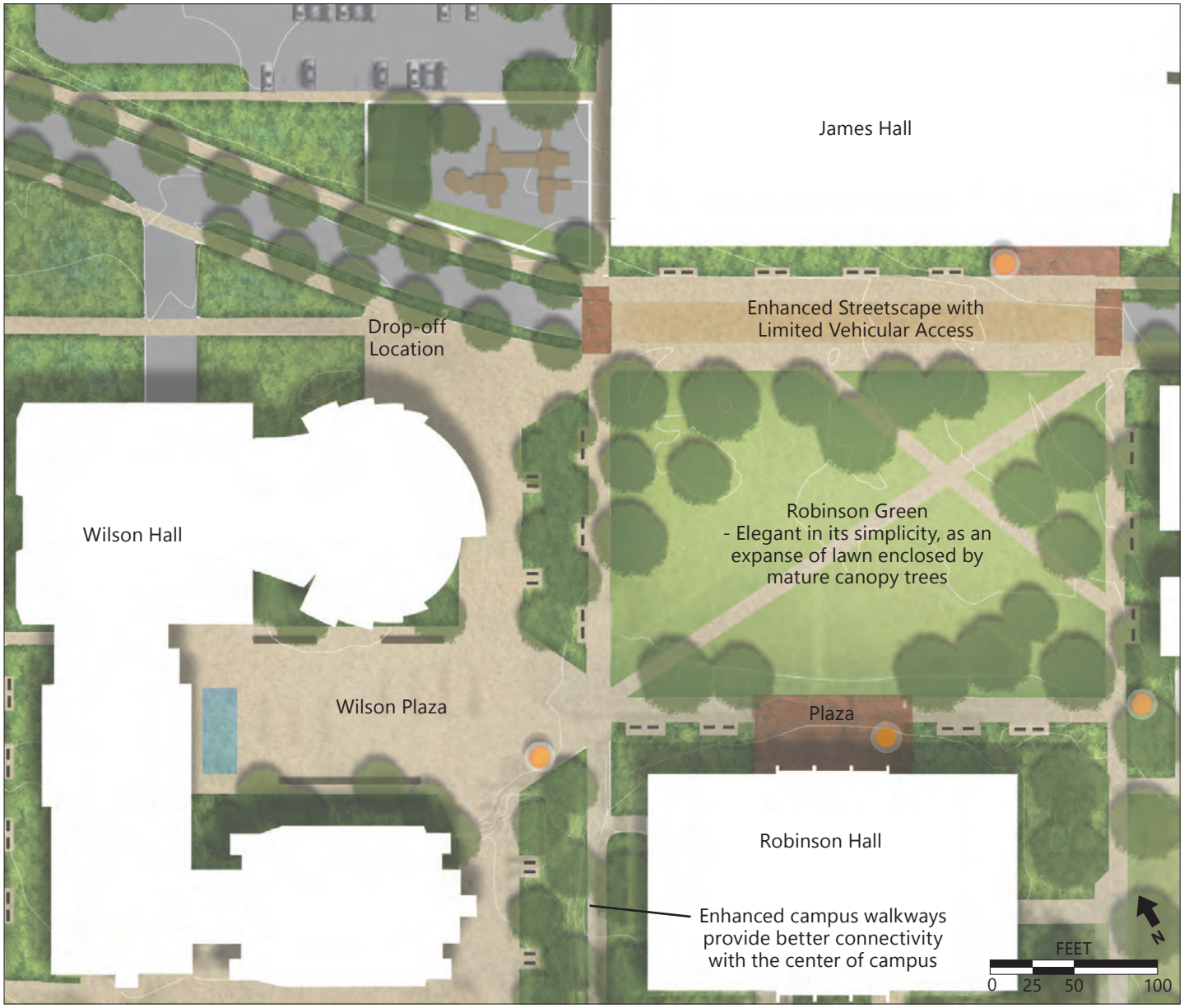


Robinson Green is reconfigured as an active college quadrangle on North campus. Currently, the space is surrounded by roadways and drives, which separate it from pedestrians. In this plan Robinson Green is the center of a major flows of pedestrian traffic between classes, making it a key open space on campus. A select access transit roadway defines the northern edge of the green (1). By limiting the roadway barrier on the north and removing the barriers on the west, south, and east, the green is directly connected to the major pedestrian walkways and becomes an intuitive destination. The updated green provides an elegant central space, an active collegiate plaza, locations for campus art, and a variety of seating configurations (2). It becomes a major college green in the spirit of University Green in front of Bunce Hall. The central green is simplified into one continuous expanse of lawn and canopy trees, edged and intercepted by well-established campus walkways. A plaza in front of Robinson Hall provides a hardscape area to accommodate any need for more active meeting space (3).

This area is populated with benches, bike racks, and the other site furniture necessary to support the use of this space. Locations for campus art have been sited to best take advantage of view corridors (orange dots on plan), allowing views along the major walkways, which helps establish this area as a larger arts corridor. A proper streetscape south of the James Hall provides bench seating facing into the central green (4). Benches are placed to face one another along other major walkways to encourage conversation (5). See further detail in *Appendix II*.

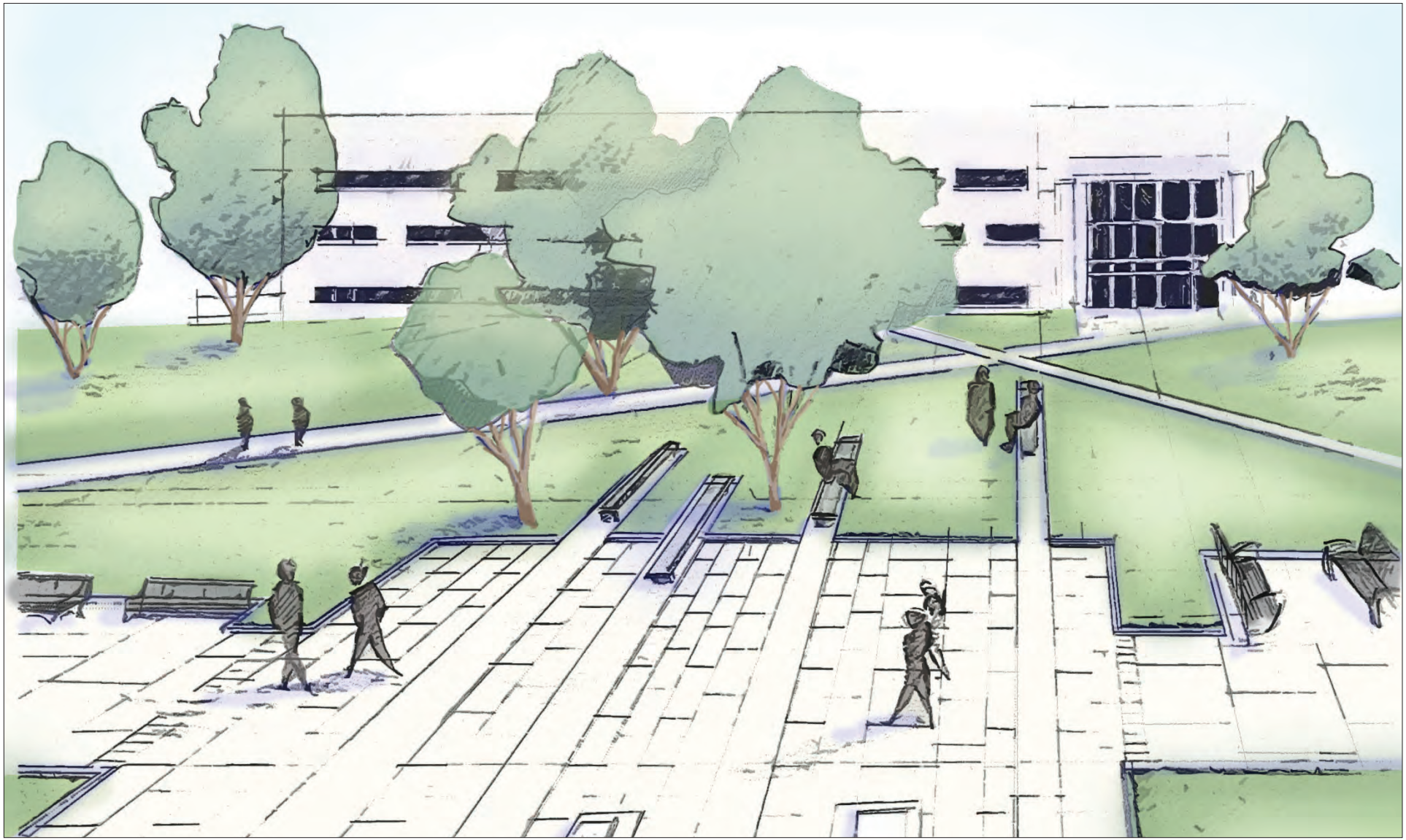
Wilson Plaza is reconfigured as a major meeting space for public gatherings. It also provides appropriate configurations for smaller meeting areas within the larger plaza (6). A water feature anchors the space to the west (7). The orange dots on the plan denote potential locations for art installations. The introduction of a native plant massing along the plaza exterior provides a calming sense of enclosure. Similarly, plantings between the plaza and the building enhance the space (8).

Benches are strategically sited to allow for both larger meeting spaces and small private conversation nooks (see typical designs of such seating within the paving standards in *Appendix II).* Reduction of unnecessary hardscape on the east and north ends of the plaza makes the plaza more inviting. Drop-off access and relocated accessible parking is provided at the northern edge of the plaza (9).



A mature tree canopy and a simple but elegant organization of pathways through a lawn space creates a sense of place immediately identified with the university. The orange dots on the plan denote potential locations for art installations.

Major elements of the concept



Sketches courtesy of Rowan University

Robinson Circle is re-envisioned as Robinson Green, enhanced by mature canopy, and a simple and clear set of pathways through this new iconic and peaceful campus space. This sketch features a view looking north from Robinson toward James Hall.

Sketches courtesy of Rowan University

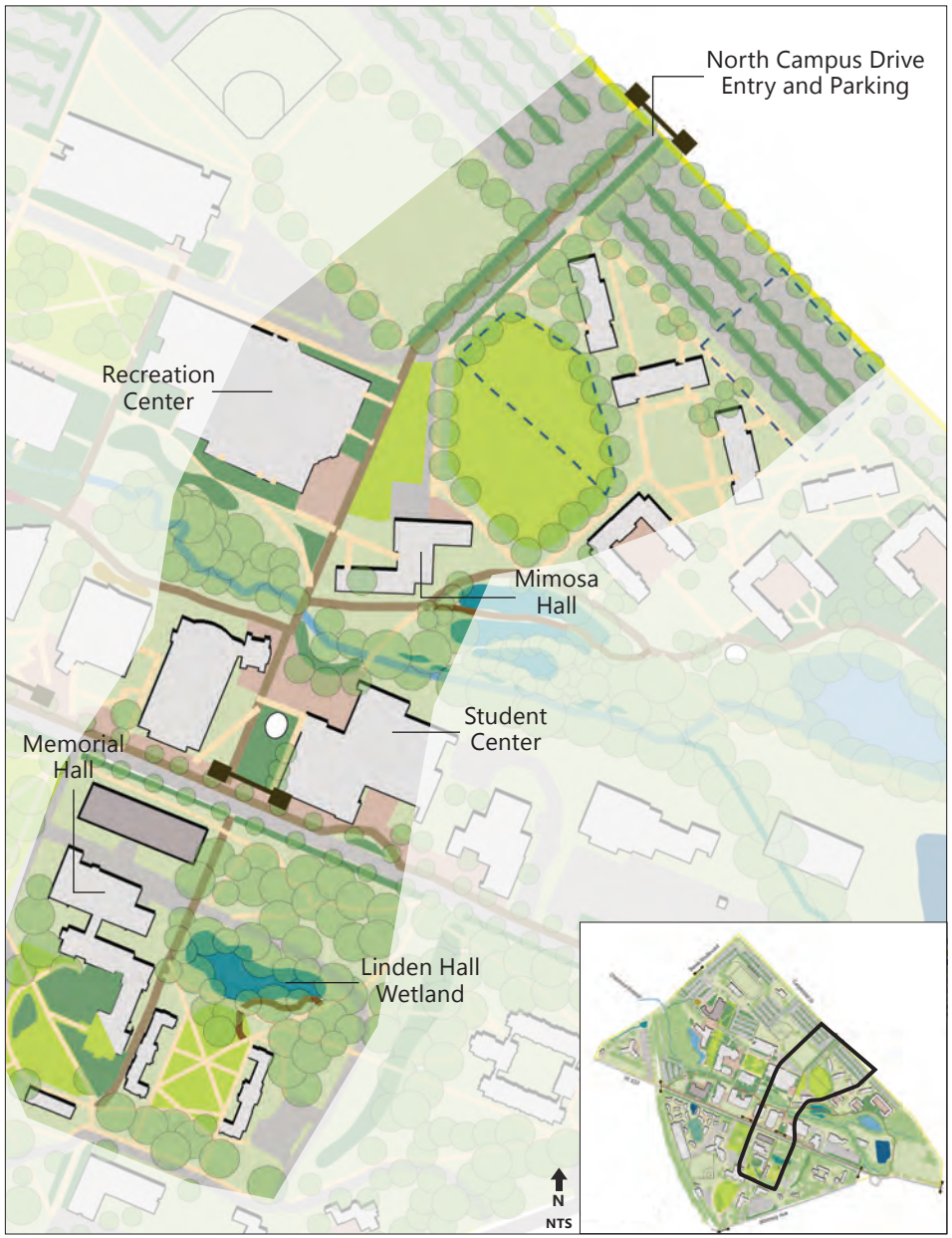
The updated plaza in front of Wilson Hall includes space for performance and rehearsal, as well as enhancements of increased vegetation to create shade and a water feature as a visual amenity.

Hardscape plazas have much potential to be inspiring interactive spaces that can accommodate a myriad of uses. Some plazas may have more hardscape and some may include integrated water features and stormwater filtration gardens as landscape amenities—sometimes to frame or create spaces within.

Seating and other features can be designed as sculptural elements that connect the hardscape with the softscape. They can be designed to create outdoor rooms or small gathering nooks. Vegetation is designed to integrate with adjacent spaces, whether they are more formal campus greens or more natural ecological features like Chestnut Branch. Further considerations for the design of hardscape plazas can be found in *Appendix I*.

The design of this hardscape plaza at University of Delaware integrates stormwater management gardens with seating and gathering spaces.

Focus Area 2–North/South Corridor



Focus Area 2 is a linear campus corridor connecting North and South campuses (above and below Rt. 322), and linking a variety of unique campus spaces. The North/South corridor begins at the entrance to campus at Carpenter Street and North Campus Drive. Traveling south it includes the Recreation Center Plaza, Intramural Fields, Mimosa Hall Green, and the north-south walkway that connects to the Student Center plaza. Continuing southward it crosses Rt. 322, encompassing Linden Hall green and Memorial Hall green.

The goals for this focus area are:

- To integrate stormwater management practices along a major corridor (including campus paths and streets) that define a new campus aesthetic.
- To create a series of interesting and inspiring spaces on campus for students to gather, study, and socialize.
- To strengthen interior circulation through the design of walkways, accessible pathways, street crossings, and bike paths, creating a cohesive campus experience that connects North and South campuses.
- To integrate Chestnut Branch into the student experience.
- To introduce natural stormwater treatment practices as new landscape amenities that serve as areas for respite and research.
- To create a defined sense of identity and entry for the campus.

This corridor is an important focus area, in that it serves to strengthen and parallel the two existing north/south campus corridors: Discovery Walk and Imagination Walk. This corridor also provides a unique opportunity for the University to consider the edge conditions of the campus and how those conditions communicate the University's mission to the broader community. This linear corridor connects much of what defines the Rowan University campus; residential spaces, recreation fields, student affairs plazas, and academic greens.

CAMPUS TYPOLOGIES IN THIS LOCATION

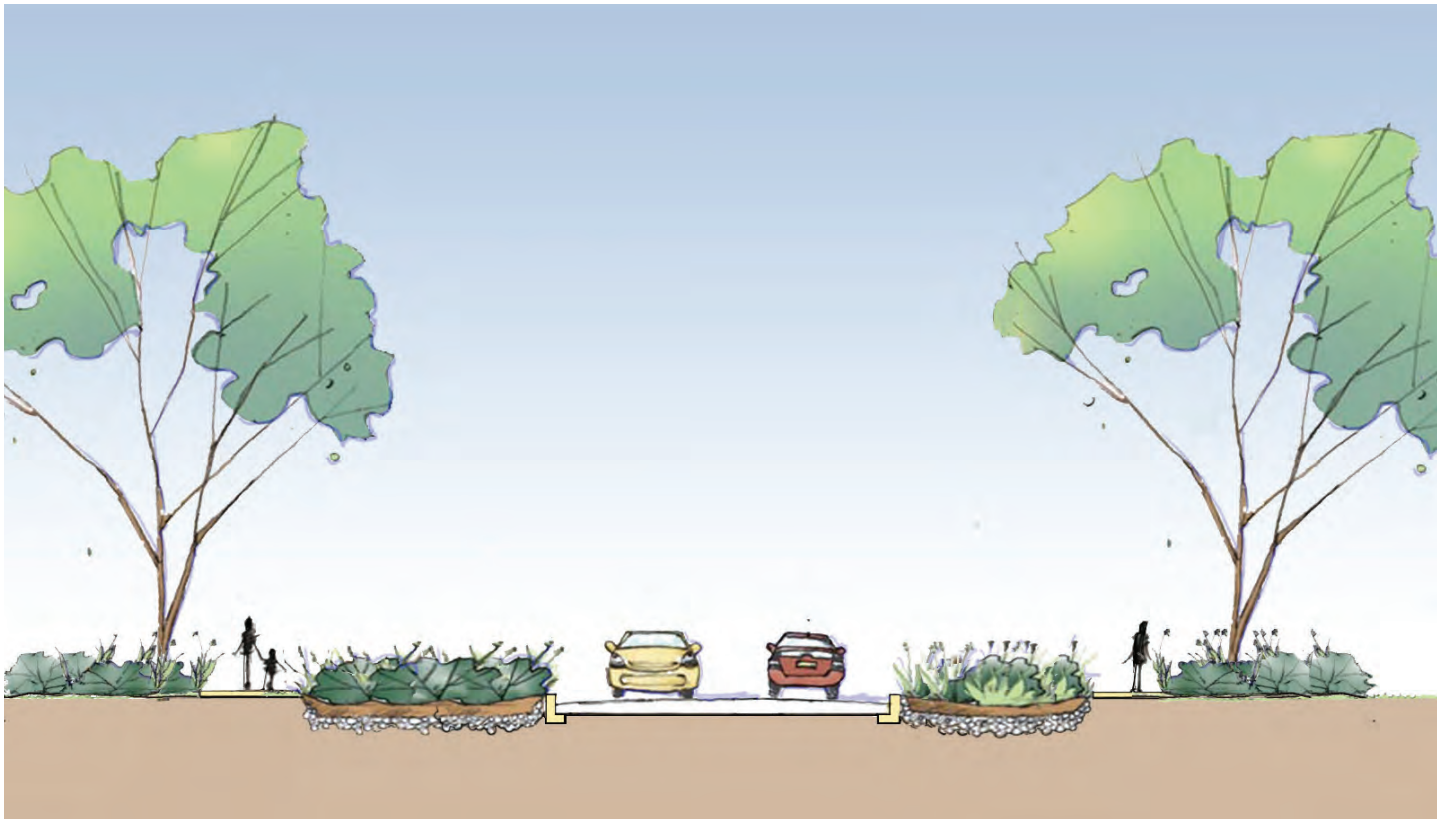
Campus Gateways | Streetscapes | Stormwater Management | Parking

GATEWAY ON CHESTNUT/PARKING/NORTH CAMPUS DRIVE

Every university strives to have its campus provide a unique identity for its students and faculty, one that engenders a sense of pride and connection that lasts well past the years spent studying and learning on campus.

Entries to the Rowan campus, as well as movement within the campus, provide a diverse set of challenges for establishing this cohesive identity. It is important that gateways provide a sense of arrival and connection, communicating that a student is home. It is equally important that gateways act as a clear welcoming component for visitors to campus (1).

Concurrent design projects that are under way are working to solve existing stormwater issues. These include improvements to the parking lots along Carpenter Street and the length of North Campus Drive that integrate stormwater management practices (2, 3, & 4). This provides an opportunity to consider improvements to this entry as a gateway to campus. Considerations in this location include an enhanced drive flanked by canopy trees and linear bioswales (3). This updated entry drive to campus will introduce beautiful "working" landscapes to Rowan, highlighting lush plantings and the ability to treat stormwater from the adjacent impervious surfaces. The parking lots may include permeable pavement or bioretention islands that help break up the monotony of the parking and provide increased shade (4). The edges of the lots may be planted with trees and shrubs to help frame these spaces, while treating the stormwater runoff that is flowing across these large paved areas (5).



Tree row Sidewalk Bioswale North Campus Drive Bioswale Sidewalk Tree row

The pedestrian gateway at North Campus Drive and Carpenter Street features sidewalks lined with plantings, reinforcing the campus identity and aesthetic. The stormwater practices being developed in the concurrent design effort will meet water management needs.

There are many options for integrating vegetative practices within parking lots to help with the attenuation and management of stormwater. Bioretention islands may be planted with a combination of herbaceous species and woody plants including canopy trees, which have the added benefit of providing shade and creating a space that feels smaller and more enclosed. Permeable pavers or asphalt may also be used to help with infiltration of stormwater. These practices may be designed as a research project that could be monitored for water quality and other variables.

Examples of permeable pavement, pavers, and planted bioretention areas in parking lots

RECREATION CENTER/MIMOSA HALL

CAMPUS TYPOLOGIES IN THIS LOCATION

Streetscapes | Stormwater Management | Pedestrian Walkway

North Campus Drive provides the main entry from Carpenter Street into the Campus. There have been perennial issues with large amounts of stormwater flowing down the Drive and flooding the Rec Center. One focus of this master planning effort is to consider creative ways to address this issue while improving the overall aesthetic of this campus arterial street.

The vision for the updated North Campus Drive highlights stormwater management practices integrated into an improved streetscape design, with linear bioswales that convey the water along the street, slowing and filtering it before it arrives at the Rec Center (1). Subsurface storage is also an option under the Intramural Fields, in the case of larger storm events (2). At the Intramural Fields the fence is removed and replaced with a tree border to increase canopy coverage in this portion of campus. This field may be replaced with artificial turf, which could coincide with the introduction of the subsurface storage.

Bioretention cells along the eastern frontage of the Rec Center divert stormwater flows from the building and create a new visual amenity that ties to a campus landscape aesthetic that promotes bold and visually stimulating plantings between buildings and pathways (3). The stormwater becomes a feature in the enhanced entry plaza at the southeast edge of the Rec Center in a runnel that continues the conveyance of the water south toward Chestnut Branch (4). As art is considered for placement throughout the campus, there may be an opportunity to have an art piece at the southern end of the Rec Center plaza, directing views south toward the stream and the Student Center (5).

The entry plaza at the Rec Center provides a new and improved gathering space for students. The new campus green at Mimosa Hall continues to reinforce the connections between these two buildings and includes the opportunity for art installations (6). The existing parking lot is transformed into a drop-off loop that promotes improved circulation and movement but still accommodates parking, service, and accessibility to Mimosa Hall (7).

Major elements of the concept

Photo courtesy of Rowan University

The Rec Center landscape provides an opportunity to integrate vegetated stormwater practices to treat runoff from the sidewalks.

This corridor provides the opportunity for dialogue between built structures like the Rec Center, pictured here, and the flows of water that are headed to Chestnut Branch from Carpenter Street, through the integration of a suite of linear vegetated stormwater practices. The practices also increase the diversity of landscape plantings and define gathering and recreation spaces for students outside of the Rec Center and Mimosa Hall to the east.

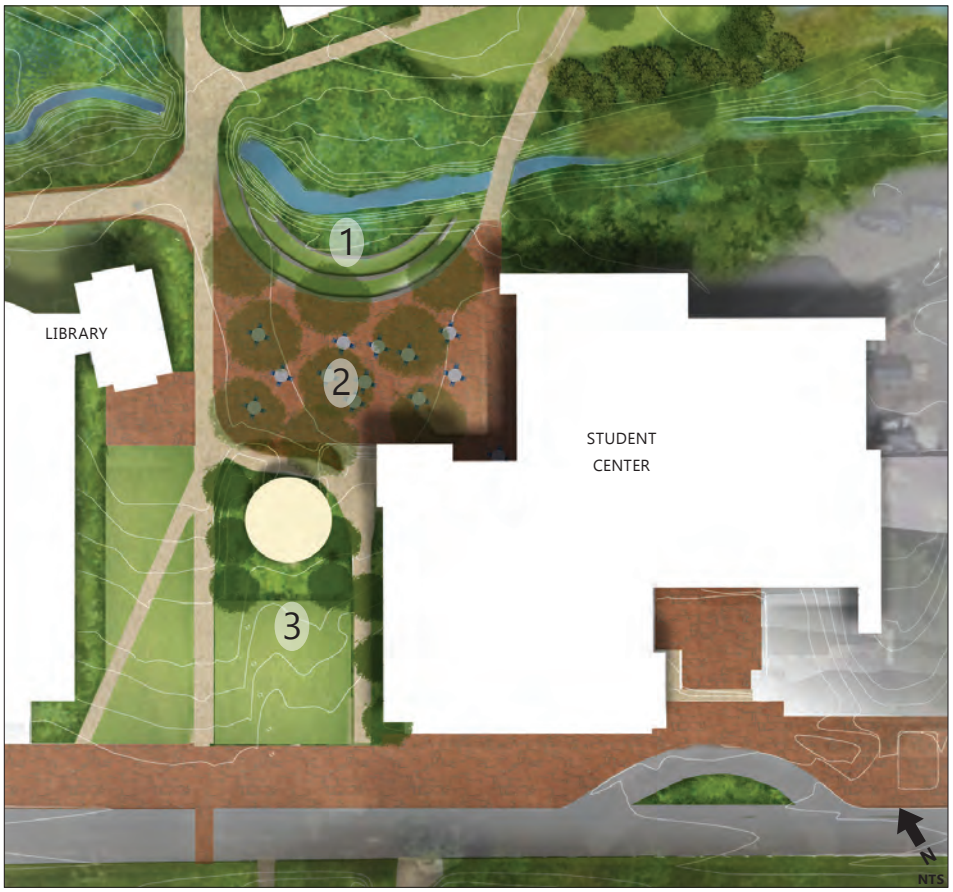
There are many ways to integrate stormwater treatment practices into the landscape while also accommodating pedestrians and other campus needs. Hardscape plazas feature planted or sculptural elements that convey or filter stormwater. Raised boardwalks traverse linear bioswales that run alongside a path or a street. Trees, shrubs, or herbaceous plants create visually stimulating gardens that provide multiple functions, from stormwater management to enhanced or framed views, to new outdoor rooms.

Examples of integrated stormwater management practices on campuses

CAMPUS TYPOLOGIES IN THIS LOCATION

Outdoor Learning | College Plaza | Pedestrian Walkway

STUDENT CENTER PLAZA AND AMPHITHEATER

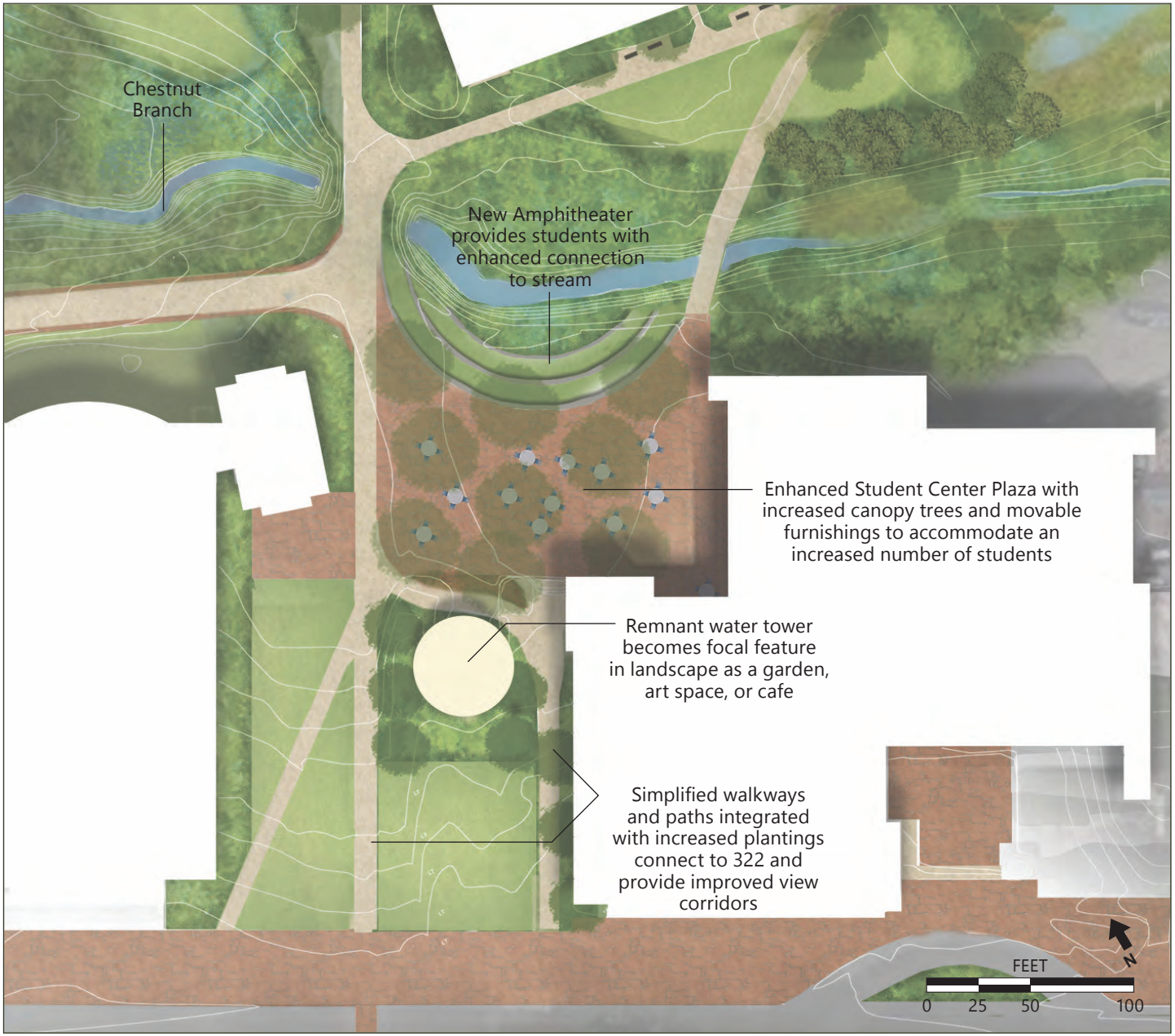


The current Student Center Plaza is a sea of hardscape with some scattered seating. It barely acknowledges the presence of the stream and has been noted as needing updated furnishings.

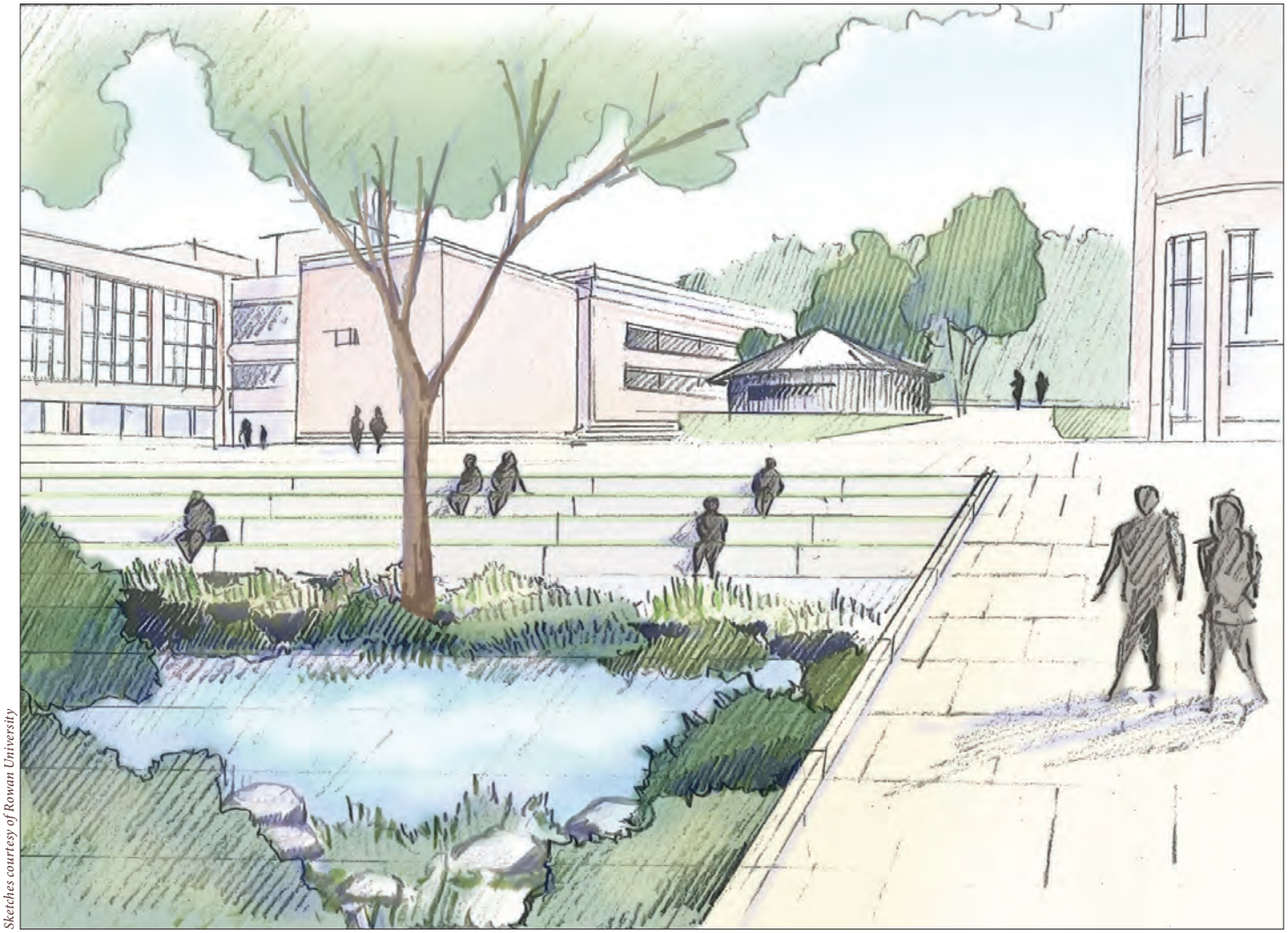
A new amphitheater is proposed at the bend in Chestnut Branch as it passes in front of the Student Center (1). The amphitheater is designed to both enhance the stream buffer and act as a unique gathering space for students at the Student Center. It proposes a series of tiered steps and low mow turf panels planted with canopy trees that better link the stream to the plaza, increase shade and create a new outdoor gathering space. This amphitheater will need to be designed to respect and respond to the floodplain and the stream buffer. It has the potential to host classes, performances, informal gatherings, lounge space, and study space near the center of campus.

The Student Center Plaza is envisioned as a flexible outdoor space with movable furniture and increased tree canopy. It will provide students with a more comfortable and attractive space that features enhanced views to the stream (2). With its updated design, this enhanced plaza space has the potential to become a campus focal point, including a combination of hardscape and softscape and a renewed relationship with Chestnut Branch. The walls of the Student Center may even be used to project movies or other art installations.

South of the plaza and along the western edge of the Student Center, the pathways that connect to Rt. 322 are envisioned to be narrowed and simplified, with increased plantings of canopy trees and understory vegetation. This not only allows for views across Rt.322, it reinforces the plaza's location as the hub for student activities on campus (3). The remnant water tower form is envisioned as a sculptural piece that could host permanent or temporary art works, a café, or a garden. A slow-ramping walk is envisioned to connect Rt. 322 to the Student Center Plaza. Future plans include the potential for an addition that connects the Student Center with the Library.



Major elements of the concept



Sketches courtesy of Rowan University

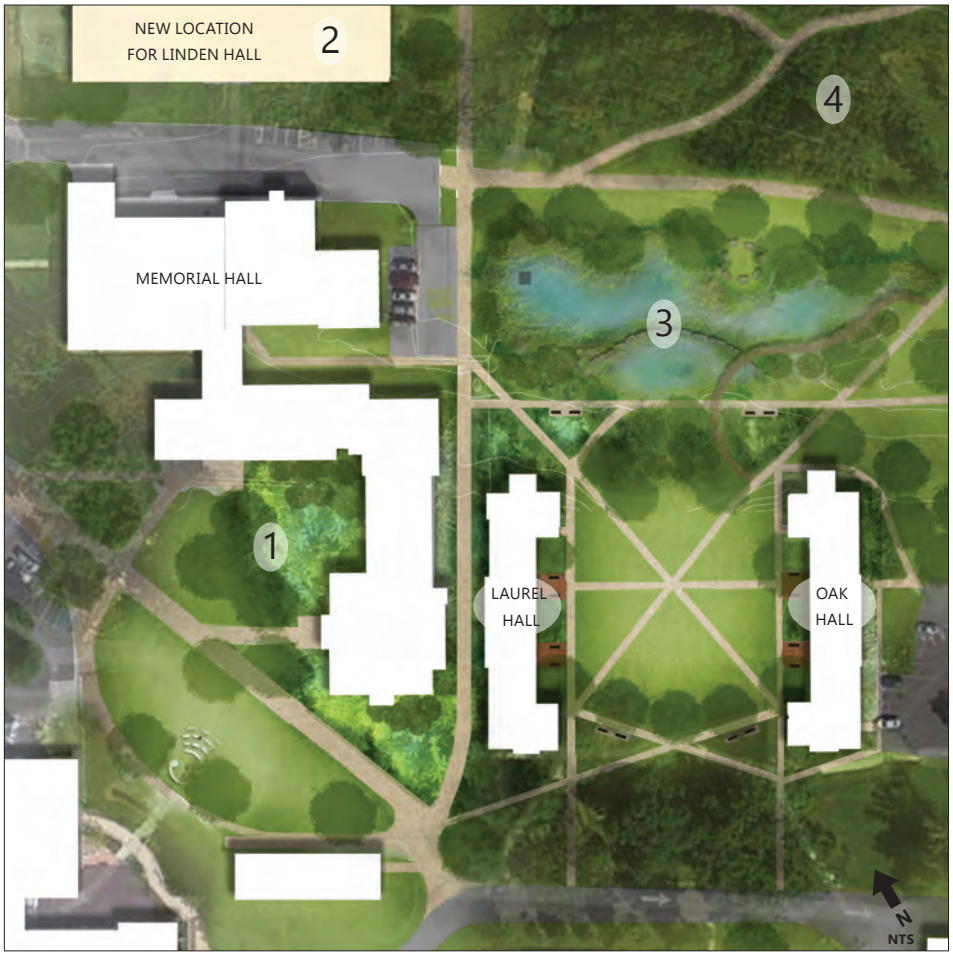
The new amphitheater and enhanced plantings that connect with the entry at Rt. 322, create an inviting and exciting space that complements the activities hosted within the Student Center and engages the campus community with Chestnut Branch.

The arcing pattern of the amphitheater form speaks directly to the forms of Chestnut Branch. What better place to explore and engage this important campus natural feature than at the Student Center? A new space for gathering, study and learning, the amphitheater will be designed to be a natural feature that accommodates multiple uses and still serves to strengthen the stream buffer through increased tree canopy and planted zones of native herbaceous plants and shrubs near the stream bed. The plaza will be enhanced through the inclusion of tree canopy and movable furnishings to create a more comfortable and enticing open space area for students to enjoy.

FOCUS AREA 2

MEMORIAL HALL/LINDEN HALL

CAMPUS TYPOLOGIES IN THIS LOCATION



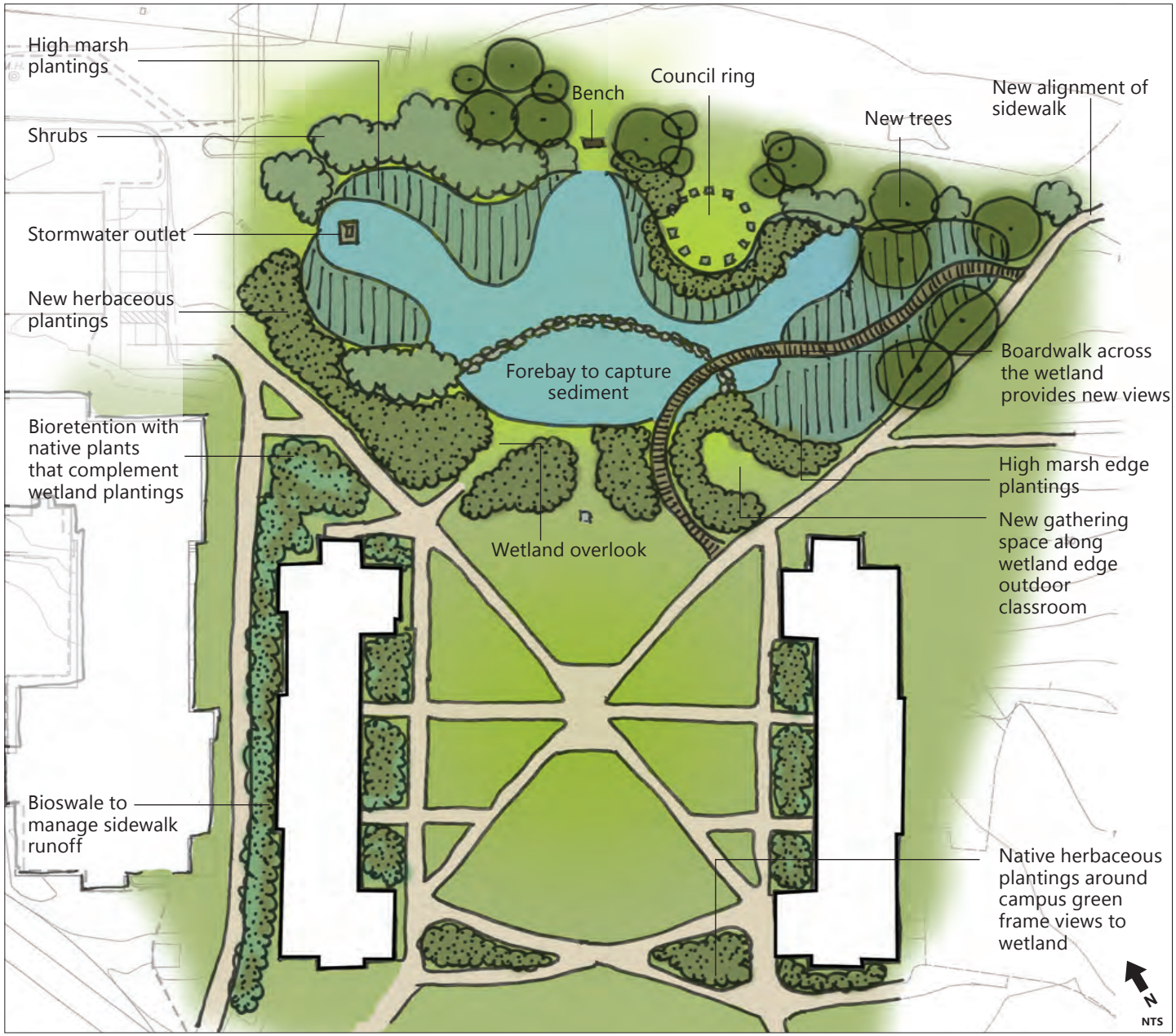
Memorial and Linden Hall provide two opportunities on the campus area south of Rt 322 to enhance the campus landscape while incorporating natural landscape features that help to manage stormwater (1). Through a common plant palette and the integration of new landscape amenities that embrace and celebrate stormwater and ecology, South Campus begins to relate to North Campus in a more visible way.

Linden Hall

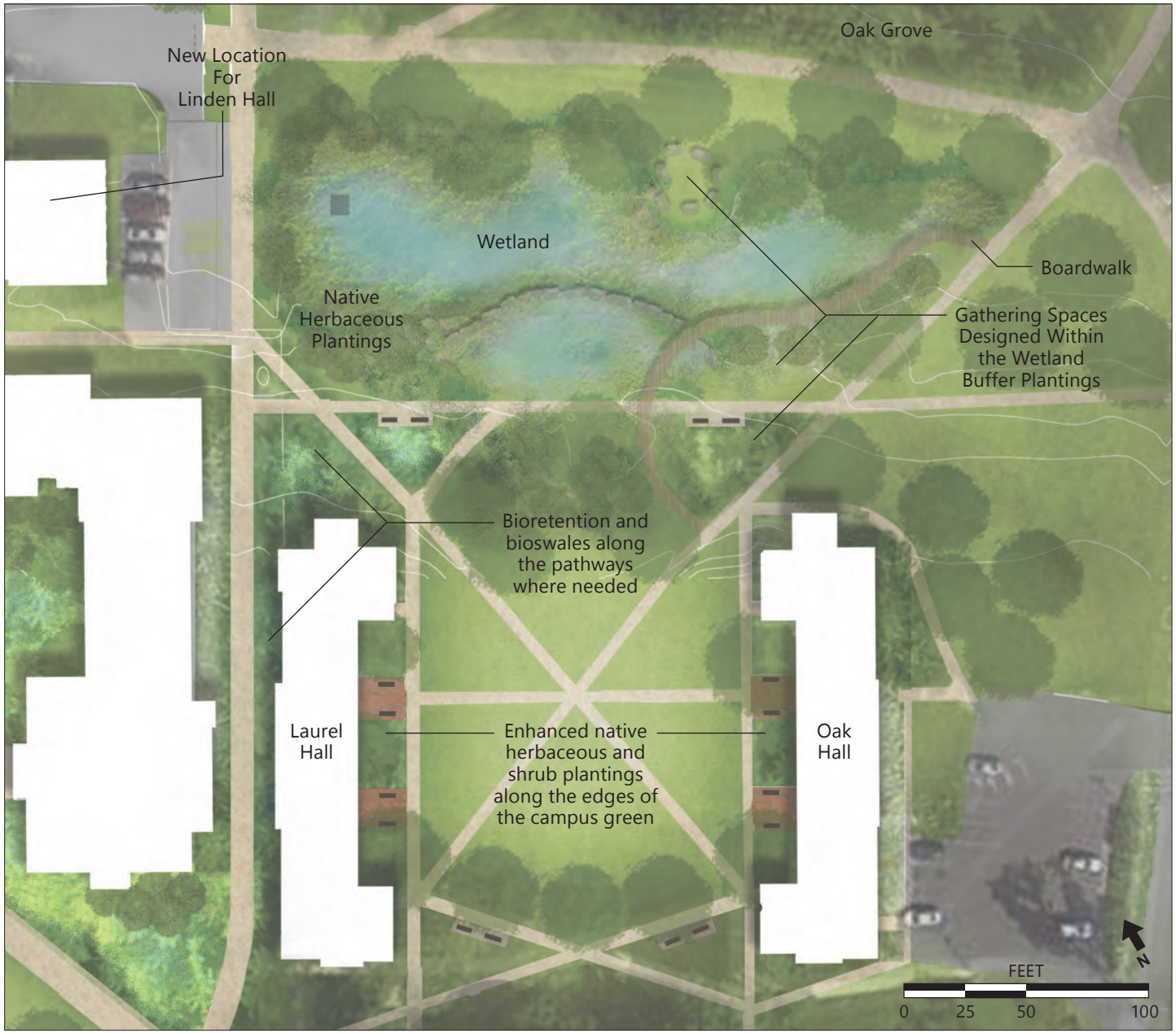
Linden Hall has been noted as a challenging location for ongoing stormwater management/flooding issues. There are perennial problems with flooding, because the existing grade causes large amounts of stormwater to flow north from the higher elevations of the courtyard flanked by Laurel and Oak Halls. Prior discussions of a redesign of Linden Hall incorporated more space for stormwater management around the building. This concept proposes that Linden Hall be relocated to a site to the northwest, along Rt. 322 (2). The new location for Linden Hall along Rt. 322 reinforces Rowan's street frontage on this major thoroughfare.

(Alternatively, if a replacement building is suggested at the existing location of Linden Hall, then stormwater management would need to be designed in concert with the new building.)

This proposed relocation provides an opportunity to use the entire footprint where Linden Hall currently stands as a stormwater wetland (3). It transforms the space into a natural landscape feature that manages stormwater and provides a new green space that connects seamlessly with the Oak Grove to the east and north (4). This wetland creates a stronger connection between North and South campuses by expanding the palette of natural features (wetlands and woodlands) that speak to the historical ecology of the campus and its relationship to Chestnut Branch.



This process sketch shows the design considerations for the proposed stormwater wetland where Linden Hall currently sits.



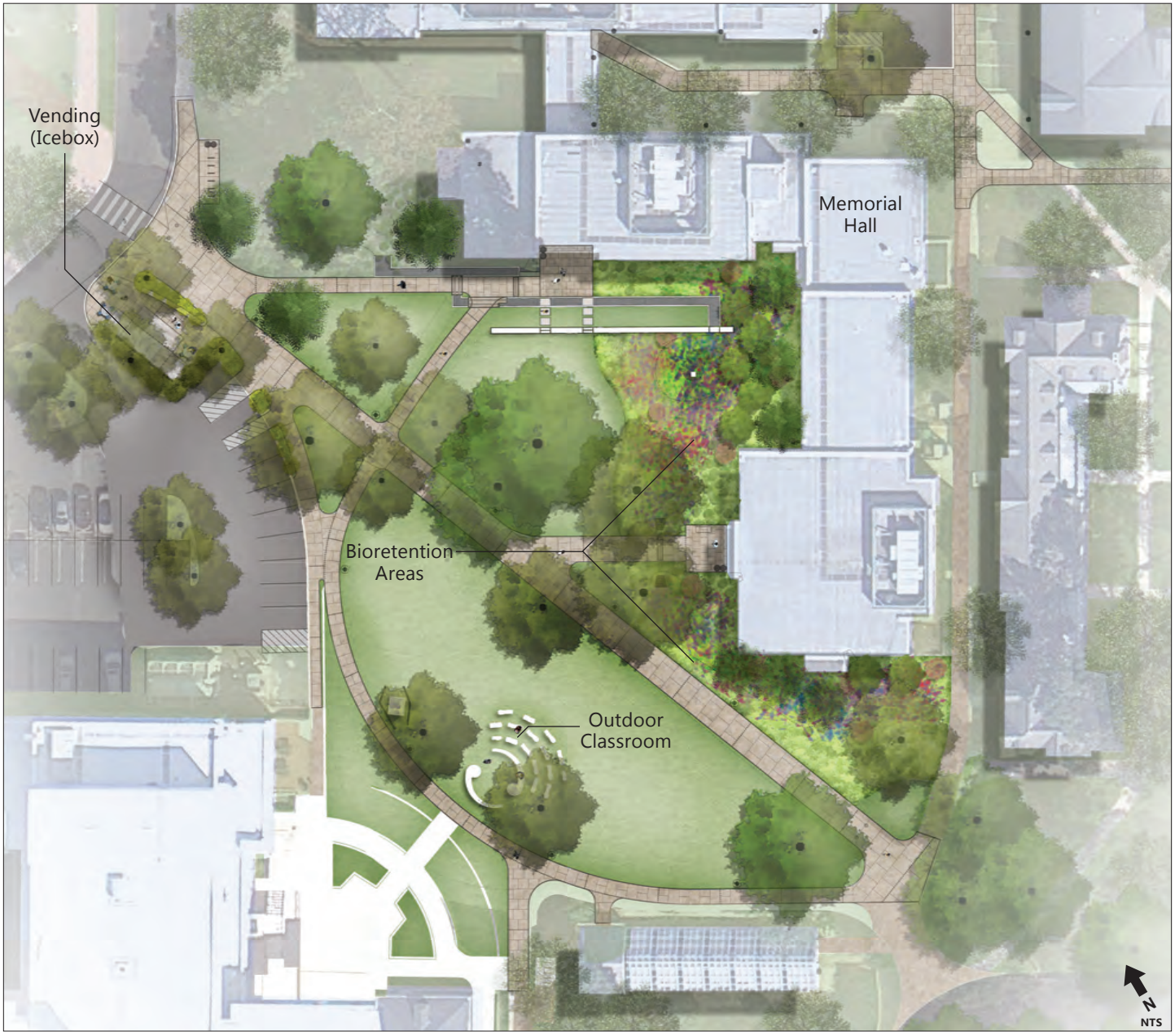
Major elements of the concept

The Linden Hall wetland provides a new gateway and passive recreation space for residents on South Campus, as well as a living laboratory in which students and faculty can actively study and engage in monitoring and stewardship activities.

A boardwalk traverses the wetland on the east side, and small gathering and outdoor classroom spaces are designed within the wetland buffer plantings, along with an overlook and a council ring. The boardwalk enhances the visitor's connection to the wetland through open views and a sense of being enclosed within the wetland. Students will be greeted with the sounds of insects, birds and amphibians, and the fragrance, colors and textures of a diverse native plant palette.

This diverse plant palette includes meadow, shrub-scrub, and canopy trees and is suggested for both the wetland area, as well as the enhanced plantings between Laurel and Oak Halls, and the existing paths on the edge of the campus green.

Sketches courtesy of Rowan University



Memorial Hall

As part of the concurrent initiative to manage stormwater hot spots across the campus, Memorial Hall's landscape is redesigned to better manage stormwater as well as create new outdoor gathering and classroom spaces.

A series of landscape features have been designed to manage stormwater along the edges of the building using bioretention. Other landscape improvements include an outdoor classroom space and a new location for a food vendor.

Major elements of the concept

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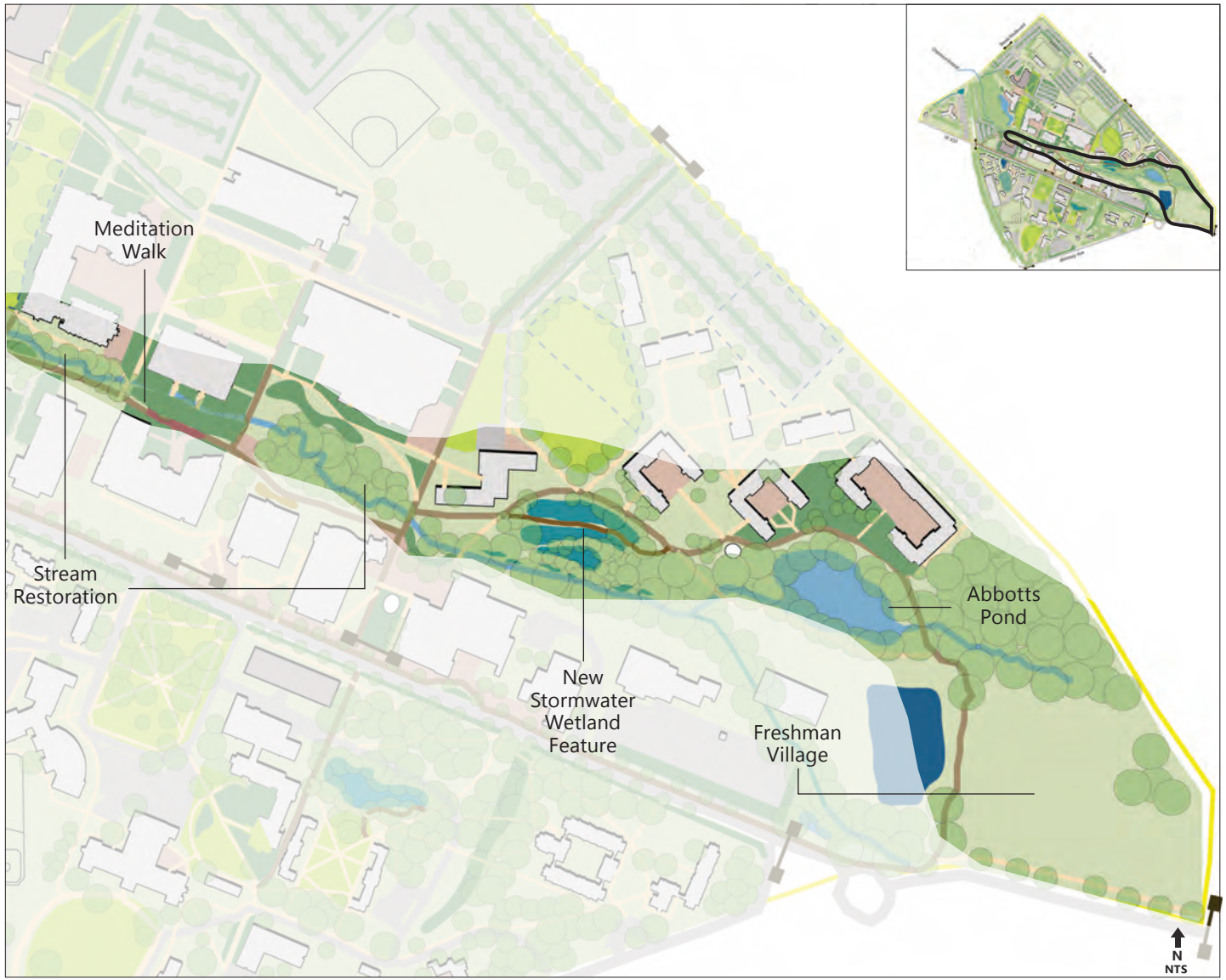
Focus Area 3–Chestnut Branch/Meditation Walk



Chestnut Branch is a defining feature in the campus landscape. Meditation Walk, along the stream corridor, links the physical experience with the intellectual, and provides the primary east-west corridor through North Campus.

While certain portions of Meditation Walk are clearly experienced as a major pedestrian walkway, other sections are less clearly defined. The walk has a prominent place at the center of the campus but not so much at either end—where it enters woodlands and natural areas associated with waterways. Rather than a hindrance, these natural spaces that bookend the walk provide a unique opportunity to connect with the ecological legacy of the campus through an enhanced extension of the walkway.

As these concepts are implemented, Chestnut Branch is a celebrated feature that is stewarded by members of the campus community. The floodplain is restored and design enhancements along the stream accommodate a wider vegetated buffer. There are further opportunities to connect the natural aesthetic of the stream with upland stormwater management practices and enhancement of existing natural features at Abbotts Pond. These elements also provide the ideal opportunity to embrace the campus as a living laboratory landscape—where natural and hydrological processes are studied and monitored.

CAMPUS TYPOLOGIES IN THIS LOCATION

Stream Enhancement | Pedestrian Walkway | Outdoor Learning

MEDITATION WALK

Meditation Walk is the central academic walk on the Rowan North campus. To enhance this important pathway, the master plan recommends a special treatment of Meditation Walk with the introduction of an ashlar pattern scored concrete edged with brick banding (See further detail of this paving standard in *Appendix II*). This walkway carries a significant amount of traffic and is suggested to be sixteen feet wide to meet this need. The walkway parallels Chestnut Branch, providing views to the stream. This active walkway has the potential to become one of the identifying elements of the Rowan campus—a beautiful walk adjacent to a restored natural corridor. Strategic placement of benches along the walkway further enhances this connection with the Chestnut Branch. Consistent and ample furnishings, pavement, bike racks, and plantings all help reinforce this corridor as a central part of the Rowan experience.

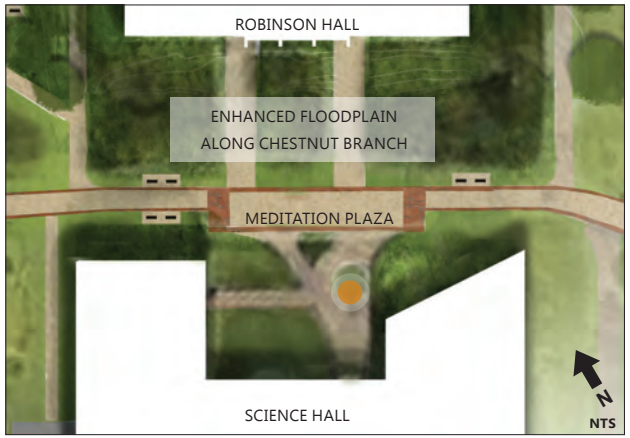
Meditation Plaza is an important meeting space along the walk. Therefore, the plaza is recommended to be enhanced with a special treatment of the paver. Distinguishing the paving of the plaza from the walkway enhances and clarifies the plaza as a meeting space, distinct from the adjacent Meditation Walk. Pedestrian walkways are further described in the campus typologies in *Appendix I*.

Pulling the plaza closer to Science Hall and farther away from Chestnut Branch allows some topographic relief for expansion of the stream floodplain and the creation of a healthier stream corridor. Gardens introduced to this area should be accommodated on the south side of Meditation Walk and Meditation Plaza, preserving the northern edge for views into the restored natural stream corridor.

Photo courtesy of Rowan University

Meditation Walk (top) spans the North campus, from the woods on the western end to Abbotts Pond on the east end. Meditation Plaza (bottom) is located by Science Hall.

Science Hall | Foundation Plantings | Meditation Walk | Vegetated and Stabilized Slope | Enhanced Floodplain | Chestnut Branch | Robinson Hall



A cross section (above) and a plan view (left) of the enhanced Meditation Walk and Chestnut Branch corridor. Paving is enhanced to articulate a special experience along Meditation Walk. The orange dot highlights an existing art installation. See Appendix II for more detail on paving standards.

Meditation Walk is envisioned to be sixteen feet wide through the heart of campus, with the exception of Meditation Plaza, and edged with native plants, providing a wider floodplain along Chestnut Branch.

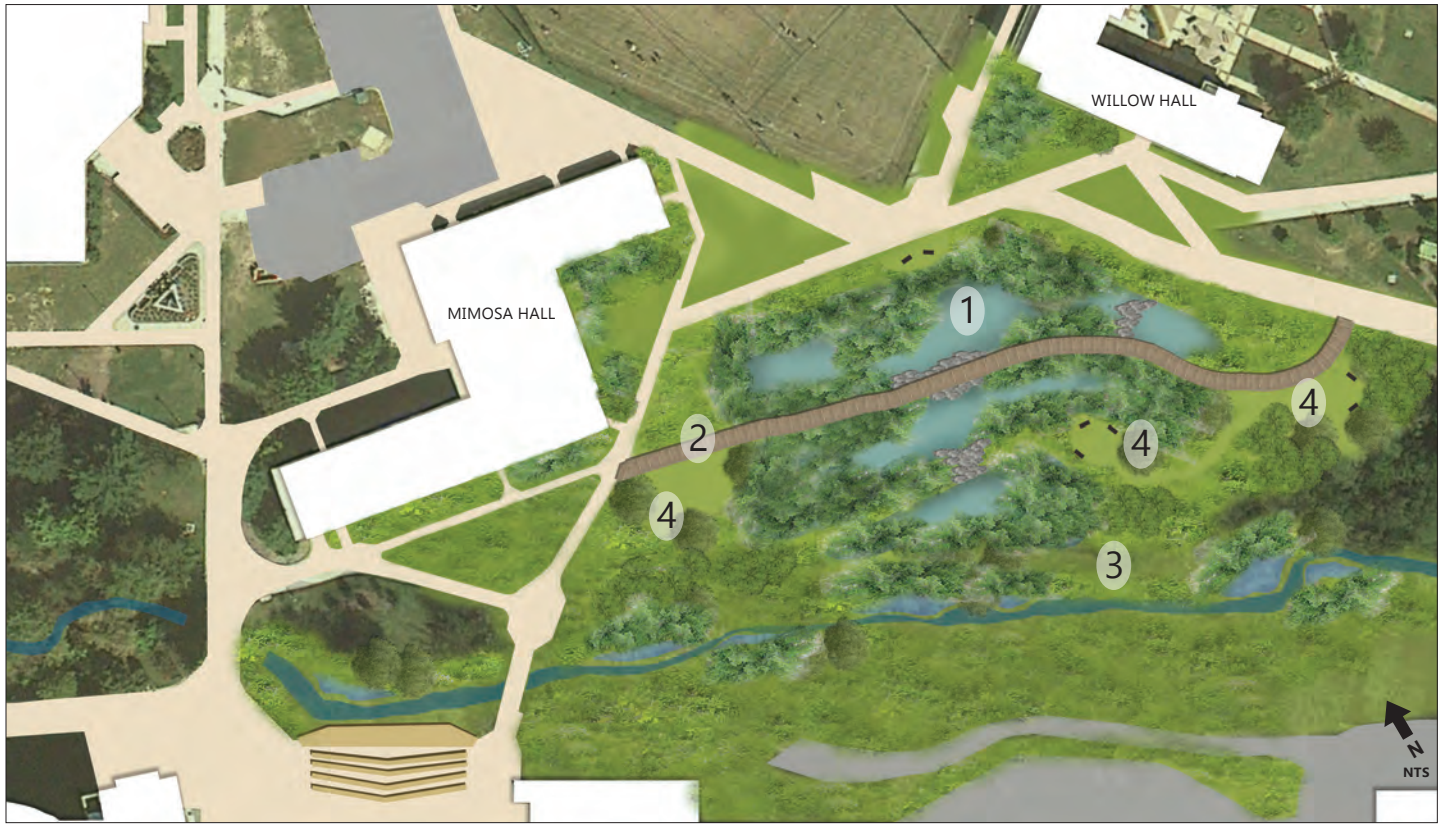
While the experience will vary from the outer edges, where it is more wooded, to the inner portions where it is more urban, consistent paving materials, widths and planting palettes will help create the a sense of continuity through campus, heightening the sense of community and connection.

Meditation Walk connects the campus core with the natural areas on either end of campus.

CAMPUS TYPOLOGIES IN THIS LOCATION

Stream Enhancement | Stormwater Management | Outdoor Learning

STREAM ENHANCEMENT AND STORMWATER MANAGEMENT AT BASKETBALL COURTS

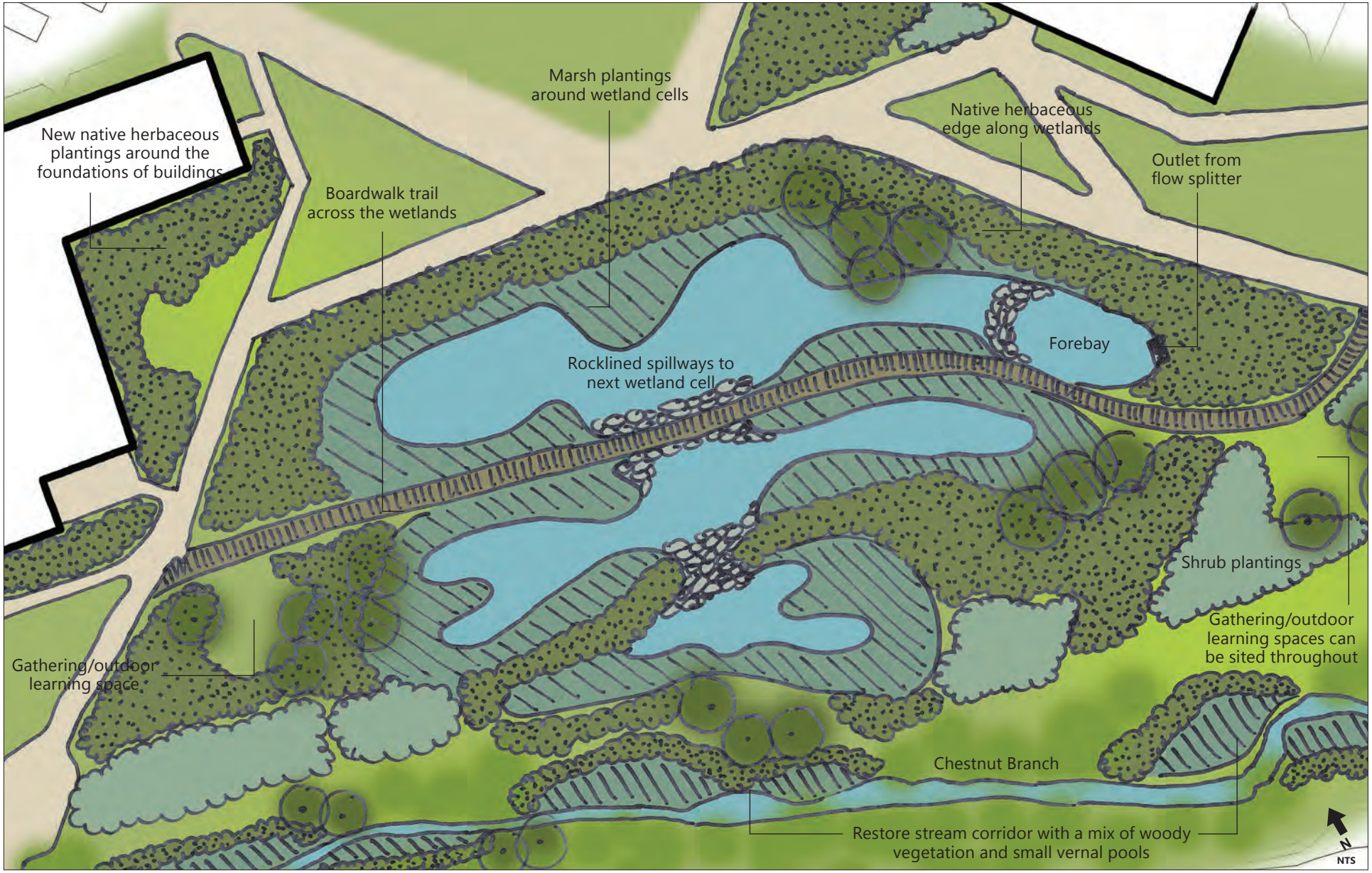


Stormwater wetlands have the potential to be an amenity, an opportunity for passive recreation, and an opportunity for engaged learning.

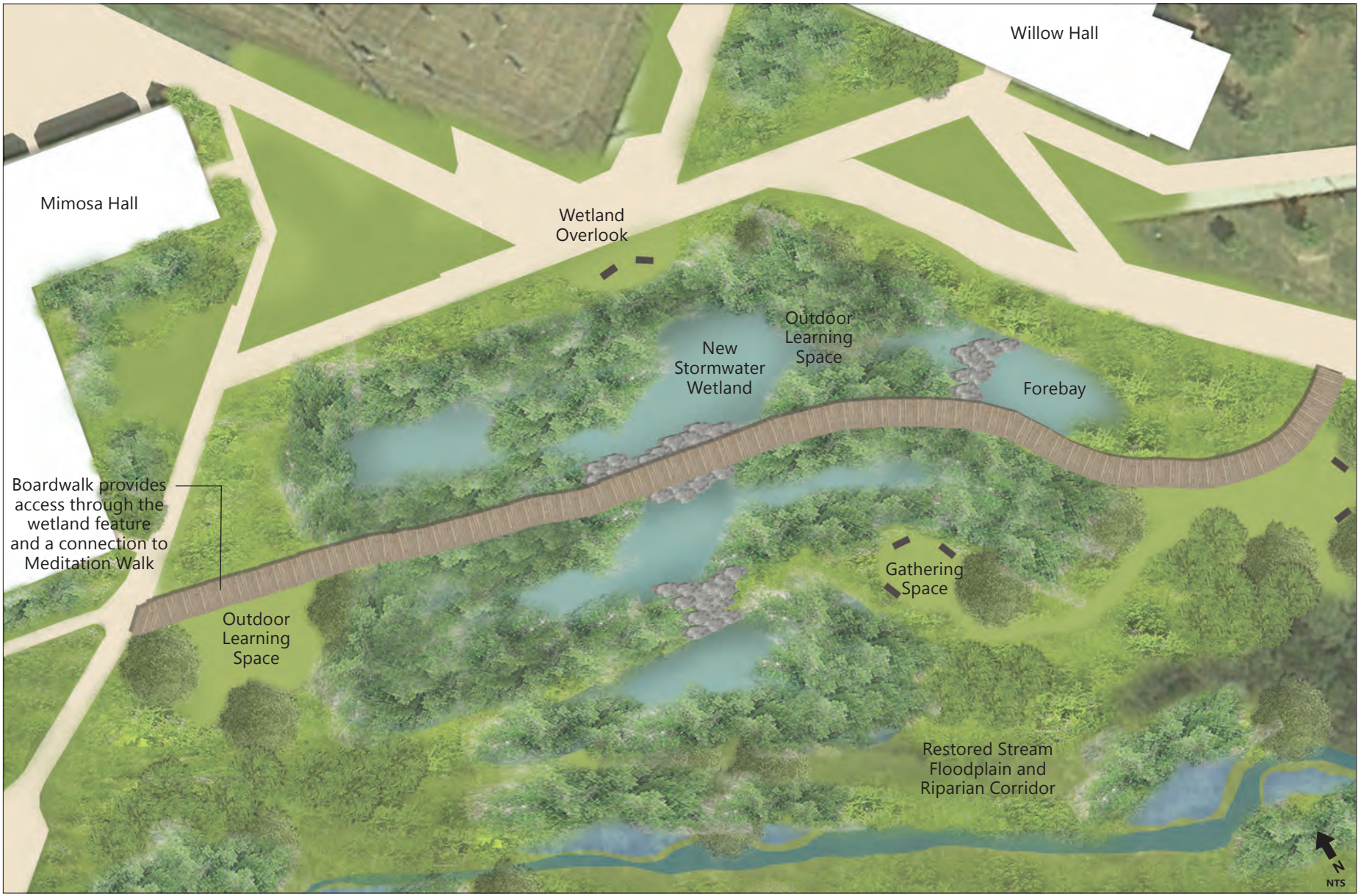
The basketball courts to the east of Mimosa Hall provide the single, largest space on North Campus for the surface treatment of larger stormwater flows that are coming mainly from off-campus, and entering Chestnut Branch east of the Student Center. The idea is to divert flows of water from the large stormwater pipe into a created wetland system that supports multiple functions. The wetland will help filter, slow, and cool the stormwater before it reaches the stream (1).

This wetland system also creates a new landscape amenity and visual interest along Meditation Walk with the inclusion of a boardwalk crossing (2). The wetlands transition directly into an enhanced floodplain along Chestnut Branch— which provides for further stormwater attenuation and improved habitat (3). This wetland can also serve as a living laboratory for students in the life sciences, as well as new inspiration for students in the social sciences and the arts, with gathering and learning spaces accommodated throughout. Gathering spaces and small, open lawn areas have been included around the wetland to support passive recreation and outdoor classroom needs (4).

Because the basketball courts are an important amenity for many students, their relocation will be an important priority that can be accommodated on lands that will transition from athletics and intramurals, with the development of West Campus.



This process sketch shows the design considerations for the proposed stormwater wetland where Linden Hall currently sits.

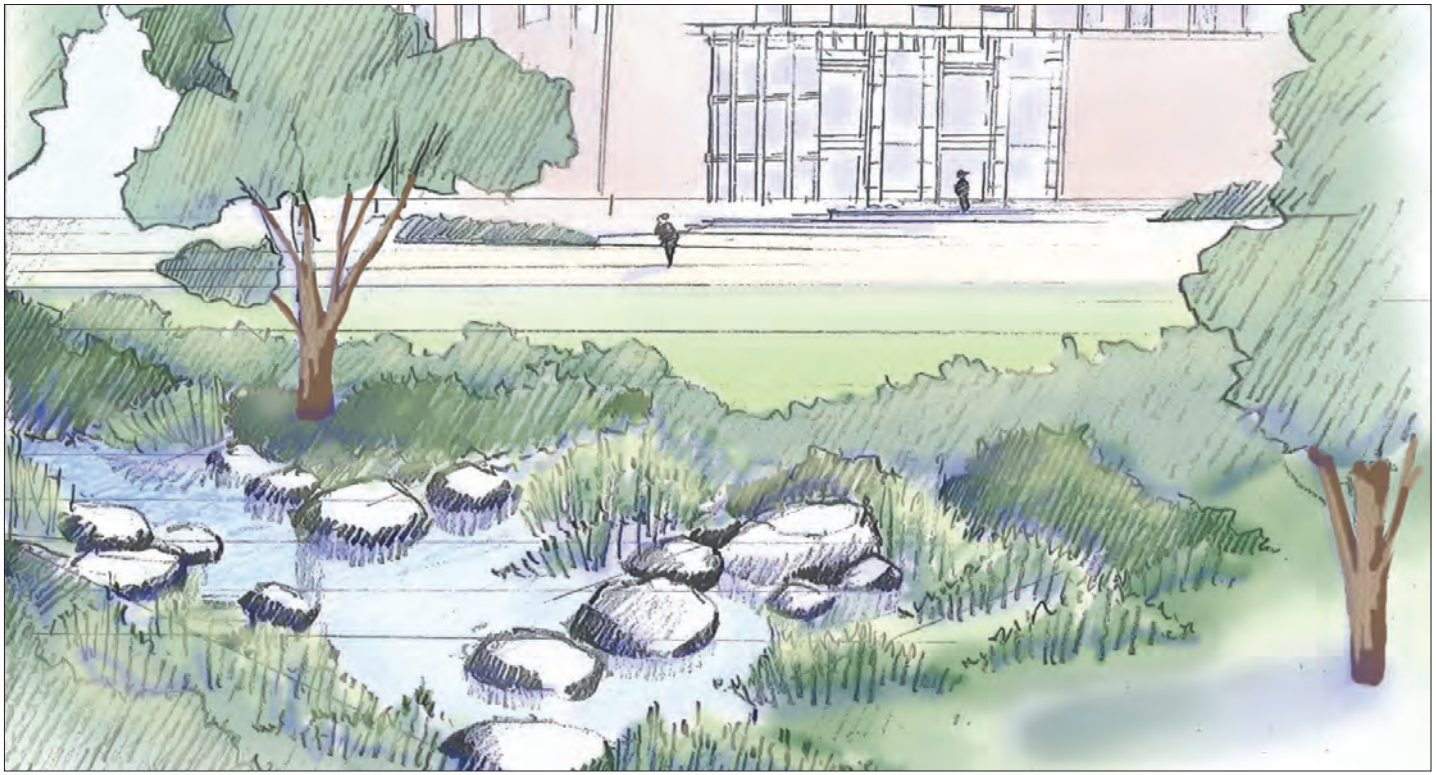


Major elements of the concept

Restoration of the stream corridor is important for the overall long-term stream health and function.

Restoration considerations include:

- Control and management of invasive species along the entire stream corridor.
- Floodplain expansion and restoration.
- Reforestation.
- Native planting enhancements.
- Stabilization of banks.
- Structural and biological diversity.
- Enhanced visual connections through limited improved viewsheds and small openings down to the stream.



Sketches courtesy of Rowan University

CAMPUS TYPOLOGIES IN THIS LOCATION

Pond Edge | Pedestrian Walkway | Outdoor Learning | Stormwater Management

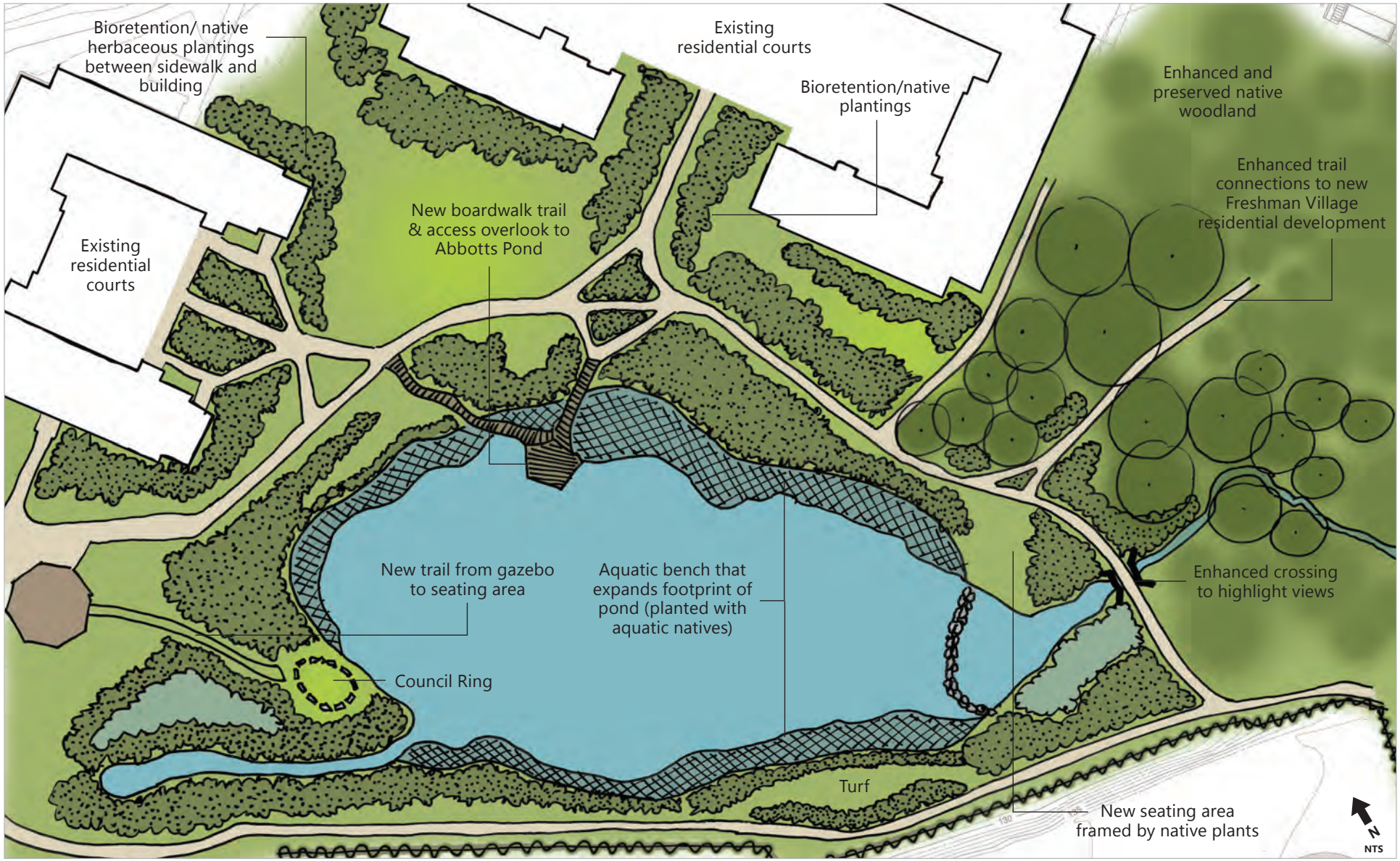
ABBOTTS POND RESTORATION AND ENHANCEMENT

Abbotts Pond is already a special natural feature on North Campus. It is characterized by mown turf along the edges and a gazebo to the west. There is anecdotal evidence of wildlife, including turtles and geese, but there is the potential for a much more robust natural system.

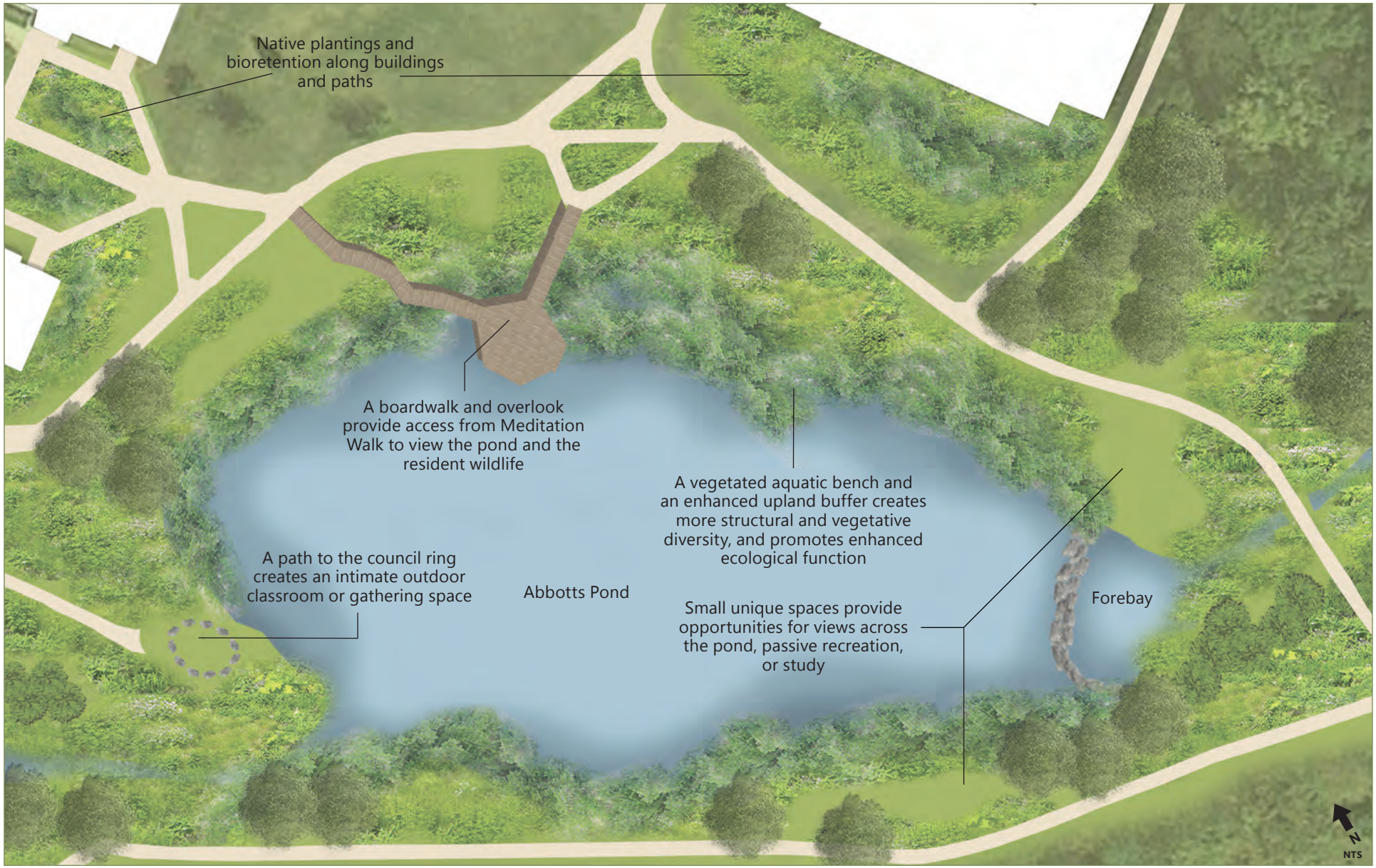
To improve the pond's ecological function, and the overall aesthetic, a diverse, vegetated edge should be established along the pond. The edge should also be broadened, through the addition of a vegetated aquatic bench (1). New canopy trees and shrubs are integrated into the design. The trees enhance the existing woodland to the east and provide for a more appropriate transition to this natural area from the surrounding residential courts.

Some limited areas of turf are suggested at key locations, in order to provide for continued access to the pond and views across the pond (3). A new boardwalk and overlook invite visitors to experience the restored pond edge and view wildlife from a new perspective (4).

The entire pond system becomes a unique amenity for the residents of Chestnut and Magnolia Halls, as well as the new Freshman Village to the east. The southern edge of the pond includes a path that runs along the current facilities storage area. A vegetated screen is suggested along this fence to create a more natural frame for views north toward the pond (5).

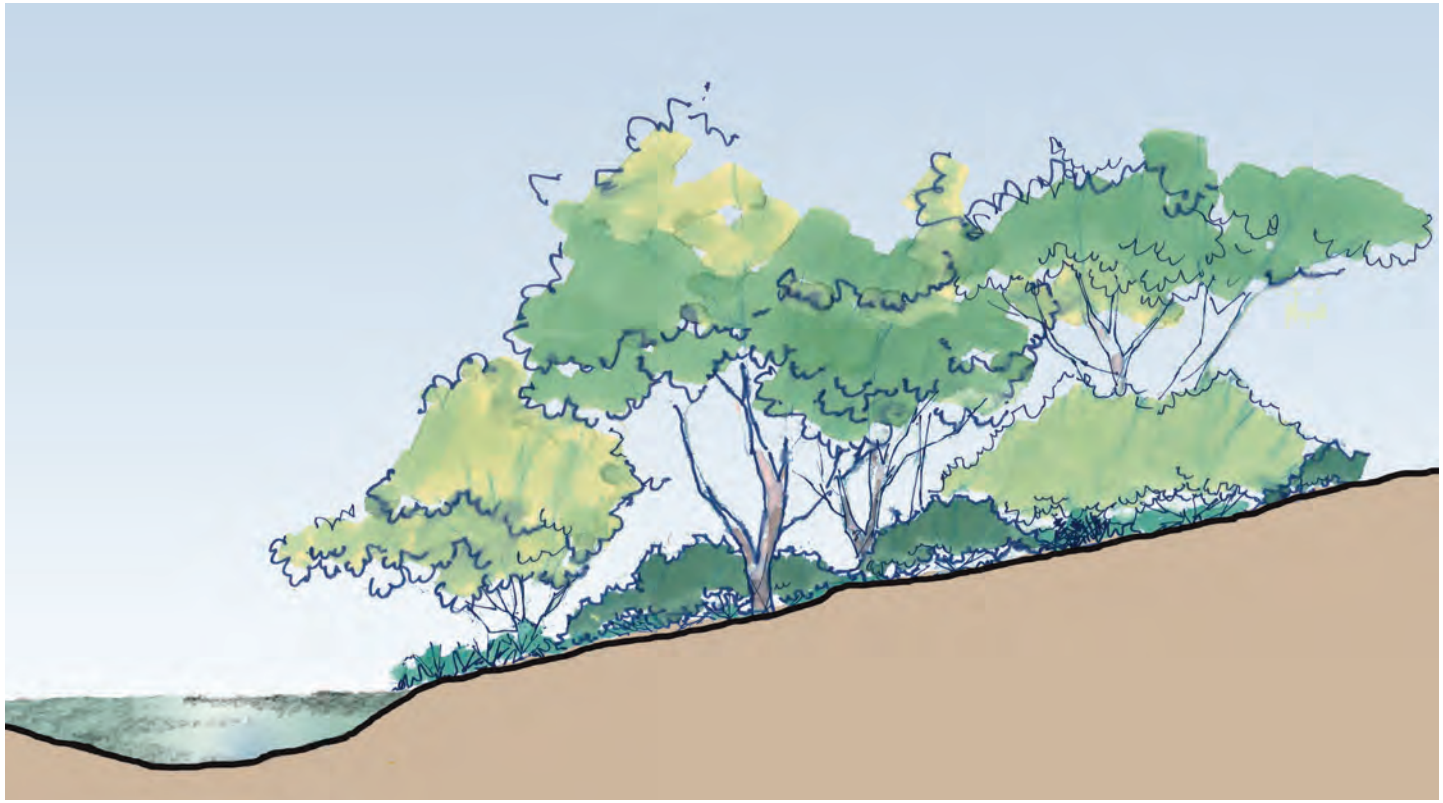


This process sketch shows the design considerations for Abbotts Pond.



Major elements of the concept

The restored pond edge can incorporate a diverse array of plantings from wetland plants to upland herbaceous natives and shrubs, to midstory and canopy trees. Diversity of vegetation and structure will lead to a more resilient and sustainable natural landscape here and across the campus. Further detail for the pond edge typology can be found in *Appendix I*.



Sketch (c) Biohabitats Inc.

Pond

Vegetated and Stabilized Slope With Wetland and Upland Native Plants and Shrubs

Sketches courtesy of Rowan University

The inclusion of a boardwalk and overlook provides unprecedented access to Abbotts Pond. These features are opportunities for passive recreation, a peaceful space near residence halls, and a renewed connection to the natural resources that have defined this landscape historically. Ponds and wetlands are celebrated landscape features on many college campuses and they often become destinations and iconic images of the institution.

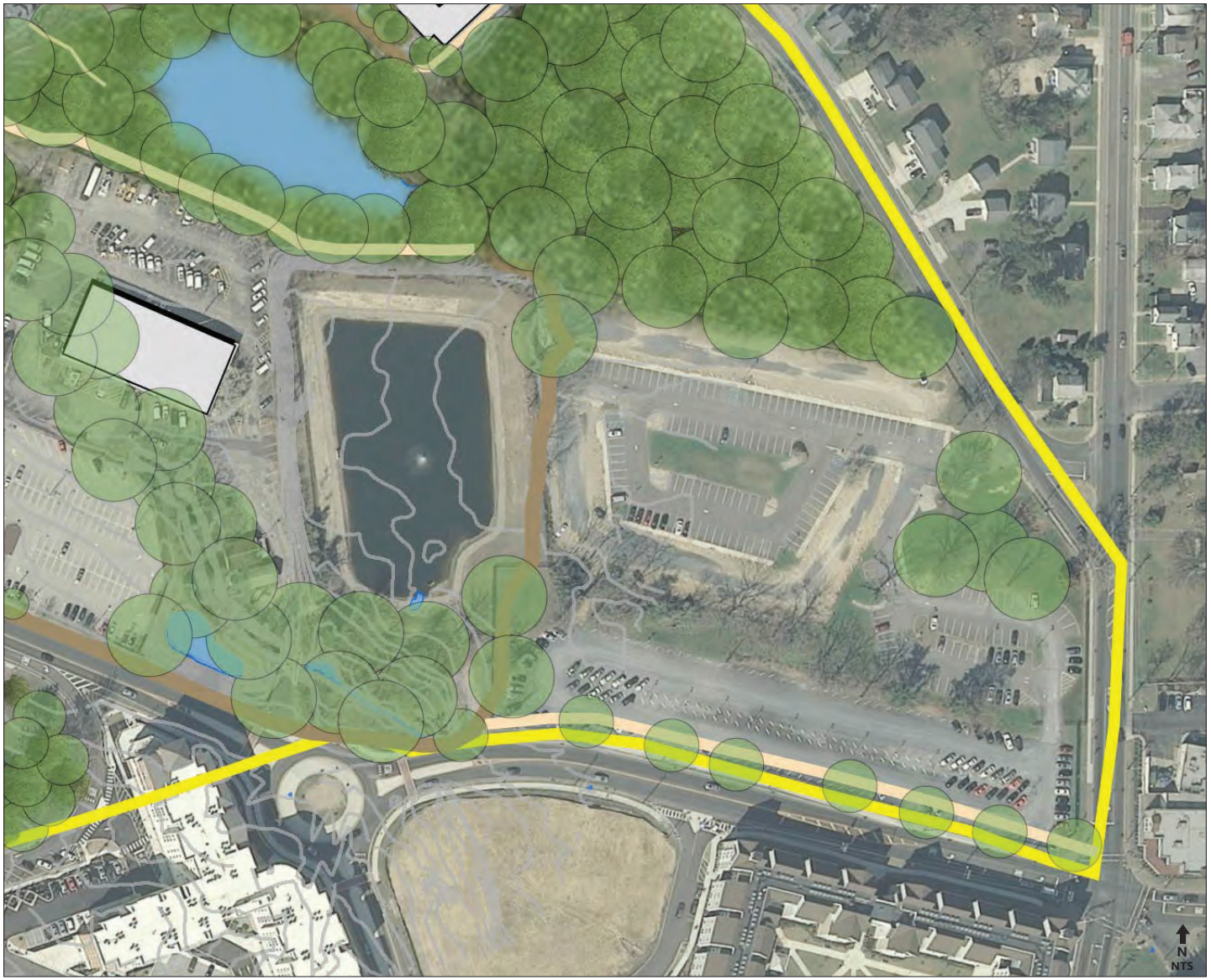
FRESHMAN VILLAGE

Residential Court | Pedestrian Walkway | Stormwater Management

The proposed Freshman Village residential halls on the far eastern edge of the campus are still under development at the time of this master planning effort, but they are an important consideration since they are located at a defining edge of campus. The new residence halls have the potential to become the main eastern gateway to the campus. Meditation Walk will eventually connect this site with the heart of campus, improving connectivity and campus identity.

The aim is to examine how connectivity can be enhanced, how stormwater management can be integrated, and how collegiate open spaces can be woven into site design. Thoughtful and cohesive landscape design that reflects the rest of North Campus can create a sense of place, a sense of arrival, and a sense of connection.

An equally important consideration is for the additional ecological/environmental studies that could be done to support the preservation of potentially sensitive habitat in the woodland to the north of the Freshman Village site. The stream that feeds Abbotts Pond runs through this woodland and is therefore an important resource in the vicinity of this new development.



Location of proposed Freshman Village residential development on the western end of campus

Protection of mature native tree canopy along the headwaters of the Abbotts Pond drainage.

Meditation Walk extends to Freshman Village.

The woodland ecological connection from west to east across the campus is enhanced.

Opportunities for nature trails, passive recreation, and outdoor classrooms serve to enliven this wooded campus edge.

The Courts serve as a centerpiece of the new residential housing, providing comfortable and welcoming social and gathering spaces in the areas outside of the buildings.

Active recreation spaces are integrated into the design of the Freshman Village open space.

The new residential development becomes the new eastern gateway to campus.

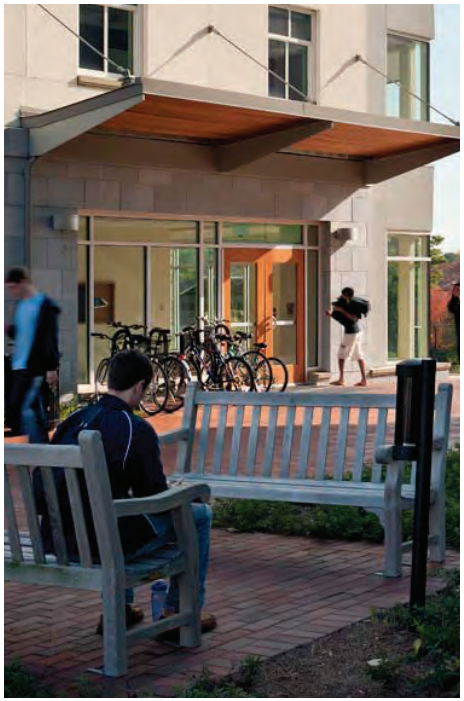
Green infrastructure is integrated into the design of the development footprint and the buildings (opportunities for green roofs on lower level roofs).

A tree-lined streetscape along Rt. 322 links the interior woodland to the campus edge and provides an enhanced gateway experience.

The headwaters of Chestnut Branch are enhanced.

A conceptual sketch of Freshman Village that shows the potential for connectivity, new social spaces with integrated green infrastructure, and an extension of Meditation Walk

The Courts of the Freshman Village are designed to complement the scale of the buildings that surround them, creating a comfortable space for residents. The landscape is designed to be flexible in the open space, in order to accommodate many different potential program needs. Bioretention, rain gardens, and bioswales can be integrated into the landscape design, along building foundations and paths.



4-CAMPUS WIDE RECOMMENDATIONS

Photo courtesy of Rowan University

Areas across campus (from the Science Hall above, to Magnolia Hall below) provide further opportunity for stormwater management and enhanced landscape design and circulation.

While the planning concepts detailed in the Focus Areas provide a broad swath of opportunities for stormwater management and landscape design improvements applicable across the campus, there are other considerations outside of the Focus Areas that require further attention.

This chapter provides more detail about campus wide recommendations for promoting a holistic approach to stormwater and landscape planning, laying the foundation for a vibrant future at Rowan University. It considers issues associated with key hotspots for stormwater issues, floodplain and stream considerations, landscape architecture, programmatic considerations, and suggested future studies and plans that can promote a resilient and sustainable future for the campus and community.

Stormwater

DAYLIGHTING OF CHESTNUT BRANCH AND TRIBUTARIES

A daylighted stream at University of Virginia

As the campus grew, historic tributaries to Chestnut Branch, as well as portions of the stream itself, were buried and integrated within a piped urban stormdrain network. (Many of these historic tributaries are shown in the historic ecological conditions mapping found in *Appendix III*). The burial of these waterways and subsequent development in the stream's floodplain has resulted in flooding and other issues associated with large storms. Where natural channels have the ability to dissipate energy in a natural floodplain, stormdrain networks create increases in velocity and energy of water flowing through a system. This in turn can result in flooding, erosion and degradation of the downstream portions of the stream.

Recommendations for addressing these issues include looking for opportunities to daylight sections of both Chestnut Branch and its first order tributaries (See Stream Enhancement typology in *Appendix I*):

- Chestnut Branch at the Cassady Building,
- A northern tributary at the proposed location of the Engineering School expansion,
- A southern tributary adjacent to the new Business School
- Restoration of the stream corridor of Chestnut Branch along the reach from the Heating Plant to Westby Hall, to include a wider low-lying floodplain bench and riparian buffer.

GREEN STREETS

A significant amount of stormwater is flowing from the surrounding neighborhoods and within the campus toward the Chestnut Branch stream corridor, for a number of reasons. First, the University has been built in the historic floodplain. In addition, increased urbanization in the areas surrounding the Campus means that there is more stormwater that isn't soaking into the ground where it falls and instead is flowing toward the stream (and the campus). Finally, the water will find any paths of least resistance toward the lowest points in the landscape, which are often undersized stormwater pipes that were not designed to handle the amount of water currently flowing to them.

For example, a single inlet behind the Rowan University Student Center serves to drain a large area of campus, including the Oak Grove. Sheetflow from the Oak Grove drains across Rt. 322 and into the loading dock and maintenance storage area behind the Student Center. This area is also considered a hotspot for poor water quality, because of the opportunity that water finds to intermingle with uncovered storage areas and leachate from dumpsters. Further to the west on Rt. 322, the Library also experiences flooding as a result of the high volume of water during a storm surge. The driveway, on the west side of the building has a single 3-inch diameter inlet to capture all of this water. In large storms, water flows down the steps from the driveway into the building, ultimately pooling in the lowest level of the mechanical room. Curbing has been added to elevate the area leading into the stairwell. The success of this measure has not been fully tested, and the inlet pipe remains undersized for the amount of water that is received here. Locations across the campus are also feeling the pressure from direct overland flow of stormwater from some of the surrounding neighborhoods. On-campus solutions can only help to address these issues, but further discussions with the City of Glassboro may result in a more holistic systems approach to stormwater management both on public rights-of-way like Rt. 322 as well as other neighborhood streets in the vicinity of the campus.

Green streets in Portland, OR

A diverse plant palette can be utilized in streetscape designs that integrate stormwater management practices.

Recommendations:

- Creation of a series of drainage improvements along Rt. 322 to re-direct sheet flow from South Campus into BMPs like bioretention areas
- Conversion of Rt. 322 into a "green street" that integrates bioswales and bioretention features where appropriate, with increased tree canopy and curb bumpouts that improve pedestrian crossings between north and south campus while managing stormwater runoff (see Stormwater Management Typology in *Appendix I*)
- Creation of a pollution prevention plan for the area behind the Student Center, which may include covering or otherwise containing maintenance storage and dumpsters
- The introduction of green streets or the integration of residential stormwater best management practices (BMPs) in the streets and properties within the immediate vicinity of the campus, in order to capture and treat more stormwater before it reaches the stormdrain pipe systems that empty into Chestnut Branch. These practices could also provide traffic calming, where needed.

BIORETENTION, RAIN GARDENS, BIOSWALES AND OTHER BMPS

There are numerous locations across the campus where small stormwater BMPs can be integrated into the landscape as part of future architectural or landscape improvements. See the stormwater management typology in *Appendix I*.

Recommendations:

- Integration of bioretention or bioswales, as sidewalks and pathways are replaced or updated to help treat the stormwater closer to where it falls
- Incorporation of stormwater management practices like foundation plantings, as landscapes around buildings are improved, to help with existing maintenance or drainage issues. Stormwater BMPs can be designed to be aesthetic amenities in the landscape, including showy vegetation and pedestrian crossings that highlight these landscape features.
- Integration of small rain gardens to enhance a landscape space and provide an opportunity for campus donors to beautify, while promoting sustainable low impact design and development on campus.

A bioretention area traversed by boardwalk paths in Lynchburg, VA

PARKING LOT TREATMENT

Bioretention islands in parking lots in Portland, OR and Newark, DE

Traditional parking lots contribute to existing flooding around the campus. There can be localized flooding when stormwater flows to centralized inlets and then discharges directly to Chestnut Branch. In addition to contributing to an increased volume and flashiness in the watershed, parking lots contribute to a decline of water quality in the stream. Oil, grit, and debris from the parking lot is suspended in the water that is washing across the pavement, which is then conveyed directly into Chestnut Branch, where it affects the health of aquatic communities in the stream system. Parking lots often face flooding challenges as a result of overwhelmed stormdrain networks and clogged inlets. Settlement and rutting of the pavement also creates areas where stormwater ponds in the parking lots.

Recommendations:

- Retrofitting existing parking lots with stormwater best management practices like bioretention, bioswales, and increased tree canopy, in order to provide water quality benefits and promote infiltration closer to where the water falls. (See illustrative typical cross section on *page 3-9.*)
- Installation of bioswales in the median or along the perimeter of parking lots, creating a disruption in the flow of water, filtering pollutants, and improving the aesthetic value of a parking lot (see Parking Lot typology in *Appendix I*).
- Reconfiguration of the parking and traffic patterns to minimize the loss of parking spaces in these lots while incorporating green infrastructure.
- Use of plantings that will tolerate snow stock piling can be used where appropriate.

Drainage Improvements

NORTHERN OFFSITE DIVERSION

Stormwater from surrounding neighborhoods flows through the campus before reaching Chestnut Branch, contributing to flooding concerns throughout the campus. There are six stormdrain systems that convey stormwater from the surrounding neighborhoods through the campus. The peak flows of stormwater from these contributing areas affects the hydraulics of Chestnut Branch, often occurring coincidentally with peak flows of campus drainage into the stream, and resulting in flooding on campus along the stream corridor. Because this is a combination of stormwater from both on and off campus, there is the possibility that separating some of these flows could help temper the effects on the campus in larger events. In Focus Area 2 the creation of the wetland is one on-campus effort to help manage these large flows of stormwater from off-campus. Other practices near the EPA apartments will also address these issues. However there may be a need to think creatively about ways to further minimize flows to the campus.

Recommendation:

- Consideration for a rerouting of stormwater from an approximately 20-acre neighborhood to the northwest of campus (across from the stadium) which currently drains though campus by way of 4.5-foot stormdrain pipe. This would involve rerouting this area's drainage along Carpenter Street, to the west side of Bowe Blvd, and then discharging to Chestnut Branch below campus. This will lessen the flow to a degraded stream channel at the outlet of the stormdrain, relieve the burden on the existing stormdrain network, and reduce the peaks of Bowe Blvd. This will require coordination and collaboration with the City of Glassboro and New Jersey Department of Environmental Protection (NJDEP), which regulates stormwater discharges in the state. NJDEP will not permit an increase of flow downstream of campus. However, preliminary modeling has shown that re-routing the drainage around campus does not increase downstream peak discharge. Further analysis would be necessary during subsequent design phases if the offsite diversion strategy is pursued.

THE TRIAD

The Triad Building shares its stormdrain network with the Borough's stormwater system, which drains a major area of off-campus residential development. During major storms, this system can become overwhelmed and stormwater backs up in the basement of the building, which includes apartments and mechanical equipment. Sheet flow from the parking lot has also been observed flowing through the south side doors into the basement of the building.

Recommendations:

- Separation between campus stormdrains and municipal, allowing off-campus runoff to bypass the Triad area and outfall directly to the creek downstream of the CSX railroad line.
- Consideration of a retrofit of the Triad parking lot stormwater BMPs that reduce runoff from frequent events and improve water quality.
- Creation of a new vegetated stormwater storage area at the north end of the parking lot, which would control runoff from the building and parking lots.
- The addition of a backflow preventor at the outfall from the building, to keep floodwaters from backing up into the building.

The Triad

THE TOWNHOUSES

The Townhouses

The Rowan University Townhouses experience excessively wet foundations, which has led to a mold problem within the buildings. A mitigation program has been implemented for the entire complex. The source of moisture is the downspouts on all buildings. The downspouts were not tied into a drainage collection system, as intended in the initial design.

Recommendations:

- Connecting downspouts to existing stormdrain infrastructure or installation of new stormdrains that can convey stormwater away from the buildings and reduce ice build-up on the sidewalks.
- Water quality treatment and stormwater detention can be provided in the existing stormwater wetland and sand filter.

Chestnut Branch Floodplain

CHESTNUT BRANCH DRIVE

Chestnut Branch flows under Bowe Boulevard directly downstream of Lot A, where the new Business School is being developed (at the time of the development of this Plan). The existing berm and culvert configuration at Bowe Boulevard has been in place for approximately 45 years. Two five-foot diameter corrugated metal pipes convey Chestnut Branch under Bowe Boulevard. During major storm events, the berm embankment and the floodplain of Chestnut Branch act as a retention pond, restricting the discharge and temporarily storing water on campus. In larger storms and in recent years as storms have become more severe, this has caused significant damage to infrastructure and property on campus, including flooding in Robinson Hall and floating vehicles in Lot A, and it prevents safe ingress/egress along the Chestnut Branch Drive.

Recommendations:

- Limitations on Chestnut Branch Drive: limited to emergency vehicles only.
- Restoration of the floodplain to a natural wooded condition, which could include trails and outdoor classrooms (see Stream Enhancement and Outdoor Classroom typologies in *Appendix I*).
- Daylighting the existing main stormdrain under Lot A as part of the stormwater design associated with the improved parking and landscape associated with the new Business School (this stormdrain serves much of South Campus and Rt. 322).

Chestnut Branch Drive

Landscape Architecture

OAK GROVE

The Oak Grove (top) and a vegetated stormwater swale in Swarthmore College's arboretum (bottom).

The iconic Oak Grove is characterized by historic specimen trees. It is a popular place for students to gather or walk beneath the expansive canopy. Over time concentrated stormwater flows have eroded a small channel in the landscape that slopes down toward Rt. 322. It is important to protect and preserve valuable natural resources like the Oak Grove and manage stormwater in a way that doesn't undermine the success of this historic campus landscape.

Recommendations for the Oak Grove include:

- Creation of a stable, vegetated, dry stream channel to help manage the stormwater that is flowing through this landscape. This natural channel should be designed in a manner similar to a bioswale, balancing the conveyance of large storm events and promoting infiltration and detention of smaller events.
- Addition of cobble grade control structures to maintain a stable conveyance feature through the subtly sloped landscape.
- Inclusion of native shade-tolerant vegetation that can also tolerate periods of inundation and drought.
- Enhancement of the grove understory for further stabilization and biodiversity
- Regular survey of health of the oak trees and new plantings as needed to maintain this iconic woodland grove landscape

GATEWAYS

Multiple gateways have been identified within the master plan. Gateways can be established through plantings, pedestrian gates, signage, entry gates, and building placement, among others. The gateways will all be addressed in an approach that is unique to that location. The approach for gateway design will reinforce a sense of identity and consistency across campus and utilize a common palette of materials. Further detail on gateways is included in the description of campus typologies in *Appendix I*.

Recommendations:

- Design of several key gateways with a more formal treatment, including new signage that signifies a major entry to campus.
- Creation of pedestrian-focused gateways that reinforce pedestrian access to campus, mainly between North and South campus at the crossing of Rt 322.
- Design of gateways that strengthen and reinforce key entry locations where there will be enhanced plantings on either one, or both, sides of the streetscape.

From top: The existing gateway at University Green and the proposed gateway

Sketch courtesy Rowan University

ART ON CAMPUS

Art outside of Rowan Hall

Rowan University has begun a campus-wide garden and art installation program. The master plan highlights the locations for these gardens and works of art, as identified by Rowan University on *page 2-23*.

Locations for art installations have similarly been identified by Rowan University. When the University is considering a new installation, an established endowment for the art's maintenance and oversight should be considered. Multiple pieces of art should be treated as a campus art collection and have the opportunity to be included on a campus arts walk, self-guided art tour, and periodically guided art walk.

Costing for art pieces on campus varies and frequently included donated work from an individual. Similarly, the maintenance for art varies greatly from one piece to another. As such, no cost has been established for the Rowan University identified Art Installation locations.

Further considerations for a cultural arts corridor is included in *Appendix VI*.

Recommendations:

- Creation of a design review process, for the selection or approval of donated pieces.
- Creation of a maintenance strategy that promotes periodic maintenance for all campus art pieces.

CAMPUS GARDENS

Along with the art program, Rowan University has begun a garden installation program. The master plan highlights the locations for these gardens as identified by Rowan University in *Chapter 2*.

Gardens present an opportunity to develop a consistent native landscape palette that reinforces the regional context of campus, against which specimens are showcased. Instead of individual specimen plantings, larger landscape gestures including malls, groves, allees and groupings of trees and plant material should be promoted. Rain gardens and bio-retention areas can be incorporated as gardens. Defining a unique collection strategy early on will help establish a unified landscape character across campus. Gardens necessitate additional maintenance, so a mechanism for arboretum and garden maintenance should be established with the garden proposals. For costing purposes, a cost per square foot has been considered for the University-identified garden sites.

See *Appendix VI* for more information on the University's plans for campus gardens.

Stormwater and garden features in Charlottesville, VA (top) and Chicago, IL (bottom)

Next Steps, Programming, and Future Studies

Photo courtesy Rowan University

Sunset on campus

This master plan serves as a long term planning document for campus stormwater management and landscape elements. There are a number of efforts that are not part of this scope but will be important next steps for continuing to strengthen and enhance the University's campus landscapes. These include more detailed studies to help provide further understanding of existing resources and create a more robust database for future management. Several of these are described in further detail in the following pages.

FUTURE STUDIES/DATABASES

- A detailed Campus Tree and Vegetation survey (woodland inventory) for entire campus property, collected and stored in a geodatabase
- A Campus Ecological Study of sensitive habitat areas
- An Infrastructure Asset Management Database
- A database for Stormwater and Landscape BMP Assessment and Management (and an MOU for maintenance responsibilities)
- A Waste Management Study
- An Emergency Vehicle Access Study as part of a comprehensive Campus Transportation Study

FUTURE PLANNING/PROGRAMMING

- A Comprehensive Facilities Master Plan update
- A Maintenance Plan for campus landscapes, including Integrated Pest Management
- A Natural Resource Adaptive Management Plan for campus natural resource areas
- Invasive Species Management Plan for the campus landscapes
- A meeting with City of Glassboro to discuss options for partnerships on green streets & BMPs initiatives
- An Arboretum Plan to direct future use of the campus greenhouses
- An Art Corridor/District development
- A Campus Art Committee
- An Emergency Access Master Plan for campus
- A forest management plan that recognizes the campus as a single landscape management concern
- A study of the campus to determine the existing carbon footprint and goals for reductions. (A goal could be to offset the carbon being released from the heating plant through forest management.)

CAMPUS-WIDE INFRASTRUCTURE INVENTORY AND MAPPING

The existing infrastructure on Rowan University is extensive. Numerous stormdrain systems, ponds, rain gardens, and other stormwater infrastructure have been installed throughout the campus's history. Mapping and availability of critical data such as pipe sizes, inverts, and pipe material is inconsistent due to missing data or multiple data sources.

Recommendations include:

- The development of a comprehensive campus-wide infrastructure database
- Completion of field survey for areas where data gaps are identified, to gather critical information
- Verification of all existing information, to ensure completeness and accuracy

This information could be used by the university to better maintain existing infrastructure, identify and track maintenance concerns, and prioritize infrastructure improvements.

Note: Rowan University is required by state law to sweep its parking lots monthly. Mechanical parking lot sweeping has greatly reduced debris build up in the 137 inlets on campus. The outlets to the stream channel have also benefited from mandatory cleaning of paved areas.

Deteriorated condition of municipal stormwater infrastructure

WATER BALANCE

Stormwater wetlands at University of Delaware

For Rowan University, water is an important natural resource for irrigation, energy, and human health. However, no mechanism currently exists to track the movement and usage of water on Rowan's campus. It is critical to understand the sources of water and primary uses to identify opportunities for conservation, harvesting, and reuse. A water balance captures this information and could be used to inform future management decisions. Improved water management results in long-term cost savings and minimizes waste of this valuable resource.

In order to maintain the current turf on campus, irrigation and fertilization is necessary due to the unique soils at the edge of the Pine Barrens. The current irrigation system is fed by the City of Glassboro's municipal water. The irrigation system has been mapped by facilities staff, but it currently only exists as physical markups—no digital database of the system exists.

Energy services on campus include both a chilled water system and steam lines that crisscross campus. Steam lines require ongoing maintenance efforts due to groundwater, which also reduced the system's efficiency. Facilities are currently exploring manhole waterproofing and other protective measures to reduce system inefficiencies.

The high groundwater table on campus has also proven to be a maintenance burden. No groundwater mapping information is available, but currently high groundwater is being pumped from sumps underneath the Recreation Center pool and throughout manholes on campus. This pumped groundwater is a significant source of clean water that could be reused.

The recommendation is for the development of a Campus Water Balance and Sustainability Plan which would include the following:

- Digitization of all water systems in a central infrastructure database (See Infrastructure Inventory and Mapping in this section)
- Quantification of the supply and demand in the context of seasonal variability
- Development of an analysis of both water use and cost during an average month, as well as during a peak month
- Determination of potential water supplies that can be used to meet or offset those demands, including: groundwater mapping, rainwater harvesting from proposed new buildings, conservation landscaping for reduced irrigation and fertilizer demands; new technologies for irrigation, heating, and cooling delivery
- Consideration for the use of a controlled system, to limit waste and reduce overall irrigation water usage

FOREST MANAGEMENT PLAN AND TREE INVENTORY DATABASE

Throughout campus there are small pockets of forest that provide important habitat and ecosystem services. Conservation and management of these areas requires an understanding of what currently exists, threats to the ecosystem, and a plan to management.

Recommendations:

- Development of a comprehensive vegetative and tree inventory database. The tree inventory database should consist of location, type, health, and size of all trees meeting a specified criteria.
- A forest management plan can include contextually-relevant strategies for addressing threats to the native ecosystem, reforestation opportunities, promotion of native vegetation, and control of invasive species. Forest management is an approach that recognizes the campus as a single landscape management concern. Once an energy study is done, carbon offsets could be considered along with targets for reforestation.
- An Integrated Pest Management Plan can be developed for the entire campus landscape

CAMPUS-WIDE INVASIVE SPECIES MANAGEMENT PLAN

Invasive species threaten overall ecosystem health. They often outcompete native species for resources and space, thus dominating the landscape. This dominance or change in landscape endangers native populations by throwing an ecosystem off balance. Native plants have also been shown to require less maintenance and water than their non-native counter parts.

Recommendations:

- The development of an invasive species management plan for the entire campus. The plan should include both strategies that target the eradication of invasive species and recolonization of affected areas with native species.
- Creation of a curricular component of the plan that examines the benefits of native species and describes how to identify invasive species.

RIPARIAN MANAGEMENT PLAN FOR CHESTNUT BRANCH CORRIDOR

The riparian zone (along both sides of a stream) is the first line of defense for a healthy stream ecosystem. Riparian trees, shrubs, and grasses create a buffer that slows overland flows of water, minimizing streambank erosion, promoting nutrient uptake, providing shade to the stream, and supporting a robust variety of flora and fauna. Currently, the riparian corridor along Chestnut Branch varies in terms of overall health, width, and its ability to maintain a healthy ecosystem.

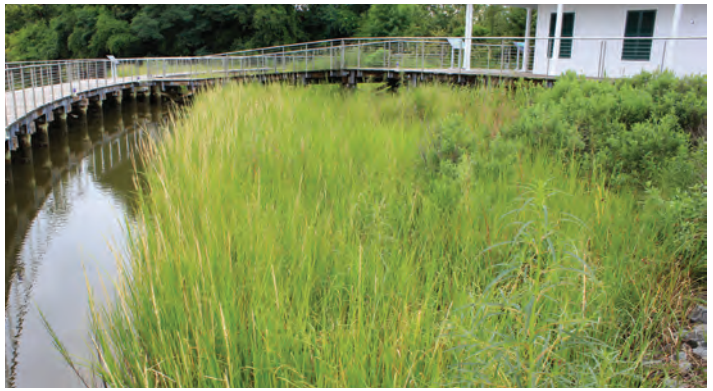
Recommendations:

The creation of a riparian management plan for the entire length of Chestnut Branch within the campus boundary. This plan should not only address the management of existing riparian areas but identify opportunities for both creation of new riparian zones and expansion of the existing. Strategies should be developed to promote native groundcovers, understory, and canopy; control invasive species; and provide education opportunities.

Woodland behind Rowan Hall

5-IMPLEMENTATION PLAN

PROCESS



Stormwater and landscape concepts included in the implementation plan include wetlands with boardwalks and pond edge enhancements.

As a planning tool for Rowan University stakeholders, an Implementation Plan has been developed in order to prioritize each project and plan for potential phasing of the projects over the next 15 years *(see Table 1 on page 5-5)*. All of the potential transformations to the Rowan campus presented in the Focus Areas and Campus Wide Recommendations chapter are displayed in the figure on page 5-4. Each individual project was given a priority and phase according to its congruence with the Master Plan goals and objectives, feasibility, and potential capital costs, as shown in *Table 1*.

The projects include:

- Stormwater management retrofits, such as incorporating green infrastructure to existing parking lots.
- Ecological restoration and management opportunities
- Landscape transformations, such as modifications to campus quads, plazas and pathways.

The Master Plan also includes a list of future studies and programmatic considerations needed to ensure sustainable management of the campus infrastructure over the long term. These studies could be performed by an outside consultant, or implemented by Rowan faculty, staff, and students. More information on future studies, programming, and next steps are included in *Chapter 4*.

SCORING DESCRIPTION

To determine the **Congruence with Master Plan Goals** and objectives, the projects were given a score from 0 to 3 for each master plan objective. A score of 0 indicated that the specific goal was not applicable to the project, while a score of 1 to 3 indicated the project's individual impact toward meeting that goal. For each project, the goal-specific scores were totaled and then normalized by the highest number of points that project could achieve. The highest number of points for a project was determined by excluding non-applicable goals (those that received a score of 0). The final Congruence with Master Planning Goals scores were derived from a quartile distribution of the normalized project scores. A final score of 3 indicates strong congruence with the overall goals of the master plan and a final score of 1 indicates a less strong congruence with the overall goals of the master plan.

The **Feasibility** score was based on the overall coordination and constraints required for a particular project. If successful project completion requires significant coordination or buy-in from a non-university stakeholder, the project was given a lower feasibility score. Projects that had significant constraints due to utilities or campus operations also received a lower feasibility score. A score of 3 indicates that the project was contained on university property, would require little coordination with outside stakeholders, and could be constructed with minimal impacts to campus. A score of 1 indicates that the project would require significant coordination with outside stakeholders or require significant relocation of utilities or other infrastructure.

Photo courtesy of Rowan University

Science Hall along Meditation Walk

Bioretention with boardwalk crossing

Planning level capital costs (**Cost Factor**) were developed for each project to reflect cost estimates associated with design, construction, and maintenance. For all projects, both the stormwater management costs and landscaping requirements were considered, based on an analysis of stormwater construction costs performed by King and Hagan[1] in 2011 and on industry standards. Annual maintenance costs were assumed to be 1% of construction costs, if not included within the King and Hagen study. The final cost score was determined based on an upper and lower quartile distribution of the capital costs. A score of 3 indicated a low cost (<$300,000), 2 indicated a medium cost ($300,000 to $2,000,000), while a score of 1 indicated a high cost (>$2,000,000).

The individual scores from each of these three factors were totaled to develop a final **Total Score**. The final scores were organized by **Tiers** into Tier 1 with a SCORE >6 (BLUE on the Table on page 5-5); Tier 2 with a SCORE = 6 (RED); and Tier 3 with a SCORE <6 (GRAY).

1 2001. King, Dennis and Patrick Hagan. Costs of Stormwater Management Practices in Maryland Counties. Prepared for Maryland Department of the Environment Science Services Administration (MDESSA). Ref. No. [UMCES] CBL 11-043.

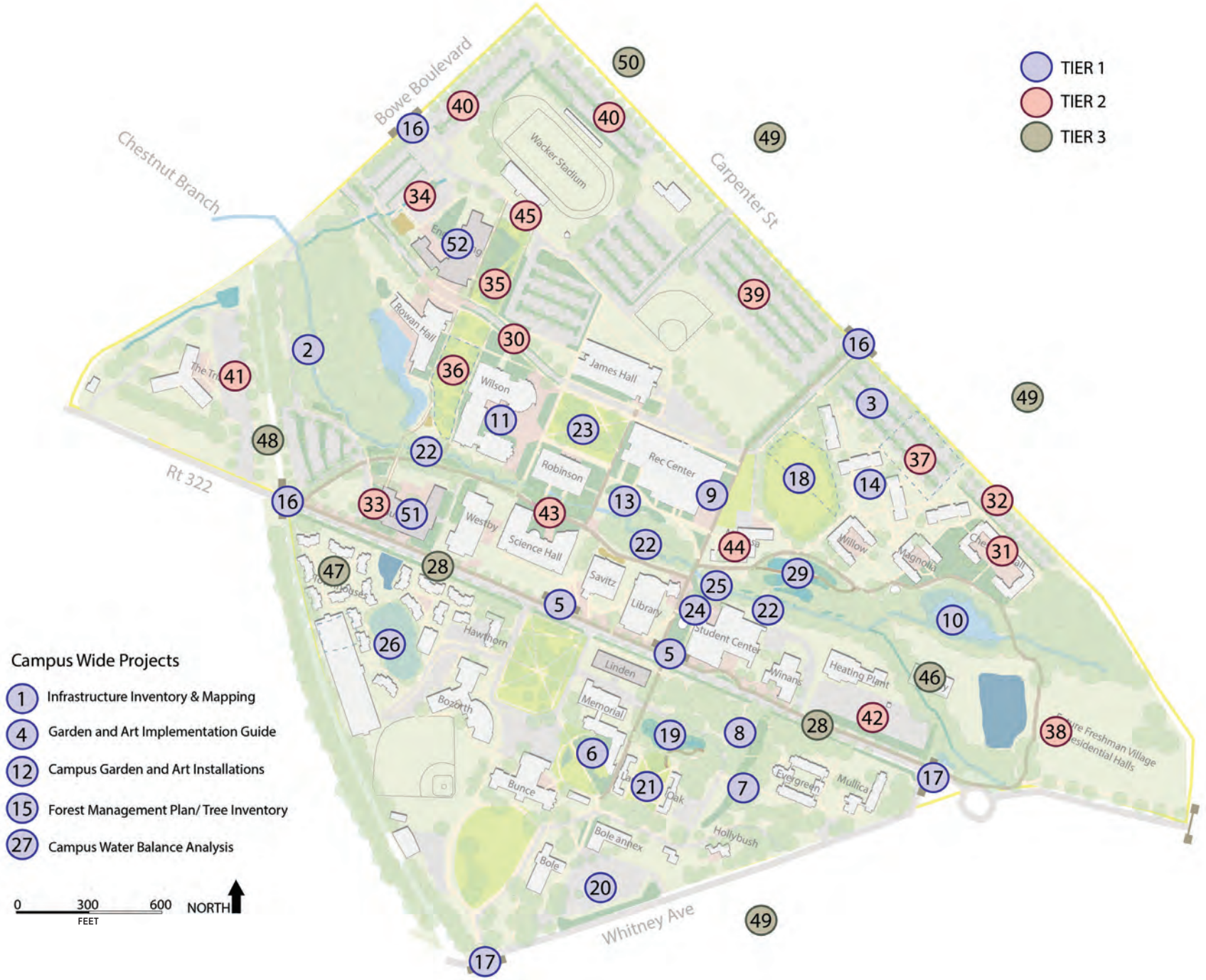

TIER 1
TIER 2
TIER 3
Bowe Boulevard
Chestnut Branch
Carpenter St
Rt 322
Whitney Ave
Wacker Stadium
Rowan Hall
James Hall
Wilson
Robinson
Rec Center
Westby
Science Hall
Savitz
Library
Student Center
Winans
Heating Plant
Linden
Memorial
Hawthorn
Bozorth
Bunce
Oak
Evergreen
Mullica
Hollybush
Bole annex
Bole
Willow
Magnolia
Campus Wide Projects
1 Infrastructure Inventory & Mapping
4 Garden and Art Implementation Guide
12 Campus Garden and Art Installations
15 Forest Management Plan/ Tree Inventory
27 Campus Water Balance Analysis
0 300 600
FEET
NORTH

TABLE 1: IMPLEMENTATION PLAN FOR PROPOSED PRACTICES, INCLUDING PRIORITIZATION AND PHASE

Tier	Project ID (on Figure)	Practice Type	Project Name	Congruence with MP Goals	Feasibility Factor	Cost Factor	Total Score	Phase*
1	3	SW	EPA Parking Lot (GI)	3	3	2	8	1
1	6	SW	Memorial Hall (GI)	3	3	2	8	1
1	7	SW	Oak Grove Bioswale	2	3	3	8	2
1	9	SW	North Campus Drive and Rec Center (GI)	3	3	2	8	1
1	10	SW	Abbotts Pond Restoration & Enhancement	2	3	2	7	1
1	14	SW	EPA Quad (GI)	2	3	2	7	2
1	18	SW	Intramural Field (Subsurface)	3	2	2	7	2
1	19	SW	South Campus (Linden Hall) Wetland	3	2	2	7	2
1	20	SW	Lot R & P Parking Lot (GI)	2	3	2	7	3
1	21	SW	Oak & Laurel Hall (GI)	1	3	3	7	1
1	23	SW	Robinson Green (GI)	3	3	1	7	2
1	29	SW	North Campus (Basketball Court) Wetland	3	2	2	7	3
1	2	LA	Chestnut Branch Reforestation & ISM	2	3	3	8	1
1	5	LA	Gateways (Pedestrian)	3	3	2	8	1,3
1	8	LA	Oak Grove Enhancement	2	3	3	8	1
1	11	LA	Wilson Plaza (GI)	3	3	1	7	2
1	13	LA	Dr. Creamer Memorial	1	3	3	7	1
1	16	LA	Gateways (Landscaped)	1	3	3	7	1,2
1	17	LA	Gateways (Signage)	3	3	1	7	1,2
1	24	LA	Student Center Plaza	3	3	1	7	3
1	25	LA	Student Center Stream Amphitheater	2	2	3	7	3
1	26	LA	Townhouses Wetland Enhancement	2	2	3	7	2
1	12	LA	Campus Garden & Art Installations	2	3	1	6	1,2

* Phase 1 = ongoing and within 0-5 years; Phase 2 = 6-10 years; Phase 3 = 11-15 years

Tier	Project ID (on Figure)	Practice Type	Project Name	Congruence with MP Goals	Feasibility Factor	Cost Factor	Total Score	Phase*
1	1	PP	Campuswide Infrastructure Inventory & Mapping	3	3	3	9	1
1	4	PP	Garden & Art Implementation Guide	2	3	3	8	1
1	15	PP	Forest Management Plan & Tree Inventory Database	1	3	3	7	1
1	22	PP	Chestnut Branch Riparian Restoration & Management Plan	1	3	3	7	3
1	27	PP	Water Balance Analysis	2	2	3	7	1
2	31	SW	Chestnut Hall (GI)	1	3	2	6	1
2	32	SW	Chestnut Hall Parking Lot (GI)	1	3	2	6	1
2	33	SW	College of Business (Daylighting)	2	2	2	6	1
2	34	SW	College of Engineering (Daylighting)	2	2	2	6	2
2	36	SW	South Engineering Green (Subsurface)	2	2	2	6	2
2	37	SW	EPA Parking Lot (Subsurface)	3	1	2	6	1
2	38	SW	Freshman Village Courts (GI)	1	3	2	6	1
2	39	SW	Lot B & Proposed Parking Lots (GI)	1	3	2	6	3
2	40	SW	Lot C & D Parking Lots (GI)	2	3	1	6	3
2	41	SW	Lot F (Triad) Parking Lot (Daylighting)	2	3	1	6	3
2	42	SW	Lot J Parking Lot (GI)	1	3	2	6	3
2	44	SW	Mimosa Green (GI)	2	3	1	6	2
2	30	LA	Campus Drive Green Streets	3	2	1	6	2
2	35	LA	North Engineering Green (LA)	2	3	1	6	2
2	43	LA	Meditation Walk Improvements (at Science Center)	2	2	2	6	3
2	45	LA	Stadium Walk to Road Conversion	3	2	1	6	3

* Phase 1 = ongoing and within 0-5 years; Phase 2 = 6-10 years; Phase 3 = 11-15 years

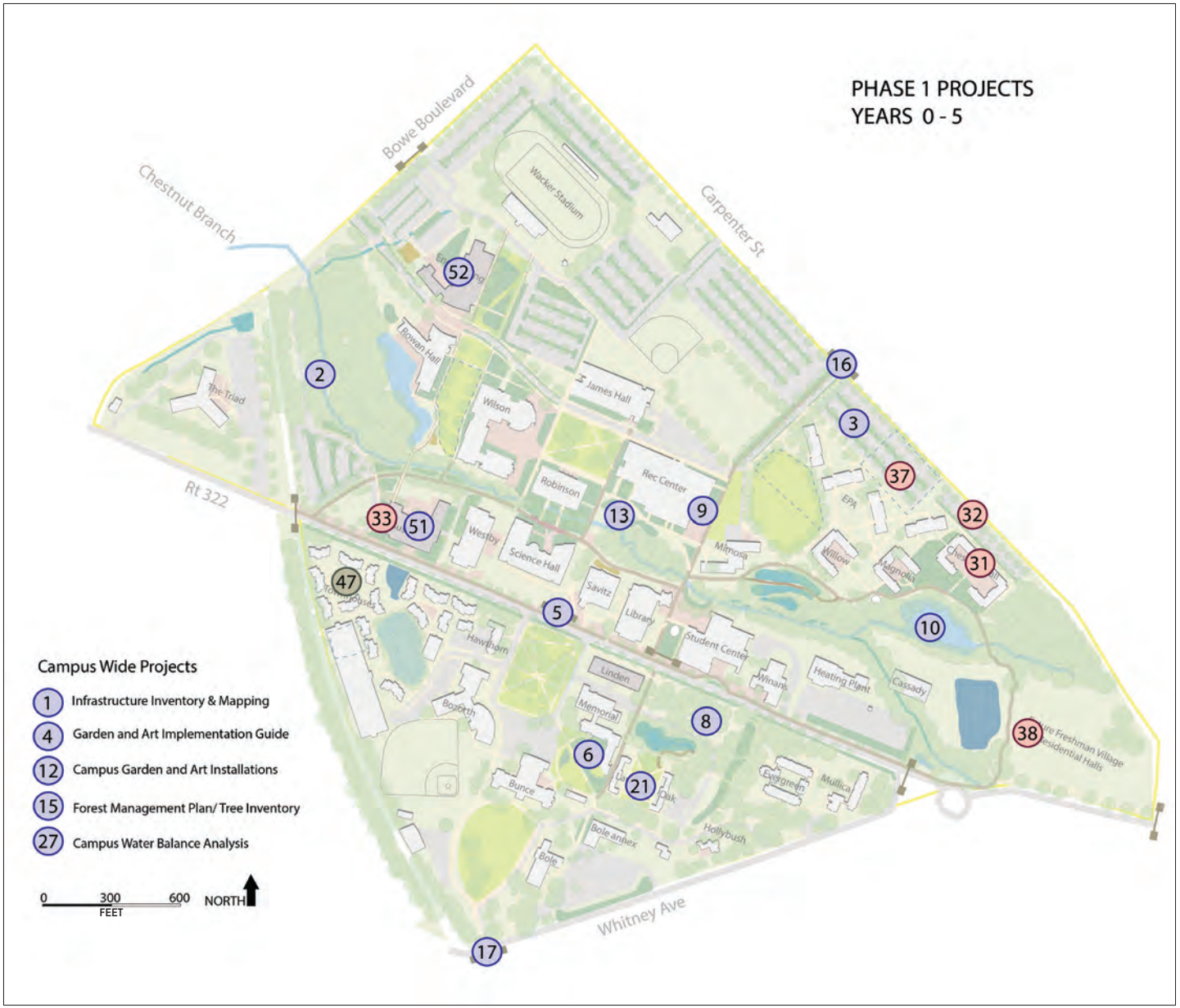
Tier	Project ID (on Figure)	Practice Type	Project Name	Congruence with MP Goals	Feasibility Factor	Cost Factor	Total Score	Phase*
3	46	SW	Cassady Daylighting	2	1	2	5	2
3	49	SW	Glassboro Residential Greening	2	1	1	4	2
3	47	DR	Townhouses Drainage Improvements	1	2	2	5	1
3	48	DR	Triad Diversion	1	2	2	5	3
3	50	DR	Carpenter Diversion	1	1	1	3	3
3	28	SW	Rt. 322 Enhancements/SWM/ Green Streets	2	2	1	6	3

* Phase 1 = ongoing and within 0-5 years; Phase 2 = 6-10 years; Phase 3 = 11-15 years

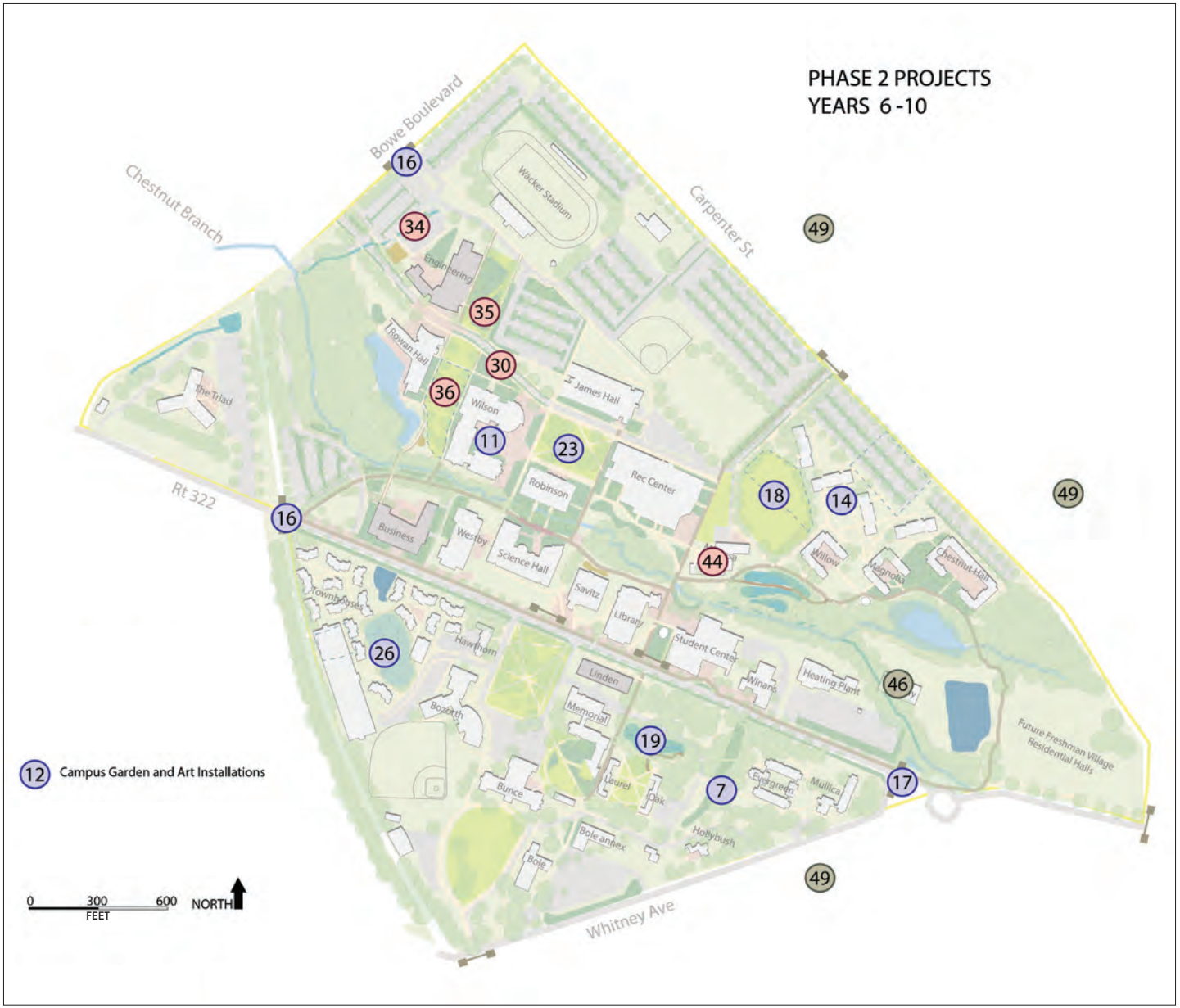
Additional Projects that are currently under way:
51–New Business School Building, Landscapes and Parking Lot-Phase 1
52–New College of Engineering Building and Landscapes-Phase 1

A suite of projects are underway or planned at a smaller scale, so they are not included in the prioritization plan above. These include: Hawthorne Landscape, Bozarth Landscape, Townhouse Park, Nursery/Greenhouse, Front patio of student Center, Westby Plaza, Gazebo Building, Meditation Boardwalk, North Dorm patio, North Dorm Green, Wilson bus pull off, Landscapes for EPA buildings, Plaza for Evergreen & Mullica, and the Patio under bridge.

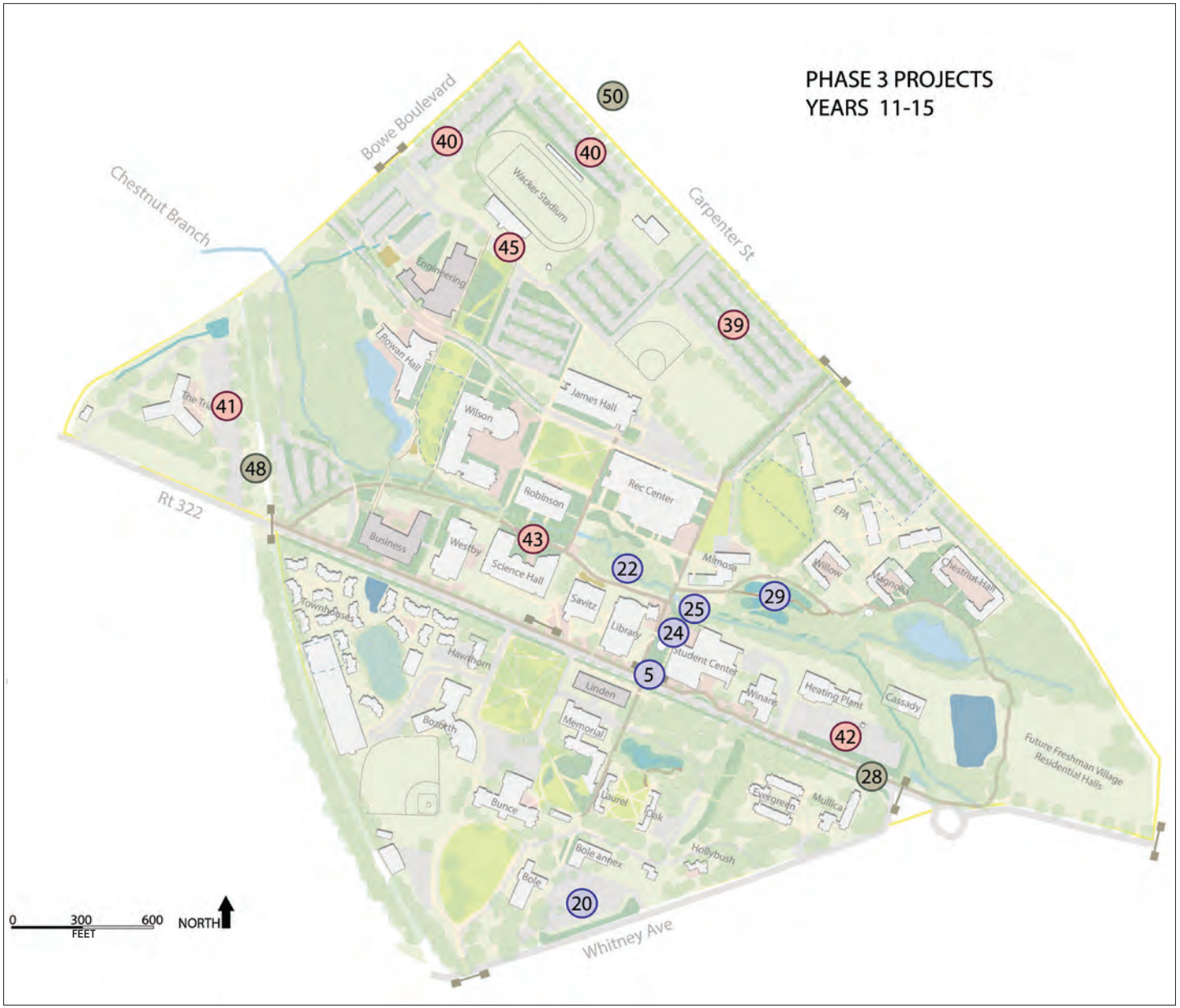
The following pages show the projects listed in the Implementation Plan, organized by phase.



1. Campuswide Infrastructure Inventory & Mapping
2. Chestnut Branch Reforestation & ISM
3. EPA Parking Lot (GI)
4. Garden & Art Implementation Guide
5. Gateways (Pedestrian)
6. Memorial Hall (GI)
8. Oak Grove Enhancement
9. North Campus Drive/ Rec Center (GI)
10. Abbotts Pond Restoration & Enhancement
12. Campus Garden & Art Implementation
13. Dr. Creamer Memorial
15. Forest Management Plan/ Tree Inventory
16. Gateways (Landscaped)
17. Gateways (Signage)
21. Oak & Laural Halls (GI)
27. Water Balance Analysis
31. Chestnut Hall (GI)
32. Chestnut Hall Parking Lot (GI)
33. College of Business (Daylighting)
37. EPA Parking Lot (Subsurface)
38. Freshman Village Courts (GI)
47. Townhouses Drainage Improvements
51. New Business School Building & Parking
52. New College of Engineering Building & Landscapes



7. Oak Grove Bioswale
11. Wilson Plaza (GI)
12. Campus Garden & Art Installations
14. EPA Quad (GI)
16. Gateways (Landscaped)
17. Gateways (Signage)
18. Intramural Field (Subsurface)
19. South Campus (Linden Hall) Wetland
23. Robinson Green (GI)
26. Townhouses Wetland Enhancement
30. Campus Drive Green Streets
34. College of Engineering (Daylighting)
35. North Engineering Green (LA)
36. South Engineering Green (Subsurface)
44. Mimosa Green (GI)
46. Cassady Daylighting
49. Glassboro Residential Greening



5. Gateways (Pedestrian)
20. Lot R & P Parking (GI)
22. Chestnut Branch Riparian Restoration & Management Plan
24. Student Center Plaza
25. Student Center Stream Amphitheater
28. Rt. 322 Enhancements/ Green Streets/SWM
29. North Campus (Basketball Court) Wetland
39. Lot B & Proposed Parking Lots (GI)
40. Lot C & D Parking Lots (GI)
41. Lot F (Triad) Parking Lot GI/ Daylighting
42. Lot J Parking Lot (GI)
43. Meditation Walk Improvements (at Science Center)
45. Stadium Walk to Road Conversion
48. Triad Diversion
50. Carpenter Street Diversion

6-GLOSSARY

Amenity (Landscape Amenity; Pedestrian Amenity): A term referring to an attractive or beneficial feature of a development, such as an improved streetscape, generous sidewalks and shade trees, improved circulation opportunities, or an attractive public gathering space or plaza.

Biodiversity: Biodiversity is the measure of variety of all levels of life from genetics to species and their interaction within a given biome or ecosystem, and is often used as a measurement of health within the system. This quantifies the health and complexity of an ecosystem and includes air, soils, water, plants, animals, insects, fungi and bacteria.

BMPs (Best Management Practices): Stormwater BMPs are techniques, measures or structural controls used to manage the quantity and improve the quality of stormwater runoff. The goal is to reduce or eliminate the contaminants collected by stormwater before it flows into streams and rivers. Definition from the EPA: http://www.epa.gov/.

Cultural resources: The variety of human-made products, artifacts, and behavior that a community or group values and seeks to preserve as its heritage legacy, including its history, traditions, art, literature, music, technology, and urban design.

Daylighting: In urban design and urban planning, this refers to the process of restoring all or part of a stream or waterway which had previously been buried in a culvert or an underground conveyance. Typically, the goal is to restore to a more natural state.

Development: The physical extension and/or construction of urban land uses. Activities include: subdivision of land; construction or alteration of structures, roads, utilities, and other facilities; grading; and the clearing of natural vegetative cover. Routine repair and maintenance are not considered development activities.

Erosion: Erosion is the accelerated process of detachment and transportation of soil due to wind, water or gravitational forces. Erosion is a natural process but in ideal conditions soil erosion is happening at roughly the same rate as soil formation. Erosion has become an increasing problem because it removes soil at rapid rates that result in increasingly unstable and degraded conditions.

Floodplain, FEMA 100-year: The area, as mapped by the Federal Emergency Management Agency (FEMA), which would be covered by the 100-year flood. The 100-year flood is defined as an event, which has a one percent chance of occurring in any one year. The area defined as a 100-year floodplain may have limitations on development, and could require insurance and or infrastructure to reduce flood events.

Functional (working) landscapes: Landscapes that are designed or managed to provide a specific function or product. In the context of stormwater these landscapes include treatment features such as bioretention, rain gardens, and street tree pits, which are designed to be integrated into landscape areas to receive and filter stormwater runoff. These practices include elements that require a greater level of precision design, in contrast to landscape conversion, in order to provide benefits and functions associated with stormwater treatment.

Gateways: Key entry points to the campus.

Geographic Information System (GIS): A computer-based information system that is used to input, store, retrieve, manipulate, analyze and output geographically referenced data, in order to support decision-making for planning and management of land use, natural resources, environment, transportation, urban facilities, and other administrative records.

Green infrastructure: An adaptable term used to describe an array of practices that use natural systems—or engineered systems that mimic natural processes—to enhance overall environmental quality and provide utility services. As a general principal, Green Infrastructure techniques use soils and vegetation to infiltrate, evapotranspirate, and/or recycle stormwater runoff.

Habitat hubs (patches): For species native to an area to continue to survive within areas of human development, habitat is needed that existed prior to development. These areas of habitat which are interspersed within areas of development or disturbance are called habitat patches or hubs. Habitat patches come in an infinite number of sizes and shapes and can have varying degrees of connectivity with each other. Factors that affect the quality and effectiveness of the patches include size, amount of undisturbed interior habitat available in a patch, type of species using the patch, ecological health, and proximity to other habitat patches.

Habitat linkages (corridors): The connections between hubs/patches are called habitat corridors or linkages. Studies have shown that the wider the linkage the higher the quality.

Hydraulic: The force of flowing water, ie. velocity, turbulence.

Hydrologic: The source, amount, temporal variation of water flows; more relevant to flow regime.

Invasive species management: Species of flora and fauna that proliferate uncontrollably, often out-competing and replacing local diverse species assemblages. Invasive species can be exotic or native and can be detrimental to ecosystems and often result in an overall decrease in biodiversity.

Landscape: The space outside of the building envelope.

Native vegetation: Plants that are indigenous to the site and to areas contiguous to the site.

Natural resources: This term refers to the variety of biological and physical values found in nature and may include, at the project level, the site's geology and soils, terrain, slope characteristics, vegetation and wildlife habitat, and hydrology. Natural resource protection often considers the multiple benefits to the community of flood control and watershed protection, open space and habitat protection, and trails and other recreational opportunities.

Open space: Any area of land, essentially unimproved and not occupied by structures or man-made impervious surfaces, that is set aside, dedicated, or reserved in perpetuity for public or private enjoyment as a preservation or conservation area.

Physiographic province: A geographic region with a specific geomorphology and a specific subsurface rock type or structural elements. A continent may be subdivided into various provinces, each having a specific character, physical relief, and environment which contributes to its uniqueness.

Regenerative design: Regenerative design creates and sustains healthy ecological systems that continue to manifest themselves long into the future. This design approach celebrates interdisciplinary collaboration, understanding the dynamics of multiple interacting systems and recognizing the uniqueness of place and time.

Regenerative Stormwater Conveyance (RSC): Regenerative Stormwater Conveyance is a vegetative channel design which promotes a more stable stream-like system to convey, filter, and infiltrate runoff, as well as provide habitat enhancement. It is not simply an outfall stabilization (e.g., with riprap) but rather a vegetative design that can be used to repair outfall areas as well as provide stormwater management in areas with appropriate space available.

Riparian corridor: The linear interface between land and stream. Plant communities along the river margins are called riparian vegetation, characterized by hydrophilic plants. Riparian corridors are significant in ecology, environmental management, and civil engineering because of their role in soil conservation, their biodiversity, and the influence they have on aquatic ecosystems. In some regions the terms riparian woodland, riparian forest, riparian buffer zone, or riparian strip are used to characterize a riparian corridor.

Sediment: Fragmented organic or inorganic material derived from the weathering of soil, alluvial, and rock materials; and transported by water, wind, ice, and gravity.

Site analysis: An inventory and assessment of natural and cultural site features collected to inform development that will be responsive to unique site constraints and opportunities.

Stream restoration: The repair of degraded stream habitat that may include changing bank and flood plain structure and vegetation.

Sustainability: The most widely quoted definition internationally is the "Brundtland definition" of the 1987 Report of the World Commission on Environment and Development—where sustainability is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." (EPA's Region 10 Sustainability website provides more information on definitions and history of "Sustainability.")

Traffic calming: Any number of street modifications to slow or divert traffic, including speed humps, traffic circles (or roundabouts), curb bump-outs, raised planters, or other obstructions.

Viewshed: The area within view from a defined observation point.

APPENDICES

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Appendix I–Campus Typologies
INTRODUCTION

A comprehensive approach to landscape at the University of Georgia has created a strong landscape identity to campus. Here, individual projects reinforce a campus-wide vision to open space.

At Rowan University, it is the experience of the whole, not of individual components, which determines the character of the place. Defining a comprehensive approach for campus open space ensures that as individual projects are initiated, a restatement of campus-wide initiatives occurs. The typologies presented here establish a set of priorities and criteria through which all individual site improvement projects can be addressed simply and elegantly. These design approaches and the associated design guidelines have been developed to provide a general level of direction necessary to create a coherent campus, yet provide enough latitude to allow flexibility and change, design creativity and building individuality.

This appendix outlines an approach for each of the campus typologies on the following page:

- Pedestrian Walkway
- Campus Green
- College Plaza
- Residential Court
- Stream Enhancement
- Pond Edge
- Outdoor Learning
- Campus Gateways
- Streetscapes
- Parking
- Stormwater Management

CAMPUS TYPOLOGIES

For each typology on the following pages, a short description is accompanied by photos of contextually relevant precedents and design guidance for implementation on the Rowan campus. These same typologies have been noted in the 2- Master Plan and in 3- Focus Areas - where campus enhancements have been described in more detail. This acts as a guide for the future aesthetic and function of the campus.

PEDESTRIAN WALKWAY

CAMPUS GREEN

COLLEGE PLAZA

RESIDENTIAL COURTS

STREAM ENHANCEMENTS

POND EDGE

OUTDOOR LEARNING

CAMPUS GATEWAY

STREETSCAPES

PARKING

STORMWATER MANAGEMENT

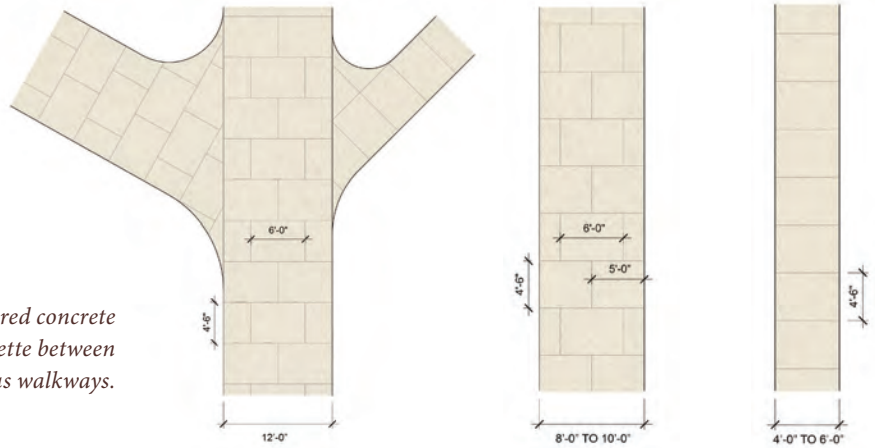
PEDESTRIAN WALKWAYS ORGANIZE CAMPUS CIRCULATION.

Consistent material helps unify the campus aesthetic. Economical concrete pathways are accented with detailed scoring patterns.

Campus walkways connect the campus while also helping to define the University as one whole. A clear and comprehensive system of pathways knits the campus together and establishes a consistent material palette. Increasing the connectivity and quality of campus walkways allows a contiguous and collegiate pedestrian experience. The consistent ribbon of pedestrian pathways provides opportunities to further link academic programs and support student life activities. North and South campus will be more seamlessly connected. Meditation Walk will extend to Rowan Boulevard. Enhancing connections to and across Chestnut Branch allows the campus to embrace this natural resource and the many ecological and aesthetic benefits it can provide.

Walkways will be a variety of scales, but constructed with the same material (See further information on standards in *Appendix II).* The detailing of the scored concrete walkways brings a level of sophistication to an economical product. By sizing the Primary walkway to accommodate modest service and access needs, continued fire access is provided to all buildings while the look of a pedestrian path is maintained. Select service access has similarly been accommodated on a restricted as-needed basis.

Bikes and skateboard use is suggested for select paths throughout the campus. See the map on page 2-11 for further detail.



A hierarchy of simple scored concrete pathways create a common palette between different scales of campus walkways.

PEDESTRIAN WALKWAYS–DESIGN GUIDELINES

Pedestrian walkways serve to connect the campus, providing circulation routes through the campus - directing flows to major destinations, creating spaces for both pedestrians and cyclists, and providing promenades along major walks and smaller paths for more ancillary destinations.

- Create a cohesive and connected series of paths and walkways that traverse the campus and support an enhanced experience.
- Abide by an established hierarchy of widths for new paths and trails, which accommodate pedestrian traffic and plows, but no vehicles. All vehicular access to be restricted to a series of paths designated as such.
- Design sidewalks and paths to drain to treatment areas, filter strips, or buffers. Incorporate edge treatment, providing a new aesthetic along walkway edges that uses gravel/stone/brick, designing for maintenance needs like plowing and sightlines for safety and visibility. Such edge treatment can provide for stormwater infiltration and conveyance, a depository for winter salts and sand, and a visually attractive border.
- Trees or shrubs that produce fruit should be located far enough from pedestrian sidewalks that the fruit does not fall on sidewalks.
- Existing trails through woodland areas should be enhanced, in lieu of new trails that may lead to ecological fragmentation. The woodland by Rowan Hall, the proposed stormwater wetlands near Mimosa and where Linden stands, Abbotts Pond, and the Woodland to the east of Chestnut can all serve as destinations for outdoor study.

CAMPUS GREEN IS THE CHARACTER DEFINING OPEN SPACE OF CAMPUS.

Photo courtesy of Rowan University

University Green (top) highlights the characteristics of a successful campus green. The space is defined by buildings and edge walkways and provides flexible space on the central lawn for a diverse set of programming needs. Campus greens may be open lawns or covered with canopy trees. The edges of the space may be reinforced with edge plantings that also provide storm water management opportunities.

One of the most iconic landscapes on a collegiate campus is the campus green. This often centrally-located quadrangle develops a character that is synonymous with the institution. It provides gathering spaces for impromptu and ceremonial events and is organized with a simple and rational network of pedestrian paths. A campus green can be tree-lined or canopy covered. Ideally a variety of these types are provided across campus.

Typical campus greens will be designed to consist of a simple combination of shade trees, expansive central lawn areas, consistent materials, while providing storm water management opportunities at the edges. A careful studied relationship between the building entrances and the green such as the implementation of foundation plantings that can accommodate adjacent storm water management needs create a transition between buildings and open space. Greens can accommodate many types of seating, that help promote a sense of place. Seating can be designed into the planted edges to provide for areas to study, rest or watch the goings-on in the green. Consideration for historic preservation may be necessary in iconic spaces like University Green, where enhancements will respect long views of the historic building facade.

New campus greens across campus are intended to expand the successes of University Green across campus, providing more central open spaces campus-wide.

CAMPUS GREEN–DESIGN GUIDELINES

Greens can provide positive and attractive spaces for social gatherings, and other activities, which integrate and demonstrate the natural environment and local ecology into the campus context, as space or use allows. Greens can accommodate recreation and respite, supporting health and relaxation, and allowing students to commune with nature.

- Greens should be designed to consist of a simple combination of shade trees, expansive central lawn areas, consistent materials, while providing storm water management opportunities at the edges.
- Where turf does exist, Integrated Pest Management should be the adopted maintenance regime - See note in Chapter 4 about future needs.
- With each new development project and each building renovation on campus, smaller open spaces shall be integrated into the site design (as appropriate with associated programming and design intent), while responding to the surrounding campus context. The design of these open spaces will be visually and physically connected across the campus.
- Maximize the use of native plants adapted to local site conditions and micro-climates throughout campus. The design intent is to support biodiversity, reduce pesticide use, increase wildlife habitat (depending on space and programming use) and maximize water conservation.
- Create ecologically sustainable campus greens by integrating stormwater management systems on the edges, using native plantings that may provide some habitat value, amending soils as required to establish a healthy profile, and by creating gathering and seating areas for students, faculty, staff and visitors.
- Landscape budgets should be an integral portion of new construction budgets, and should be based on a percentage of total construction costs. Funds allocated for landscape improvements should not be redirected to fulfill funding shortages in other areas of construction.
- Where appropriate, utilize plantings and landforms to create flexible spaces outdoor classroom and social gatherings in campus greens. (See further detail under Outdoor Learning.)

COLLEGE PLAZA PROVIDES ACTIVE HARDSCAPES WITHIN THE HEART OF CAMPUS.

clockwise from left: Plazas can incorporate storm water management into the landscape. Movable furniture allows for flexible seating options and the easy addition or removal of seating as needed over time. Service access of streets that penetrate a college plaza can be treated to read as part of the plaza, rather than a divider of the greater space.

Plazas are landscape spaces dominated by paving to support heavy pedestrian activity. This active space contributes to a sense of shared community life and is often located adjacent to major building entries. A combination of fixed and movable seating is recommended for flexibility. Intimate seating and gathering spaces may also be designed into plazas. These highly used spaces are excellent opportunities for water features and sculpture. The organization of seating, water features, and sculpture can help promote a sense of place and spatial identity through new experiences in these spaces.

When developing new or updating existing plazas, it is important to have an adequate soil structure and mix to support the growth of healthy trees and plantings in these paved areas.

At Rowan University, a great opportunity exists to integrate stormwater into the landscape features of the college plaza. Plazas should be designed to support the program in adjacent buildings as well accommodate pedestrian circulation through these spaces. Plazas are most successful at busy campus “crossroads”.

COLLEGE PLAZA–DESIGN GUIDELINES

- With each new development project and each building renovation on campus, plazas shall be integrated into the site design as appropriate with associated programming, while responding to the surrounding campus context. The design of these spaces will be visually and physically connected across the campus.
- Drain sidewalks and plaza hardscape areas to vegetated treatment zones, filter strips, or buffers. Incorporate edge treatment, providing a new aesthetic along walkway edges that uses gravel/stone/brick, designing for maintenance needs like plowing and sightlines for safety and visibility. Such edge treatment can provide for stormwater infiltration and conveyance, a depository for winter salts and sand, and a visually attractive border.

RESIDENTIAL COURTS ARE THE OUTDOOR LIVING AREAS FOR RESIDENT LIFE.

Residential courts provide clear access to buildings and places for individual and group seating. Planting areas have the opportunity to double as storm water management areas.

The exterior space and outdoor commons associated with the adjacent residence hall define residential courts. Courtyards are intimate small-scale spaces where students wait, meet, and interact. They are the outdoor living rooms of the residence halls. Courts include both fixed and movable seating for flexibility. These spaces primarily serve adjacent buildings and accommodate pedestrian circulation within the court. Their proximity close to residence halls reinforces the potential use for both individual use and use as an outdoor meeting room for groups.

Stormwater management, a potentially diverse plant palette that can be used as an educational tool, and a consistent materials palette reinforce the campus character within these spaces. Creating small, intimate gathering spaces for social congregation or small scale outdoor meeting space reinforces the student experience within these spaces. The addition of plantings to these spaces provides seasonal change, diversity, and added interest throughout the year.

RESIDENTIAL COURTS–DESIGN GUIDELINES

- Provide space for active and passive recreation, near new or improved residential facilities.
- Courts include both fixed and movable seating for flexibility.
- Integrated vegetative stormwater management practices should be considered for the edges of paved courts, when deemed appropriate.
- A diverse plant palette can be used as an educational tool and to frame and provide shade in the courts.
- A consistent materials palette reinforces the campus character within these spaces.

STREAM ENHANCEMENT: DAYLIGHTING, STREAM RESTORATION, AND FLOODPLAIN

Chestnut Branch has the potential to be a stunning natural feature of the Rowan Campus.

Healthy streams are often characterized by a diversity of native plants, as well as fallen or decomposing trees and organic material; they will have channels that meander- flowing apart and coming back together; and an abundance of logs, boulders, and undercut banks with deep pools in some locations and shallow areas in others. As flood waters expand on the associated floodplains, during or immediately following major storms, the water slows and silt settles out. Some water seeps into the ground, being filtered along the way through plant roots and soils, and eventually feeding aquifers.

The portion of Rowan University campus north of Rt 322 has been developed almost entirely in the floodplain of the Chestnut Branch stream corridor. The stream is very dynamic in nature, since it is an urban stream fed primarily by stormwater runoff from the campus and beyond (hundreds of acres drain from the town of Glassboro into the stream through the campus drainage network). This has led to issues of flooding on campus, as well as erosion and unstable banks. Existing vegetation is mainly nonnative and invasive, lacking the diversity, structure and food sources that native wildlife rely upon for habitat.

Chestnut Branch bisects the Rowan University campus, creating a unique natural resource amenity for the University. A healthy stream corridor would have a diverse native vegetated buffer along both sides of the stream that provides essential ecosystem services including: habitat for native wildlife, stabilization of soils along the stream's edge, shade that keeps the stream at an appropriate temperature, and a wide floodplain that helps mitigate flooding in upland areas. Buffers for a stream of this size would potentially be anywhere from 50' to 150' wide on each side of the stream. While those buffers may not be a realistic option with the current development footprint, there are opportunities for enhancing the stream form, managing the vegetative buffer with a more diverse and native plant palette, and restoring the floodplain and portions of the stream where it is less stable.

STREAM ENHANCEMENT–DESIGN GUIDELINES

- Promote the preservation and restoration of Chestnut Branch, its tributaries and wetlands on campus through innovative site development and design. Protect and restore the natural hydrology and flow paths across campus, including natural landscape recharge areas and depressions.
- Promote watershed health and ecological function and bank stability through a diverse native plant palette in riparian buffer plantings along Chestnut Branch.
- To protect university assets, avoid building any new structures within the floodplain and floodplain fringe- instead enhancing that area with plantings and restoration of the floodplain where possible. Remove existing structures in flood prone areas over time as they reach the end of their useful life cycle.
- Use the natural hydrologic features that exist on the site of proposed improvements or new development, or directly adjacent to the site, as the primary driver for landscape planning and stormwater management design, through conservation of drainage patterns, water budget, soils, and vegetation.
- Where appropriate, reconnect the stream to the floodplain through channel restoration and enhancement of the native vegetative buffer.
- Stabilize outfalls and the stream channel, encouraging groundwater flow for low flows and providing safe conveyance of high flows through practices including plunge pools, step pools, and created wetland areas.

POND EDGE IS THE DESIGNED COMPONENT OF WATER'S EDGE

Abbotts Pond provides a natural amenity and outdoor living laboratory space on campus, not unlike the pictured amenities at other universities.

Abbotts Pond is a likely relic of the agricultural heritage of the region- an old farm pond that has served many purposes over the years. It is now the centerpiece of the residential portion of North Campus, serving as habitat for turtles and geese, and a place of respite and contemplation.

Currently the pond's edge has some native vegetation on the southern side as well as nonnative vegetation. However it is a landscape dominated by turf grass- which attracts a large number of geese. Their presence can have an adverse effect on water quality, as their droppings wash into the pond. The natural setting, and its close proximity to the residential area of campus creates an opportunity to take advantage of this natural resource- as an aesthetic amenity and an opportunity for research about the function of natural systems on campus.

An improved vegetative edge (converting turf to native grasses, sedges and meadow plants) as well as shrubs and trees, will create new and improved visual interest as well as much more visible and resilient habitat for native wildlife. The Pond could be improved as habitat for more native wildlife including turtles, amphibians and native bird species. Restoration of a wetland edge within the water- which helps provide improved water quality, more diverse aquatic habitat, and a variation in landform along the pond.

Aesthetics of the Pond can be enhanced with planting designs that focus views and a boardwalk access area that overlooks the Pond. The trail to the south, as well as the path to the north can be enhanced with more diverse native plantings to create more visual interest and small gathering areas and outdoor classroom spaces.

The pond can also provide an important location for future biological studies of the campus ecosystems. Monitoring its current status as well as its changes over time, can provide a great on campus opportunity as a living laboratory.

POND EDGE/WOODLAND TREATMENT–DESIGN GUIDELINES

- Enhance and restore the native woodland with a diverse selection of vegetative species, which help promote ecological health.
- Maintain a maximum no-mow zone (or zone of alternative low maintenance vegetation) of 12 feet and a minimum no-mow zone (or zone of alternative low maintenance vegetation) of 8 feet from all naturalized areas (the woodland behind Rowan Hall, etc).
- Establish, augment or restore buffers around the perimeter of the ponds to enhance water quality and wildlife habitat, while maintaining aesthetics and access. Ponds should be managed to provide a natural woodland, shrub and meadow buffer that supports native plant diversity but that also offers key locations for access and framed viewsheds.

OUTDOOR LEARNING PROVIDES OUTDOOR EDUCATION AND LIVING LABORATORIES ON CAMPUS.

above left: Movable seating and outdoor chalkboards allow for flexible classrooms that can be adjusted for class size and location. Other examples include the addition of slate on a blank façade of a building to support learning; above right & near right: An amphitheater is a traditional outdoor classroom that supports the teacher as lecturer. These spaces can be integrated into larger plazas and greens to have value as a campus-wide gathering space beyond classroom.

Opportunities exist across campus to develop outdoor learning spaces for Rowan University. These spaces can take many forms. Some outdoor learning spaces are formed with permanent, fixed seating organized in traditional lecture environments with the teacher in the center as the dispenser of knowledge. A typical amphitheater is an example of this type of outdoor classroom space. Other outdoor classrooms have flexible seating and promote a more personalized classroom space. These spaces can be as simple as providing outdoor movable furniture and chalkboards across campus. Slate can be used on a blank façade of a building to allow for the occasional lecture to move outside. These types of spaces allow the "classroom" to easily convert to other uses.

Only a limited number of traditional, fixed outdoor classrooms can be supported at any one given University. Strategically locating these spaces adjacent to academic buildings makes them the most successful. These traditional spaces are best when designed to be part of a larger plaza or green. In contrast, more flexible learning environments can be accommodated in much larger numbers across campus. Their flexible nature allows them to function as a both outdoor classrooms when needed as well as general outdoor space. This flexibility is what makes them a good candidate for classrooms at an evolving University, where class size and pedagogy changes over time.

OUTDOOR LEARNING (CLASSROOM/RESEARCH)–DESIGN GUIDELINES

- Utilize plantings to create spaces useful for discussion, outdoor classroom and social gatherings, and texture in College Greens, limiting hardscape and paving.
- Incorporate educational signage in the design of spaces, with supporting narratives and graphics that helps interpret the ecology and innovative practice of the space. Have at least one sign posted with each new project. Include a posting on the University website for further information on the purpose and progress of each new development project and associated landscape and stormwater best management practices.
- On sites close to academic buildings, provide strategically located flexible outdoor spaces conducive to class meetings, which integrate with the natural environment.
- Provide educational/research opportunities in the landscape as part of the implementation of stormwater BMPs and native landscape enhancements. Monitor water quality and infiltration rates within research areas.
- Create new opportunities for stewardship in campus natural areas such as: "adopt a green space" program for students, students helping create signage and interpretive elements along the trails/walkways, along Chestnut Branch, the woodland areas, and at Abbotts Pond.
- Daylight water where feasible, integrating hydrologic and natural resource enhancement features into the campus landscape and the daily experience of students and faculty, incorporating educational signage where and when space allows. Teach that stormwater is a resource not to be wasted and where appropriate integrate research and monitoring opportunities.

CAMPUS GATEWAYS ESTABLISH WELCOMING AND DEFINED CAMPUS EDGES.

A family of pedestrian and vehicular gates greets visitors to campus. Consistent design elements and materials, in this case locally quarried stone, reinforce the campus aesthetic.

Campus Gateways provide a welcoming identity to campus visitors while also helping to better define the University. A combination of walls, portals, plantings, banners, and building placement can work together to define a campus gateway and establish a clear identity on the street. A family of pedestrian and vehicular scaled gateways is recommended to establish clear entries at Rowan University.

The landscape treatment of a campus' perimeter and its entrances provides an important tool for defining "place." Characteristics of well-designed campus edges and entrances distinguish the campus from local surroundings, create a welcoming environment and positive first impressions, and establish a sense of arrival through the designed landscape including gateway structures. Campus edges and entrances create a defined edge by implementing plantings, fencing, or site walls; mark entries with identifiable signage and built elements; and reinforce a sense of arrival.

CAMPUS GATEWAYS–DESIGN GUIDELINES

Gateways are the welcoming space that helps beckon to visitors, informing them they have arrived. The gateway can reflect the identity of the University, through style, color and signage.

- Design planting displays at campus gateways, building entrances or other special places to provide color and/or seasonal visual interest.
- Incorporate stormwater BMPs into the design of new gateways, as appropriate.
- There may be opportunities at campus gateways or other key locations for non-native ornamentals, which are included on an approved plant list. When utilizing non-natives, ensure they complement the native palette, are not invasive, and are nursery grown, legally harvested, or salvaged for reuse from on or off site.

STREETSCAPES: DESIGN APPROACHES FOR GREEN, COMPLETE STREETS.

clockwise from top left: Green Streets integrate stormwater management into the landscape beautifully and efficiently. Even intersection paving can be designed to create gateways into campus. Consistent material reinforces the campus identity along an edge street.

Edge and entry streetscapes are a great opportunity to act as campus gateways by reinforcing the University's presence and campus identity. A designed street with anchor buildings, an established campus edge, and a consistent landscape should work together to define campus to the public. A unified streetscape consisting of complimentary canopy trees, consistent plantings, lighting, and street furniture will designate the boundaries of the campus and provide a comfortable walking environment for pedestrians. Streetscape plantings and detailing can receive stormwater from the adjacent impervious roadways and walkways. These streets, often referred to as Green Streets, are both beautiful and educational. The combination of consistent paving, furnishings, plantings, lighting, and signage, allow streets to become meaningful entry portals and edges to campus that reinforce a clear arrival experience.

STREETSCAPES–DESIGN GUIDELINES

- Streetscapes should be designed as green corridors and pedestrian spine, expressive of the ecological context of the Chestnut Branch watershed- incorporating and/or enhancing pedestrian access and bike accommodations.
- All streetscape projects or improvements should incorporate water quality treatment elements and stormwater best management practices.
- Streetscape tree pits should be a minimum of 225 cubic feet and provide proper growing media and spacing to allow for mature trees.
- Trees placed within streetscape retrofit and improvement projects shall be located a minimum of five (5) feet away from utilities. For new construction trees shall be located a minimum of ten (10) feet away from all major underground utilities, and fifteen (15) feet from all above ground utilities, structures, and buildings.
- Crosswalks should be provided in support of pedestrian traffic and paved with visually apparent, recycled or sustainable materials.
- In the case that a new transit stop is necessitated at a project site by future development and programming, locate new transit stops out of zones known to be areas of stormwater ponding and nuisance flooding.
- Enhance campus streets near natural areas with native seasonal flowering trees, such as

PARKING

With the integration of stormwater management practices parking lots can have an improved aesthetic and provide multiple functions.

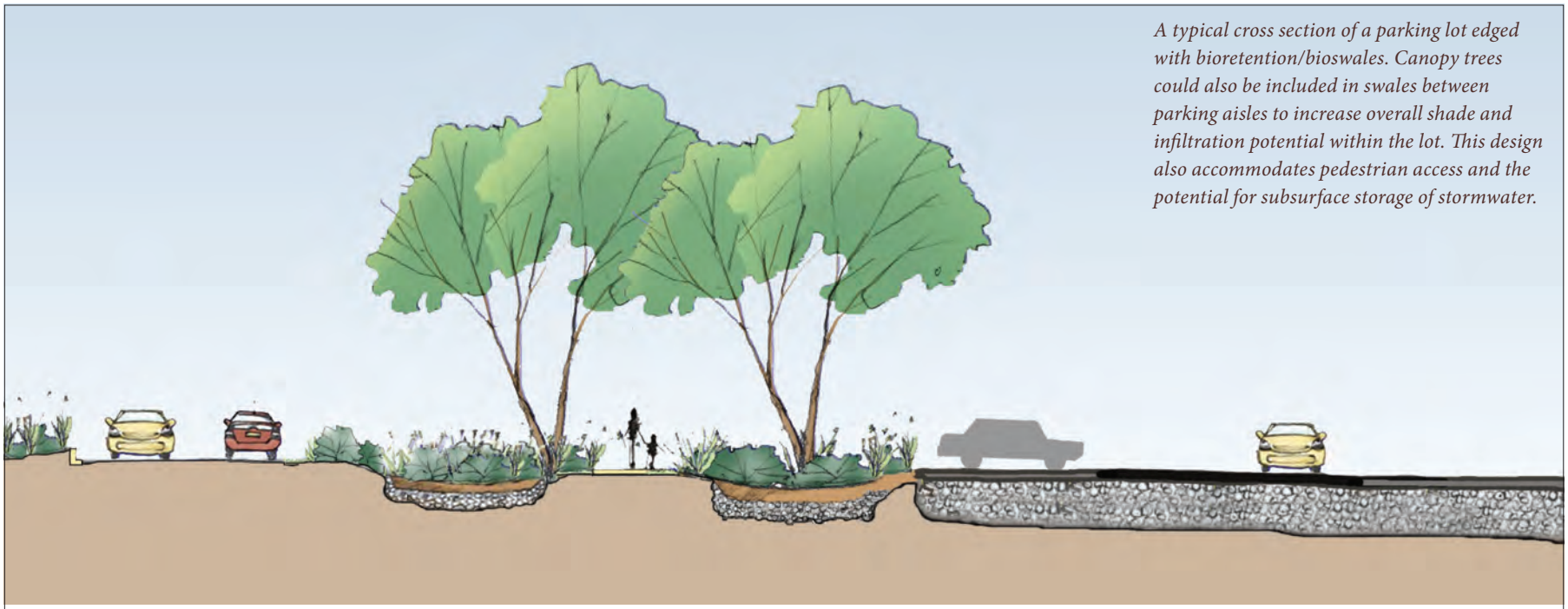
Rowan University has traditionally attracted a large number of commuter students thus leading to a need for large areas of parking. The 2009 Facilities Master Plan noted there were over 4000 parking spaces on campus, with only 500 in a parking structure. While there is a goal to evolve from a commuter campus to a more traditional residential campus there will still be the need to accommodate parking and understand the effects of the traditional parking design on water quality and experience on the campus.

Large paved surfaces, like parking lots, tend to cause serious issues with water quality, associated with runoff after storms. Runoff that may take several hours to flow from a grassy meadow or a forest before it reaches a stream, may only take a few minutes when it is flowing from a parking lot. This leads to serious water quality issues and potential problems with flooding. Water quality issues associated with runoff from parking lots include: increased water temperatures, unfiltered or captured flow of water that contains harmful contaminants like oils, metals, and other particles coming off of the vehicles and in car exhaust. Another environmental issue associated with parking lots is increased heat of the air associated urban heat island effects of large black paved surfaces in an area that may otherwise be a field of a forest.

Integrated green infrastructure practice like bioretention or bioswales that collect, filter, and store the water nearer to where it falls can help mitigate these issues in parking lots. Having vegetated practices throughout a parking lot provides more locations for water treatment. Increased tree canopy in parking lots also provide shade and visual relief in an otherwise monotonous environment , adding vertical structure, color and texture to the landscape, and providing a sense of enclosure.

PARKING–DESIGN GUIDELINES

- For new or renovated parking lots, design to incorporate stormwater management, and other landscape elements into the parking, while configuring lots for better circulation and established needs, providing pedestrian and bicycle accommodation.
- Remove unnecessary impermeable pavement, and use porous materials where feasible.
- Maximize tree canopy in parking lots to help mitigate the effects of urban heat island and treat stormwater, while creating a more positive visual experience.



A typical cross section of a parking lot edged with bioretention/bioswales. Canopy trees could also be included in swales between parking aisles to increase overall shade and infiltration potential within the lot. This design also accommodates pedestrian access and the potential for subsurface storage of stormwater.

STORMWATER MANAGEMENT: INTEGRATE WATER MANAGEMENT IN FUNCTIONAL AND VISUALLY APPEALING WAYS ACROSS CAMPUS.

Stormwater can be managed in a myriad of ways, from ponds to water features in campus plazas.

Given the university's desire to create a sustainable campus environment it will be important to consider the functionality of landscapes, where stormwater management practices are integrated seamlessly within campus designs. Stormwater management must not only follow best practices but incorporate native plants to connect with the existing natural resource areas on campus, including Chestnut Branch, Abbotts Pond, and the existing wetlands.

Stormwater management can be seen as a green infrastructure on campus, creating working landscapes that perform important ecological functions, creating spaces that bridge the contrast between the traditional formal landscape design of college campuses, and the aesthetic and vegetative diversity of native ecological systems, and interpret and build upon the inherent patterns of the campus landscape.

On-campus stormwater management features may include the following: bioretention, bioswales, rain gardens, green roofs, subsurface storage areas, regenerative stormwater conveyance, conversion of turf to native meadows, underground filters, stormwater ponds and wetlands, permeable pavement, and stream restoration. These integrated stormwater best management practices (BMPs) will be featured as landscape amenities and opportunities for education and research.

Stormwater wetlands or ponds

Bioretention

Integrating buildings and vegetation
New building architectural design will consider integration of stormwater capture and infiltration features in developing site location and design strategies. Designers will consider inclusion of green roofs, living walls or green canopies, stormwater planters, and cisterns. Green roofs should be considered for those buildings that may have views from other structures, to provide visual interest and educational opportunities. Living walls and green canopies can also be integrated into parking deck design to better provide habitat and vegetative connections, as well as along building walls that have little visual interest.

Hardscape considerations
New and replacement hardscape projects for parking lots, plazas, walkways, and streets should consider upland treatment practices including parking lot bioretention, as well as permeable paving for new walkways, hardscape areas, plazas, and streets.

Environmental stewardship
To reinforce the importance of the College's connection to the environment, projects will incorporate paths through the Oak grove and vegetative areas in a manner that allows them to be an amenity and learning tool. As the ribbon of pedestrian pathway is developed, new opportunities for stewardship should be incorporated in projects.

Green roofs

Bioswales

Bioretention along parking lots

STORMWATER MANAGEMENT–DESIGN GUIDELINES

- Meet, and exceed where practical, all stormwater regulatory requirements.
- Provide full water quality treatment (as defined by the applicable design criteria) as close to the generating source as possible, and at a minimum within the project's limit of disturbance.
- Prevent increases in nonpoint pollution, including fertilizer runoff from maintained landscapes.
- Reduce effective impervious surface by minimizing total impervious cover, disconnecting directly connected impervious areas (rooftops etc), and using alternative materials.
- Create and implement upland treatment BMPs within the campus core (Campus Green, College Plaza, Outdoor Learning, Parking Lots) that promote stormwater management and help create visibility- where pedagogy meets place. Implement no-mow areas where habitat character and landscape succession etc. may be studied. These practices augment the restoration and treatment practices being employed in the stream channel or floodplain, in order to provide the appropriate level of quantity, rate and quality control.
- Daylight water where feasible, integrating visual and physical manifestations of the campus hydrology and connections to Chestnut Branch and the larger watershed (connecting water and to the campus experience) within the campus landscape. Incorporate educational signage where and when space allows.
- Refrain from building in areas subject to localized flooding under a 10-yr storm event scenario.
- Pursue rainwater harvesting strategies for beneficial use purposes such as greywater plumbing or irrigation as a first consideration for all rooftop runoff.
- Require maintenance activity and schedule for all BMPs and adhere to it. Keep records/database of activities to support adaptive management.

Permeable pavement

Soil conditioning

Subsurface storage

- Create a detailed inventory of significant vegetation on campus based on size, age, quality, diversity, uniqueness and location.
- Establish project review procedures, land use review procedures and resource maintenance programs to ensure the trees' long-term preservation.
- Employ arborists on a regular basis to monitor the health of the trees (especially in the Oak Grove, the woodland near the new student housing, and the woodland patch behind Rowan Hall) in order to prioritize any major decision regarding tree health and safety issues.
- Establish an adaptive management plan for the forest and riparian zones.
- Adhere to an approved campus plant list. Maximize use of native plants adapted to site conditions, and micro-climates throughout campus. The design intent is to support biodiversity, reduce pesticide use, increase wildlife habitat [depending on space and programming use] and maximize water conservation. There may be opportunities at campus gateways or other key locations for non-native ornamentals, which are included on the approved plant list. When utilizing non-natives ensure they complement the native palette, are not invasive, and are nursery grown, legally harvested, or salvaged for reuse from on- or off site.
- Utilize plants, which attract butterflies, birds and other beneficial wildlife. The design intent is to support biodiversity, reduce pesticide use, increase wildlife habitat [depending on space and programming use] and maximize water conservation. The use of species that are currently listed on any of the following lists as invasive is expressly prohibited: State Noxious Weeds laws, Federal Noxious Weeds laws, or regional invasive lists. (Sources: New Jersey Invasive Species Council, New Jersey Dept. of Environmental Protection, <http://www.state.nj.us/cgi-bin/governor/njnewsline/view_article_archives.pl?id=1786> , New Jersey Dept. of Agriculture, Division of Plant Industry, <http://www.nj.gov/agriculture/divisions/pi/>)
- Create naturalized meadow areas where mowed turf will be reduced.

GENERAL LANDSCAPE GUIDANCE–DESIGN GUIDELINES (CONTINUED)

- All soil disturbances will be mitigated with appropriate amendments, restoring soils' ability to support healthy plants based on soil testing and unique planting needs in different spaces, as well as the soils' ability to support biological communities, and provide water storage and infiltration as described in the Sustainable Sites Initiative (SITES) for Prerequisite 7.2 and Credit 4.4. (SITES guidelines and benchmarks are still in draft form.) See SITES website for more information: <http://www.sustainablesites.org/report/>.
- Soils associated with planting areas of stormwater systems shall meet approved specifications for the identified practice per NJDEP requirements or, if absent, the criteria referenced above.
- Create a landscape and maintenance management plan with each new development project that addresses landscape areas and stormwater facilities. As part of the plan identify and delineate low maintenance design and planting areas.
- Mow any specified native grassland or meadow areas once a year, twice a year maximum.
- Fertilize as needed rather than routinely. When needed, use a slow-release organic fertilizer in lieu of petroleum based fertilizers, a fertilizer with a high percentage of slow-release nitrogen. Suitable products that are commercially available are marketed and certified as 'organic' or 'natural' fertilizers. Organic materials include, but are not limited to, items such as sea grasses/kelp, rock powder, bone meal, whey, bean meal, blood meal, composted manure, etc. Product nutrient content should be identified in the standard form of Nitrogen (N), Phosphorous (P) and Potassium (K) ratios.
- Mulch helps plants retain moisture in the root zone while reducing soil and water run-off. It also inhibits weeds and minimizes compaction as a result of foot traffic. Mulch should be maintained at a depth of 2 to 3 inches to retain moisture and inhibit weeds and 3 to 4 inches to minimize compaction from foot traffic. The mulch should be made from recycled hardwood or another recommended sustainable materials.

- Plan for and implement maintenance activities designed to reduce the exposure of pollutants to stormwater: minimize exposure to rainfall of stored materials that could contribute pollutants; develop and implementing a spill response plan; avoiding non-stormwater discharges (e.g., wash water); minimize the use of salt for deicing; avoid routine maintenance of construction equipment on site to reduce pollutant loadings of oils, grease, hydraulic fluids, etc.; avoid fueling of vehicles on site to the maximum extent practicable.
- For BMPs, make sure new plantings are care for during establishment period with necessary watering and weeding. Aerate lawns and topdress with compost. Confirm water soaks in per design specifications. Confirm overflow piping is not clogged. Remove litter and weeds from bioretention features. Mulch planting beds. Develop a management plan that leaves organic matter in place (leaf litter in particular) or adds organic matter on an annual basis to ensure enduring organic matter.

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Appendix II–Campus Standards

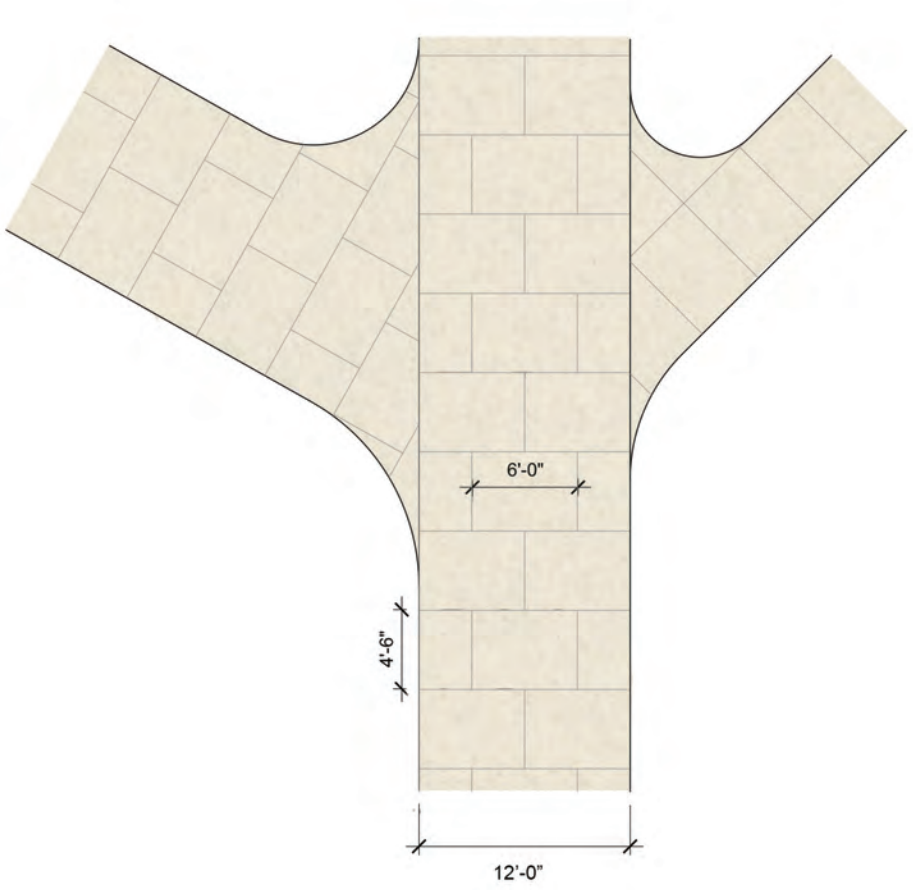
INTRODUCTION

Current campus furnishings at Rowan University come in a variety of styles resulting in an inconsistency to the character of the campus.

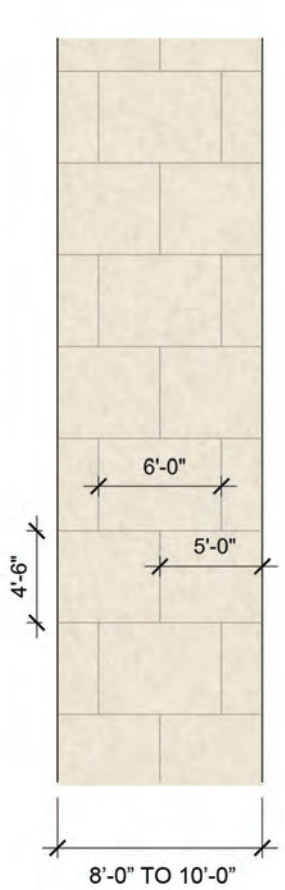
Campus Standards have been established to create a consistency of site furnishings and walkway details across campus. Currently, the Rowan campus has many different styles of site furnishing and walkways. Within the campus environment, these different details do not compliment each other and result in an inconsistency to the feel and character of the campus landscape. The addition of standards to the Rowan campus will help link campus spaces with the consistent use of quality furnishing and details.

PAVING STANDARD

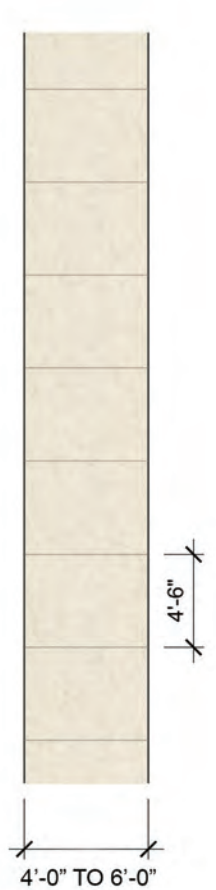
Scored concrete in ashlar pattern



PRIMARY

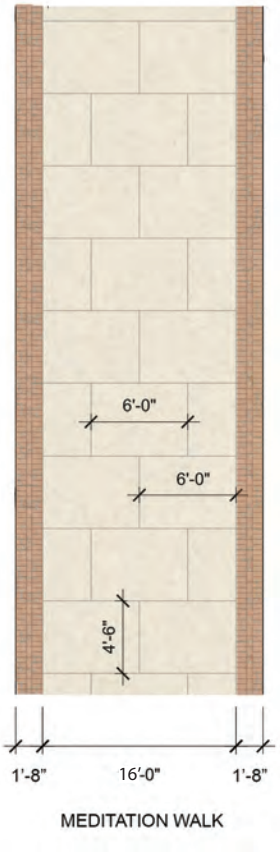


SECONDARY

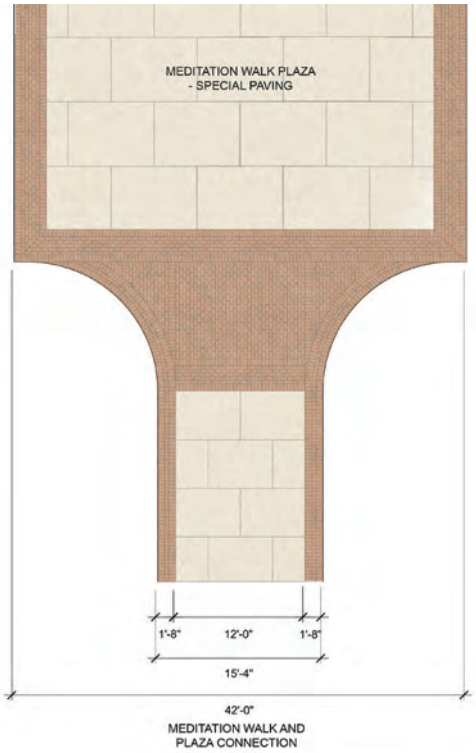


TERTIARY

All campus walks should be designed to accommodate emergency access, plowing, and ADA accessibility requirements.



MEDITATION WALK



MEDITATION WALK AND
PLAZA CONNECTION

New campus standards propose consistent concrete walkways with an ashlar scoring pattern. The walkways have been sized to accommodate a variety of widths necessary to meet the needs of the Rowan campus.

Primary walkways have been designed and located to provide fire access to adjacent buildings. Secondary and tertiary walkways have similarly been sized and detailed to accommodate their specific foot traffic.

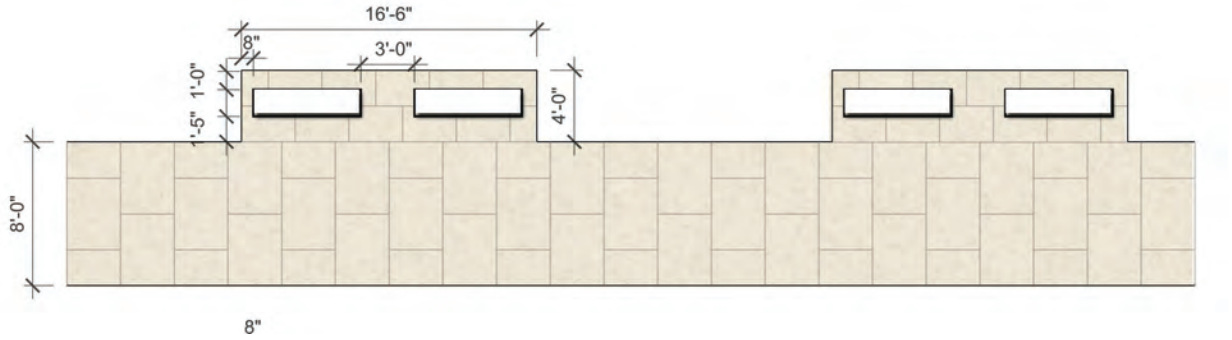
Meditation Walk is the central academic walk on campus. The unique character of this walkway on campus is reinforced with a special paving pattern unique to this path. Mediation Walk will have a field of concrete in a scored ashlar pattern edged with brick banding. The walkway will maintain a consistent 16 foot width.

Special plazas across campus have flexibility in their design, while maintaining the consistent use of scored concrete and brick. Plazas may have a field of brick or concrete, whichever is most appropriate for each setting. The consistent use of these two materials will help establish a coherent character to spaces campus wide.

Working the local fire marshall, Meditation Walk should be designed to accommodate the appropriate fire and rescue vehicles that will access this pathway.

PAVING STANDARD

Double benches along walkways



Facing benches along walkways provide conversation nooks along pathways

Benches and Seating Notes

The standards shown here are for double bench configurations that promote small gatherings and intimate spaces within the context of campus greens. As noted in the detail below, these benches are designed to sit within the naturalized landscape configurations along campus greens.

Additional benches can be added to provide increased seating capacity. This approach should be developed on an as-needed basis and would be designed to the unique constraints of that site. Benches with backs: 6” to hold anchor bolts. Benches without backs: minimum 10” for feet.

SITE FURNISHINGS

Existing Standards

Bench
Victor Stanley Steelsite RB Series RB28, Color VS-Black, 6'
both back and backless

Trash Receptacle
Victor Stanley Ironsites Series SD-42, 36 gallon with side door opening, liner and with DS-42 lid, Colro VS-Black

Exterior Recycling Station
Envyrozone,
The Rowan Opticycler

Exterior Lighting (South of Rt. 322)
Holophane Utility GranVille with Lunar Optics, 175 Watt metal halide, multi-tap ballast model GVU 175 MH MTB (6, 7, or 8) NSB; Wadsworth 12' cast aluminum pole, black model W12C/17-CA/BK

Exterior Lighting (North of Rt. 322)
Lithonia Lighting KAD 250W & 400 W metal halide, multi-tap ballast, dark bronze finish, 4" square pole, 14' pole height for pedestrian areas, 20'-30' pole height for roadway

Pavers
4"x 8"x 2" E.P. Henry - 70% Azalea (top left), 15% Red (bottom left), 15% Brown (right), herringbone pattern

15%

TRASH AND RECYCLING RECEPTACLES

Victor Stanley Ironsites Series, "SD-42"

36 gallon with side door opening, liner and with "DS-42" lid, black powder coated (SAME AS EXISTING CAMPUS STANDARD)

Ash Urn - Victor Stanley Ironsites Series, "S-20"

Stainless steel ashtray (10" diameter, 2" depth), uncovered, black powder coated finish

BENCH

Victory Stanley, Steelsites RB Collection, "RB-28"

Black powder coated, 6' length (also comes in 4' and 8' lengths), no intermediate armrests

Victory Stanley, Steelsites RB Collection, "RB-12" Backless

Black powder coated, 6' length (also comes in 4' and 8' lengths), no intermediate armrests

LIGHT POST

Louis Poulsen "Albertslund Maxi Post", 250W, black powder coated

Mounted on: "Pole Round Straight (RSA)", 10' pole height for pedestrian areas, Aluminum, black powder coated

FLEXIBLE SEATING

Landscape Forms 35 Mingle

4-seat unit, or 5-seat unit (5-seat provides room for wheelchair access), Black Powder Coated, backed, aluminum cast seat frames with perforated aluminum panel, Catena table top

BOLLARD

Maglin "MTB650 Series Bollard"

33" height, 6 5/8" diameter, Color: Black Gloss. This bollard can be either fixed or removable. Standard installation recommended: fixed; MTB650-B1. The removable bollard is only used in specific locations on campus, to be determined by the university, where service vehicles, fire truck, etc. need access: MTB650-B4.

BIKE RACK

Creative Pipe, Inc., Lightning Bolt (LR Series), "LR-P-5-SM-P"

Perpendicular LR Rack, 5 Bike Capacity, surface mounted, black powder coated finish

SEAT WALL

Locally mined stone with bluestone coping

Seat walls will be added to sites as appropriate. Their detailed design and location will be site specific and may result in a single-sided seat wall that also acts as a retaining wall, or a double sided seat wall that is a free-standing wall. In both cases, the walls will maintain a flat cap at seat height.

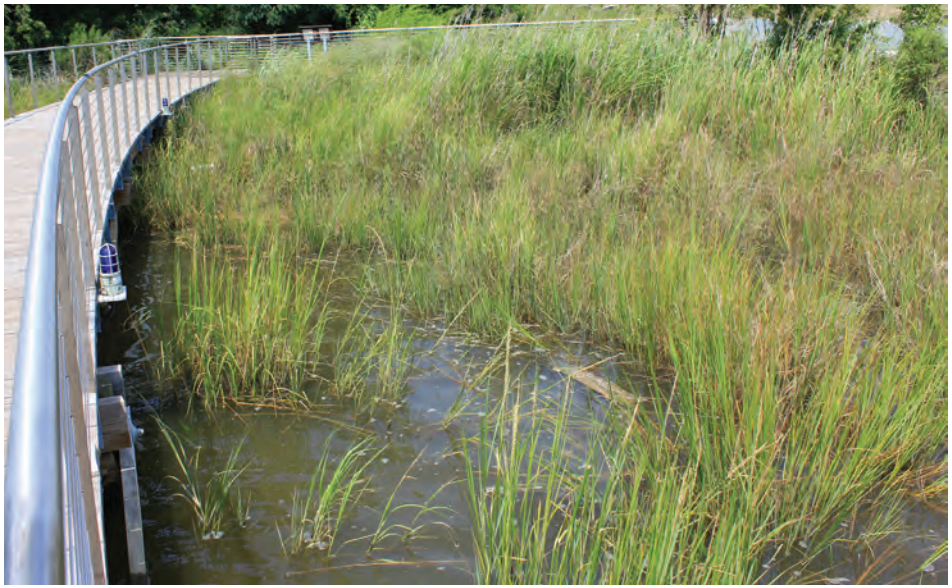
SKATEBOARD RACK

Board Loch "Spartan-7"

Floor mounted on a flat concrete surface, secures up to 7 skateboards, zinc plated finish

Appendix III–Existing Ecological Conditions

INTRODUCTION



Understanding the broader ecological conditions informs opportunities on campus.

Understanding both the broader landscape ecological patterns, along with more specific site characteristics, provides a more holistic understanding of the landscape legacy as well as the existing ecological function.

Landscape ecology focuses on the patterns and flows that appear in a landscape, associated with ecosystem services – both above the surface and below. It often focuses on habitat hubs, corridors, patches and the broader mosaic of patterns that provide the habitat needs for a given species or group of species. Looking at a broader context (migratory routes and regional connections) leads to a greater understanding of a campus's place within the larger ecological and hydrological systems.

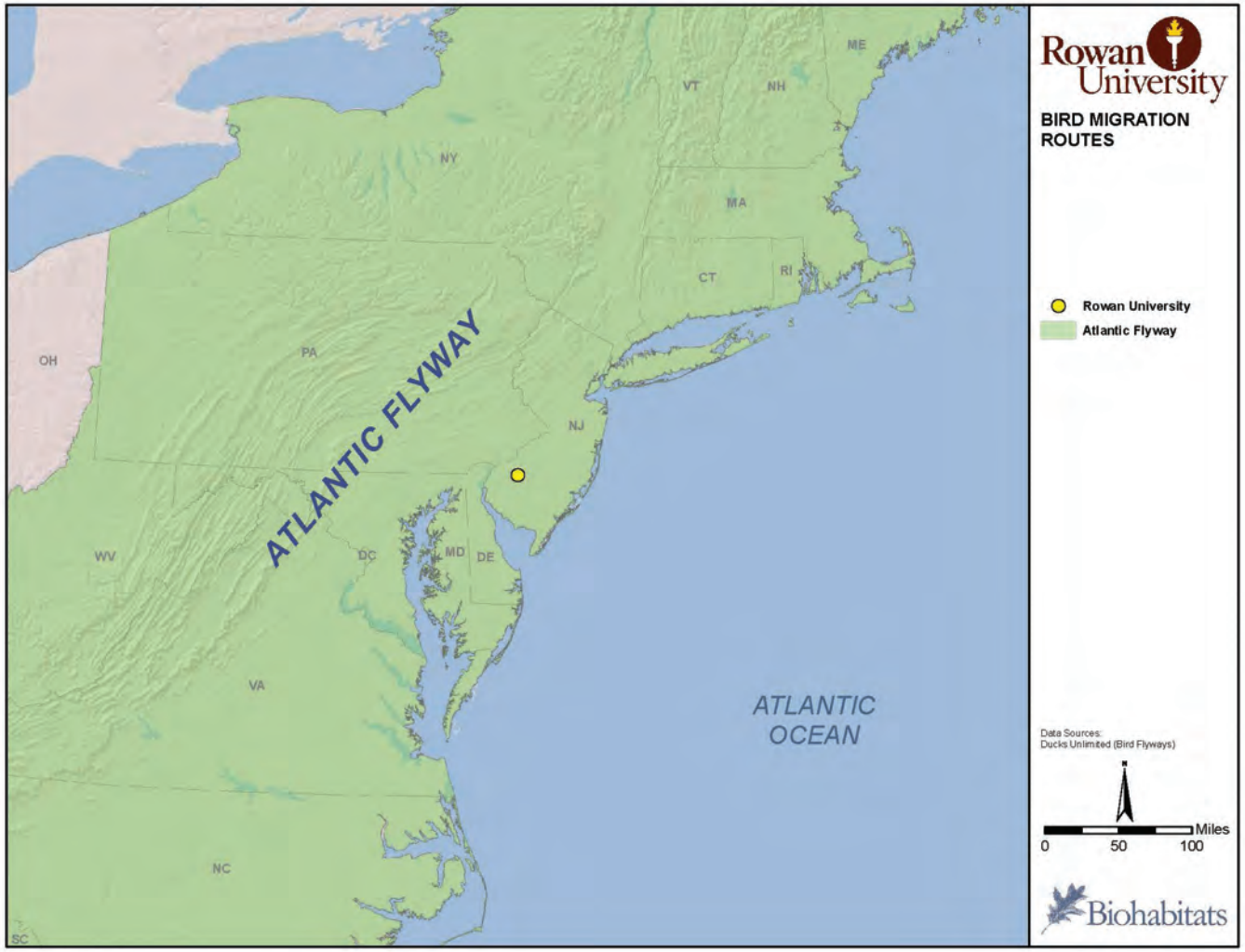
Vegetated corridors provide protection for biodiversity along streams as well as dispersal routes for recolonization of species that may be displaced through disturbance. Stream corridors also provide resource management services, including flood control, sediment control, clean water, and habitat for fish and other migratory populations. Tree canopy can provide windbreaks and microclimate controls, as well as recreation and respite areas.

This appendix shares the information from the regional scale to the scale, including geology, soils, landcover, watersheds, hydrology, and natural heritage sites.

REGIONAL FLYWAY AND BIRD HABITAT

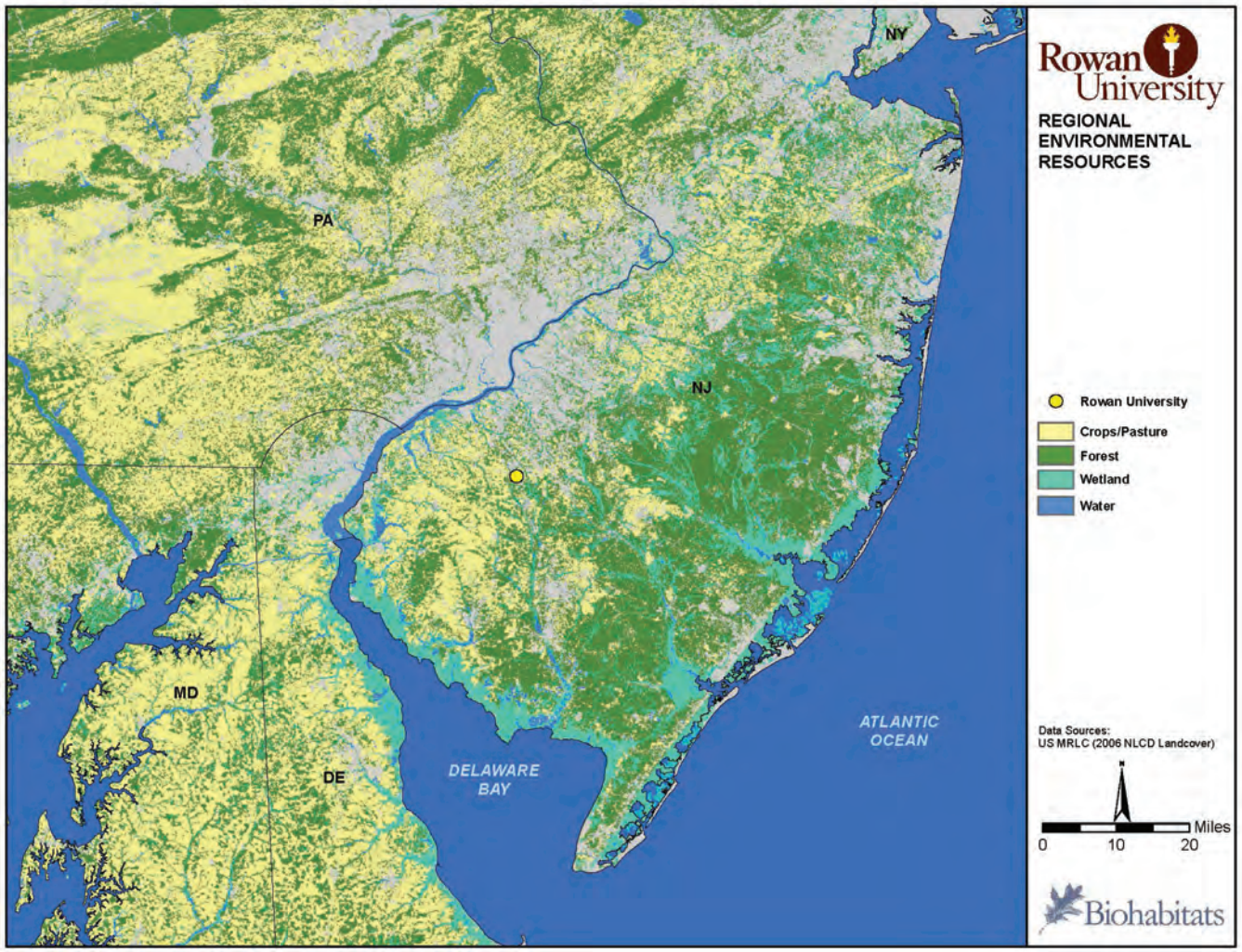
Rowan's campus sits within the Atlantic Flyway. Its location in Southern New Jersey means that it sits quite close to both the Delaware River and Delaware Bay/Estuary, as well as the Atlantic Coastal. Southern New Jersey is home to a diverse selection of wildlife habitat including large pine barren forests, Atlantic cedar swamps, as well as estuarine and tidal marshes. The John Heinz National Wildlife Refuge in Philadelphia, just west and south of Rowan is a major stopover point along the Atlantic Flyway[1], as is the Delaware Bay, to the south.

"The Delaware Bay has received international recognition as a Western Hemisphere Shorebird Reserve Network site, a Ramsar Site per the Convention on Wetlands of International Importance especially as Waterfowl Habitat, and an Audubon Important Bird Area of global significance… Songbirds, raptors, and upland game birds migrating in fall become concentrated along the Delaware Bay coast in New Jersey since the open water of the bay creates a barrier to migration." [2]



[1] *http://www.birds.cornell.edu/AllAboutBirds/studying/migration/pathways*
[2] *http://www.state.nj.us/dep/fgw/pdf/2009/minutes/ensac_docs/dwp_afc_letter.pdf*

REGIONAL ENVIRONMENTAL RESOURCES



Rowan is located at the center point of three significant waterbodies: the Delaware River, The Delaware Bay and the Atlantic coast. In terms of regional environmental context, Rowan is located along a boundary that separates predominantly agricultural land (to the west) and forested and wetlands to the east and south (the Pinelands or Pine Barrens). These forested and wetland systems to the east include some rather large state forest and preserve lands including Belleplain State Forest, Wharton State Forest, Byrne State Forest; and are home to pine/oak upland forest, pygmy pine plains, Atlantic white cedar swamp, hardwood swamps, savannas, and aquatic habitats.[3]

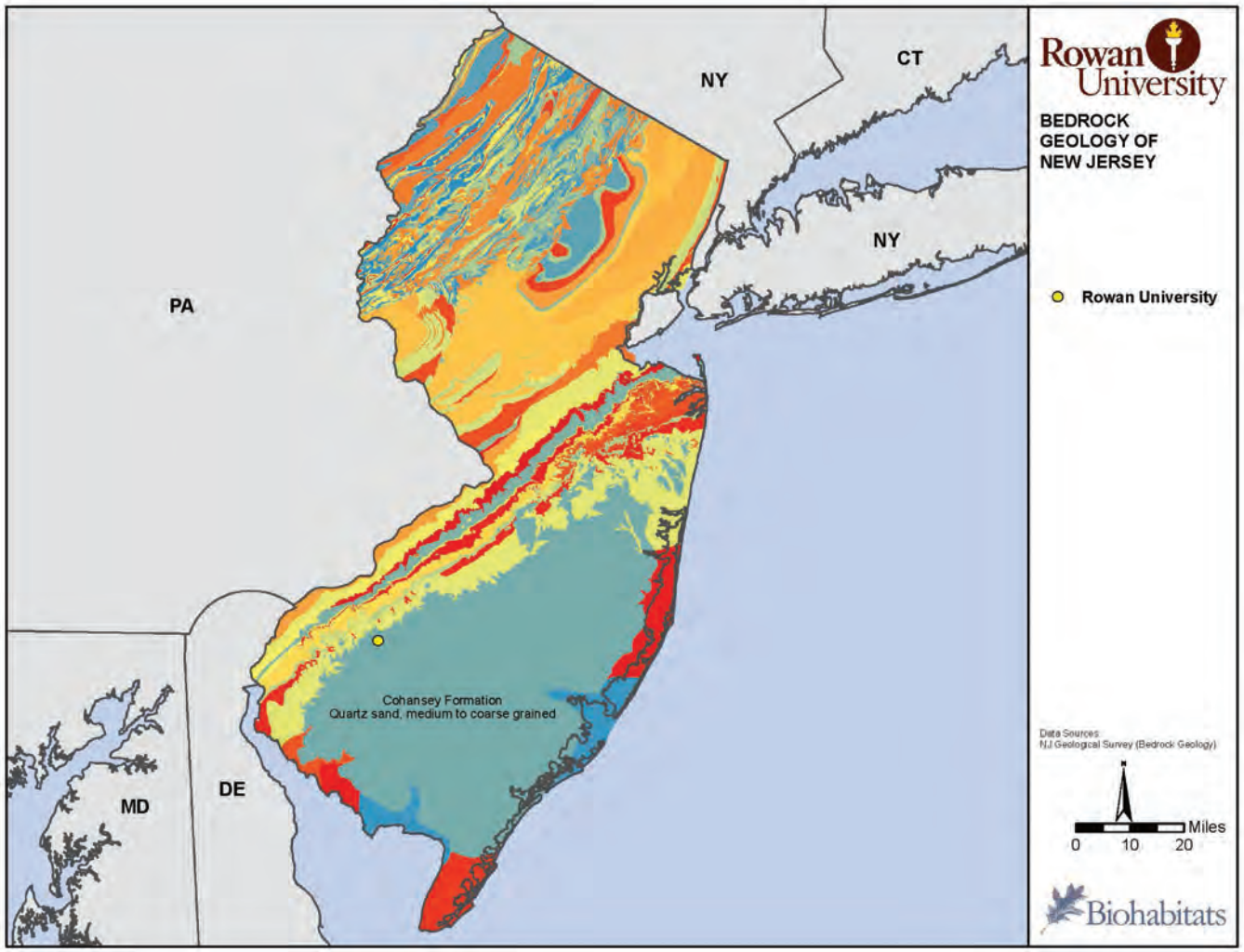
[3] *http://www.pinelandsalliance.org/ecology/*

BEDROCK GEOLOGY AND UNDERLYING HYDROLOGY

Rowan is located within the Cohansey Formation of bedrock geology, which is characterized by quartz sand, medium to coarse grained and the primary rock type is alluvium.[1] This geological formation helps provide the foundation for the soils that are found in the region. It also helps to define the physiographic provinces of the region.[2]

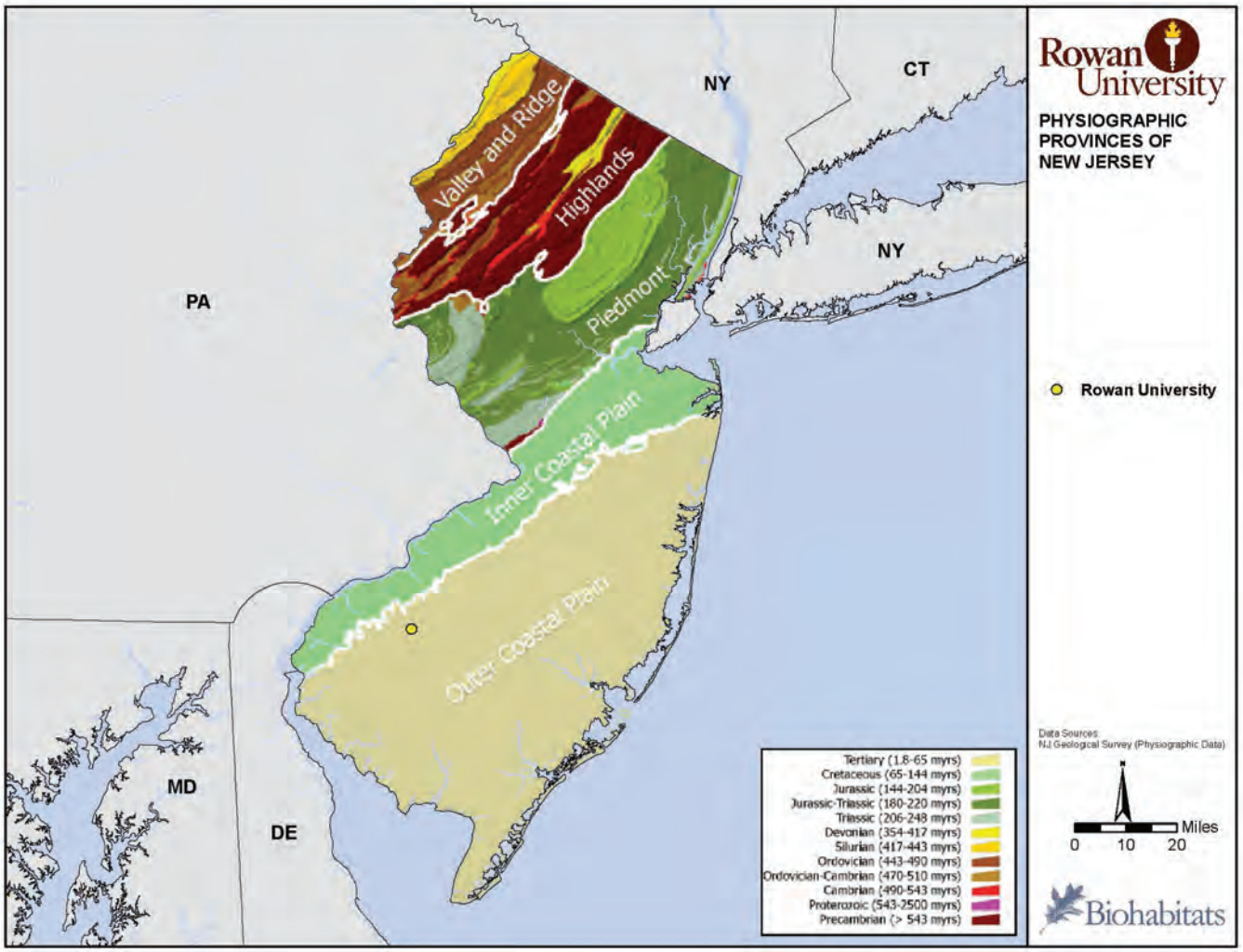
It is also the location of the Kirkwood Cohansey Aquifer system. This aquifer system is rare in that it is mainly a very shallow system that provides the foundation for the Pine Lands ecology.

"Ninety percent of the water in the streams, rivers and wetlands is supplied by this aquifer system in the form of baseflow. In addition, since water in this aquifer often occurs less than a few feet beneath ground surface, it directly supplies water to the roots of Pine Barrens trees, shrubs and plants… On average the Pinelands receives about 44 inches of precipitation annually. About half of this water is transpired by vegetation or evaporates. A small amount enters streams as storm runoff. Only about 17 to 20 inches annually actually enters the ground. Some of this water works its way through the soil and eventually reaches the water table. From here a portion flows into nearby streams and wetlands providing the necessary water to sustain these ecosystems."[3]



[1] *http://tin.er.usgs.gov/geology/state/sgmc-unit.php?unit=NJTch%3B0*
[2] *http://www.nj.gov/pinelands/science/current/kc/*
[3] *http://www.pinelandsalliance.org/ecology/water/groundwaterandaquifers/kirkwoodcohansey/*

PHYSIOGRAPHIC PROVINCES



Resources:
http://www.nj.gov/dep/njgs/enviroed/infocirc/provinces.pdf
http://www.cumauriceriver.org/botany/provinces.html - ecological communities of the inner coastal plain (Delaware River Basin)
http://nctc.fws.gov/resources/knowledge-resources/pubs5/web_link/text/geolsect.htm

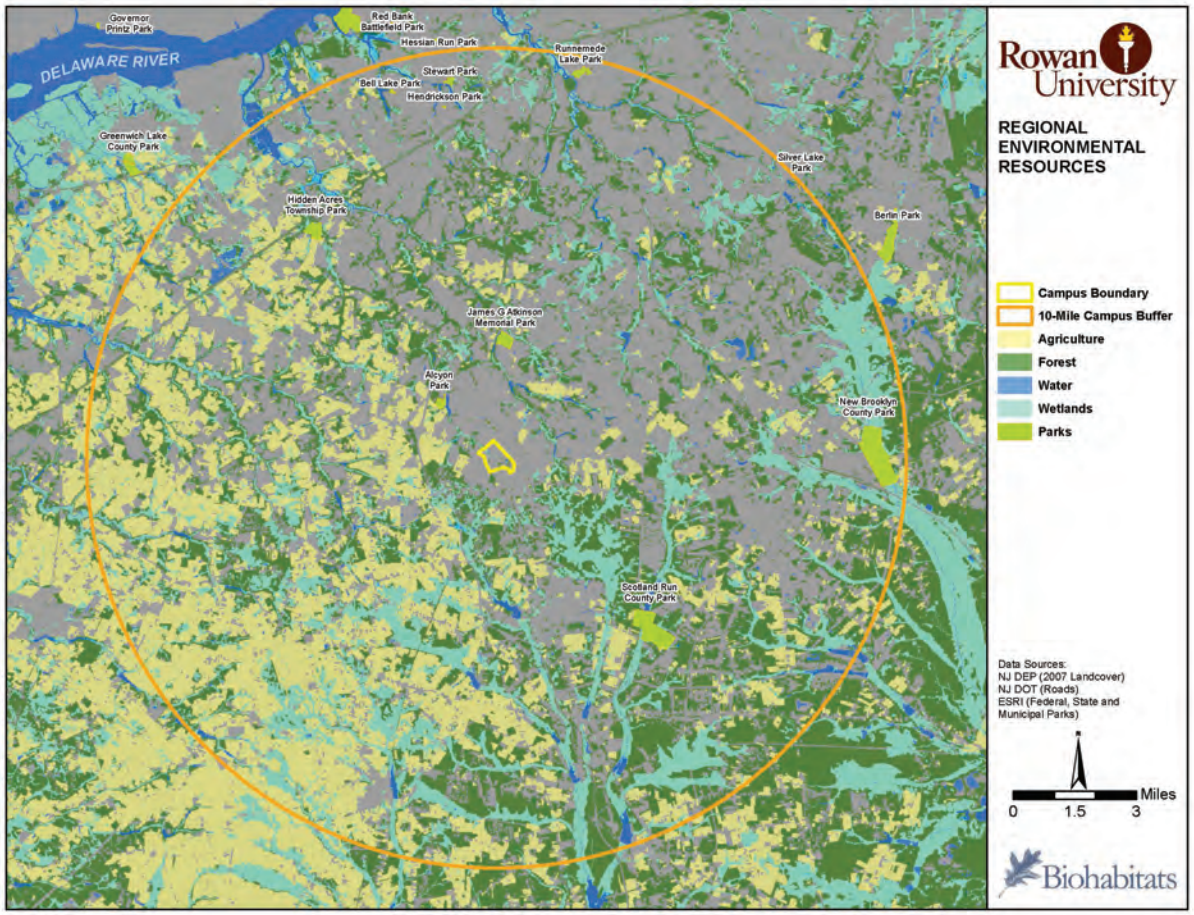
Rowan is located within the Outer Coastal Plain physiographic province of the State of NJ, aligning with the bedrock geology shown in the previous figure. It is however very close to the boundary of the Inner Coastal Plain. The water that flows through the campus is a tributary to the Delaware River, as will be shown on a later figure of regional hydrology, which is more indicative of the Inner Coastal Plain. Since it lies along this boundary, the ecological features of the Rowan campus landscape may be a reflection of both. The Outer Coastal Plain is characterized by relatively flat terrain, underlain with sands and gravels. Inner and Outer Coastal Plains share a handful of ecological communities including: southern mixed oak forest, upland pine forest, upland oak forest, red-maple sweet gum forest, Virginia pine successional forest, pitch pine lowland forest, and pine barrens savanna. The Inner Coastal Plan is known for its very rich agricultural soils, good for farming and orchards-giving the Garden State its name, while the Outer Coastal Plain is known more for its excessively well-drained sandy soils of the Pinelands, and the swamp soils known for cranberry and blueberry farming.

REGIONAL LANDCOVER AND ECOLOGICAL CHARACTERIZATION

As noted in the broader regional ecological mapping above Rowan is located in an urbanized area (Glassboro), which is nestled between active agricultural lands to the west and south, and forested and wetland areas to the east. There are a number of local parks within the vicinity, where more active open space is available. Rowan (and Glassboro) fall within the Southern Piedmont Plains conservation zone of the New Jersey Wildlife Action Plan (WAP), a statewide action plan that the NJ Division of Fish and Wildlife (DFW) staff, with input from the public, the state's conservation groups and other stakeholders, developed as a blueprint for the future conservation of NJ's species of greatest conservation need.

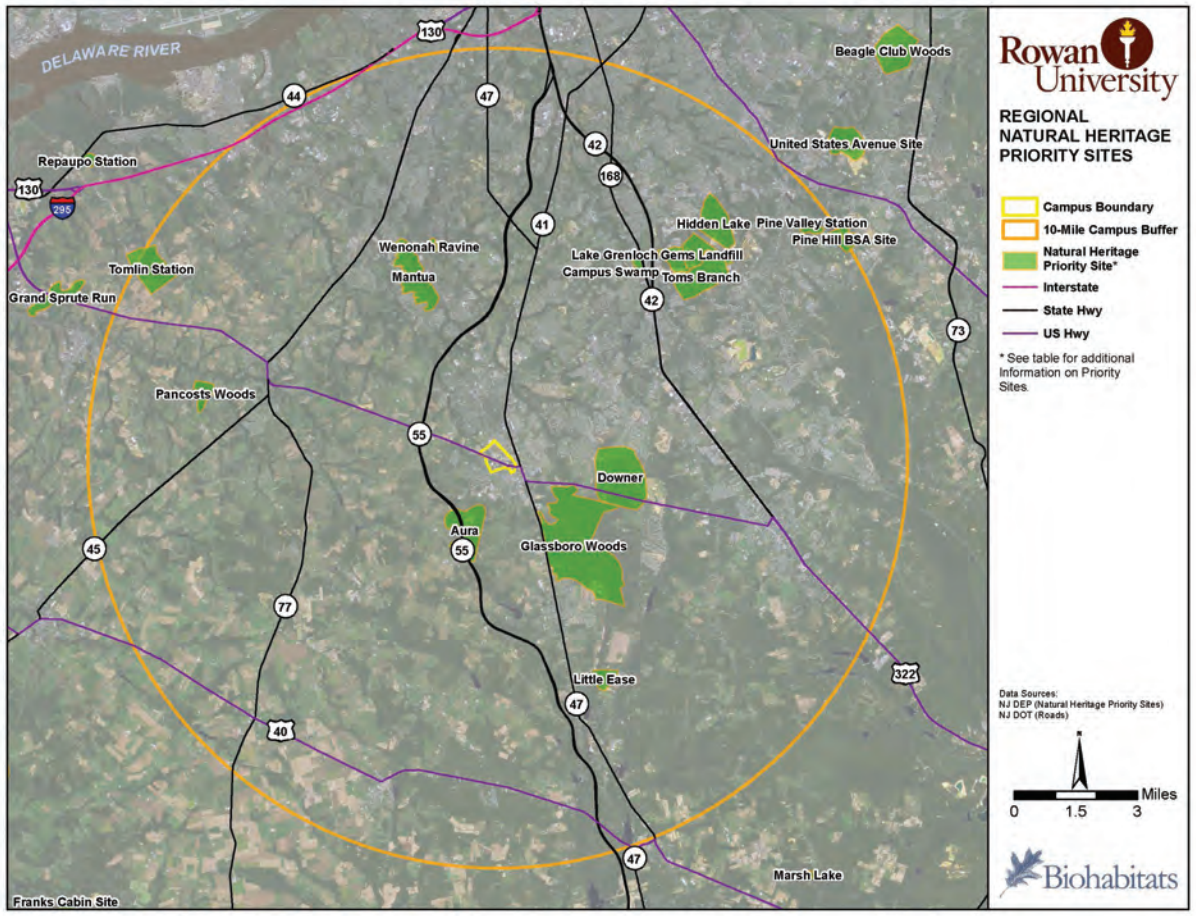
The WAP for the Southern Piedmont Plains states that "Clearing of vegetation along rivers and streams is a leading cause of habitat loss, fragmentation, and degradation of riparian and aquatic ecosystems. Loss of vegetated buffers along streams and rivers increases runoff of contaminants from roads and developed areas, impacting aquatic communities and the terrestrial wildlife that rely on them. Roads and development that bisect riparian systems are barriers to wildlife movements, isolating less mobile wildlife populations (particularly reptiles, amphibians and fish) and increasing the risk of local extinctions."[1]

Thus the opportunity to improve the ecological character and function of Chestnut Branch, as it flows through the center of the campus, is an important one that could have beneficial impacts to the regional ecology.



[1] *http://www.nj.gov/dep/fgw/ensp/wap/pdf/15.pdf & http://www.nj.gov/dep/fgw/ensp/wap/pdf/pamphlet_piedmont.pdf*

REGIONAL NATURAL HERITAGE PRIORITY SITES/ECOLOGICAL SIGNIFICANCE



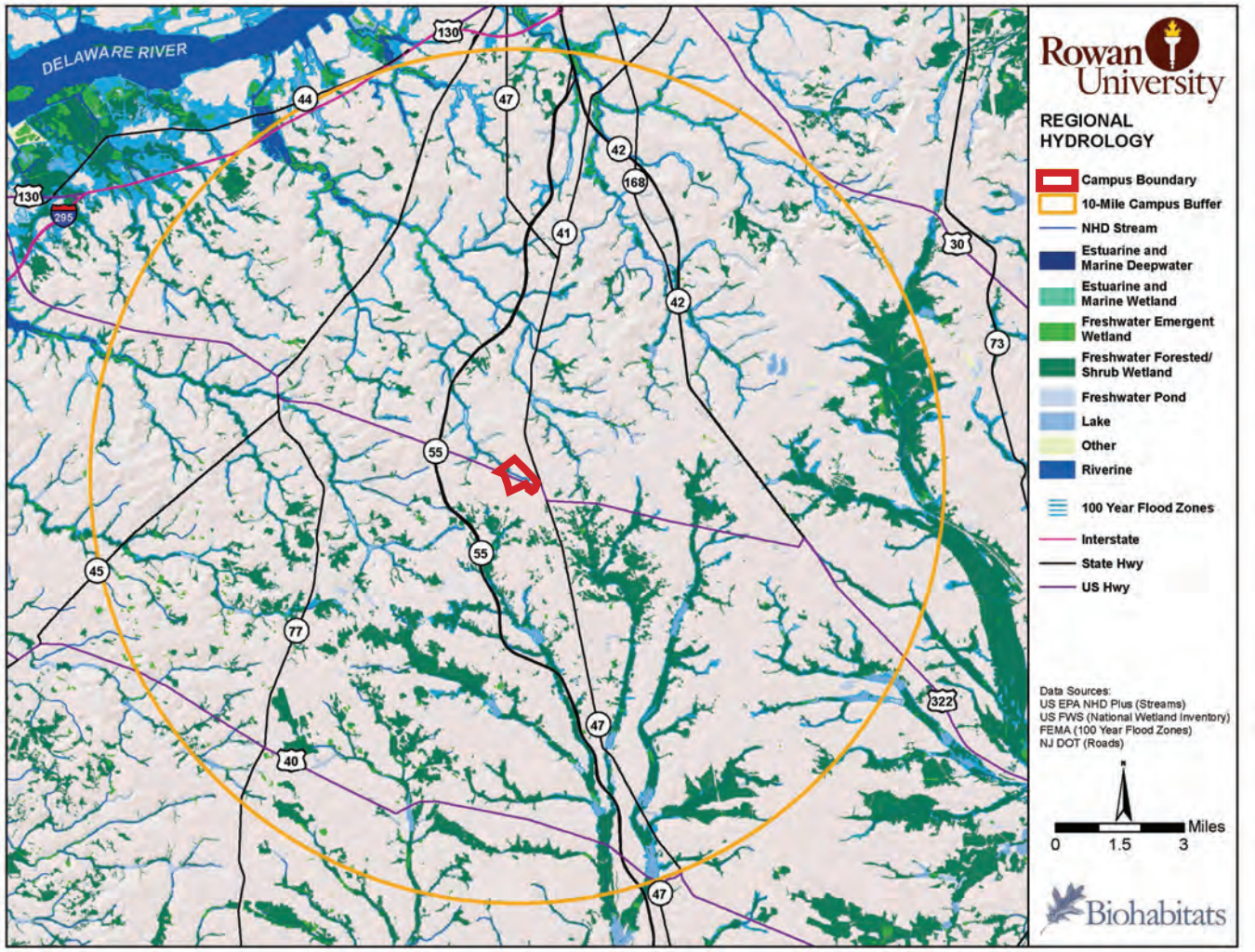
Within the vicinity of Rowan there are a number of natural heritage priority sites that have been identified by the New Jersey Department of Environmental Protection. These help provide some contextual understanding of the ecological legacy conditions in the immediate vicinity of the campus, the fragmentation of the ecosystems. This may also provide some insight for the habitat potential of restoring natural areas on the campus.

The three closest to Rowan are Glassboro Woods, Aura, and Downer. Aura is an undisturbed swampy woodland that is bordering a streamlet, and is home to one federally listed plant species and one special concern plant species. Downer is a red maple/Atlantic cedar swamp with sphagnous spring seeps, which is home to a good population of a globally rare state endangered plant species. Glassboro Woods is a red maple hardwood swamp along Little Ease Run and its tributaries, which includes wetland habitat and an upland buffer for a federally listed threatened plant species and a globally rare insect species. These three sites are actually part of watersheds that drain to the south, away from Rowan.

The Natural Heritage sites that drain to the Delaware within a 10 mile radius of campus include Mantua and Wenonah Ravine. In fact Mantua is located along a rich wooded ravine further downstream on Chestnut Branch of Mantua Creek, hosting one federally listed threatened plant species, two confirm extant state listed endangered plant species, and one additional plant species of concern. Wenonah Ravine is along a wooded ravine within the Inner Coastal Plain, which is the only known location within the state of New Jersey of a critically imperiled tree species.

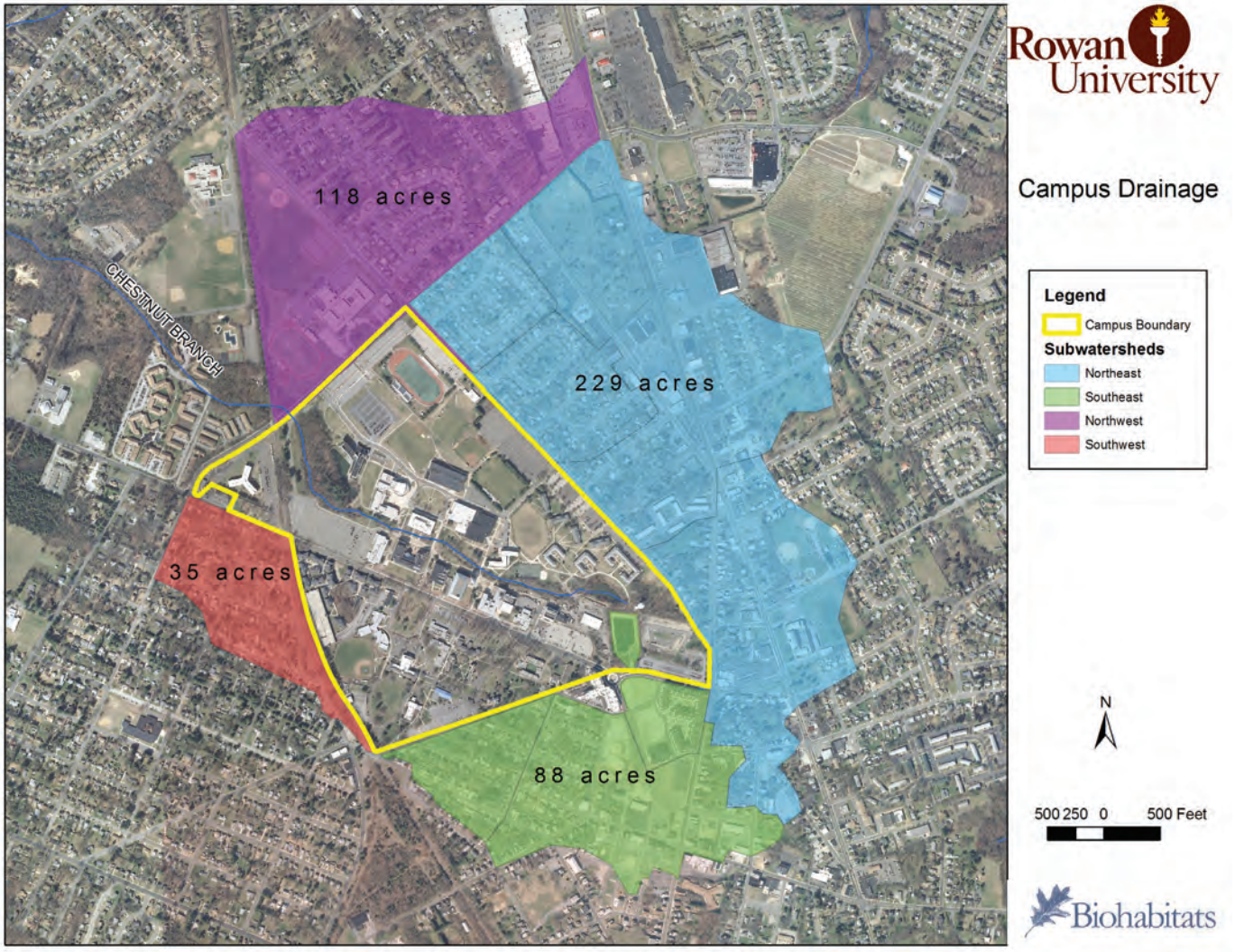
REGIONAL HYDROLOGY

Rowan sits at the headwaters of Chestnut Branch, a tributary to Mantua Creek. Mantua Creek, which eventually empties into the Delaware River at Lodge Point, across from the Philadelphia International Airport, drains over 50 square miles of Gloucester County and is characterized by gently rolling, wood terrain dotted by small lakes. It is predominantly a mix of suburbia and productive agricultural landscapes. Chestnut Branch is described as a "typical stream in an agricultural watershed undergoing suburban development." It bisects the campus and collects and conveys all the stormwater from the campus, and a significant portion of the surrounding community. It has been noted that "excess runoff has caused an increase in runoff, a decrease in water quality along the stream, and severe bank erosion in many locations along the stream corridor."



Resources:
http://www.sjlandwater.org/watershedorgs/mantua.html
http://www.researchgate.net/publication/237637960_Assessment_and_Restoration_of_Chestnut_Branch_of_Mantua_Creek_An_Educational_Partnership
http://ascelibrary.org/doi/abs/10.1061/40685%282003%29148

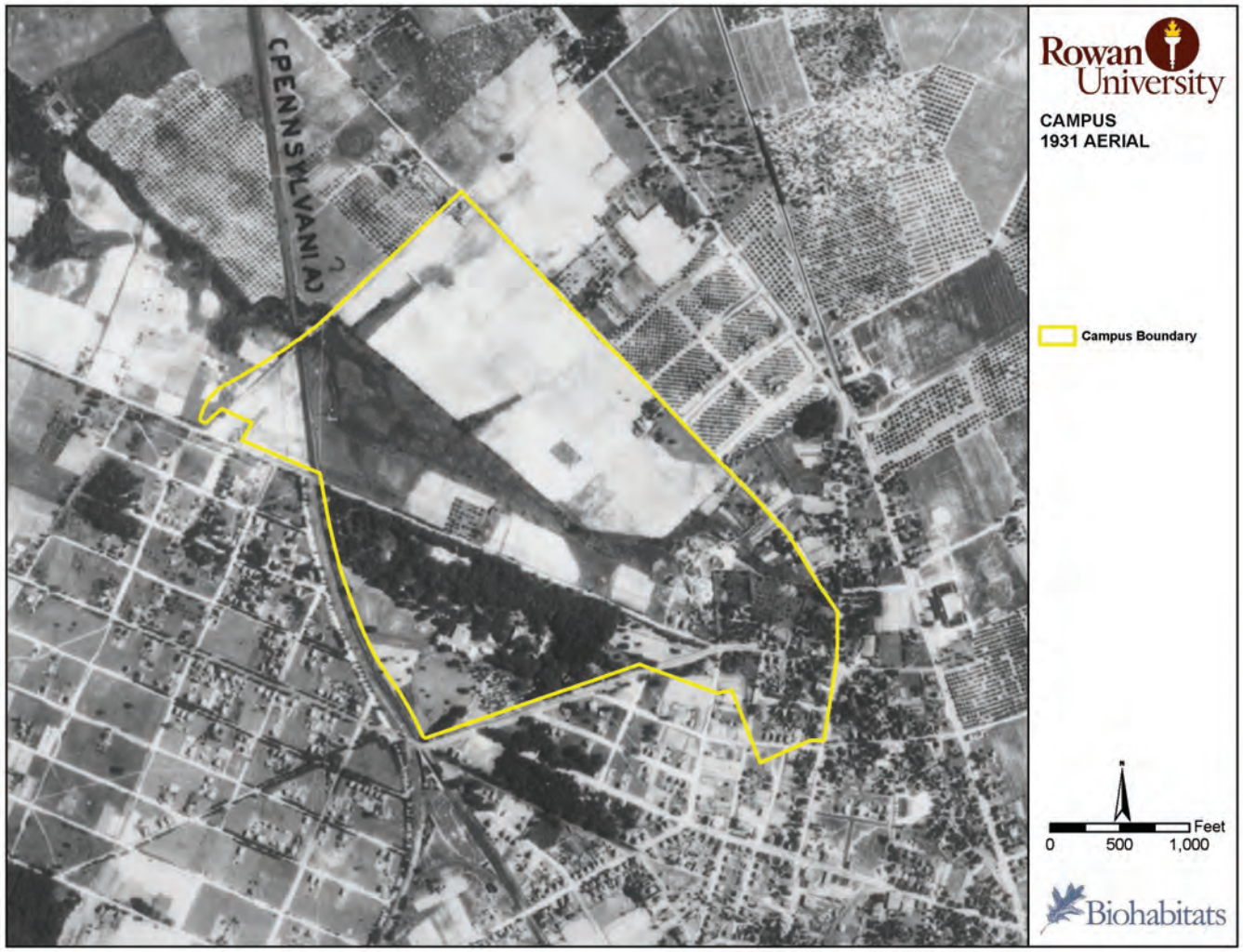
CAMPUS DRAINAGE AND WATERSHEDS



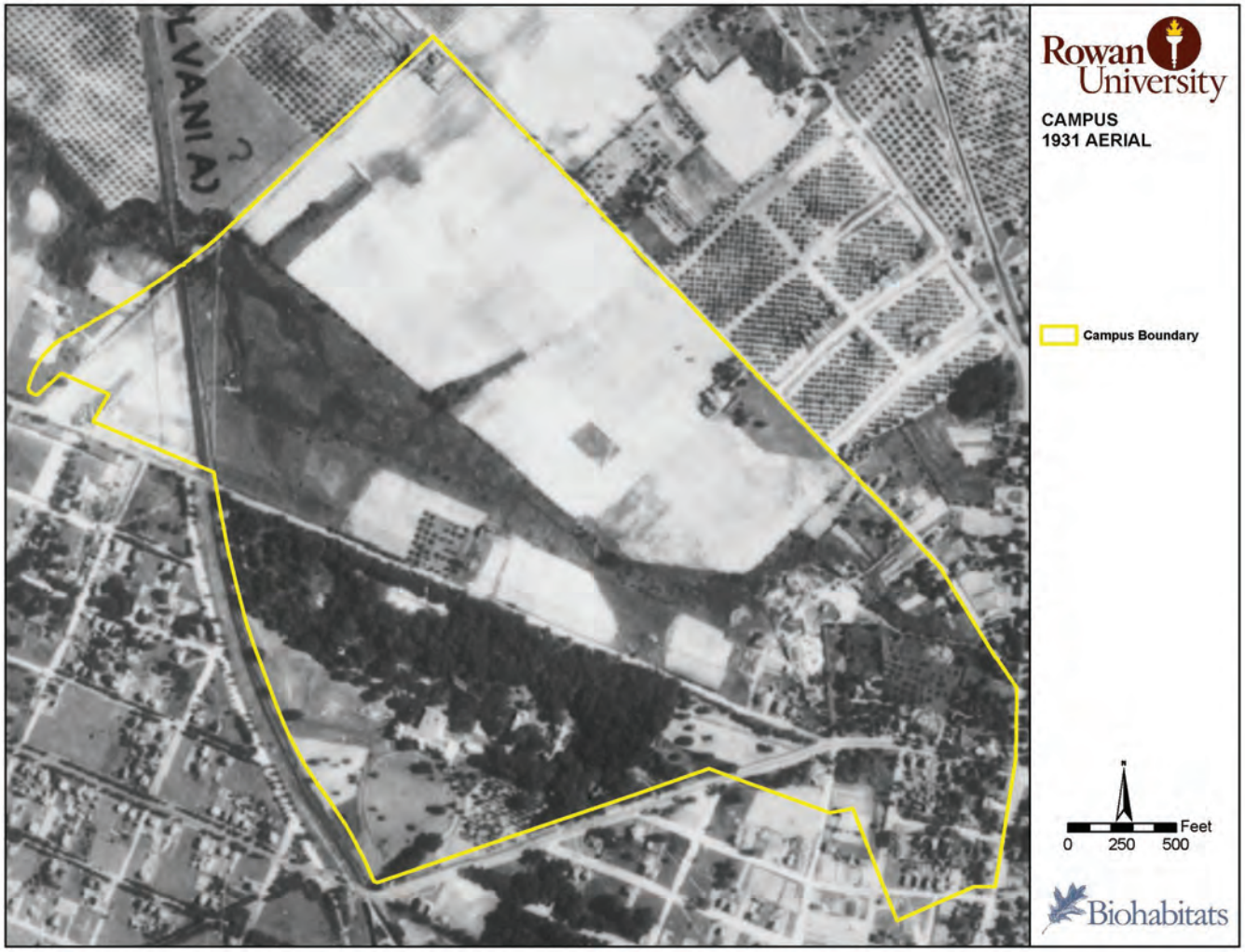
There are 3 drainage areas that convey stormwater from the surrounding neighborhoods. These drainage areas total over 397 acres of land outside of the campus, which serves as an incredible stress (in terms of untreated stormwater runoff) on this natural stream system within the bounds of the campus. Most of this water in coming into the stream via stormwater pipes but there is also some overland flow. As will be made clear on the topographic map of the campus Rowan basically sits as a bowl in the landscape, along the stream's floodplain.

HISTORICAL LANDSCAPE PATTERNS IN THE LANDSCAPE AROUND ROWAN

A number of historic aerials are available for the campus but the earliest aerial found is from 1931. This shows the dominant landscape patterns in the vicinity of the campus as well as on the campus proper. The land north of Route 322 is a combination of what looks to be the stream, an active wetland/floodplain system, and agricultural lands. Chestnut Branch and its associated floodplain is very apparent both on campus and as it flows north and west toward Mantua Creek. Just outside of the campus bounds there is evidence of orchards or other productive ag lands. The land to the south is a combination of residential and urban (Glassboro), as well as some agriculture and wooded areas. The active rail line are also noted (Pennsylvania).



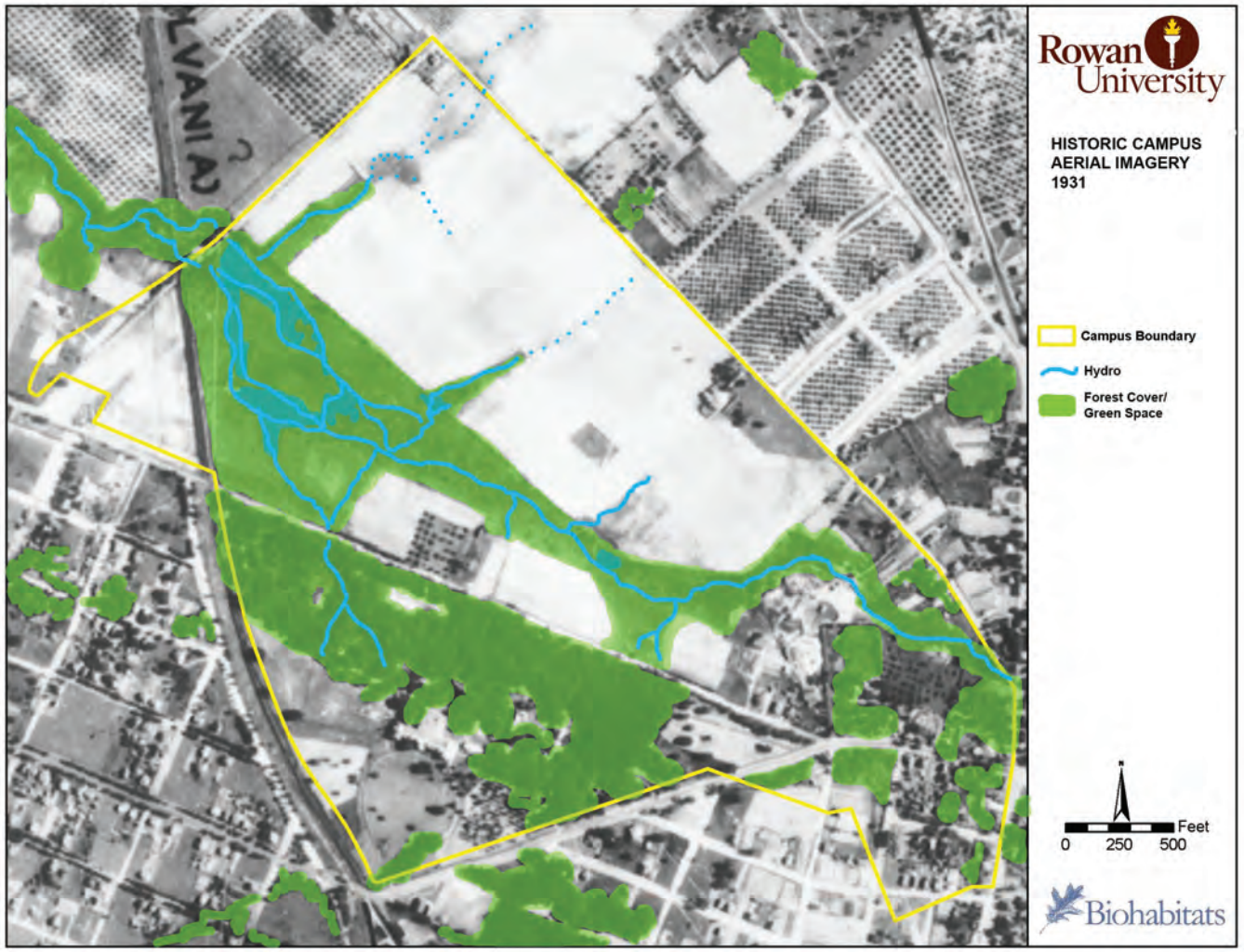
HISTORICAL LANDSCAPE PATTERNS ON THE ROWAN CAMPUS



Zooming into the campus, more detail appears with regard to the prevalent land cover and land use patterns on the campus proper. The yellow boundary depicts today's campus extents. At the time, Rowan's (Glassboro Normal School) campus was mainly to the south of Rt. 322 and was comprised of a large forested tract along 322 with the buildings to the south (Bunce Hall and the green, as well as Hollybush are visible in the aerial). To the north of 322, Chestnut Branch and its floodplain appears to have been avoided as some lands were cleared for agricultural production.

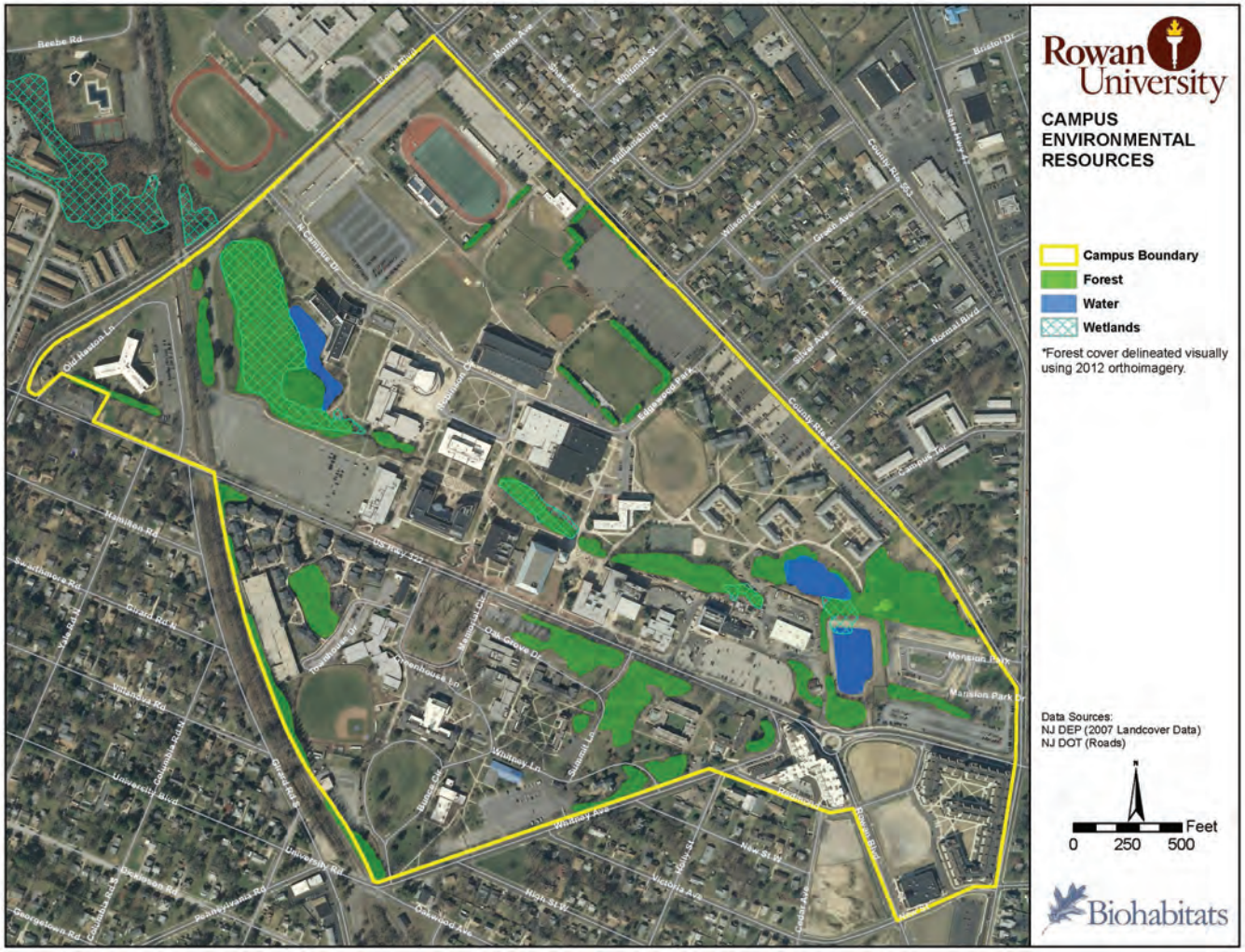
FOREST AND HYDROLOGY PATTERNS INTERPRETED

Interpreting the shades and textures of the 1931 historic aerial one begins to see the vegetation and forest cover that characterized the Chestnut Branch floodplain and the Rowan campus. Even more intriguing are the patterns that can be pulled out of the wetlands and small tributaries that feed Chestnut Branch throughout the campus.



(Hydrology and Forest Cover/Green Space visually interpreted from photo)

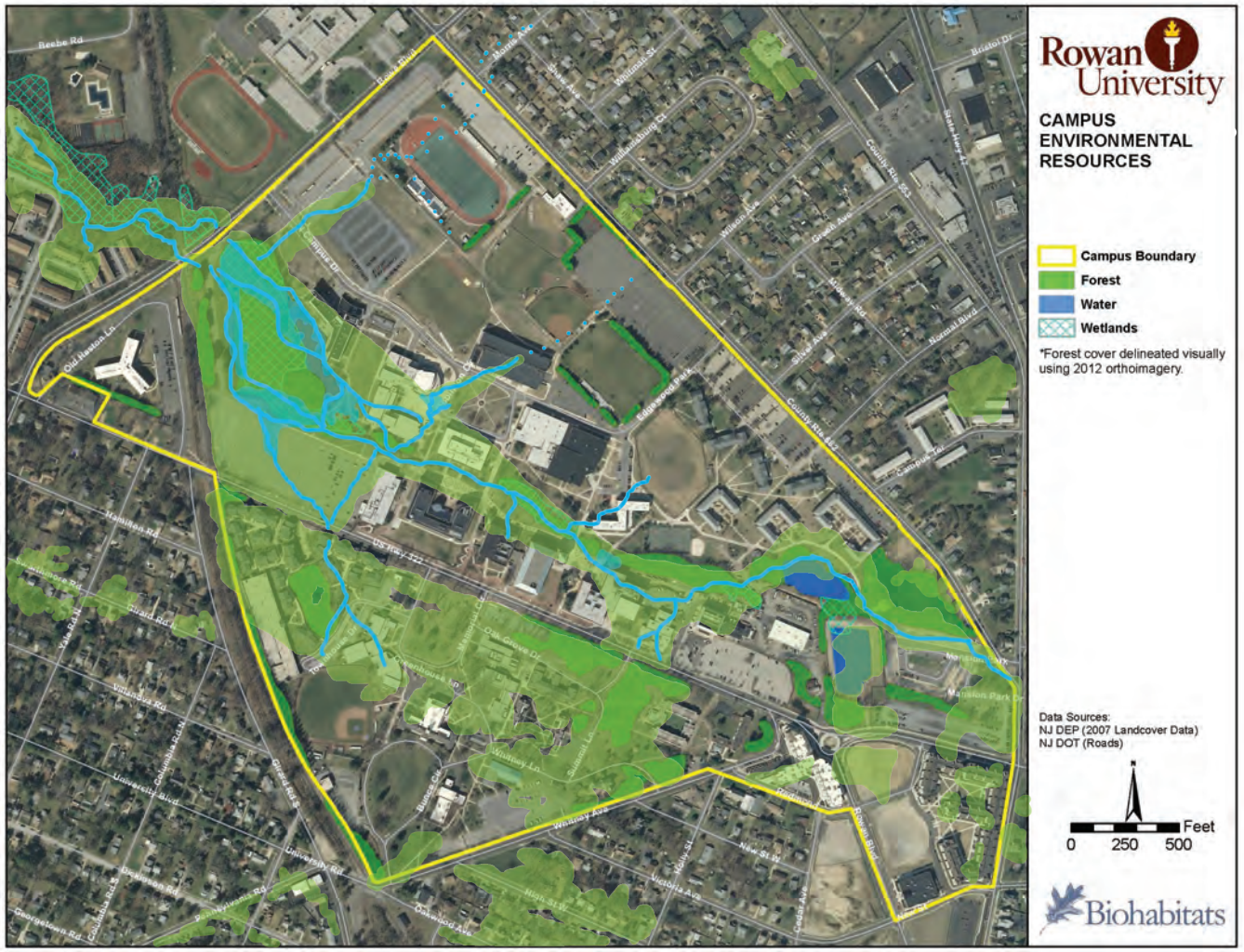
CURRENT CAMPUS ENVIRONMENTAL RESOURCES



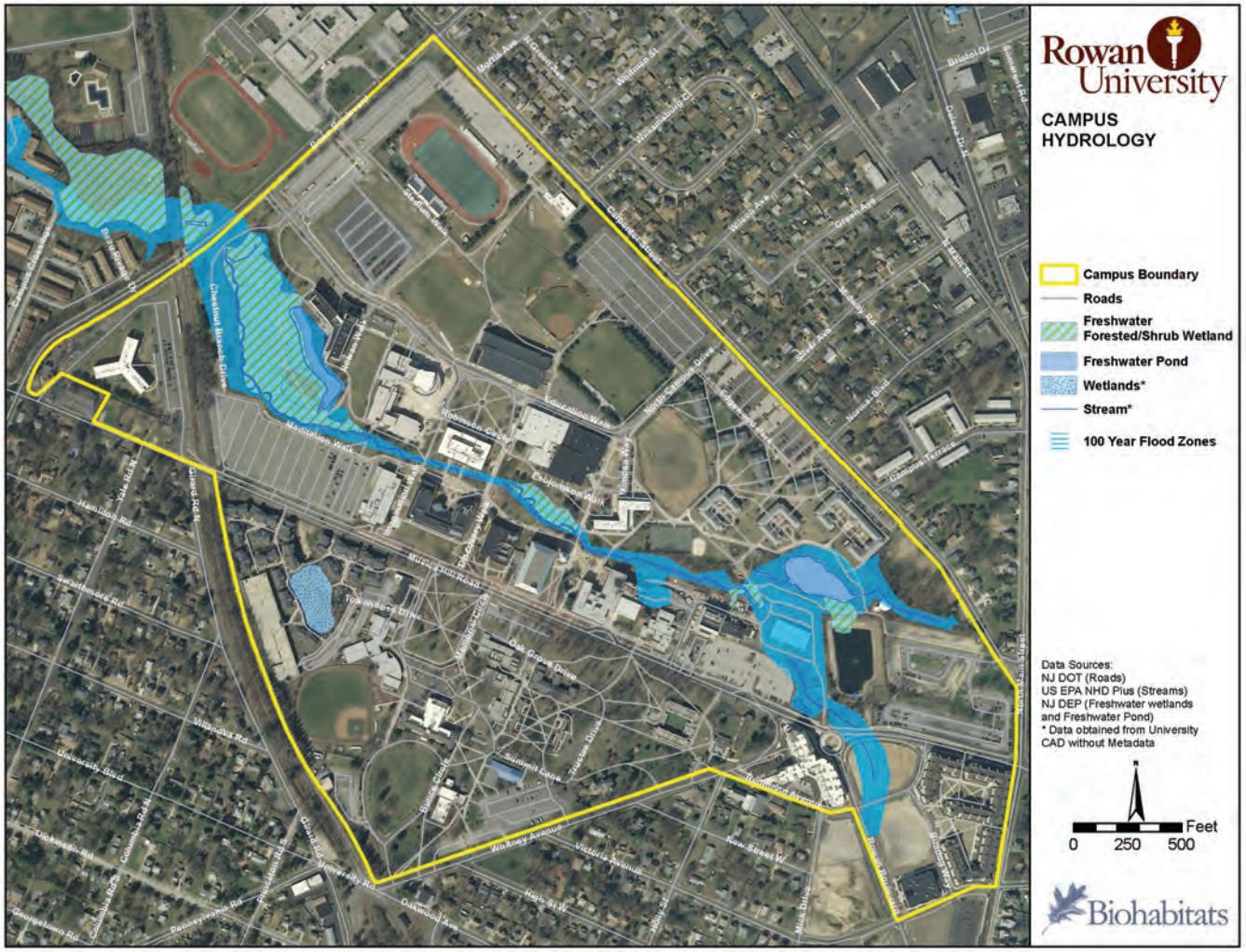
The current campus conditions include a number of open water areas (ponds and stormwater facilities), as well as wetlands, and fragmented forest cover (mainly in the Oak Grove and in small patches along Chestnut Branch).

CURRENT CAMPUS ENVIRONMENTAL RESOURCES SEEN WITH HISTORIC LAND USE OVERLAY

When one overlays the interpretation of the historic vegetation and hydrology on today's conditions, one starts to see how and why there may be issues with flooding in this highly altered landscape, and where there may be opportunities to explore daylighting or at least having surface treatment of stormwater conveyance in areas where there were historic tributaries to the stream. Chestnut Branch, prior to the development of the north campus, may have had a much more braided or meandering character as it wound along the floodplain. Wetlands and tributaries feed the stream. Many of these were most likely piped and buried, as the campus grew.



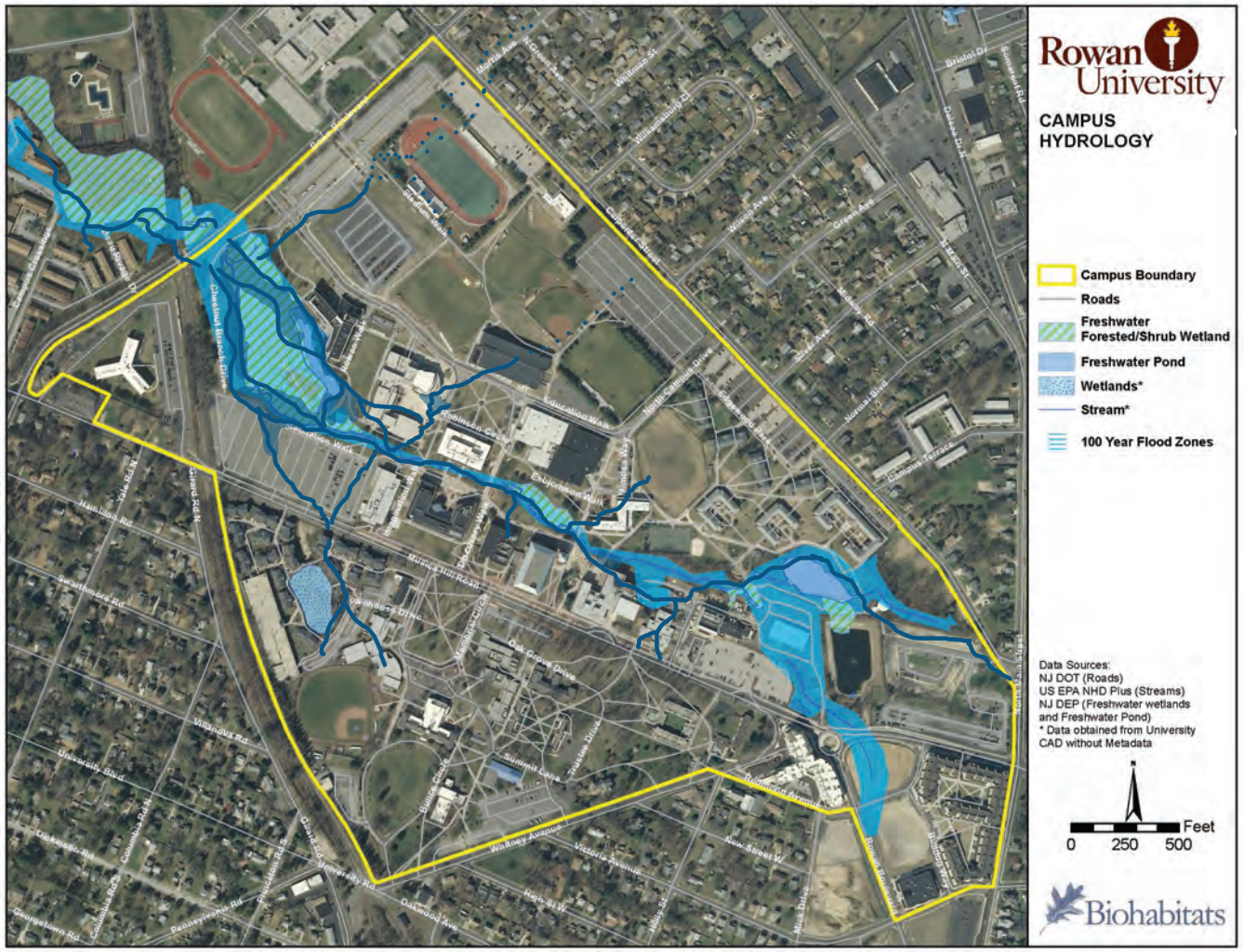
CAMPUS HYDROLOGY



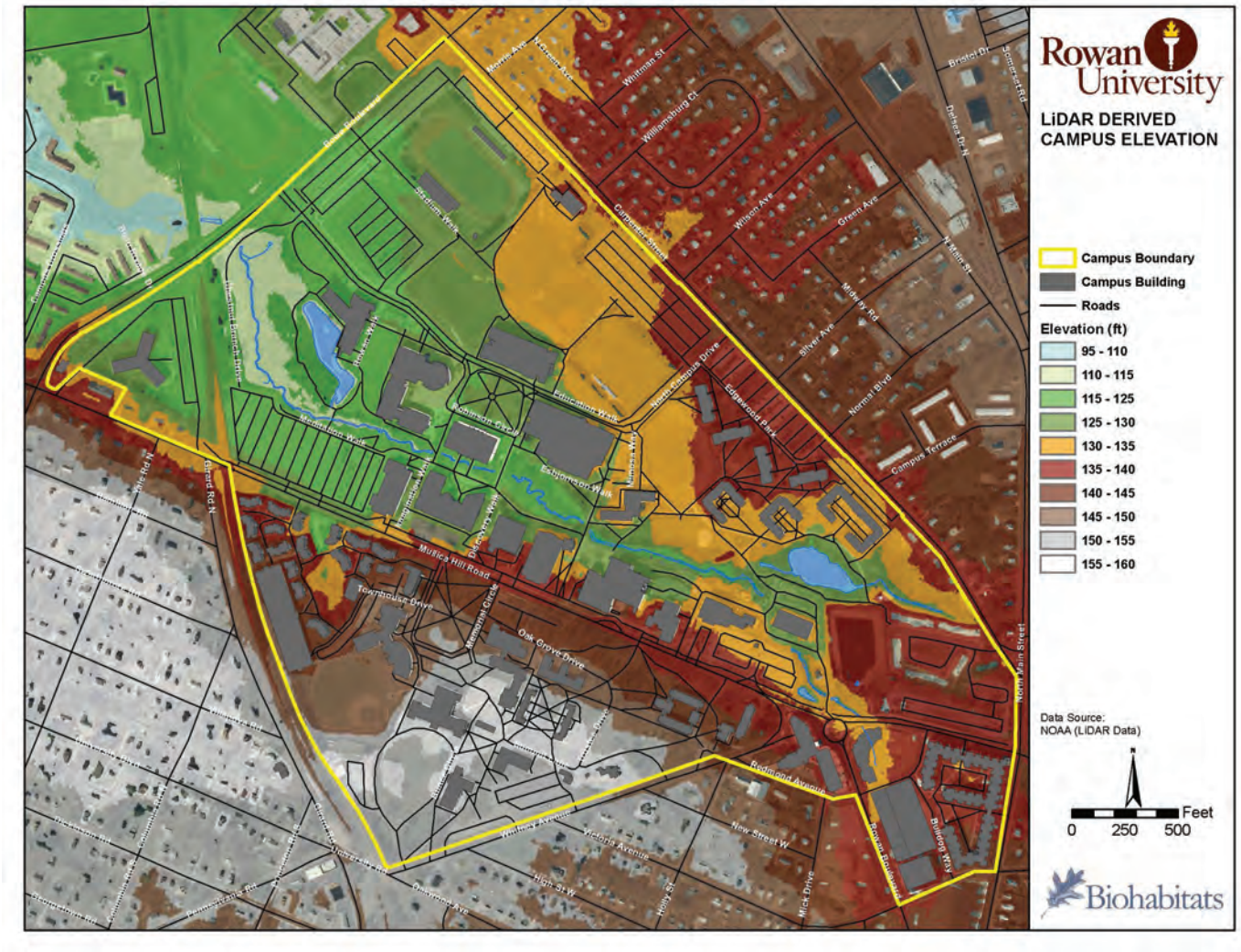
The existing hydrologic data includes freshwater forested shrub wetland on campus, as well as freshwater ponds, and the stream. The FEMA 100 year flood zone shows areas noted for potential flood events.

CAMPUS HYDROLOGY WITH HISTORIC STREAMS

This image shows the interpretation of the historic streams overlaid with the existing campus hydrologic data.



CAMPUS ELEVATION



Elevations on campus range from 110-115 along Chestnut branch near Rowan Hall, to 150-155 at Bunce Hall. The low point is the stream valley along the central east-west axis of the campus, and the hydrologic flows witnessed on campus serve to confirm this with all water flowing toward the center of campus and then westward along the stream. The highest portion of the campus is the entire portion of the campus south of Rt. 322 – which is the historic portion of the campus. It does appear that most of the newer development on the north campus is in lower elevations near the stream. A 30-40' change in elevation results in significant head pressure in storm drains, especially at the Triad building.

CAMPUS SOILS

The campus is dominated by Urban soil complexes that include Aura, Westphalia, Aura-sassafras, and Downer soils; as well as Fluvaquents along the floodplain/stream valley (see map on following page).

As noted in the diagram these soils are variable in their hydrologic soil group notation. The urban soil complexes appear to provide opportunities for infiltration, as they are in the B group. In terms of wildlife and habitat potential each soil group provides different opportunities for ecological function.

- Aura soils tend to provide the foundation for open land wildlife species (with grasses and wild herbaceous plants).
- Aura-sassafras shows more potential for open land wildlife as well as woodland wildlife, supporting wild herbaceous plants and hardwood trees, and even coniferous plants and shrubs.
- Downer provides foundations for woodland wildlife and some open land wildlife, supporting wild herbaceous, hardwood, coniferous trees and shrubs.
- Westphalia is similar to Downer.
- Woodstown is also similar, although it does not support coniferous plants.
- Fluvaquents provide good potential for open land and woodland wildlife, including habitats like grasses and legumes, wild herbaceous, hardwood trees, and shrubs (see Table 11 in the Soil Survey for Gloucester County).

From the Soil Survey for Gloucester County:

> "The interspersing of cropland, idle fields, and borders of hardwood and pine forest provide diverse plant communities, or "edges," utilized by many wildlife species. Other wildlife, including small, isolated reptile and amphibian populations, require more specialized wetland habitats… Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama. Habitat for woodland wildlife consists of areas of deciduous and/or coniferous plants and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer. Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, red maple, apple, dogwood, hickory, blackberry, and blueberry. Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pitch pine, Atlantic white-cedar, red cedar, and juniper."

Data sources:

Soils in Gloucester County: http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/new_jersey/NJ015/0/NJGloucester1_07.pdf

Native vegetation noted for Aura loamy sands include: red, white, black oaks and some pitch pines.

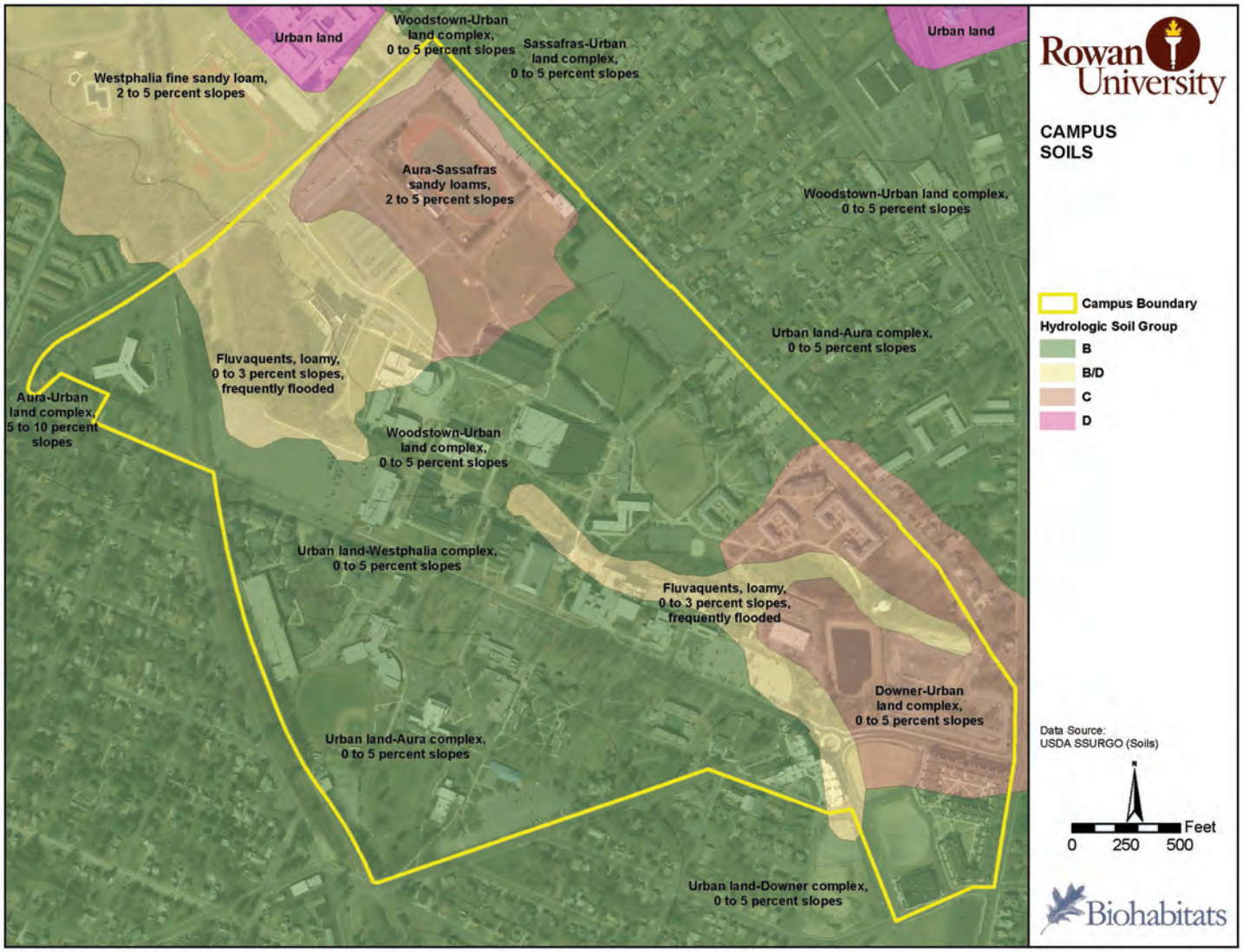
Native vegetation noted for Downer loamy sands include: mixed forest of oak and pine.

Native vegetation noted for Westphalia soils include: mixed oaks, beech, yellow-poplar, and holly.

Native vegetation noted for Woodstown: red, black, and white oaks. In places there may also be yellow-poplar, beech, and pitch pine.

Native vegetation noted for Sassafras: mixed oaks that include scattered pines.

http://www.crssa.rutgers.edu/people/jhasse/enri_html/report_html/chapters/008.html



Campus soils as described on previous page

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Appendix IV–Existing and Proposed Conditions Hydrologic Modeling

BACKGROUND

Biohabitats characterized the existing and proposed conditions of stormwater rainfall/runoff for Rowan University's main campus using the HEC-HMS modeling program (US Army Corps of Engineers). The model is a public domain software system that uses widely accepted hydrologic runoff simulation for single events. The purpose of the hydrologic modeling tool is to evaluate existing conditions, for analysis of a variety of master planning scenarios that will be tested. The results were used to inform the implementation plan (see *Chapter 5*), and the congruence with Master Plan goals. Specifically, the results of the proposed hydrologic scenarios were used to score goals 1.1 and 3.1, which focused on restoring a more natural hydrology to Chestnut Branch, and creating landscapes that capture and filter runoff. Using this evaluation approach, when combined with other prioritization factors allows for making determinations about the best implementation opportunities that optimize the full range of planning objectives.

The existing conditions hydrologic and hydraulic model parameters were developed based on the University's stormwater collection system map, available GIS soil and land use databases available from the New Jersey Department of Environmental Protection (NJDEP), and supplemented by any relevant site/project specific information and mapping. Other known or anecdotal stormwater and water quality problems identified during stakeholder interviews and the data gathering and review process were accounted for, to the extent practicable. A limited amount of field reconnaissance occurred to confirm drainage elements and flow paths, especially with respect to off-site runon to the campus.

Event-based model simulations were performed for a typical range of storm conditions (Water Quality, 2-, 10-, and 100-year events) to characterize the flooding potential and vulnerability of the campus areas and infrastructure (buildings, streets and parking, ball fields, etc.), with consideration of external sources of stormwater which may impact management on campus. The model was calibrated against regional regressions equations from the New Jersey StreamStats website. The previous North and South Campus Drainage Studies were used for qualitative comparison with predictions of the hydrologic model.

For proposed conditions modeling, an "uncontrolled" build out scenario of the campus was developed using the proposed physical changes associated with the 2013 Long Range Facilities Master Plan without any additional stormwater control measures beyond what currently exists. Then, the stormwater benefits associated with the implementation of the projects discussed within this master plan were quantified using HEC-HMS. Model input parameters such as curve number and lag time were adjusted to reflect changes associated with green infrastructure or stream daylighting practices proposed within each subwatershed. Routing changes were required to model the additional surface and sub-surface storage projects, as well as the diversion of two off-campus subwatersheds.

EXISTING CONDITIONS MODEL INPUT PARAMETERS

The HEC-HMS model contains all the subwatersheds, major conveyance channels and pipes, and ponds on campus. The crossing at Bowe Blvd was treated as a pond basin in the model due to its tendency to detain flood flows due to the culvert restriction. Drainage area subwatershed delineations were created according to topographic data, on-campus drainage network surveys, field verification, and best professional judgment. Twenty-four subwatersheds were delineated to a point just downstream of the railroad tracks in order to appropriately model the dynamics of the two culverts of Chestnut Branch at the lower section of campus. Figure A4-1 shows locations of the subwatersheds.

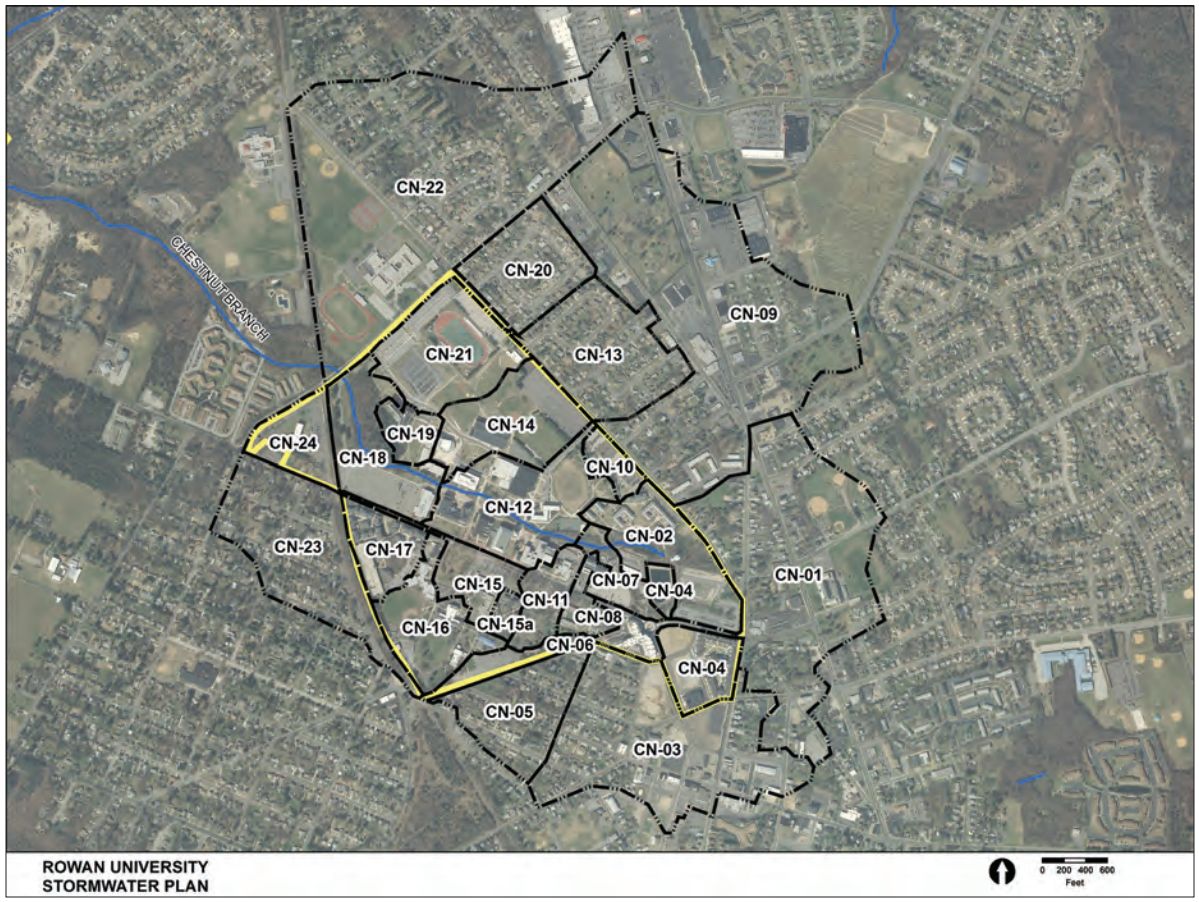


fig. A4-1

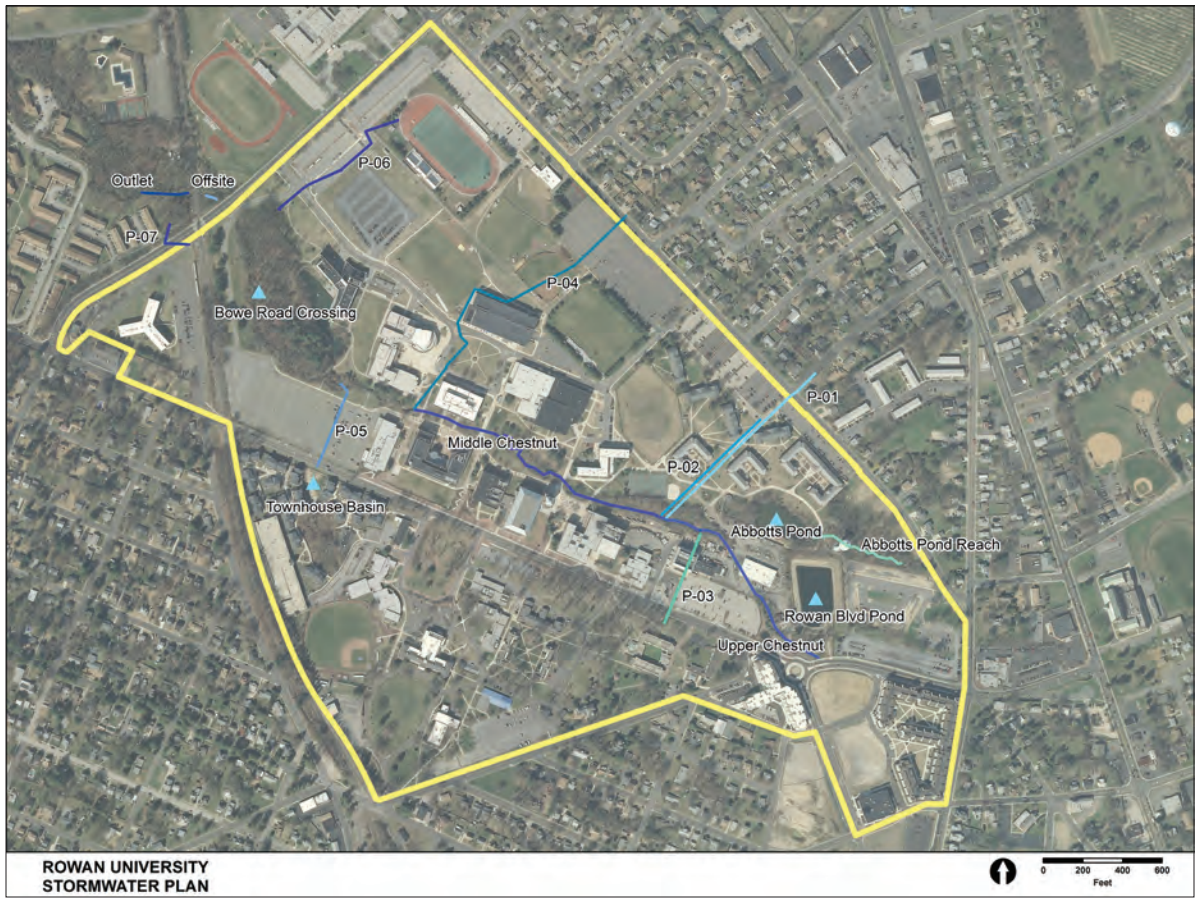


fig. A4-2

Meteorological data was set according to NJDEP standard 24-hr rainfall depths. The SCS Type III unit hydrograph was used. In addition, a model run based on the Type III Delmarva unit hydrograph was performed. Since Rowan University is within in the Coastal Plain, the Delmarva Unit Hydrograph is appropriate.[1] However, for 100-year floodplain modeling, the Delmarva dimensionless unit hydrograph is not recommended for establishing the 100-year flow since it can reduce the peak flows (NJDEP).

New Jersey land use codes were used to characterize land cover in the watershed to Chestnut Branch. Major land use types included Residential, Commercial, Athletic Fields, and Other Urban Land. The predominant hydrologic soil group on campus were B soils, indicating lower runoff potential in pervious areas (*see the soils map in Appendix 3*).

Flow paths were delineated in GIS to compute the lag time for each subwatershed. The flow paths were predominantly roof runoff to a paved surface and directly to the stormdrain, so the resulting lag times are short. Conveyance reaches including pipes and open channels were added to the model in order to route upstream drainage areas downstream, and were created according to best-available topographic information. See Figure A4-2 for the reach designations used in the model.

[1] *http://www.nj.gov/dep/stormwater/rainfalldata.htm*

EXISTING CONDITIONS MODEL CALIBRATION

New Jersey StreamStats was used to delineate a drainage area to a point below the railroad tracks and generate the regression equation data necessary for a regional regression analysis. The regression equations take into account actual gauged stream flow data from USGS for the inner coastal plain to generate synthetic peak discharge values for an ungauged site, such as Chestnut Branch.

The capacity of piped conveyance reaches were modeled using HY-8. Results of the pipe capacity was compared to the HEC-HMS results to verify that the discharge values were within reason.

EXISTING CONDITIONS MODEL RESULTS

Results from the existing conditions HEC-HMS model are included below for all 24 individual subwatershed drainage areas (*Table 1*). Results from the 2-, 10-, and 100-year Type III Delmarva unit hydrograph are shown, as well as the standard Type III distribution for the 100-year event. Drainage areas flowing to Chestnut Branch from off-campus are highlighted in red.

TABLE 1: CATCHMENT SUMMARY TABLE: TYPE III – DELMARVA AND STANDARD UNIT HYDROGRAPHS

Model ID	Drainage Area (sq miles)	Curve Number	Lag Time (mins)	Type III - Delmarva Unit Hydrograph			Type III - Standard Unit Hydrograph
				2-year (cfs)	10-year (cfs)	100-year (cfs)	100-year (cfs)
CN-01	0.11	77	20.2	39.2	83.4	183.5	270.9
CN-02	0.03	81	10.8	19	37.3	77	106.8
CN-03	0.09	79	5.5	61.1	123.7	261.3	328.4
CN-04	0.02	72	3.6	10.9	25.5	60.3	71.2
CN-05	0.03	75	5.0	18.1	39.9	89.6	111.2
CN-06	0.02	81	6.2	13.3	26	53.3	68.1
CN-07	0.01	85	8.7	7.7	14.1	27.5	36.9
CN-08	0.01	89	9.1	7.4	12.7	23.5	31.6
CN-09	0.17	80	6.3	119.2	237.1	493.6	633.7
CN-10	0.01	92	3.6	9.8	16	28.5	33.4
CN-11	0.01	74	7.0	6.3	14.3	32.8	43
CN-12	0.04	81	9.7	27.5	54	111.3	152.1
CN-13	0.04	77	18.9	15.9	33.8	74.4	109.3
CN-14	0.03	78	4.9	22.8	46.9	100.6	123.8
CN-15	0.02	83	19.8	9.2	17.4	34.9	51.2
CN-16	0.03	78	21.7	9.7	20.2	43.7	64.9
CN-17	0.02	88	7.5	15.3	26.6	49.7	65.1
CN-18	0.03	85	4.7	30.5	55.3	107.1	130.7
CN-19	0.01	86	16.8	5.3	9.5	18.4	26.5
CN-20	0.03	78	10.8	15.4	32.1	69.4	96.4
CN-21	0.04	76	5.2	23.1	49.7	109.9	137.3
CN-22	0.18	75	13.1	70.7	156.9	356.4	507.7
CN-23	0.06	74	22.8	14.8	33.8	78.2	117.1
CN-24	0.02	90	9.1	15.7	26.4	48.4	65
Total	1.059						

Each individual pond on campus was modeled using HEC-HMS, and the results are included in Table 2. Both the Delmarva and Standard Type III Unit Hydrograph results are presented. Note that the 100-year discharge was predicted to overtop the Bowe Blvd Road Crossing (road elevation 118.2-ft) in both scenarios. A backwater analysis was performed on the Bowe Boulevard Culvert to create an inundation map of lower Chestnut Branch (*see Figure A4-3*).

fig. A4-3

http://www.nj.gov/dep/fgw/ensp/wap/pdf/15.pdf & http://www.nj.gov/dep/fgw/ensp/wap/pdf/pamphlet_piedmont.pdf

TABLE 2: POND SUMMARY TABLE: TYPE III – DELMARVA AND STANDARD UNIT HYDROGRAPHS

Model ID	Drainage Area (sq miles)	Type III - Delmarva Unit Hydrograph						Type III - Standard Unit Hydrograph	
		2-year peak (cfs)	10-year peak (cfs)	100-year peak (cfs)	2-year peak elevation (ft)	10-year peak elevation (ft)	100-year peak elevation (ft)	100-year peak (cfs)	100-year peak elevation (ft)
Rowan Blvd Pond	0.11	2.9	23.2	200.9	131.2	133	136.4	230.7	136.6
Abbots Pond	0.15	30.5	67.7	107.9	126	127.7	130.6	113.2	131.1
Townhouse Basin	0.02	13.2	22.5	43.9	123.2	124.3	127.2	62.7	127.4
Bowe Road Crossing	0.80	192.8	306.3	1021.8	114.8	116.7	119.3*	1177.2	119.5*

**Overtops roadway crest, elevation 118.2-ft*

TABLE 3: REACH SUMMARY TABLE: TYPE III – DELMARVA AND STANDARD UNIT HYDROGRAPHS

Open-channel conveyance reaches were used to route runoff and combine individual drainage area hydrographs. The results are included in Table 3, at right.

Model ID	Drainage Area (sq miles)	Type III - Delmarva Unit Hydrograph			Type III - Standard Unit Hydrograph
		2-year (cfs)	10-year (cfs)	100-year (cfs)	100-year (cfs)
Abbots Pond Reach	0.11	39.2	83.3	183.4	270.6
Upper Chestnut	0.17	38.8	79.3	319.6	380.4
Middle Chestnut	0.55	209.4	427.7	990.3	1272.1
Offsite	0.99	249.7	430.2	1297.9	1519.2
Outlet	1.059	274.7	483.4	1402.0	1667.0

TABLE 4: PIPE REACH SUMMARY TABLE: TYPE III – DELMARVA AND STANDARD UNIT HYDROGRAPHS

Model ID	Drainage Area (sq miles)	Pipe Size (in)	Type III - Delmarva Unit Hydrograph			Type III - Standard Unit Hydrograph
			2-year (cfs)	10-year (cfs)	100-year (cfs)	100-year (cfs)
P-01	0.17	54	119	236.8	493.1	631.3
P-02	0.01	18	9.8	16	28.5	33.3
P-03	0.01	18	7.4	12.7	23.4	31.5
P-04	0.08	43 x 68	32.7	69.1	151.3	191
P-05	0.06	36	31.4	59.3	117.8	155.5
P-06	0.07	50	37.1	79	173.7	222.1
P-07	0.07	36	27	54.4	116.2	154.6

** Red shading indicates pipe capacity is exceeded assuming free-flow.*

Closed pipe conveyances were modeled using HY-8 and HEC-HMS. In most cases the 100-year discharge in HEC-HMS is greater than the computed capacity from HY-8. In the summary table (*Table 4*), the values that exceed the capacity of the pipe reach are highlighted in red. It is not expected that these pipes are designed to convey the 100-year event, but the comparison builds confidence that the 2- and 10-year results are consistent with pipe capacity.

The HEC-HMS results were compared to New Jersey StreamStats below (*Figure A4-4*). In general the model results are consistent with the upper confidence interval for the regression equations. This is reasonable to expect, given the highly modified and urban Chestnut Branch watershed. Both the Delmarva unit hydrograph and Standard Type III hydrograph results are shown.

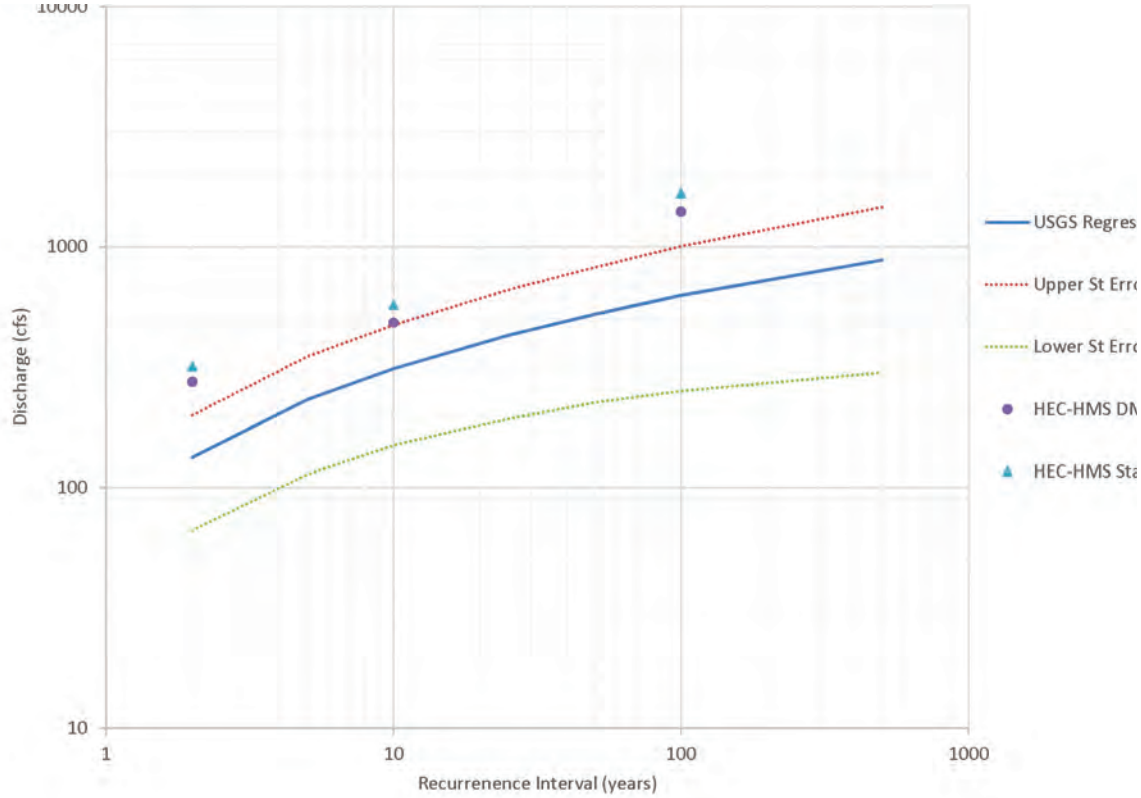


fig. A4-4

TABLE 5: UNIT DISCHARGE BY SUBCATCHMENT

Model ID	Delmarva UH	Standard Type III UH
	2-year peak unit discharge (cfs/acre)	2-year peak unit discharge (cfs/acre)
CN-10	2.17	2.57
CN-18	1.55	1.91
CN-17	1.48	1.96
CN-24	1.47	1.99
CN-08	1.42	1.93
CN-07	1.21	1.65
CN-06	1.17	1.52
CN-09	1.10	1.44
CN-03	1.10	1.41
CN-14	1.09	1.37
CN-12	0.96	1.34
CN-21	0.95	1.22
CN-19	0.93	1.37
CN-02	0.91	1.29
CN-05	0.91	1.16
CN-04	0.84	1.01
CN-20	0.78	1.11
CN-11	0.75	1.02
CN-15	0.75	1.11
CN-22	0.60	0.87
CN-13	0.56	0.84
CN-16	0.55	0.83
CN-01	0.54	0.82
CN-23	0.42	0.65

Unit discharges were computed and reviewed as a metric for identifying catchments generating the most runoff per unit area. These catchments are candidates to target or focus retrofit efforts on. Table 5 presents the unit discharges by catchment using three categories or break points. Areas shown in the map on the following page.

The two catchments (CN-10 and CN-18) with highest unit discharge rates are dominated by parking lots and impervious areas. The offsite catchments have smaller unit discharges in general, as a result of lower impervious cover. Exceptions include CN-09 and CN-03 which have significant commercial areas. Figure A4-5 illustrates the unit discharges across all subwatersheds.

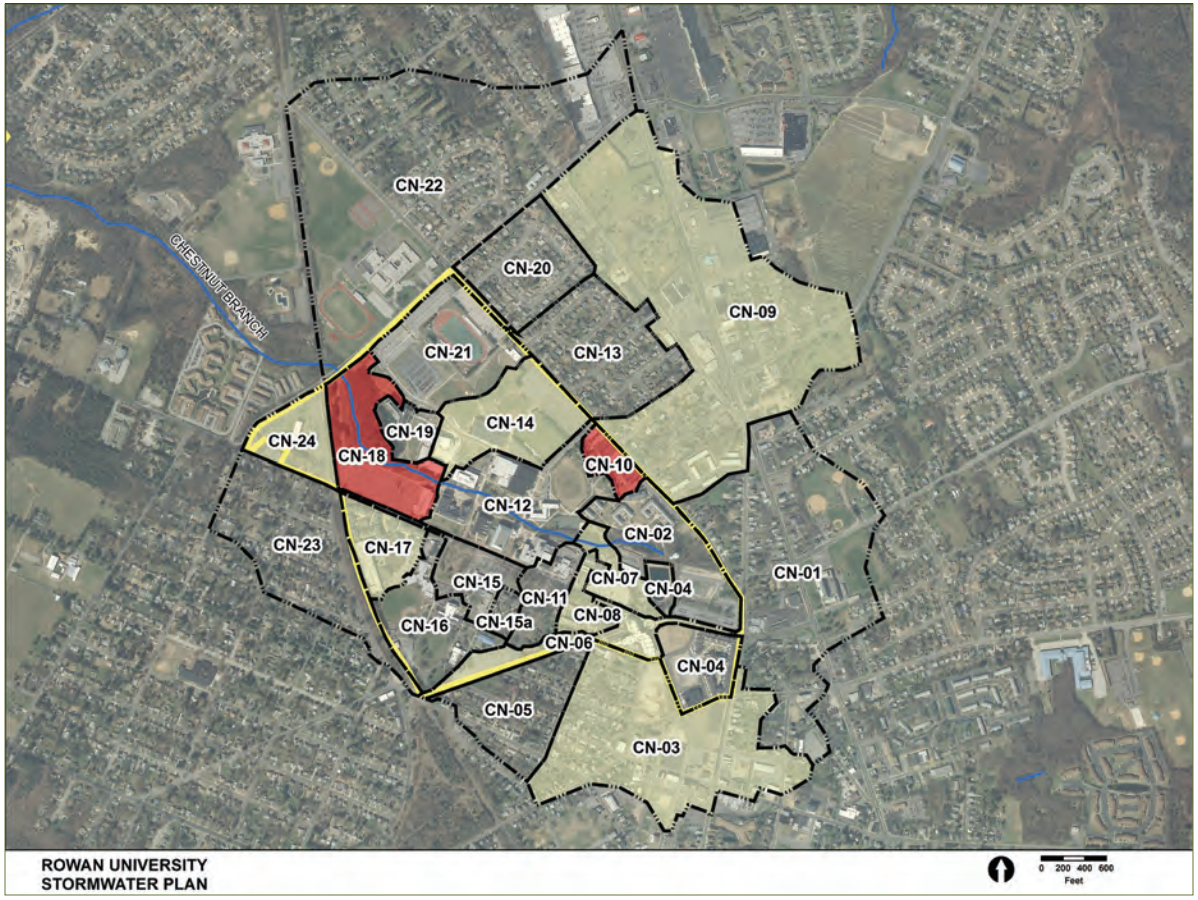


fig. A4-5

PROPOSED CONDITIONS HYDROLOGIC MODEL DEVELOPMENT

The proposed conditions model consisted of future land uses on the campus developed using the 2013 Long Range Facilities Master Plan, including the new Engineering and Business School Buildings and associated parking lots, new Freshman Village dorm buildings, changes to Linden Hall. After accounting for the proposed space requirements for buildings and facilities, the stormwater management and landscape transformations presented in this Master Plan were incorporated into the model as new storage BMPs, water quality practices (green infrastructure or GI), stream daylighting practices, and diversions of existing off-campus drainage areas. Only the Delmarva hydrograph was used to model the results using HEC HMS, since no floodplain mapping was incorporated in the results of this Master Plan.

CHANGES TO MODEL INPUT PARAMETERS

Green infrastructure practices were modeled using the "Change in Runoff Curve Number Method" (McCuen, R., MDE, 1983). This methodology is based on runoff volume reductions associated with infiltration practices and develops a storm event based curve number.

$$CN^* = 200/[(P+2Q+2)-\sqrt{(5PQ+4Q4)}]$$

It was assumed that these practices would treat NJDEP's water quality volume of 1.25 inches. An implementation rate of 20% was assumed for the Glassboro Residential Greening program, which is consistent with similar initiatives throughout the country. Table 6 compares the existing curve numbers and the proposed curve numbers.

Adjustments were made to lag times to account for the effects of green infrastructure and stream daylighting along the subwatershed flow path. The roughness coefficients were adjusted in TR-55 to reflect changes in landuse along the flow path for sheet flow and shallow concentrated flow. For stream daylighting, manning's n value was adjusted along with the cross-section and wetted perimeter. Table 7, compares the lag times of the existing and proposed conditions for each subwatershed.

TABLE 6: PROPOSED CURVE NUMBERS

Sub-Watershed	Existing Conditions	Proposed - Final Configuration	
		2-year	10- and 100-year
CN-01	77	76	77
CN-02	81	81	81
CN-02b		81	81
CN-03	79	77	78
CN-04	72	72	72
CN-05	75	73	74
CN-06	81	79	79
CN-07	85	80	80
CN-08	89	87	88
CN-09	80	79	80
CN-10	92	84	85
CN-11	74	72	72
CN-12	81	79	80
CN-13	77	76	77
CN-14	78	78	79
CN-15a		80	81
CN-15b	83	80	81
CN-16	78	78	78
CN-17	88	88	88
CN-18	85	82	83
CN-19	86	86	86
CN-20	78	76	77
CN-21	76	74	76
CN-22	75	74	75
CN-23	74	73	73
CN-24	90	90	90

TABLE 7: PROPOSED LAG TIME (IN MINUTES)

Sub-Watershed	Existing Conditions	Proposed - Final Configuration
CN-01	20.2	20.2
CN-02	10.8	10.8
CN-02b		10.8
CN-03	5.5	5.5
CN-04	3.6	3.6
CN-05	5.0	5.0
CN-06	6.2	6.2
CN-07	8.7	21.6
CN-08	9.1	9.1
CN-09	6.3	6.3
CN-10	3.6	12.5
CN-11	7.0	7.0
CN-12	9.7	9.7
CN-13	18.9	18.9
CN-14	4.9	4.9
CN-15a		6.2
CN-15b	19.8	27.2
CN-16	21.7	21.7
CN-17	7.5	7.5
CN-18	4.7	4.7
CN-19	16.8	16.8
CN-20	10.8	14.0
CN-21	5.2	9.3
CN-22	13.1	13.1
CN-23	22.8	22.8
CN-24	9.1	9.4

CHANGES TO ROUTING

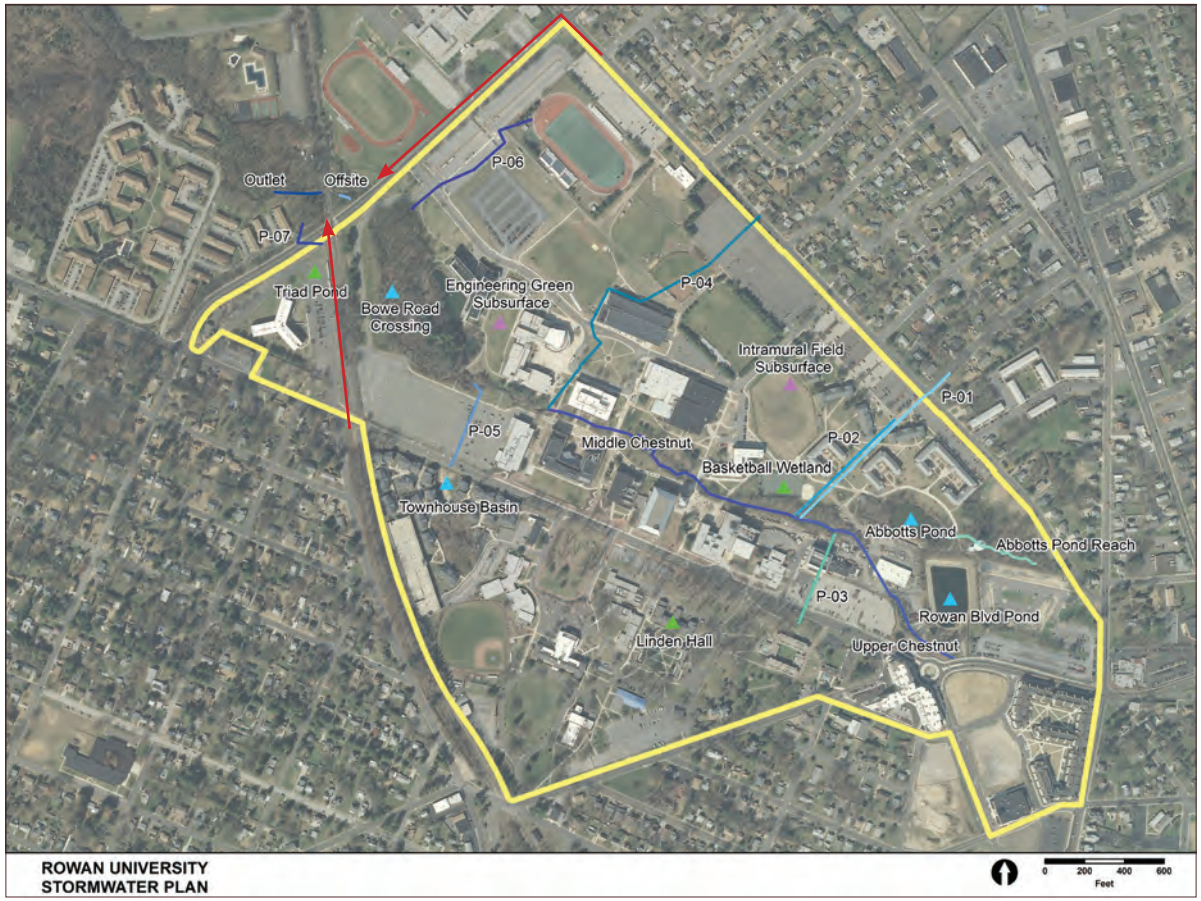


fig. A4-6

Proposed wetland storage BMPs were modeled by adding a pond element to the model. Storage volumes for these facilities were developed in ArcGIS and outlet structures sized to provide adequate detention, while safely conveying the 100-year event without overtopping. CN-02 was divided into CN-02 and CN-02b, since the Freshman Village will drain to the Rowan Boulevard pond once completed. Similarly, Linden Wetland required that CN-15 was divided into CN-15a which drains to the wetland and CN-15b based on its location within the subwatershed. Subsurface storage practices were modeled using a diversion with a maximum storage volume and inflow function. The diversion structures for subsurface storage were modeled assuming that base flow and small storms would bypass the storage, while larger events could be diverted to reduce peak flow. No downstream connection was included for these practices. The diversion of CN-23 and CN-20 was done by changing the routing for those subwatersheds and adjusting the lag time due to the proposed stormdrain pipes. Figure A4-6 illustrates all of the modeling storage BMPs and changes to the reach routing parameters.

PROPOSED MASTER PLAN MODEL RESULTS

Implementation of the projects described in this Master Plan will result in significant reductions in peak flow for the 2-year storm. Reductions were still observed for the 10- and 100-year events, however they are less pronounced. Green infrastructure practices increase infiltration and provide attenuation of stormwater within the landscape, mimicking a more natural hydrology. Table 8 shows the effect of these practices on the peak discharge for each of the subwatersheds. The largest reductions of peak discharge are found in subwatersheds where existing parking areas and plazas are proposed to be retrofitted with green infrastructure practices, such as CN-21, CN-10, and CN-02. The Cassady parking lot retrofit combined with the stream daylighting project account for the reductions in CN-07.

These decreases in stormwater runoff combined with the new storage features, have an impact on the peak discharges in both the pipe reaches and stream reaches. Table 9 shows the storage capacity and peak discharges for each of the existing and proposed storage features. The five new proposed storage features increase the on-campus storage potential by 46-74% for the 2- and 10-year events. As shown in Table 10, the two year peak discharge in the stream is reduced for all reaches by up to 24%. Significant reductions are also observed for the 10-year storm event for all reaches, except for Abbott's Pond Reach. This upstream reach receives a majority of its flow from off campus (CN-01). The reductions for the 100-year event less pronounced, however Bowe Road Crossing experiences a 12% reduction. The increase in the peak at upper chestnut is a result of changes in hydrograph timing, and the capacity of the Rowan Boulevard Pond which would now receive runoff from the Freshman Village dorms. Figure A4-7 illustrates the resulting reduction in peak discharge across all subwatersheds.

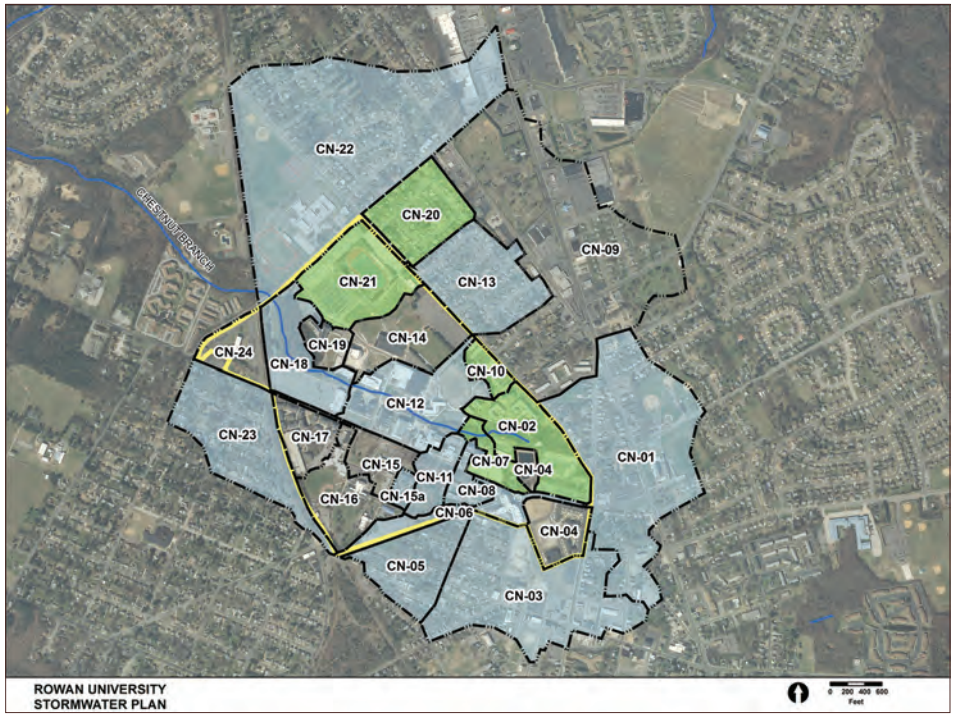


fig. A4-7

TABLE 8: CATCHMENT SUMMARY TABLE – PEAK DISCHARGE COMPARISON

Hydrologic Element	2-year peak (cfs)			10-year peak (cfs)			100-year peak (cfs)		
	Existing	Proposed	Peak Reduction (%)	Existing	Proposed	Peak Reduction (%)	Existing	Proposed	Peak Reduction (%)
CN-01	39.2	37	6%	83.4	83.4	0%	183.5	183.5	0%
CN-02	19	12.9	32%	37.3	25.3	32%	77	52.1	32%
CN-02b		8.7			12.1			24.9	
CN-03	61.1	54.8	10%	123.7	119.7	3%	261.3	256.7	2%
CN-04	10.9	10.9	0%	25.5	25.5	0%	60.3	60.3	0%
CN-05	18.1	16	12%	39.9	38.4	4%	89.6	87.8	2%
CN-06	13.3	12	10%	26	24.4	6%	53.3	51.5	3%
CN-07	7.7	3.9	49%	14.1	7.8	45%	27.5	16.3	41%
CN-08	7.4	6.8	8%	12.7	12.4	2%	23.5	23.2	1%
CN-09	119.2	113.1	5%	237.1	237.1	0%	493.6	493.6	0%
CN-10	9.8	4.5	54%	16	8.6	46%	28.5	16.8	41%
CN-11	6.3	5.5	13%	14.3	13.2	8%	32.8	31.4	4%
CN-12	27.5	24.8	10%	54	52.3	3%	111.3	109.4	2%
CN-13	15.9	15	6%	33.8	33.8	0%	74.4	74.4	0%
CN-14	22.8	22.8	0%	46.9	48.5	-3%	100.6	102.4	-2%
CN-15a		2.7			5.5			11.4	
CN-15b	9.2	5.3	13%	17.4	10.9	37%	34.9	22.7	35%
CN-16	9.7	9.7	0%	20.2	20.2	0%	43.7	43.7	0%
CN-17	15.3	15.3	0%	26.6	26.6	0%	49.7	49.7	0%
CN-18	30.5	26.6	13%	55.3	52.4	5%	107.1	104.1	3%
CN-19	5.3	5.3	0%	9.5	9.5	0%	18.4	18.4	0%
CN-20	15.4	12.1	21%	32.1	27.3	15%	69.4	59.9	14%
CN-21	23.1	16.1	30%	49.7	39.4	21%	109.9	88	20%
CN-22	70.7	66.4	6%	156.9	156.9	0%	356.4	356.4	0%
CN-23	14.8	13.9	6%	33.8	32.4	4%	78.2	76.5	2%
CN-24	15.7	15.5	1%	26.4	26.1	1%	48.4	47.8	1%

TABLE 9: POND SUMMARY TABLE - PEAK DISCHARGE COMPARISON AND STORAGE VOLUMES

Hydrologic Element	2-year peak (cfs)		2-year Storage Volume (ac-ft)	10-year peak (cfs)		10-year Storage Volume (ac-ft)	100-year peak (cfs)		100-year Storage Volume (ac-ft)
	Existing	Proposed	Existing	Proposed	Existing	Proposed			
Abbotts Pond	30.5	25.6	9.2	67.8	62.1	19.4	107.9	104	42
Basketball Wetland		9.1	7.1		12.8	10.6		23	15
Linden Hall		0.3	0.3		0.5	0.6		0.8	1.3
Rowan Blvd Pond	2.9	3.3	3.1	23.2	29.4	11.8	200.9	231.2	31.4
Townhouse Basin	13.2	13.2	1.8	22.5	22.5	3.2	43.9	43.9	6.1
Triad Pond		9.1	2		22.3	3.5		33	6.2
Intramural Field Subsurface		19.2	0.5		20	0.6		20	0.6
Engineering Green Subsurface		5.3	0.6		9.5	0.6		6.9	0.6
Existing Total			14.1			34.4			79.5
Proposed Total			24.6			50.3			103.2

REACH ROUTING RESULTS

Closed stormdrain pipes included in the model are also showing the benefits from the addition of green infrastructure and storage practices. Table 11, compares the peak discharges for these pipe reaches for the existing and proposed conditions. The largest reductions are seen in reaches where wetland and other storage practices are proposed. The drastic reductions shown for P-06 and P-07 are a result of the diversion of CN-20 and CN-23, respectively.

The water surface elevation at the Bowe Blvd. Crossing is also reduced in all storm events. Table 12 compares the water surface elevation at this crossing in the existing and proposed conditions. Overtopping of the crossing by approximately 1 foot is still expected in the 100-year event. A completed hydraulic model would need to be developed to accurately predict water surface elevations and floodplain characteristics for Chestnut Branch.

Overall, these changes have a positive effect on the hydrology of Chestnut Branch, primarily by reducing the peak discharge, which in turn would reduce erosion and water surface elevations experienced within the creek during runoff events. The infiltration practices proposed in this Master Plan would also increase baseflow in the creek and improve water quality. Also important to note, the peak discharge at the downstream most point, denoted as Outlet in Table 10, is reduced in all storm events. Therefore the proposed Master Plan changes to Rowan University Campus are not expected to increase the hydrologic response downstream of the campus, therefore protecting downstream infrastructure and Acylon Lake.

TABLE 10: STREAM REACH SUMMARY TABLE - PEAK DISCHARGE COMPARISON

Hydrologic Element	2-year peak (cfs)			10-year peak (cfs)			100-year peak (cfs)		
	Existing	Proposed	Peak Reduction (%)	Existing	Proposed	Peak Reduction (%)	Existing	Proposed	Peak Reduction (%)
Abbotts Pond Reach	39.2	37	6%	83.3	83.3	0%	183.4	183.4	0%
Upper Chestnut	38.8	30.1	22%	79.3	67.3	15%	319.6	344.5	-8%
Middle Chestnut	209.4	158.9	24%	427.7	373.4	13%	990.3	970.7	2%
Offsite	68.3	62.6	8%	140.5	137.2	2%	306.4	302.5	1%
Outlet	73.5	67.7	8%	150.9	147.3	2%	328.7	324.4	1%

TABLE 11: PIPE REACH SUMMARY TABLE - PEAK DISCHARGE COMPARISON

Hydrologic Element	2-year peak (cfs)			10-year peak (cfs)			100-year peak (cfs)		
	Existing	Proposed	Peak Reduction (%)	Existing	Proposed	Peak Reduction (%)	Existing	Proposed	Peak Reduction (%)
P-01	119	93.8	21%	236.8	216.8	8%	493.1	493.1	0%
P-02	9.8	4.5	54%	16	8.6	46%	28.5	16.8	41%
P-03	7.4	6.8	8%	12.7	12.4	2%	23.4	23.2	1%
P-04	32.7	31.9	2%	69.1	70.6	-2%	151.3	153	-1%
P-05	31.4	27.3	13%	59.3	52.6	11%	117.8	104.1	12%
P-06	37.1	16	57%	79	39.4	50%	173.7	87.6	50%
P-07	27	15.5	43%	54.4	26.1	52%	116.2	47.7	59%

TABLE 12: ELEVATION AT BOWE ROAD CROSSING

	2-year (ft)	10-year (ft)	100-year (ft)
Existing	114.8	116.7	119.3
Proposed	114.2	116.3	119.2
Reduction (ft)	0.6	0.4	0.1

REFERENCES

Ries, KG, Guthrie, JD, Rea, AH, Steeves, PA, and Stewart, DW. 2008. StreamStats: A Water Resources Web Application. U.S. Geological Survey 2008-3067, 6 p.

McCuen, R., MDE 1983. Modeling Infiltration Practices Using the TR-20 Hydrologic Program, (http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/SoilErosionandSedimentControl/Documents/Modeling%20Infiltration%20wTR%2020.pdf)

USACE, 2013. Hydrologic Modeling System (HEC HMS) v4.0, U.S. Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center, Davis, CA.

NJ DEP, 2004. New Jersey Stormwater Best Management Practices Manual. New Jersey Department of Environmental Protection, Division of Watershed Management, Trenton, NJ

Federal Highway Administration, 2014. HY-8 v7.30 Aquaveo, LLC and Environemental Modeling Research Laboratory, DTFH61-05-T-63053

Appendix V–Planting Considerations

INTRODUCTION

A diverse plant palette, characterized primarily by native species, promotes overall ecological health and function in the landscape and provides educational value on the campus. It is important to note that the plants suggested in this appendix should serve as examples of suitable species but that individual designs may be responsive to landscape context and design intent. Diversity in a campus landscape is critical to its long term vigor. In an undisturbed native plant population on the east coast, the typical number of different species may be as high as 68 per acre.

The range of landscape styles on the Rowan campus includes entrances and patios closely associated with buildings; stormwater management zones; natural resource zones along the stream corridor, wetlands, and woodlands; streetscapes; open park-like greens; and small donor/alumni gardens (like the rose gardens). Some of these spaces may have a more formal organization of plants, while others will reflect a more natural aesthetic.

There will be opportunities at the interface of formal landscapes and natural areas to consider a holistic design that relates to adjacent areas, forming a harmonious continuum. Plants selected for both high profile locations as well as campus ecological zones must be able to thrive in a given location, based on microclimate, soils, and the hydrology of a specific site. A diverse plant palette promotes resilience in light of climate change and its effects on campus conditions.

NATIVE, NON-NATIVE, AND INVASIVE PLANT SPECIES

In natural areas it is best to try to create a diverse and resilient native plant palette that promotes continued ecological function of the existing stream and wetland systems on campus. Availability of native species may be limited in Gloucester County, in terms of nursery production. It may be appropriate to look to other regionally relevant species as one considers changing climatic conditions, especially those that may occur in regions south within the inner and outer coastal plains of Delaware and Maryland.

Rowan University does not wish to limit the potential palette of campus plants to purely native species, especially in areas that may call for more showy plants at times of the season when natives are not blooming – so some indigenous and non-indigenous (non-invasive) plants may also be used where appropriate. Suggested percentages are listed below. Plants used in a given design should be labeled with their scientific and common names.

- Native = (n) currently listed as a native to the region, local; ie. *Gleditsia tricanthus* – Honey Locust (n)
- Indigenous/non-invasive = (i) found within the United States, native to US; ie. *Magnolia grandiflora* – Southern Magnolia (i)
- Non-indigenous/non-invasive = (nni) native to lands outside the United States; ie. *Lagerstroemia indica* – Crape Myrtle (nni)

It is recommended that landscape plans developed for the Rowan University campus adhere to a simple formula as follows:

URBAN LANDSCAPES includes streetscapes, and semiformal gardens
- Not less than 55% native species (n)
- Not greater than 25% indigenous/ non-invasive (i)
- Not greater than 20% non-indigenous/non-invasive (nni)

NATURAL LANDSCAPES (along Chestnut Branch, in Linden Wetland, Abbotts Pond, the Basketball Courts Wetland etc.)
- Not less than 85% native (n)
- Not greater than 15% indigenous/ non-invasive (i)

Using local native plant nurseries that have collected stock plants and seed from within the region is the most effective way to ensure plant material is acclimated to local conditions. Over use of certain plants opens the campus to disease and insect problems.

New species and varieties are continuously being brought into service by an innovative nursery industry thus selection in any landscape design may deviate from a given list but must go through design review and evaluation. Cultivars of a plant species, sometimes called designer plants, have been developed over time to meet very specific aesthetic needs. Cultivars may be used in a landscape design but only in limited quantities, since widespread use of cultivars may limit genetic diversity. An example of a native plant cultivar is *Acer rubrum* "October Glory" – October Glory Red Maple.

Invasive plants shall not be included in any landscape design for the Rowan campus. The following document includes a list of non-indigenous plant species in New Jersey, ranked according to their relative degree of invasiveness in natural plant communities and their documented impacts to these communities: *http://www.nj.gov/dep/njisc/docs/Final%20NJ%20Strategic%20Management%20Plan%20for%20Invasive%20Species%2011.09.pdf.* Since the list of invasive species for New Jersey is dynamic and continuously increasing it is important to check with the USDA, through their Invasive Plant Center (*http://www.invasivespeciesinfo.gov/index.shtml*). The USDA continuously updates an invasive plant list for New Jersey.

Because of it's unique location along the Atlantic Bird Flyway, near Delaware Bay, and the Chesapeake Bay regions, design review for Rowan landscapes shall also take into account plants listed as invasive in Delaware, Maryland and Pennsylvania. (Further information is available at *http://www.eddmaps.org/tools/statereport.cfm?id=us_nj and http://franklingcnjec.files.wordpress.com/2014/04/list-of-non-native-plants-in-new-jersey.pdf*).

A species cannot be considered native to a particular geographic region merely because it occurs natively somewhere within the continental United States. The USDA database lists native plants by County throughout the United States. The following link is for Gloucester County, New Jersey (location of Rowan University) and lists all 955 known native plants species: *http://www.state.nj.us/pinelands/.*

NATIVE, NON-NATIVE, AND INVASIVE PLANT SPECIES

To maximize diversity of native species on the campus it is important that local New Jersey native plant nurseries be utilized as sources for plant material. Nurseries that are known to specialize in New Jersey native plant production: Clemenson Farms Native Nursery, Estell Manor NJ;D&R Greenway's Native Plant Nursery, Princeton, NJ;Earth First Native Plant Nursery and Gifts, Egg Harbor City, NJ; New Moon Nursery, Bridgeton, NJ; Pinelands Nursery and Supply, Columbus, NJ; Steinbeiser's Farm and Native Plant Nursery, Frenchtown, NJ; Toadshade Wildflower Farm, Frenchtown, NJ; Wild Ridge Plants, Hillsborough, NJ

Native plant nurseries may not always have large specimens because their materials are often used for environmental restoration, where smaller specimens are frequently used. A campus requires sizable landscape specimens, especially woody plants planted in high pedestrian traffic zones. There are over 200 nursery growers in the State of New Jersey. Many of these nurseries while not known as native plant nurseries grow a limited amount of native species in large landscape sizes. The New Jersey Nursery and Landscape Association (NJNLA) have over 600 members across the State. They maintain a partial inventory of plants grown by their membership. In addition, a number of highly professional growers (example Tuckahoe Nursery) remain unaffiliated with the NJNLA. *Contact information for the NJNLA is 609-291-7070.*

The Borough of Glassboro is located near the New Jersey Pine Barrens. Extensive studies of this unique ecological landscape and its plants have been documented by a number of State, Federal and private agencies and organizations. The New Jersey Native Plant Society provides an excellent example of how to landscape with New Jersey Pine Barren native plants (*http://www.nj.gov/pinelands/infor/fact/Native_Landscaping_brochure*).

Georgian Court University provides a photographic and descriptive inventory of 60 out of more than 800 plants native to the New Jersey Pine Barrens (*http://www.georgian.edu/pinebarrens/index.htm*).

GENERAL PLANTING CONSIDERATIONS

The basic soils of the Rowan campus are sandy to sandy loam with minor pockets of fairly heavy clay. Originally, in the undisturbed woodlands where the campus now lays, the sandy soils would have accumulated large amounts organic matter in the woodland interior allowing it to support moisture-loving plants (both hydric and mesic). Cleared of the native woodlands, the organic matter in the soil rapidly oxidized, leaving sandy conditions prone to extremes of heat and drought during the growing seasons.

Root loss is often extensive during the digging and transplanting of woody plants (trees and shrubs) and nursery pampered plants, heavily watered and fertilized, do not typically develop extensive root systems. The transplanting of plants from nursery conditions to campus conditions requires the installation of irrigation for all projects. The irrigation system may be terminated by Facilities Operation after establishment.

Rowan University's main campus has been declared by the Board of Trustees as an arboretum. The essence of this arboretum is that it becomes an integrated part of the community. Because of the scale and scope of Rowan's arboretum, the planning and implementation of the arboretum must be both practical and sustainable, meeting both microclimate site conditions, as well as serving the many complex needs of a community of students, staff and visitors.

Landscapes, by their very nature, are dynamic spaces, changing with the seasons and evolving over time. Plants can be specified to complement one another. Flowers appear at different times of the season, growth surges are evident, fall colors are sequenced and include subtle to vibrant hues, winter conditions highlight bright berries and evergreen species, branches and trunks vary with distinct textures of bark and branching patterns. With the right landscape elements a landscape attracts all manner of wildlife, from butterflies to birds and even small mammals. By integrating appropriate habitat provisions for these creatures the campus is be enlivened and a routine daily walk will be far from monotonous. All senses can be stimulated with the sights, sounds, textures, and fragrances of the landscape shaping the experience of the passersby.

Access Considerations

Design landscape plantings so that they do not interfere with emergency vehicle access including:

- Fire trucks with outriggers extended and support equipment scattered about
- Accommodate the turning radii of 50 + foot long vehicles
- Accommodate the vehicles, even on certain walks, weighing 80,000 pound

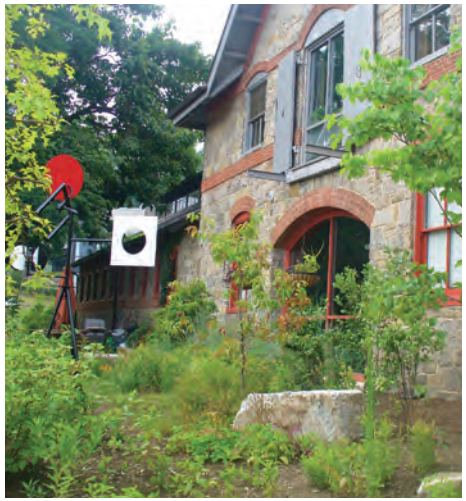
Design landscape for maintenance access including

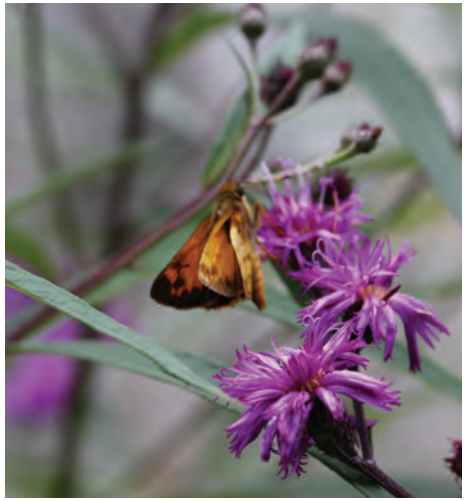
- Cranes working on roof top mounted machines and equipment
- The off- and on-loading of heavy equipment and materials by Rowan University trades and contractors.

Design landscape for storm abatement including:

- Minimizing the need for time and labor consuming hand snow shoveling
- Accommodating the turning radius of 30 hp. to 40 hp. snowing plowing tractors on pedestrian walks and patio/ plazas.
- Accommodating the turning radius on roads and in parking lots of plow trucks and heavy front end loaders.
- Account for the need to stock pile, in strategic locations, large volumes of salt laden snow and ice within a landscaped area.

CONSIDERATIONS BY LANDSCAPE POSITION





STREETSCAPES

- Plants selected for a streetscapes must be rock salt tolerant (sodium chloride), able to handle intense heat reflected off walls and pavement, have a capacity to endure very dry conditions and poor soils, and thrive in a reduced oxygen environments.
- Trees selected for streetscape areas should not be a species that generates fruits.
- Streetscape Trees should have plunging root structures (tap root types) and not shallow (fibrous) root structures that eventually heave pavement. Avoiding trees prone to wind throw should also be a consideration.

PATIOS AND PLAZAS

- Patios and Plazas, like streetscapes, are subject to similar urban stress factors. Since it is standard practice to use front-end loaders and power brooms during snow removal operations on the campus raised planter boxes may have snow mixed with rock salt stacked up on top of walls. Salt tolerant plants should be considered.
- Consider the effects of reflected heat and available soil moisture on plant survival for these locations.

AROUND BUILDINGS

- The goal should be that stormwater management and ornamental landscapes around building foundations are seamlessly woven together for a coherent landscape.
- Building entrance landscapes should provide year round aesthetic appeal. To meet aesthetic needs a combination of native and indigenous species may be specified in areas that do not directly interface with natural areas. Natural areas that interface with the buildings should incorporate natives.
- As with streetscapes and patio/plaza landscape entrance ways may be heavily treated with ice melts. For the protection of paved surfaces in these busy areas it is standard practice on campus to use ice melt products containing low levels of calcium and sodium and high levels of magnesium. Magnesium-based ice melts do not react with concrete at the corrosive level of rock salt, but nevertheless introduce a chemical into the soils of the adjacent landscape. Trees such as London Plane and shrubs such as viburnum species actually have an affinity for magnesium. Typically magnesium as a hydroxide will not raise soil PH above 7 and many ornamental plants will flourish under its influence.
- A significant characteristic of the plants used for stormwater management is an ability to be resilient in extreme wet and dry conditions. A good resource for plants to be used in bioretention is the Native Plant Society of New Jersey: *http://www.npsnj.org/pages/nativeplants_Rain_Gardens.html*

ROWAN UNIVERSITY SUGGESTED TREE SPECIES

A list of tree species, varieties and cultivars was prepared in 2010 by Rowan University to meet the mandated state requirements for tree replacement, as a result of removing a forested area to construct the Rowan Boulevard Storm Water Retention Pond. New Jersey Department of Environmental Protection (NJDEP) allowed Rowan University to install replacement trees anywhere on the 226 acre main campus. During the development of this list, it became clear that it could also serve as the foundation for a campus arboretum. The Rowan University Board of Trustees designated the entire main campus to be an arboretum in 2012. The list provided below was accepted by the New Jersey Department of Environmental Protection (NJDEP) as the framework for reforestation activity.

The quantity of a given species or variety shall continue to be based on achieving aesthetically pleasing designs that also promote environmental health and function in the landscape. For example a number of species or varieties can and should be used to achieve a cohesive streetscape. The intent of the list is to provide flexibility. Design work should not result in a collection of random specimens. Each area involving new or renovated landscapes should include the number and types of trees that promote a coherent landscape experience. Suggested tree species below are listed by landscape category/location.

Appropriate native shrubs and herbaceous plants in Gloucester County can be found here: *http://www.npsnj.org/pages/nativeplants_Plant_Lists.html*

STREET/CURB LAWN TREE TYPES

This group of trees will be used on campus to line roadways and thoroughfare type walks to form rigid geometric patterns, and architectural backdrops.

- *Acer nigra* cultivars -Black Maple
- *Acer rubrum* cultivars -Red Maple varieties
- *Acer rubrum x saccharinum* hybrids -(example Autumn Blaze, Freeman)
- *Acer saccharium* cultivars -Sugar Maple
- *Aesculus flava* -Yellow Buckeye
- Aesculus glabra -Ohio Buckeye
- *Celtis occidentalis* -Hackberry
- *Celtis pumula* -Dwarf Hackberry
- *Corylus colurna* -Turkish Filbert
- *Ginko biloba* varieties -Ginko Tree
- *Gleditsia tricanthos* cultivars -Honey Locust
- *Gymnoclatus dioicus* -Kentucky Coffee Tree (male and female)
- *Magnolia grandiflora* and varieties -Southern Magnolia
- *Platinus occidentalis x oriental* is -London Plane Tree
- *Quercus imbricaria* -Shingle Leaf Oak
- *Quercus macrocarpa* -Bur Oak
- *Quercus phellos* -Willow Oak
- *Quercus prinus* -Chestnut Oak
- *Quercus shumardii* -Shumard Oak
- *Tilia americana* cultivars – American Basswood
- *Tilia cordata* cultivars -European Linden
- *Zelkova serrata* -Japanese Zelkova

LARGE TREES FOR MASS PLANTING/RE-FORESTATION

This group of trees will be used for screening and creating canopied open space; will have to handle low fertility levels and periodic drought.

- *Abies concolor* cultivars-White Fir
- *Abies firma* -Japanese Fir
- *Cunninghamia lanceolata* -China-fir
- *Cedrus alantica* cultivars -Blue Atlas Cedar
- *Cedrus deodara* cultivars –Deodara Cedar
- *Cedrus libani* cultivars -Cedar of Lebanon
- *Chamaecyparis nootkatensis* cultivars-Alaska Cedar
- *Chamaecyparis obtusa* cultivars -Japanese Cypress
- *Cupresscyparis leylandii* -Leyland Cypress
- *Ilex aquifolium* cultivars/hybrids -English Holly
- *Ilex chinensis* cultivars/hybrids -Chinese Holly
- *Ilex opaca* cultivars - American Holly
- *Larix laricina* -Tamarack
- *Liquidambar styraciflua* - Sweet Gum
- *Liriodendron tulipifera* -Tulip tree
- *Liriodendron chinensis* -Chinense Tuliptree

- *Nyssa sylvatica* –Black Tupelo
- *Oxydendron arboretum* -Sourwood
- *Picea abies* -Douglas Fir
- *Picea concolor* -White Fir
- *Pinus aristata* -Bristlecone Pine
- *Pinus bungeana* -Lacebark Pine
- *Pinus ponderosa* -Ponderosa Pine
- *Pinus monticola* -Western White Pine
- *Pinus strobus cultivars* -White Pine
- *Pinus taeda* -Loblolly Pine
- *Pinus virginiana* -Jersey Pine, Virginia Pine
- *Populus deltoides* -Eastern Cottonwood
- *Taxodium ascendens* - Pond Cypress
- *Taxodium distichum* – Bald Cypress
- *Thuja occidentalis* cultivars -American arborvitae, White Cedar

UNDERSTORY TREES
Shade-tolerant flowering trees

- *Cercis canadensis* varieties -Eastern Redbud
- *Cercis chinensis* -Chinese Redbud
- *Cornus alterifolia* -Pagoda Dogwood
- *Cornus florida x kousa* varieties -Rutgers Dogwood Series
- *Cornus kousa* varieties -Kousa Dogwood
- *Cornus florida* varieties – Flowering Dogwood
- *Chionathus virginicus* -Fringe Tree
- *Halesia tetraptera* varieties -Carolina Mountain Silver Bell Tree
- *Magnolia macrophyllum* -Big Leaf Magnolia
- *Magnolia stellata* varieties -Star Magnolia
- *Magnolia tripetala* -Umbrella Tree
- *Ostrya virginiana* -Hophornbeam
- *Prunus laurocerasus* varieties -Cherry Laurel
- *Sassafras albidum* -Sassafras
- *Taxus cuspidate* varieties -Japanese Yew
- *Taxus baccata x cuspidate* varieties -English Yew Hybrid

SMALL TO MID SIZE FULL SUN FLOWERING AND NON-FLOWERING DECORATIVE TREES

- *Aesculus hippocastanum* -Horse Chestnut
- *Acer campestre* Hedge Maple
- *Acer ginnala* -Amur Maple
- *Acer palmatum* varieties -Japanese Maple
- *Amelanchier lavis* -Alleghany Serviceberry
- *Amelanchier canadensis* -Juneberry
- *Cotinus coggyria* -Smoke Tree
- *Crataegus phaenopyrum* -Washington Hawthorn
- *Lagerstromeia indic*a varieties -Crepe Myrtle
- *Malus spp* varieties -Crabapples
- *Myrica cerifera* -Southern Bayberry
- *Myrica pennsylvanica* -Northern Bayberry
- *Photinia x fraseri* - Photinia
- *Salix discolor* -Pussy Willow
- *Salix babylonica* – Weeping Willow
- *Sorbus aucuparia* varieties -Rowan Tree (European name), Mountain Ash (North America name)
- *Styrax japonica* -Japanese Snowbell
- *Syringa pekinensis* -Peking Lilac
- *Syringa japonica* varieties -Japanese Lilac
- *Vitex agnus castus* -Chaste Tree

SPECIMEN/ACCENT TREES
Less common species and highly ornamental types

- *Castanea chinensis* -Chinese Chestnut
- *Castanea dentate x chinensis* -American Chestnut hybrids
- *Cercidiphyllum japonicum* -Katsura Tree
- *Chamaecyparis lawsoniana* varieties -Lawson's Cypress
- *Chamaecyparis pisifera* varieties -Sawara Cypress
- *Claudrastis lutea* -Yellowwood
- *Fagus grandifolia* -American Beech
- *Fagus sylvatica* cultivars -European Beech
- *Franlinia altamaha* -Franklin Tree
- *Gordonia lasianthus* varieties -Gordonia
- *Koelrauteria paniculata* -Golden Raintree
- *Laburnum anagyroides x alpinum* -Golden Chain Tree
- *Magnolia acuminata* varieties -Cucumber Tree
- *Magnolia acuminate x denudate* varieties -Includes Sister Series
- *Magnolia denudate* varieties -Yulan Magnolia
- *Magnolia kobus* -Kobush Magnolia
- *Magnolia liliflora* varieties -Mulan Magnolia
- *Magnolia virginiana* varieties -Sweet Bay Magnolia
- *Metasequoia glyptostroboides* -Dawn Redwood
- *Pinus thunbergii* -Japanese black Pine
- *Sequoia sempervirens* -Coast Redwood
- *Taxodium distichum* -Bald Cypress
- *Taxodium ascendens* -Pond Cypress
- *Tilia tomentosa* -Silver Linden
- *Ulmus ameicana* (varieties showing disease resistant) - American Elm

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Appendix VI–University Garden, Arboretum Initiatives & Cultural Corridors

THE UNIVERSITY'S VISION FOR CAMPUS GARDENS AND AN ARBORETUM

Photos courtesy of Rowan University

Garden spaces on Rowan's campus

The University has been planning for a number of garden initiatives across the campus, as well as considering the campus as an arboretum. This appendix acts as a compendium of the materials developed to date by the University. Much of this stems from the President's interest in a garden campus.

There are potential synergies, mentioned in the body of this master plan, where gardens can provide multiple benefits, from stormwater management to habitat for native pollinators. The aim would be to make sure that future gardens integrate these important functions whenever possible, in order to support a resilient and sustainable campus. Non-native invasive species should be avoided in all gardens on campus, and those gardens located close to the Chestnut Branch corridor should maximize the use of native plant species that promote ecosystem function and stream health.

AN ARBORETUM–THE UNIVERSITY'S VISION

The arboretum at Swarthmore College

DEVELOPMENT OF A ROWAN ARBORETUM

Sixty-one percent of incoming freshman students pick the school they choose to attend based on appearance, according to the findings of the late Carnegie Foundation researcher Ernie Boyer. This statement has become anecdotal for many campus planners. First impressions play a part in many students' decision-making process, giving campus landscape a substantial role in the enrollment success of schools across the country.

An arboretum's mission is complex and multi-faceted, bridging environmental aesthetics, education and information, research, conservation and preservation, and public service. An arboretum is essentially a "living museum" specializing in long-term collections of mostly woody plants. Designated areas are set aside by an institution for the growing and display of various kinds of ornamental trees, shrubs, plants and vines. 3 Often these trees and shrubs are cultivated for scientific, ornamental or other educational purposes with the result that specimens or collections are arranged to demonstrate systematic relationships, commercial uses, or to show ecological adaptations. Each plant is accessioned, labeled, cataloged and mapped as part of the systematic method of display.4

Given its setting, historic buildings, specimen trees and shrubs that have flourished over the many years of its existence, Rowan University already has the beginnings of a campus arboretum.

The aim is for the establishment of an arboretum in the areas of the core buildings, University Green and other highly trafficked areas around the campus buildings. Eventually, the Rowan University arboretum can serve as the overarching theme for the entire campus, bringing a sense of much-needed continuity and connectivity within the main campus, integrating pedestrian and bicycle pathways with natural areas and other open space systems.

The Rowan University arboretum will be enhanced by gardens, provide experiential education opportunities and be designed by the Rowan community with assistance from the department of Facilities. The arboretum and gardens will be connected by paths and tell a story,

Garden themes could include cottage Gardens, rose gardens, edible Gardens, Islamic gardens; butterfly gardens, gardens that attract birds, intimate seating areas, small seating areas and many others. Four approaches for sustainable landscape will be emphasized: xeriscaping, permaculture, integrated plant management and creating educational programs. Students and other members of the Rowan community can participate in planting, labeling of trees, maintenance and the development of themes and plans for the gardens.

Furthermore, by showcasing the college's commitment to a beautiful and meaningful open space and educational environment, the Arboretum and gardens will serve as an indispensable tool for student recruitment and for affording an even more special and memorable setting for Spring graduation ceremonies, as well as for visitors of campus events year-round.

This initiative will be potentially funded and managed by the schools, nurseries and donors. The Rowan University Foundation can conduct fund raising for the project; in fact, it can become a visible leading edge for a broader fund raising effort for art, and other open space enhancements

The arboretum could be managed from the greenhouse, which will also be the home for the propagation of exotic plants and research. (An Arboretum committee could be formed for the initial arboretum planning and management).

In summary, the Rowan University Arboretum and gardens will enhance the aesthetic, educational, and public service qualities of the campus while promoting conservation and preservation of plants. The incentives to develop an arboretum go beyond the social, environmental and economic goals to embrace the benefit for students, faculty, staff and visitors.

Other Universities that have embraced the Arboretum concept

- The Scott Arboretum of Swarthmore College was bequeathed as a living memorial to Arthur Scott (Swarthmore Class of 1895), with a mission to display plants suited for home gardens in the area and educate the public.
- The Temple University campus in Ambler, Pennsylvania was designated an arboretum in 2000, allowing the university to apply for grants it was not previously eligible for.
- Hofstra University transformed its campus from a paved airbase to a beautiful arboretum with a bird sanctuary, becoming one of only 15 private colleges to be named a member of the American Association of Botanical Gardens and Arboreta (AABGA).
- Cornell University has a bird sanctuary, an arboretum, a botanical garden and thousands of acres of protected natural areas.
- A Shakespeare Garden at Vassar College includes specimens mentioned in Shakespeare's works.
- The University of New Hampshire is home to a major arboretum committed to expand its mission of sustainability to the whole campus with all future landscapes (Hart, 2003)
- Pennsylvania State University, one of only three "Big Ten schools" lacking a dedicated area for the study of plants, is raising funds for an arboretum that will be a model for sustainable management. The facility will be dedicated to teaching, research, outreach and extension on such themes as biodiversity, conservation, preservation of environmental quality in urbanizing landscapes, and the restoration of degraded forests and fields.
- The University of North Carolina at Wilmington (UNCW) has pegged the development of its arboretum to campus growth as a means of offsetting campus development and to fulfill a mission calling for campus preservation and conservation. Importantly, a UNCW administrator noted of the development of the arboretum, "this project will position us well as a university."
- The University of Virginia, Michigan State and University of Michigan all have arboretum collections.

GARDENS–THE UNIVERSITY'S VISION

Photos courtesy of Rowan University

Gardens may be maintained through a combination of student and community volunteers.

The gardens are envisioned as a catalogue of the senses, providing opportunities for partnerships by creating spaces that are beautiful and sustainable places for people and wildlife. Paths through the gardens may help tell the stories that celebrate Rowan's history and speak of the intrinsic connections between nature and the human community. The planned locations for these gardens are noted in the Master Plan chapter.

Intent

To provide a creative avenue for participation by the Rowan community, volunteers and the plant industry by developing place-based environments that enhance and support the university goal of an aesthetic and integrated learning open space.

Goals

- Support implementation of the Stormwater Management and Landscape Master Plan by reducing areas of turf and creating aesthetically pleasing and functional open spaces.
- Create a connected open space program that educates and involves the Rowan and garden community.
- Promote 'ownership' of open spaces on campus by working with volunteers from the Rowan and wider community.
- Understand the importance and critical need for regular maintenance of open spaces on campus and the need for joint responsibility of staff and the Rowan community for its execution.
- Use the gardens as an avenue to organize the Rowan community, and regional and local volunteers to develop skills and practice socially-responsible learning and landscape practices.
- Develop open spaces in targeted areas on campus as gardens with different themes (butterfly, edible, rose, wildlife habitat, cottage, xeriscape, permaculture, meditation, etc.)

All sketches courtesy of Rowan University

Garden sketches for locations across campus

ARTS AND CULTURE CORRIDOR AT ROWAN UNIVERSITY

A proposal prepared by Mary Salvante
Submitted by Mary Salvante & Melanie Stewart

INTRODUCTION

Public engagement, community building, and economic development plans that are strategically built around arts and cultural activities through partnerships from public, private, non-profit, and community sectors is a practice commonly termed creative place-making. It is a methodology that is key to creating a vibrant and sustainable cultural destination that can lead to capacity, audience, and revenue generation. When built into a marketing, master, and strategic plan the funding potential becomes enormous with support coming from both state and federal foundations.

PROPOSAL

In an effort to align with creative place--making practices, we propose leveraging The Arts At Rowan and the Glassboro Arts District as a contiguous cultural corridor of arts and culture activity. Technologies, that include both physical and digital elements, would be developed to interact with the cultural venues such as: GPS mapping, App locators, QR code and text messaging platforms. Physical indicators would be prompts built into architectural elements, or fabricated stations that could be graphically, or color--coded to correspond to maps and websites. Development of these technologies would encourage STEAM-focused collaborations with the engineering clinic, business school, and creative design areas. It will also encourage participation with representatives for the community, town, and student governments.

Cultural Corridor is concept name in which to frame thinking and discussion around capacity building for the arts and culture at Rowan. The name suggests a significant sector, or district that exists within a larger entity or unit. It delivers a perception of containment, which suggests ease in use and access, but remains fluid and non-delineated so a user can be non-objective in their exploration, and so new venues can be added as they emerge. The make-up of the Cultural Corridor would include public and private spaces, or hubs at the university and within the community including, but not limited to: Wilson and Bunce Theaters, the Rowan Art Gallery, Planetarium, Rowan TV and radio stations, Campbell Library, the Barnes and Noble book store, and the new downtown Glassboro spaces. Interwoven within these hubs would locate fixed elements such as the public art, signature green spaces, and outdoor classrooms and amphitheaters.

OUTCOMES

Establishing the Cultural Corridor footprint allows for more targeted marketing and promotion plans, educational collaborations, self-guided and docent guided tours, fundraising and donor giving plans and more. While these are much needed tangible outcomes the university also benefits from the intangibles that come from recognizing the arts as essential to a healthy, balanced, and vibrant environment in which to work and learn and play. The overarching achievement will ultimately be locating Rowan University as an arts and culture destination for our region.

Appendix VII–Master Planning Considerations

COMPARISONS AND CONTRASTS TO THE FACILITIES MASTER PLAN (2013)

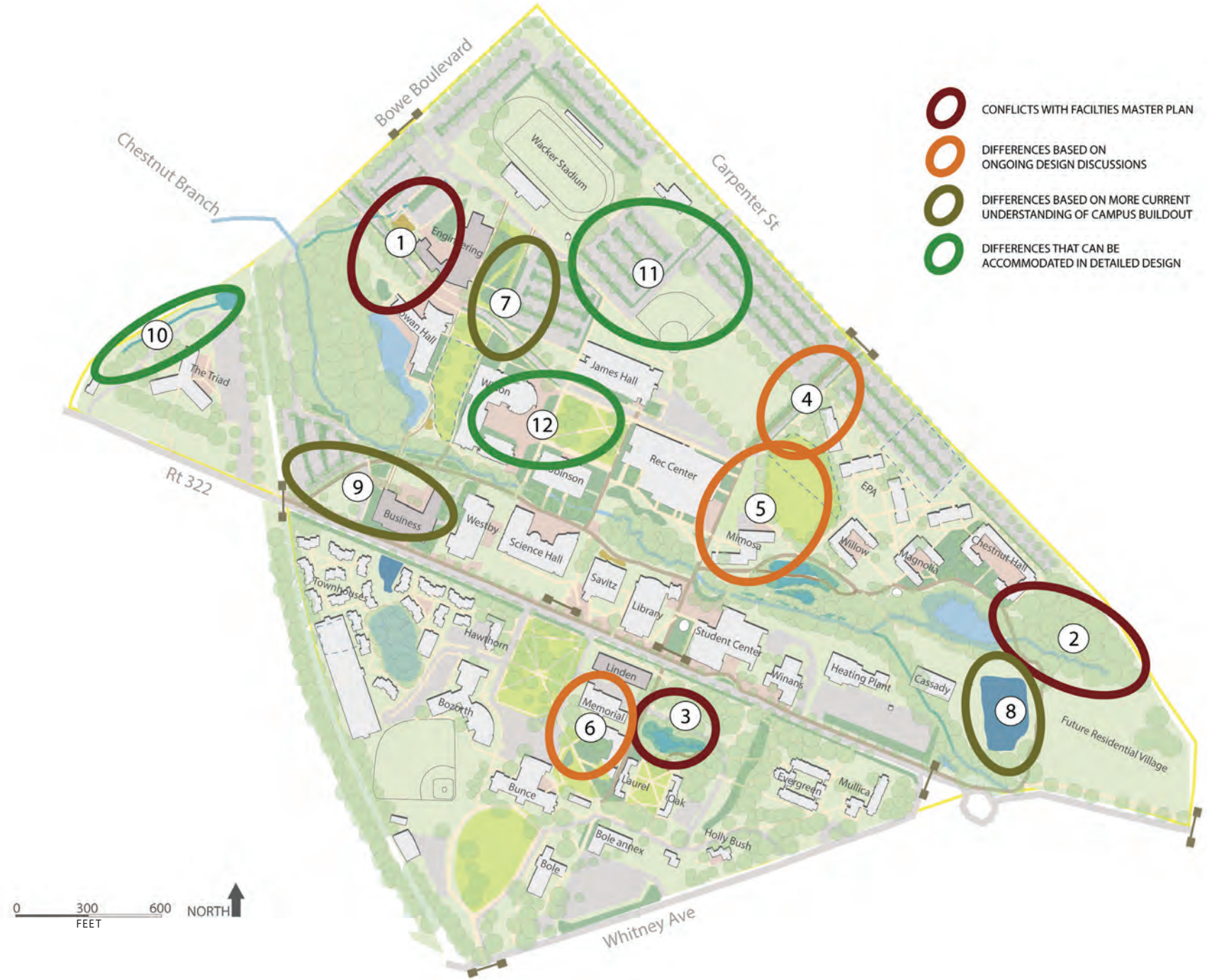
Sasaki Associates

The master plan previously developed for the campus

In 2013 an addendum to the 2007 Master Plan was issued by the Sasaki planning team, addressing significant changes in the University's status and priorities and responding to the University's new designation as a Public Research University, effective July 1, 2013. The 2007 Master Plan, and the 2013 addendum, reflected the rapid ascendancy of the institution since 1997, when it acquired University status. It considered continuing enrollment growth, improved accommodation of a growing range of academic offerings, and enhanced residential and student life investments to create a signature student experience.

When planning for a stormwater and landscape management approach for the campus began in 2014 it was important to the University that the past planning efforts inform the Stormwater Management and Landscape Master Plan in a meaningful way. To that end, the 2013 Facilities Master Plan was used as a starting point. However, in the course of this most recent planning effort it became clear that with the current understanding of ecological and hydrological conditions there would be opportunities to shift certain elements of the Facilities Master Plan.

This appendix serves to outline and describe the differences between the past plan and this plan. On the following page a diagram shows the locations of the differences. Some of these are direct conflicts between the past plan and the current trajectory of development and suggested conservation efforts for improved ecological function *(circled in red on the diagram that appears on the next page)*. Some are locations where there are differences between the past plan and current design discussions, associated with mitigating serious stormwater management issues (*circled in orange*). Others are differences based on a more current understanding of campus growth (*circled in brown*). Finally, there are a few locations where there are differences between the earlier plan and this plan, which could be accommodated with further detailed design (*circled in green*).


CONFLICTS WITH FACILTIES MASTER PLAN
DIFFERENCES BASED ON ONGOING DESIGN DISCUSSIONS
DIFFERENCES BASED ON MORE CURRENT UNDERSTANDING OF CAMPUS BUILDOUT
DIFFERENCES THAT CAN BE ACCOMMODATED IN DETAILED DESIGN
Bowe Boulevard
Chestnut Branch
Carpenter St
Rt 322
Whitney Ave
Wacker Stadium
Engineering
Rowan Hall
James Hall
The Triad
Rec Center
Business
Westby
Science Hall
Townhouses
Savitz
Library
Student Center
Hawthorn
Linden
Memorial
Bozorth
Bunce
Laurel
Oak
Bole annex
Bole
Holly Bush
Evergreen
Mullica
Winans
Heating Plant
Cassady
Future Residential Village
EPA
Mimosa
Willow
Magnolia
Chestnut Hall
1
2
3
4
5
6
7
8
9
10
11
12
0
300
600
FEET
NORTH

Location ID	Facilities Master Plan (2013)	Stormwater Management and Landscape Master Plan Differences and Rationale
1	Engineering Bldg expansion and parking deck	A revised location for the Engineering expansion now resides to the east. This location is suggested as part of a proposed green infrastructure enhancement and stream daylighting (stormwater treatment cells and swale) that follows the historic tributary to Chestnut Branch. The proposed green infrastructure feature conflicts with the facilities master plan parking deck. As further parking analysis is conducted, a decision on which of these elements is more valuable and appropriate for this campus location should be made.
2	New Buildings	This is an important forest conservation area in this plan, as a part of the East-West Chestnut Branch and riparian woodland corridor. The plan suggests that this be preserved and enhanced as mature native woodland, maintaining the natural stream corridor that flows through and feeds Abbotts Pond. Nature trails can be integrated within the woodland with the development of Freshman Village. Maintaining this area as forest will generate less runoff than a developed site which supports the overall flood reduction strategy of the plan.
3	Linden Hall and a new building to the north of Linden Hall	A stormwater wetland amenity is planned for this space to manage existing stormwater issues experienced at the current location for Linden Hall. The new wetland creates a seamless natural connection to the Oak Grove, which is suggested to be enhanced and maintained as an important historic campus landscape. This plan suggests that Linden Hall is relocated to the northwest to better support an enhanced frontage along the Rt. 322 corridor. Replacing Linden Hall, as suggested in the Facilities Master Plan, would continue to present water management and flooding challenges in this part of campus.
4	New Buildings	This plan calls for an integrated stormwater design to manage excessive amounts of runoff coming from Carpenter Street, North Campus Drive, and the EPA lot. This treatment system is integrated along North Campus Drive, which has also been noted as an important gateway for entry from the north. Elements of the Facilities Master Plan can still be accommodated in this area, but the flood mitigation goal is a necessary improvement in the area.
5	Mimosa Hall relocation and open space	The plan calls for an integrated stormwater design to manage excessive amounts of runoff coming from Carpenter Street and North Campus Drive which have historically caused flooding at the Recreation Center. This treatment system is an integrated design that incorporates updated circulation, landscape amenities, and an improved campus green outside the existing Mimosa Hall. This design also strengthens another important north/south axis on the campus, connecting to the east/west Chestnut Branch stream corridor. Elements of the Facilities Master Plan can still be accommodated in this area, but the flood mitigation goal is a necessary improvement in the area.
6	Memorial Hall expansion and realignment along Memorial Green	A new stormwater treatment landscape has been constructed outside of Memorial Hall to treat existing stormwater issues. This new amenity provides a landscape with outdoor classrooms and garden spaces. Elements of the Facilities Master Plan can still be accommodated in this area, but the flood mitigation goal is a necessary improvement in the area.
7	Proposed new building location	An expanded and enhanced campus green helps connect the new Business School to the south with the Engineering Building expansion, which creates a strong north/south axis and view corridor. This expanded campus green provides an opportunity for integrated stormwater management in bioretention gardens as well. The new Engineering Building design deviates from the Facilities Master Plan and this Stormwater Management and Landscape Master Plan responds to this design modification.
8	Open Space/ Rec Fields	A stormwater management pond was built here prior to the development of this plan, to manage stormwater from the development along Rowan Boulevard and along the Chestnut Branch stream corridor. This facility needs to remain for water quality and flood control requirements.
9	New Business Building	A revised location and configuration for the Business school building was determined by Rowan that supersedes the Facilities Master Plan. The associated parking is designed with integrated stormwater management and a landscape that responds to the steam buffer and floodplain, providing enhanced ecological value. This becomes the southern focal point of this new north/south axis campus green.
10	Expanded parking for Triad	This Stormwater Management and Landscape Master Plan calls for stormwater conveyance to bioretention that treats runoff from the Triad building and existing parking lot, with an enhanced vegetated edge of campus. The Facilities Master Plan creates a parking area in this location. The two features can be compatible and integrated with each other so long as good planning and design are practiced.
11	Proposed new building location	An interim future plan for this site is for expanded parking, during the construction of the new engineering building. This doesn't necessarily conflict with a long-term plan for buildings here but this Stormwater and Landscape Master Plan only shows the interim parking and not the long-term building scenario.
12	Expanded campus green between Wilson and Robinson Green	Based on feedback from the University during this stormwater and landscape master planning process, this space is envisioned as a combination of hardscape in front of Wilson, to accommodate performances and practice, and a campus green in front of Robinson. This deviates from what is shown in the Facilities Master Plan, but reflects more current thinking about the programming of the space.

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Restore the Earth & Inspire Ecological Stewardship

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