ELLENZWEIG

The University of Rhode Island Narragansett Bay Campus

Campus Master Plan

Volume 1

August 2016

Graduate School of Oceanography

R/V *Endeavor*

University of Rhode Island

OCEAN ENGINEERING

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1.1 Introduction

The Narragansett Bay Campus Master Plan was commissioned by the University of Rhode Island to assess the current condition of the entire Bay Campus and to provide a strategic plan for campus renewal that will serve the University for many years into the future. The Plan for Campus Renewal is intended to elevate the Graduate School of Oceanography into the first tier of oceanographic institutions by addressing the following broad goals:

Support Research and Teaching Mission

- 21st Century Research Facilities
- Long term flexibility and efficiency
- Interdisciplinary collaboration
- R/V *Endeavor* replacement
- Student space

Promote Regional Development

- Public outreach
- Incubator activities/private sector engagement
- Ocean technology

Enhance Resiliency and Ecological Function

- A marine campus model of sustainability
- Energy efficiency and infrastructure
- Land use and building consolidation
- Campus quality

Integrate Plan Components

- Buildings
- Site
- Energy

1.2 Project Process

The Master Plan project was directed by a Steering Committee, comprised of representatives of the leadership of the Graduate School of Oceanography and the Department of Ocean Engineering, as well as senior staff from URI Campus Planning and Design. This group provided guidance to the master planning team throughout the planning process. The process also involved meeting with 15 different user groups comprised of faculty, staff, and students, who provided input toward the development of a detailed space program.

The project spanned approximately 8 months, from project commencement in late 2015 to completion of this final report, published in July of 2016.

The planning effort included the following components:

- Existing conditions analysis
- Program of proposed spaces
- Development of Master Plan for Renewal
- Horn Lab building feasibility study
- Phasing strategy for implementation
- Master plan cost estimate

1.3 Existing Conditions Analysis

As part of the existing conditions analysis, the planning team analyzed all existing campus buildings, as well as campus infrastructure and campus landscape.

Existing building analysis was undertaken to determine whether the existing structures could accommodate the proposed program and meet master planning goals.

The conclusion of the analysis was a recommendation regarding which buildings should remain and which should be removed.

In parallel, the Civil and Landscape consultants analyzed existing site conditions for use in developing a master plan for the renewal of the campus site, including parking, roadways, pathways, campus utilities and planting.

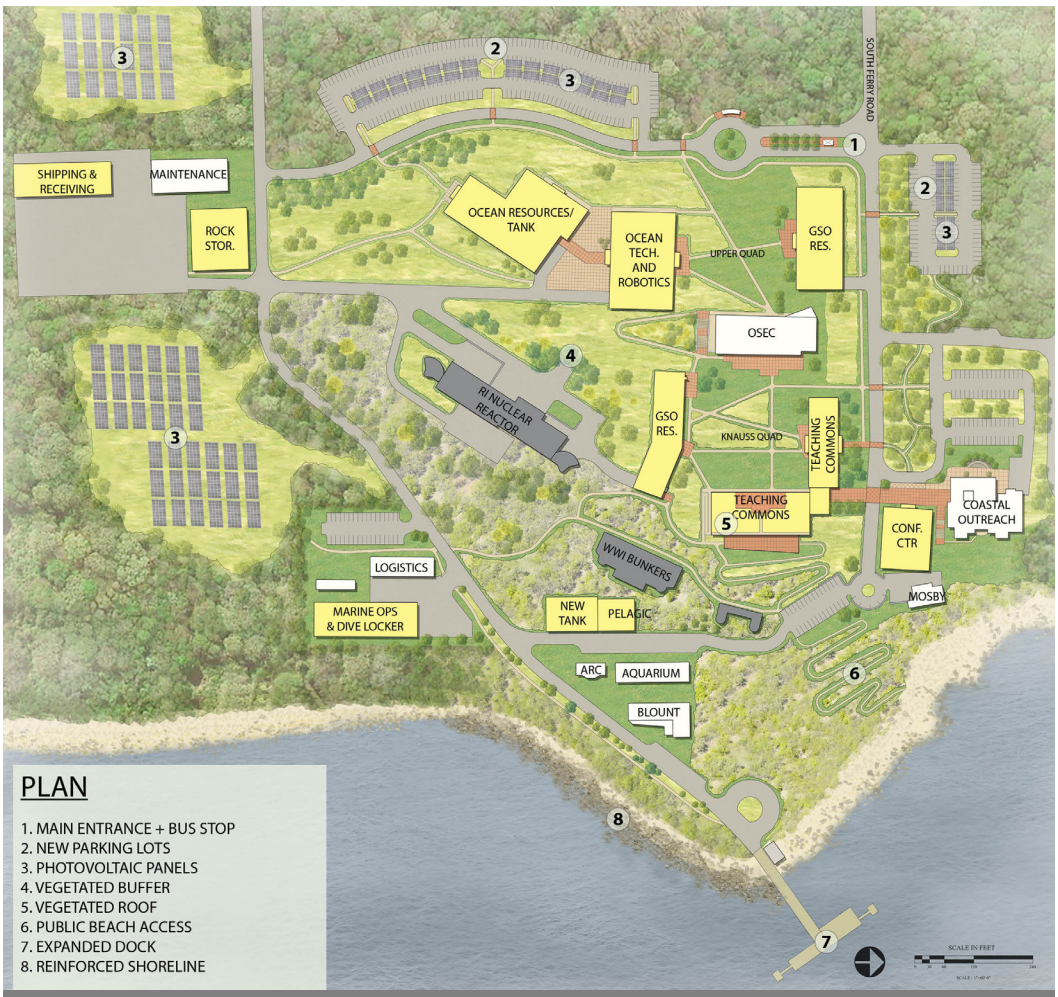
The Building Engineering Consultants analyzed the mechanical, electrical and plumbing systems in existing buildings, and their observations were integrated into the overall evaluation of each existing structure on campus.

1.4 Programming

The goal of the programming process was to establish space needs for all activities across campus. The planning team met with project stakeholders over a three-month period and developed a detailed list of spaces to meet current and future needs. Important programming concepts include promoting interdisciplinary collaboration among researchers, providing modularity and flexibility in research labs to adapt to evolving and future research foci and/or technologies, and enabling the sharing of resources across research groups.

1.5 Master Plan Recommendations

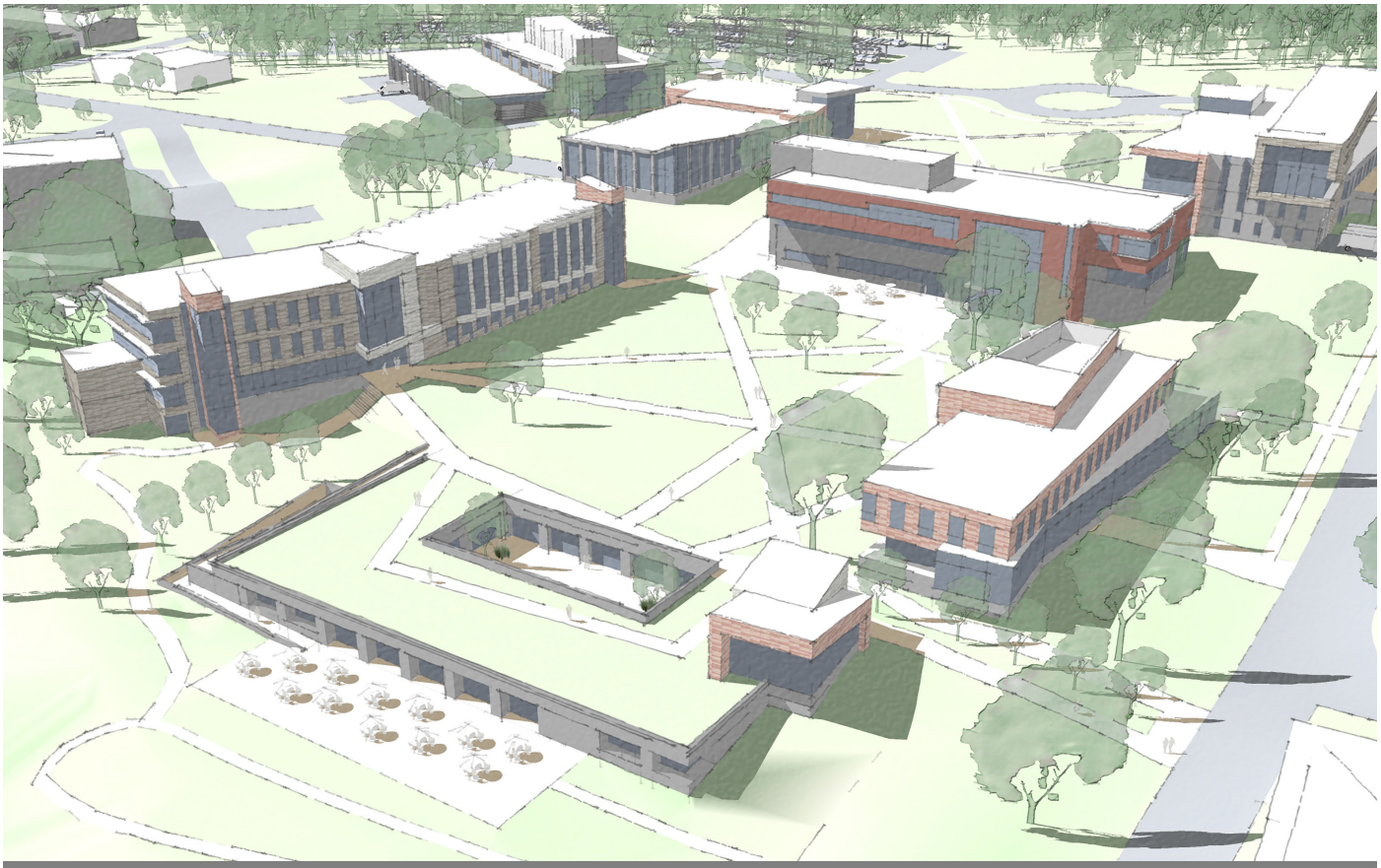
The Recommended Master Plan provides an integrated strategy for complete campus renewal. The plan incorporates recommendations for new and renovated buildings, site and landscape improvements, and sustainable and energy-saving building operation systems. The plan is founded on the notion of *renewal*: the desire to build on the particular features and character of the campus to create a fully re-imagined transformed campus environment.



Master Plan Concept Plan

New Building
Building to Remain
Non - URI Building

The plan makes recommendations for eliminating poor-quality buildings and consolidating functions to create more collaborative, flexible and energy efficient environments, separating pedestrian and vehicular circulation, improving service access and creating a pedestrian campus core; for enhancing the overall campus landscape quality and coastal resiliency, and improving drainage and other utilities. The Master Plan proposes that the Graduate School of Oceanography (GSO) and Ocean Engineering (OE) clearly maintain their individual identities, while fostering an integrated, collaborative campus environment. Finally, the Plan recommends developing a highly sustainable strategy for campus growth, emphasizing energy efficiency and reducing the campus carbon footprint.



Master Plan Concept - View of Knauss Quad from East

Total scope of building projects is as follows:

	GSF
Current Building Area	329,756
Buildings Removed	198,931
Buildings Retained	129,243
New Building Area	270,850
Total New & Retained Building Area	400,093
Additional GSF	**70,337**

1.6 Horn Lab Feasibility Study

The Master Planning team analyzed the feasibility and cost of repurposing the Horn Lab for use either as a Biology Lab building or as a classroom/student building. Based on the high cost and difficulty of renovation, it is recommended that Horn Lab be replaced rather than renovated.

1.7 Phasing Strategy

The Master Planning team worked with the Steering Committee to develop a detailed phasing strategy for the implementation of the Master Plan. The proposed strategy involves a two phased approach, beginning in 2019, with Phase One concluding in 2024, and Phase Two in 2028.

1.8 Cost Estimate

The estimated project cost of the proposed Master Plan totals $285M; Phase One project cost is estimated at $147M, and Phase Two is estimated at $138M.

The planning team assumes that the recommended option will constitute the conceptual and strategic framework for the final design phase of the project. The specific details and plans included in this report will need to be further developed to meet the final needs of the project.

2.1 Introduction

The Narragansett Bay Campus Master Plan was commissioned by the University of Rhode Island to assess the current condition of the entire Bay Campus and to develop a strategic plan for the next cycle of growth.

The campus planning effort was led by a Steering Committee, which provided oversight and direction to the consultant team.

2.2 Steering Committee

The Steering Committee was comprised of the following University representatives:

- Bruce Corliss, Dean, Graduate School of Oceanography
- Tom Miller, Director of Administration, Graduate School of Oceanography
- Dave Palazzetti, Director, NBC Facilities and Operations, Graduate School of Oceanography
- Ray Wright, Dean, College of Engineering
- Chris Baxter, Chair, Department of Ocean Engineering
- Christopher McMahan, University Architect
- Ryan Carrillo, Director, Capital Planning & Real Estate Development

2.3 URI Committee

In the course of the existing conditions analysis, programming and renewal phases, the master planning team met with the following groups in several rounds of meetings:

- Steering Committee
- Biological Oceanography
- Chemical Oceanography
- Geological Oceanography
- Physical Oceanography
- Ocean Engineering
- GSO Administration
- Outreach and Education
- Coastal Resources Center
- Libraries
- Sea Grant
- Marine Operations
- CELS / Seawater Facilities
- Robotics
- Site/Technical/Facilities/IT
- Allen Harbor
- Students

2.4 Planning Team

The Master Planning team included the following firms and individuals:

Ellenzweig
Architects and Planners
230 Congress Street
Boston, MA 02110 ..... Michael Lauber, Principal, Lab Planner
Neil Cahalane, Project Manager
Shirine Boulos Anderson, Design Principal
Peter Pogorski, Senior Technical Architect

Odeh Engineers Inc.
Structural Engineer
1223 Mineral Spring Ave
North Providence, RI 02904 ..... David J. Odeh, Principal

Bard, Rao + Athanas
Consulting Engineers, LLC ,
Mechanical/Electrical/Plumbing Engineer
10 Guest Street
Boston,MA 02135 ..... Allan Ames, Principal
Bryan Rydingsward, Project Manager
Jacob Knowles, Sustainable Design Director

Ellana Construction Consultants
Cost Estimators
120 Presidential Way, Suite 320
Woburn, MA 01801 ..... Craig Holmes, Principal

VHB, Inc.
Civil Engineering
1 Cedar Street
Providence, Rhode Island 02903 ..... Jon Stabach, Principal

Birchwood Design Group
Landscape Architect
150 Chestnut Street, 4th Floor
Providence, Rhode Island 02903 ..... Kris M. Bradner, Principal
Tim Brown, Project Manager

Appledore Marine Engineering
Marine Engineering
600 State Street, Suite E
Portsmouth, New Hampshire 03801 ..... Robert Snover, Vice President

2.5 Project Background

The University:

The University of Rhode Island (URI) is the State's public learner-centered research university. It is a community joined in a common quest for knowledge. The University is committed to enriching the lives of its students through its land, sea, and urban grant traditions. URI is the only public institution in Rhode Island offering undergraduate, graduate, and professional students the distinctive educational opportunities of a major research university. Its undergraduate, graduate, and professional education, research, and outreach serve Rhode Island and beyond. Students, faculty, staff, and alumni are united in one common purpose: to learn and lead together.

Embracing Rhode Island's heritage of independent thought, URI values:

- Creativity and Scholarship
- Diversity, Fairness, and Respect
- Engaged Learning and Civic Involvement
- Intellectual and Ethical Leadership

The Campus:

Located on the coast of Rhode Island, six miles east of the Kingston campus, Narragansett Bay Campus (NBC) is an ideal setting and natural laboratory for studying marine systems and their response to natural and human impacts. The campus houses programs and departments related to ocean research and teaching. The major tenant is URI's Graduate School of Oceanography, founded there in 1961; the campus is also home to the, Department of Ocean Engineering, a part of URI's College of Engineering. Also located on the Bay campus are facilities for several federal agencies: the Environmental Protection Agency (EPA) and National Oceanic and Atmospheric Administration (NOAA) laboratories.

The Narragansett Bay Campus contributes over 30% of the University's annual research revenues and the campus renewal will help ensure sustainability and growth of that contribution going forward. In addition, the campus contributes to the economy both at the local and state level. It is anticipated that the implementation of the Campus Master Plan will significantly increase this contribution; an Economic Impact Study (EIS) will be commissioned to more precisely define the economic outcomes generated by activity on the Narragansett Bay Campus.

Notable features of the Narragansett Bay Campus include infrastructure that provides continuous running seawater to the Ann Gall Durbin Marine Research Aquarium, Ark Annex to the Aquarium, and Luther Blount Aquaculture Laboratory; the Equipment Development Lab, which provides design, fabrication, and test capabilities for scientists; a large geological samples storage facility; GSO's telepresence hub, the Inner Space Center; and numerous specialized research facilities for physical and numerical modeling of large-scale ocean circulation or earth mantle behavior.

The Narragansett Bay Campus also serves as home port for GSO's research vessel, R/V *Endeavor*, with a pier located along the campus waterfront. The R/V *Endeavor* pier allows for efficient staging of cruises and easy access to the open ocean, only a few miles south of the campus.

Although mainly focused on research, undergraduate teaching is also conducted in these facilities Research focus areas include ocean robotics, underwater acoustics, tsunamis, coastal circulation, marine geo-mechanics, ocean structures, and offshore energy generation. The University's long-range plan is to continue to use the facilities at the NBC for ocean related research and teaching activities.

2.6 The Project

The campus, despite its unrivaled setting, needs to address several issues to help URI realize the goals identified by the University. These can be characterized as site and building issues, as follows:

Site Issues:

- Ad hoc building location, appearance
- No concept of "campus" or sense of place
- Poor land use planning
- Inefficient roadways and parking
- Poor pathways/wayfinding/site lighting
- Many buildings are located in coastal flood zone
- The nuclear plant and historic bunkers divide campus

Building Issues:

- There are multiple small buildings
- Limited opportunities for collaboration
- Many "temporary" buildings are now past their useful life
- Many buildings have aging infrastructure/failing envelopes
- Most buildings are energy inefficient
- Many accessibility problems

The purpose of the project is to address these issues in a cost effective and sustainable manner, as described in the following sections.

3.1 Project Process

The Narragansett Bay Campus Master Plan was organized to provide the following deliverables:

- Existing conditions analysis – site, infrastructure and buildings
- Programming of future space needs
- Master plan recommendations
- Horn Lab Building renovation - feasibility study
- Phasing strategy
- Cost estimate

3.2 Project Structure

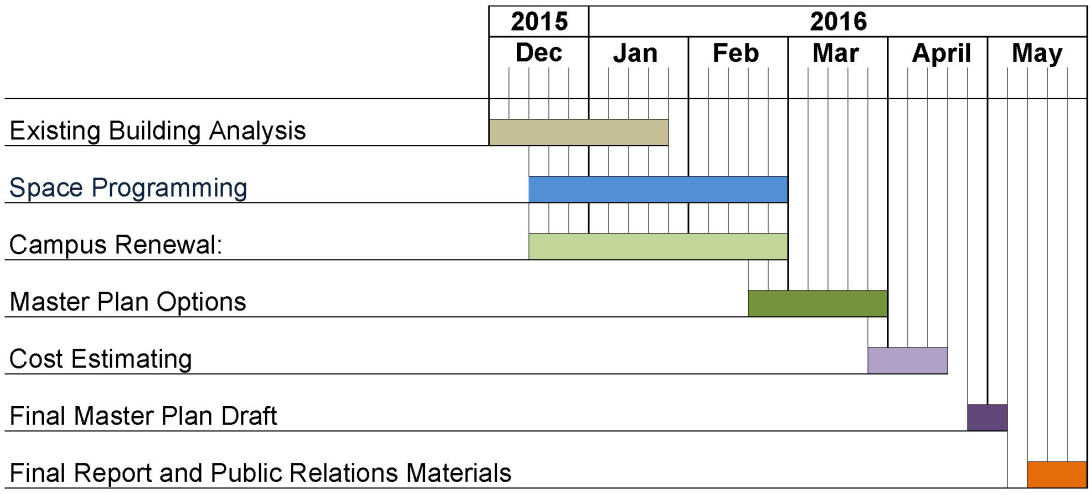
The campus planning effort was organized with a Steering Committee and with 15 specific user groups, providing detailed requirements for all campus components and systems.

The consultant team reported to the Steering Committee at the conclusion of each round of user group meetings and to URI's Senior Leadership at the conclusion of the Draft Plan phase. In addition, the planning team presented to the campus community at the beginning of the study and at the end of the Draft Plan phase.

The planning team and the marine engineering consultant also developed a program and conceptual design for the upgrade of the Allen Harbor property as a teaching, safe harbor and a boat storage/staging/dive program facility.

3.3 Process/Schedule

The study timeline was six months and included the following activities and durations:



3.4 Project Phases

The planning process was organized into two general phases:

1. Existing Conditions Analysis / Space Programming
2. Master Plan Development

During the Existing Conditions Analysis phase, the consultant team reviewed existing site conditions, met with URI facilities' staff, and conducted detailed site and individual building tours to understand existing conditions and make recommendations for improvements. The results of this effort are documented in Section 4 and in the Appendix of this report.

The Space Programming phase of work was performed in parallel to the Existing Conditions Analysis. During this phase the planning team met frequently with faculty and staff to develop a program of specific space needs for the project. The outcomes of this effort are described in Section 5 and in Appendix D of this report.

In the Master Plan phase of work, the consultant team explored a number of master plan options that would accommodate the space program, address the existing conditions issues, and meet the project goals. Once the preferred approach was identified, the planning team worked with the Steering Committee to explore a number of preferred phasing strategies. In parallel, the planning team developed a series of cost/phasing scenarios before arriving at the recommended two phased approach. The results of this work are documented in Sections 6 and 8 of this report.

A number of other activities were conducted in parallel with the activities noted above, and are included in the Master Plan. These include:

- Horn Lab Feasibility: As part of the Study, the planning team studied the Horn Lab Building to examine the relative costs of renovating the building versus replacing it. This effort included detailed architectural, structural, mechanical and code analysis of the existing facility, and the development of a conceptual design for both its re-use and its replacement as a laboratory building. The feasibility study conclusion, to replace Horn with a new research lab building, is detailed in Section 7 of this report.
- Pier Improvements: In order to accommodate a larger regional class research vessel to replace the RV *Endeavor*, the planning team worked with a marine engineering consultant to develop a conceptual design for the pier improvements needed; that recommendation is outlined in Section 6; full documentation is included in Appendix B.
- Allen Harbor: The planning team and the marine engineering consultant also developed a program and conceptual design for the upgrade of the Allen Harbor property as a teaching facility; that recommendation is outlined in Section 6; full documentation is included in Appendix B.
- Site survey: At URI's request, the planning team engaged a surveyor to prepare topographic surveys of the Narragansett Bay Campus and a more detailed survey of the Horn Laboratory project area. These are provided under separate attachment.

3.5 Cost Estimating

At the conclusion of the Master Plan, cost estimates were developed for all of the recommended capital improvements, based on various phasing scenarios. Cost estimates were based on the space program, master plan drawings, and scope of work/basis of design narratives and phasing scenarios prepared by the planning team. These scope-of-work packages were estimated with the appropriate escalation to reflect various phasing schedules to arrive at the final cost estimate included in Section 9 and Appendix F of this report.

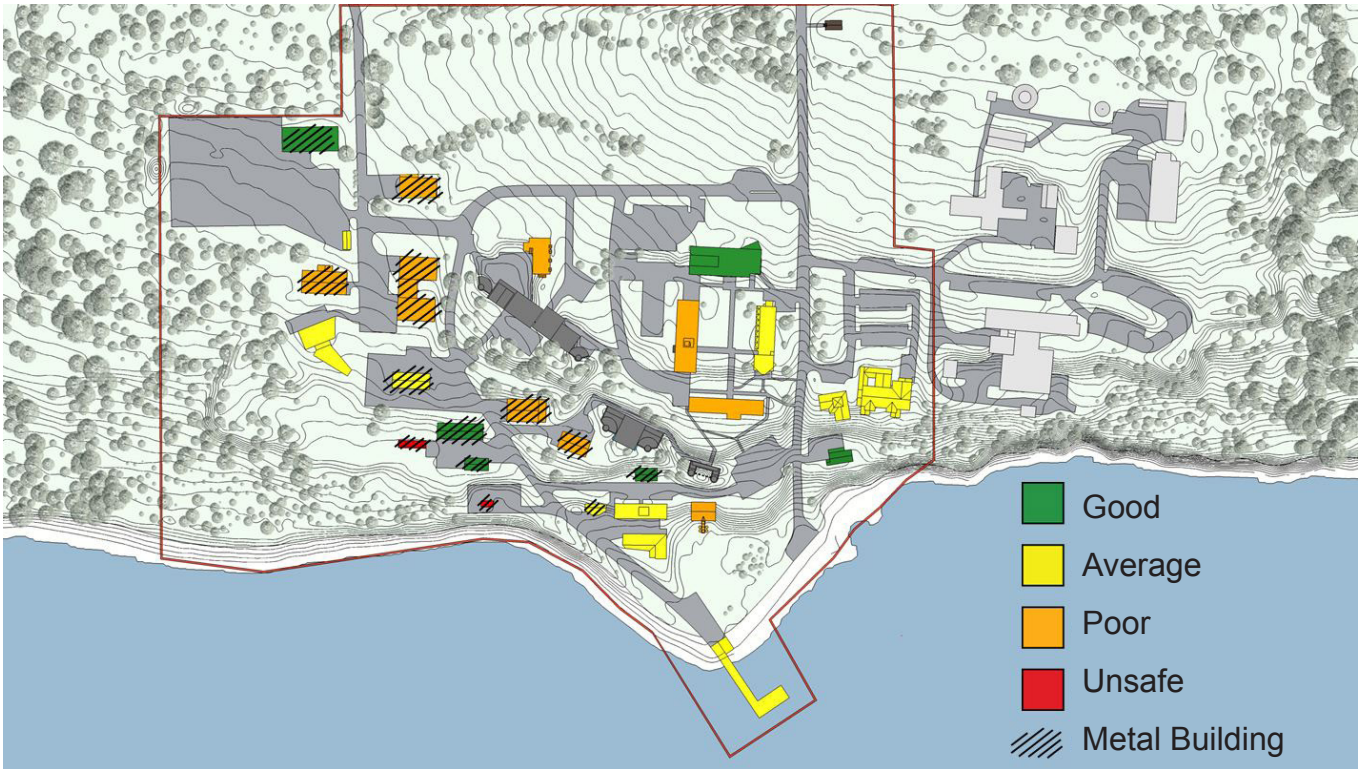
3.6 Final Recommendation

The Steering Committee reviewed the various options prepared by the planning team. The option recommended in this report represents the approach preferred by the committee and is included in Section 6 of this report.

4.1 Existing Conditions Analysis

The planning team analyzed all of the existing buildings, campus infrastructure and landscape. The existing building analysis was undertaken to determine the ability of the existing structures to accommodate the proposed program and to meet the master planning goals. The analysis evaluated the condition of each existing building to determine the feasibility and suitability for re-use, and to establish the likely cost for renovation or replacement. The work involved site visits and analysis by Architectural, Structural, HVAC, Electrical, Plumbing, and Fire Protection consultants.

Existing Site Conditions- Scope of Work



Site Plan- Existing Buildings Conditions

The conclusion of the analysis was the recommended demolition of those buildings that were deemed as unsafe or in poor condition. In addition, several buildings that are in average condition are suggested as being candidates for demolition based on the cost and difficulty of maintaining these facilities beyond the next 10 years. Many of the metal industrial buildings fall into this category, as these are generally outdated and considered incompatible with a campus environment.

Middleton Building - Exterior

Horn Lab - Typical research lab space

In parallel with the existing building analysis, the consultants listed above were joined by the Civil and Landscape consultants in analyzing the site conditions.
The existing conditions analysis is summarized on page 4-2; the detailed existing conditions analysis is included in Appendix D.

Site/ Accessibility

View across South Ferry Rd with MERL beyond

The campus slopes steeply toward the Bay, creating multiple challenging and non-compliant accessibility conditions. Access currently requires vehicular transportation to parking adjacent to individual buildings in some cases. Most buildings and their parking areas do not meet current accessibility standards. The road system provides workable circulation, but has insufficient curb cuts and eroding curbing in many locations.

Architecture

The buildings were constructed between the 1950s and 2013, and total approximately 350,000 gross square feet of space. Some have been relocated. Their structural systems include wood, masonry, steel and concrete, as well as combinations. Nine of the buildings are pre-engineered metal buildings, comprising approximately 25% of the total floor area; seven are shingle-clad, comprising approximately 20%.

The site is subject to strong winds and airborne salt from the Bay, which accelerate corrosion of exposed building components. Primary weather exposure is from the Bay (east), with the most accelerated deterioration evident on the east-facing facades, particularly with wood components. Water leaks are a primary concern. Generally, the buildings need roof repairs, sealant replacement, masonry re-pointing, and wood trim repair including replacement of missing and loose wall shingles.

Those buildings which are presently not fully accessible to persons with disabilities represent a minor investment to upgrade in some cases, and a major challenge in others. Primary challenges include situations where walls must be relocated for required clearances, and conditions where restrooms are staggered on alternating floors by gender with no elevator available. This assessment does not represent a full accessibility survey, but is an evaluation based upon obvious compliance issues. A full analysis of this issue is recommended; not converting them to full ADA compliance can expose the University to legal challenge.

Hazardous materials abatement has reportedly been minimal thus far. We recommend a full survey to support the development of a realistic cost estimate to renovate, relocate or demolish each building.

Several potentially serious concerns have been identified, which require further assessment and are noted in the summary conditions chart following this section, and further discussed in each building's detailed assessment. These include the following:

- Watkins Laboratory: Assess Laminated wood beam crack
- Horn Laboratory: Remove gas pipe from stairwell
- Maintenance Building: Assess life safety: fuel storage and mezzanine egress
- Perkins Small Boat Facility: Assess wood wall girts and roof purlins
- Aquarium Ark: Add thermal barrier over flammable foam wall insulation
- Marine Resources Building: Assess tree trunk column cores decay
- Coastal Institute Building: Assess horizontal crack at precast floor plank, and mold
- Campus-wide issue: Prohibit storage in stairwells

The following minor structures are unsafe, and it is recommended they be demolished, as they appear to be severely deteriorated, and pose potential life safety and/or property damage hazards from masonry collapse and/or wind-borne projectiles:

- Quonset Hut
- Lagoon Mesocosm Control Building

MEP/FP Systems

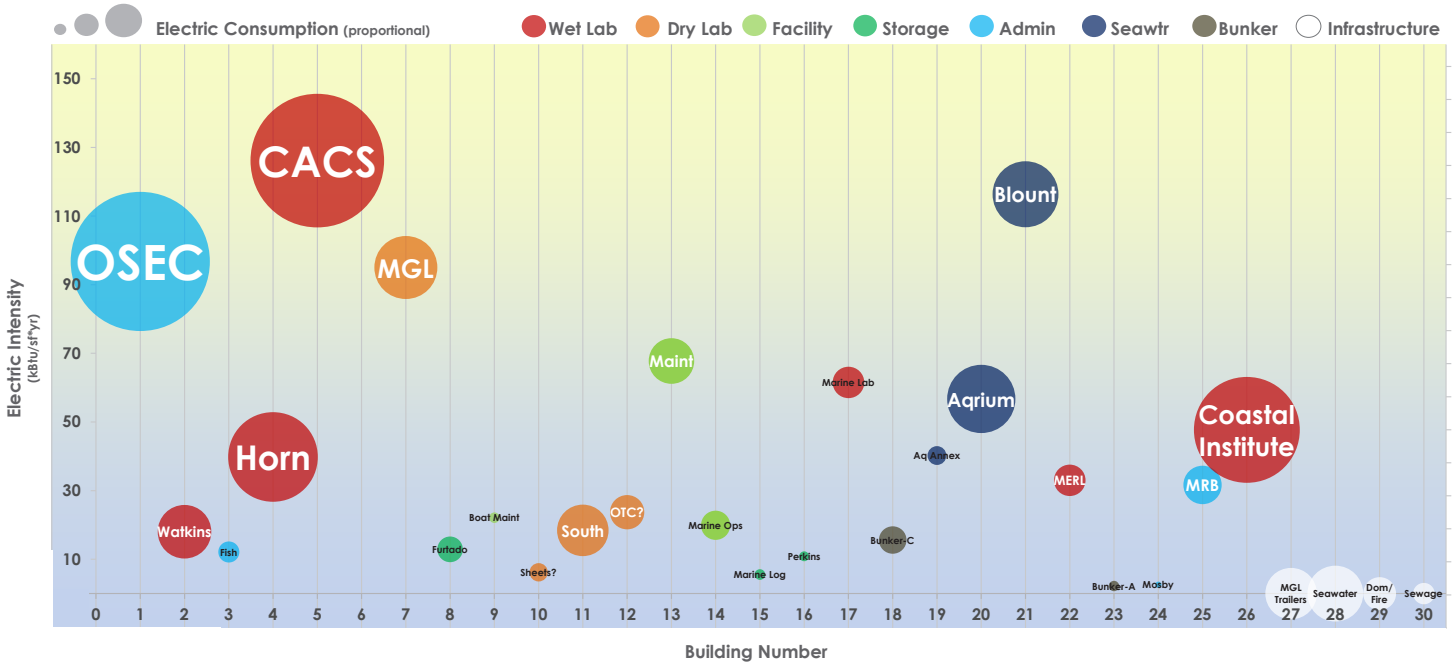
The conclusion of the detailed analysis of the existing MEP systems is that many buildings lack centralized systems resulting in added maintenance and higher energy consumption. These are outlined below and detailed in Appendix D.

HVAC

The majority of HVAC equipment is original and nearing end of life. Horn is an exception, where some HVAC equipment is newer. The majority of cooling and heating systems are of the lowest efficiency type (DX air conditioning units and electric resistance heating).

There is no heat recovery on 100% outside air systems in Horn, CI, CACS, and Watkins to name a few. This is code required and needs to be addressed with any major renovation.

There are 3 different controls vendors on campus. A single vendor and upgraded DDC server that connects all buildings would improve monitoring, control, and energy usage.



Electrical Consumption - by building

The bubble chart above shows electrical consumption by building between July 2014 and June 2015, by building. The position of each bubble on the Y axis represents electrical energy use intensity and the size of each bubble represents electrical consumption.

Plumbing

Lab buildings where chemicals are being used do not have pH neutralization systems, which are recommended to ensure that any lab waste is treated before entering the building's sanitary system, and additionally the site sanitary drainage system.

Lab buildings lack dedicated water systems. Typically lab buildings have separated systems for domestic water, non-domestic water (lab use), and emergency tempered water (emergency eyewash and showers). Having separate systems ensures that the domestic water is not subject to any cross connection issues with laboratory water, creating a potential hazard with drinking water.

There is a campus-wide lack of ADA plumbing fixtures and ADA toilet rooms in the majority of buildings.

There is a campus-wide lack of low flow plumbing fixtures. Most plumbing fixtures on campus are original and not efficient in terms of water conservation.

There is a campus-wide lack of efficient domestic water heating systems. These systems typically are outdated and mostly original to each building.

The natural gas infrastructure is deficient, such that several buildings are not connected to the gas supply.

Fire Protection

There is a lack of automatic sprinkler systems in many buildings that are used for storage and/or contain combustibles that should be sprinklered.

The main pump house holds 3 booster pumps acting as jockey pumps for potable water, and only 1 large fire pump. The fire pump is potential point of failure.

Another potential weak link is that the fire pump does not have a test header. Testing is performed by flowing through a circulating meter. This does not provide an efficient way to flush the system.

Electrical

All buildings campus-wide are served power by the electric utility, both using overhead and underground service from either pad-mounted or pole type transformers. The utility distribution system is open wire primary (15 kV) except underground to pad mounted transformers. The standby power availability to most buildings is limited.

The building electrical systems are serving the current demand for electricity for each building without any noted capacity deficiencies. All buildings are separately metered by the utility. Many of the older building electrical systems, while capable of continued use as is, are at the end of their usable life and are not suitable for building modernization.

While the relatively recent (2009) ESCO projects installed occupancy sensing control to capture energy savings, all lighting, lighting controls and lighting branch circuit systems should be planned for replacement for any modernization, in order to meet the state energy codes and the energy saving goals of the campus.

There is a campus-wide telecommunications duct and manhole system in good order that provides good connectivity across the current campus. Modifications to this infrastructure are likely required to support the planned separation of the primary and secondary network hubs that currently cohabitate the same room in the basement of the Horn Building.

General site exterior illumination is provided by utility owned flood lights mounted only to selected distribution poles. Floodlights are characteristically high glare and non-cut-off types, and this is likely the source of the general feeling that the campus "glows too much" at night. Better light management can be incorporated into future site planning.

Fire Alarm

The fire alarm system relies on an active relay through very old cables. This is the weakest point of the NBC reporting system. The Municipal alarm system cables are probably 30 years old; such cables are typically only rated for 20 years. Only some sections have been replaces as needed. However, the system presently does work without significant issues.

There is no redundant means to transmit an alarm to the fire department. There is presently only one loop cable for the campus. There are probably more fire alarm systems on campus than are required by the current code. Only a few of these systems have been upgraded. The majority of buildings transmit alarm via a Gamewell Master Box system, which is similar to Morse code – it is assumed to be outdated and should be replaced.

Security

For intrusion alarms there are two options for receiving signals at main campus: KP radio or Sure Guard IP. Radio is considered more reliable, but should include a pole mounted repeater to ensure range. There are no current standards for intrusion alarms on campus.

There are no security cameras on campus. A camera system is recommended as a deterrent and an investigational tool. The system should be on the Kingston Campus platform, which is Avigilon. A new camera signal is to be sent to the Kingston Campus for response coordination.

There is presently no key card entry system on campus. All locks use metal keys on a master key system. As a minimum, key card locks at building entrances are recommended.

4.2 Existing Site/Civil Conditions

The Site/Civil Analysis includes the following sections:

1. **Existing Environmental Conditions Analysis**
    - Overview
    - Topography
    - Soils
    - Coastal Resources Management Plan
    - Coastal Erosion
2. **Existing Utility Analysis**
    - Sanitary Sewer
    - Fire Service and Domestic Water Service
    - Stormwater Management
    - Gas
    - Electric and Telecommunication
3. **Campus Traffic and Circulation**
    - Traffic Volumes
    - Vehicular Access
    - Parking
    - Transit
    - Bicycle and Pedestrian Access
    - Internal Campus Mobility
    - Signage

Additional information on the following sections may also be found in Appendix D.

4.2.1 Existing Environmental Conditions Analysis

An existing environmental conditions analysis was undertaken to determine constraints and regulatory requirements for the proposed program. The analysis evaluated existing topography, soils, coastal features, wetlands, and buffers to determine the constraints and requirements for the master plan.

Overview

The URI Narragansett Bay Campus is located at the eastern end of South Ferry Road in Narragansett, Rhode Island along the west coast of the Narragansett Bay. South Ferry Road is an urban collector public right-of-way for the Town of Narragansett that connects Route 1A (Boston Neck Road) to the Bay Campus. South Ferry Road bisects the Bay Campus into a northern and a southern section with the majority of the Campus located to the south of South Ferry Road. The Campus is bounded by undeveloped woodland on the south and west, Narragansett Bay on the east, a United States Environmental Protection Agency (EPA) facility to the north and residential properties on the south.

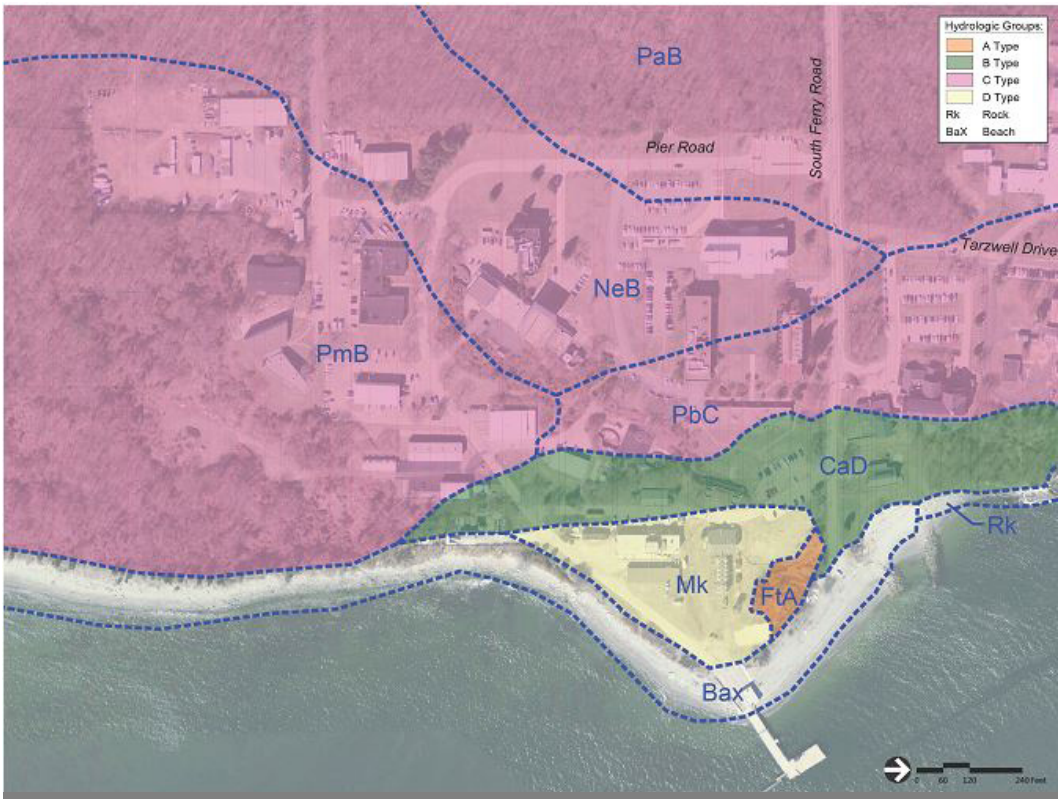
The developed portion of the Narragansett Bay Campus is located on the eastern portion of the State properties abutting South Ferry Road. Four large surface parking areas are located in the areas adjacent to South Ferry Road with several smaller lots located adjacent to individual buildings. Pier Road provides connectivity to the southern section of the campus from South Ferry Road and wraps around to Aquarium Road and the Endeavor Pier. Aquarium Road provides a second access point between the campus and South Ferry Road. Pier Road and Aquarium Road only provide access to Bay Campus buildings.

There are three Bay Campus buildings (Coastal Institute Building, the Marine Resources Building, and the Mosby Center) located north of South Ferry Road that can be accessed via Tarzwell Drive as well as driveways on the north side of South Ferry Road. Tarzwell Drive is a dead end road that also provides access to the northern portion of the Bay Campus, the EPA Atlantic Ecology Division and NOAA/NMFS/ Northeast Fisheries Center. This northern section of the campus is served by one primary parking area. This parking area is heavily utilized and is insufficient to accommodate larger visiting groups and staff parking. There is also no dedicated bus parking area in this area to accommodate school group visitors.

Topography

The Campus is located on the eastern slope of a drumlin and slopes easterly towards Narragansett Bay. According to the 1:24,000-scale topographic map for the Narragansett Pier Rhode Island Quadrangle (United States Geological Survey, photo-revised, 1975), the Campus rises from Narragansett Bay along its eastern edge to approximately 100 feet above the National Geodetic Vertical Datum of 1929 (NGVD29) on the western portion of the campus. Total relief across the campus is approximately 100 feet.

Soils



Site Plan- Soils Mapping

The surficial geology consists of dense glacial lodgement till with a mantle of windblown silt and fine sand. The Natural Resource Conservation Service (NRCS) has mapped the soil types at the campus. In general, areas west of the bunkers and marine support buildings are sandy to silty loam over glacial till noted as the following: Newport Silty Loam (NeB), Paxton Fine Sandy Loam (PaB), and Stony Fine Sandy Loam (PbC), Pittstown Silty Loam (PmB). These soils are suited for development but are limited by the slow to very slow permeability in the glacial till. Land area between the bunkers and Aquarium Road is shown to be Canton Charlton Rock Outcrop (CaD) which is well drained soils intermingled with areas of bare exposed bedrock. East of Aquarium Road is Matunuck mucky peat (Mk) which are very poorly drained soils and may be subject to tidal inundation. (See Soils Mapping)

Coastal Resources Management Plan

The URI Narragansett Bay Campus is located adjacent to tidal waters. On-site wetlands, coastal resources and associated buffer zones and setbacks on the campus are within the jurisdiction of the Coastal Resources Management Council (CRMC). The CRMC, through the Coastal Resources Management Plan (CRMP) has regulatory authority over proposed work activities occurring within or adjacent to wetlands, coastal resources and associated buffer zones and setbacks (RIGL Chapter 23, Section 46-23-1).

Site Plan- FEMA Mapping

Zone X - Areas of 0.2 percent annual chance flood; areas of one percent annual chance flood with an average depth of less than one foot or with drainage areas less than one square mile.
Zone VE- Coastal flood zone with velocity hazard, at elevation 16 (NAVD 88).

Coastal Waters

The west passage of Narragansett Bay is located east of the Campus and is a CRMC designated Type 2 Water, a designation which includes waters in areas with high scenic value that support low-intensity recreational and residential uses. These waters include seasonal mooring areas where good water quality, fish, and wildlife habitat are maintained. The CRMC prohibits activities that substantially detract from or interfere with these priority uses.

Coastal Features

The shoreline or coastal resource types observed at the Campus include CRMC-defined Coastal Bank and Cobble Beach (refer to VHB Existing Conditions Plan). The Coastal feature boundary is the inland edge of the Coastal Bank or cobble beach which is identified by the first significant break in slope (top of bank).

CRMC Buffers and Setbacks

The area of land within 200 feet of the inland edge of the shoreline is regulated by CRMC and has a designated Buffer Zone and Building Setback. A Buffer Zone is a natural area adjacent to a shoreline feature that must be retained in or restored to a “natural” vegetative condition.

Coastal Buffer Zones for an Institution are determined on a case-by-case basis by the CRMC, though the Coastal Buffer Zone Designations For Residential Development Table 2a in the CRMP may be used for guidance. Table 2A designates Buffer Zone width based on lot area and adjacent water use category (Type 2). A 200 foot buffer zone is anticipated based on applying Table 2 A to the Bay Campus. A building Setback is an area to be maintained free of structures to allow for access around proposed structures for the purposes of emergency access or maintenance.

The Buffer Zones summarized above would be measured from the inland edge of the Coastal Bank or Beach. A 25 foot Setback would extend landward of the Buffer Zone.

Site Plan- Environmental Constraints

Freshwater Wetlands in the Vicinity of the Coast

State-regulated freshwater wetlands as defined in the CRMC Rules and Regulations Governing the Administration and Enforcement of the Freshwater Wetlands in the Vicinity of the Coast (Rules) were identified on the Site and are described below.

Emergent Plant Community

An Emergent Plant Community is located northeast of the Marine Ecosystem Research Laboratory building in an isolated depression with no apparent outlet to the coast. A 2014 aerial photograph was reviewed to estimate the size of the wetland. This wetland does not appear to meet the minimum one-acre area requirement to be classified as a Marsh according to the Rules, as such an Area of Land Within 50-feet is not applied.

An approximately two foot wide stone lined drainage ditch begins at a headwall located south of South Ferry Road, flows easterly, and discharges to this Emergent Plant Community. This ditch is regulated as an Area Subject to Storm Flowage (ASSF).

The Coastal Resource Management Council (CRMC) will likely regulate the Emergent Plant Community as a Freshwater Wetland in the Vicinity of the Coast since no hydrological connection is provided to the coast. Should the Emergent Plant Community be regulated as a Contiguous Freshwater Wetland then the 200-foot Buffer Zone would be measured from the inland limit of the wetland. This Emergent Plant Community is also regulated by the U.S. Army Corps of Engineers (ACOE). The ASSF is subject to regulation by the CRMC but does not meet the criteria for wetland as regulated by the ACOE.

Floodplain

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Mapping and Flood Study for the Town of Narragansett (Community Panel Number 44009C0206J, dated October 16, 2013 and Flood Study 44009CV001B, dated October 16, 2013) indicates a Zone X along most of the eastern edge of the Campus. This zone is identified as areas of 0.2 percent annual chance flood; areas of one percent annual chance flood with an average depth of less than one foot or with drainage areas less than one square mile. Transect lines in the Flood Insurance Study identify the elevation of the one percent annual chance flood to be 10.6 feet North American Vertical Datum of 1988 (NAVD88). There is also a Zone VE, coastal flood zone with velocity hazard, at elevation 16 (NAVD 88). (See FEMA Mapping)

Permitting Assessment

Any proposed development should be designed outside the limits of the wetland resources, coastal buffer zone and setback areas at the campus. Development of the campus is limited by the presence of coastal resources and their associated Buffer Zones and Setbacks. One freshwater wetland was observed on the Campus. This wetland is regulated by the CRMC and the ACOE, and represents a development constraint.

Sea Level Rise

The CRMC requires development to accommodate a base rate of expected three to five foot rise in sea level by 2100 in the siting, design, and implementation of public and private coastal activities and to insure proactive stewardship of coastal ecosystems under these changing conditions.

Freshwater Wetland in the Vicinity of the Coast

The Freshwater Wetland Rules require applicants to consider avoidance and minimization of wetland impacts in the design of site improvements. Before approving a freshwater wetland alteration, the CRMC requires the applicant to provide proof, through an alternatives analysis, that no feasible alternatives exist that avoid impact to wetlands. Projects which propose little or no wetland impacts may be reviewed and approved as an Insignificant Alteration of freshwater wetlands.

If a project proposes to alter wetlands, the CRMC will require the submittal of an Application to Alter which must present an analysis of functions and values of the existing wetlands on-Site and an assessment of impacts to wetlands resulting from the project.

The Application to Alter will be processed as a Category B application in accordance with section 110.2 of the CRMP and the process may take as little as six months, but generally runs to 12 months or more before a decision is reached. A public notice period is included, and a public hearing must be held before the Council.

CRMC Review

Coastal waters, coastal features and the area of land within 200 feet of the inland edge of the shoreline features are regulated by CRMC. Any new development or redevelopment of existing improved areas of the Campus within the 200 foot Contiguous Area would require CRMC review and may be approved through a Category A Assent from the CRMC. This Assent process may take between one and three months and consists of an administrative review process and does not involve public notice and full review by the Council. For new development within unimproved areas of the 200-foot Contiguous Area that cannot meet the goals, policies, prerequisites, and standards of the CRMP that apply to the development, a Category B Assent application would be required in accordance with section 110.2 of the CRMP and the process may take between six and 12 months or more before a decision is reached. A public notice period is included, and a public hearing must be held before the Council. (See Environmental Constraints Plan)

Buffer Zone Management

Pursuant to the CRMP and CRMC's Buffer Zone Management Guidance certain vegetation management activities including providing shoreline access paths, view corridors, habitat management and restoration including managing invasive vegetation, and shoreline recreation can be authorized through an Application for Buffer Zone Management. No more than 25 percent of the total buffer zone area shall be affected by these management options with one exception, invasive plant management can be authorized for up to 50 percent of the total buffer zone area.

Army Corps of Engineers

The Emergent Plant Community described above is also regulated by the ACOE pursuant to Section 404 of the Clean Water Act. In Rhode Island, the ACOE has issued a Programmatic General Permit (PGP) which allows for joint ACOE-CRMC review of projects proposing up to one acre of wetland impact. In most cases, projects proposing up to 5,000 square feet of impact that have received a State permit do not require notification of the ACOE, and the CRMC Assent (permit) serves as the federal approval. Projects proposing up to one acre of wetland impact are reviewed by state and federal agencies through a joint review process. These activities may be reviewed as Category II activities by an interagency committee consisting of representatives of the U.S. Fish and Wildlife Service (USFWS), EPA, National Marine Fisheries Services (NMFS), in addition to the ACOE, Rhode Island Department of Environmental Management (RIDEM) Wetlands and RIDEM Water Quality Certification Program. If none of the reviewing agencies object, the project may be eligible for approval as a Category II PGP and the State wetland permit would serve as the federal authorization for the activity.

US Fish and Wildlife Service

According to the USFWS Information for Planning and Conservation (IPAC) Project Planning Tool, Northern long-eared bat (NLEB) habitat includes all of Rhode Island.

In 2015, NLEB received protection as a threatened species under the Endangered Species Act (ESA). Projects proposing to clear trees require Section 7 consultation with the USFWS under the ESA to proceed.

A single osprey (Pandion haliaetus) nesting platform is located within the southeastern portion of the Campus within the soil stockpiling and landscaping waste disposal area. The nest appeared to be in good shape and may have been used during the 2015 nesting season. If the on-site osprey nest is reoccupied, any construction activity that disturbs nesting osprey which results in birds being killed or injured including disturbance to the point that it causes eggs to not hatch or the chicks to die or become injured could represent a violation of the Migratory Bird Treaty Act unless a USFWS depredation permit is obtained.

Rhode Island Natural Heritage Program

A review of the Rhode Island Natural Heritage Program (RINHP) database using the on-line RIDEM Environmental Resource Map indicates that the majority of the Campus is within a RINHP polygon. Coordination with RIDEM - RINHP has indicated that the polygon is associated with two observed rare, threatened, or endangered plant species: Northern Blazing Star (Liatris scariosa var. novae-angliae) and Seabeach-sandwort (Honckenya peploides ssp. robusta). Both element occurrence records for these species are located along the coastline south of Pier Road. Seabeach-sandwort is a species of State Concern, native taxa not considered to be State Endangered or Threatened at the present time, but are listed due to various factors of rarity and/or vulnerability. Northern blazing star is State Endangered, native taxa in imminent danger of extirpation from Rhode Island. Plants listed as State Endangered are protected under the provisions of the Rhode Island State Endangered Species Act, Title 20 of the General Laws of the State of Rhode Island.

RIDEM Water Quality Certification

A RIDEM Water Quality Certification (WQC) is required to authorize work approved by a Section 404 Permit or a CRMC Assent when the Project disturbs more than five acres of land, disturbs more than 10,000 square feet (SF) of existing impervious or creates 10,000 SF of new impervious. Projects that require individual WQC are required to have a public notice and a 30 day comment period. WQC are generally issued within 90 days of submission.

RIDEM Rhode Island Pollutant Discharge Elimination System

Campus projects that result in greater than 1 acre of soil disturbance will require authorization under the Rhode Island Pollutant Discharge Elimination System (RIPDES) Regulations and the General Permit for Stormwater Discharges Associated with Construction Activity. The WQC approval would serve as the authorization from the RIPDES program pursuant to the General Permit for Storm Water Discharge Associated with Construction Activity.

Soil Erosion

There is evidence of soil erosion on the campus with the most significant areas located along the edges of South Ferry Road, in particular along the steepest section of the road at its eastern end. There are deficiencies in the collection system throughout the campus that result in flows and velocities of runoff that by-pass the collection systems leading to more significant erosion. There is also significant coastal erosion along the southeast facing bluff located immediately southwest of the pier adjacent to Pier Road. The bluff lacks any engineered revetment that would protect the coastal feature from further erosion. Further significant erosion of the coastal feature has the potential to compromise the road and associated utility services.

4.2.2 Existing Utility Analysis

The existing campus infrastructure analysis was undertaken to determine constraints and to evaluate required utility work to support the Campus Master Plan program. The analysis evaluated sanitary sewer, fire and domestic water, gas, electric and telecommunications services, stormwater, and areas of erosion.

Sanitary Sewer

The existing campus sanitary sewer system collects sanitary and lab waste services from campus buildings. The gravity pipe system is a combination of reinforced concrete pipe (RCP), vitrified clay pipe (VC) and polyvinyl chloride pipe (PVC) ranging in size from 6 inch to 15 inch. The gravity system generally runs from the higher elevations along the west and northern sides of campus down gradient to the pumping station located just south of the Aquarium Ark Building. There is emergency power provided for the sanitary lift station and there are no known capacity issues. The sanitary lift station is a critical component of the campus infrastructure. The sanitary lift station pumps effluent through an 8-inch cast iron force main within Pier Road until it connects to a gravity sewer adjacent to the Marine Geological Samples Lab and continues south to the Town of Narragansett sanitary sewer main in Onondega Road.

Fire Service and Domestic Water Service

Water service is provided to the Bay Campus by United Water Rhode Island (SUEZ) from a 300,000 gallon water storage tank located immediately north of the campus at the end of Tarzwell Drive. The water storage tank is located on property owned by the Board of Trustees of State Colleges. Water from this system is pressurized after the tank for distribution throughout the campus.

There are two water mains in South Ferry Road feeding the campus, including a 12-inch main that appears to be for fire service only. This main feeds the campus and the hydrants along South Ferry Road. There is another six inch main in Tarzwell Drive that provides domestic the campus from the water storage tank.

The campus water distribution is a loop system that connects to the main in South Ferry Road at Pier Road and at Aquarium Road. The campus fire service mains range in size from 6-inches to 12-inches and provide service to the buildings and hydrants. An additional 8 inch main provides a loop around the Ocean Science & Exploration Center, Horn Lab, and Watkins Labs. These loops provide redundancy and allow for maintenance and repair with minimal disruption to the campus. In addition the campus water mains, there are various services to the buildings range in size from 1 to 4-inches.

Stormwater Management

The stormwater management system for the campus consists primarily of collection and conveyance, with the majority of the campus lacking stormwater best management practices including water quality systems with the exception of recent projects. The stormwater system general flows from west to east, following the slope of the land, with five discharge outfalls located along the shoreline south of the pier, and three at grade outfalls that discharge into the low point (fresh water wetland) adjacent to the beach between the pier and South Ferry Road. Visual inspection of the campus shows minimal water quality treatment of runoff from impervious surfaces including pavement, sidewalks, and roofs. Catch basins typically lack traps or sediment sumps in the structures. Significant portions of the system have catch basin to catch basin connections which allow for re-suspension of sediment from incoming pipe flows. There is a water quality basin located east of the parking lot for the Perkins Boat Facility. This is an example of small scale water quality best management practices that can be implemented in other areas of the campus.

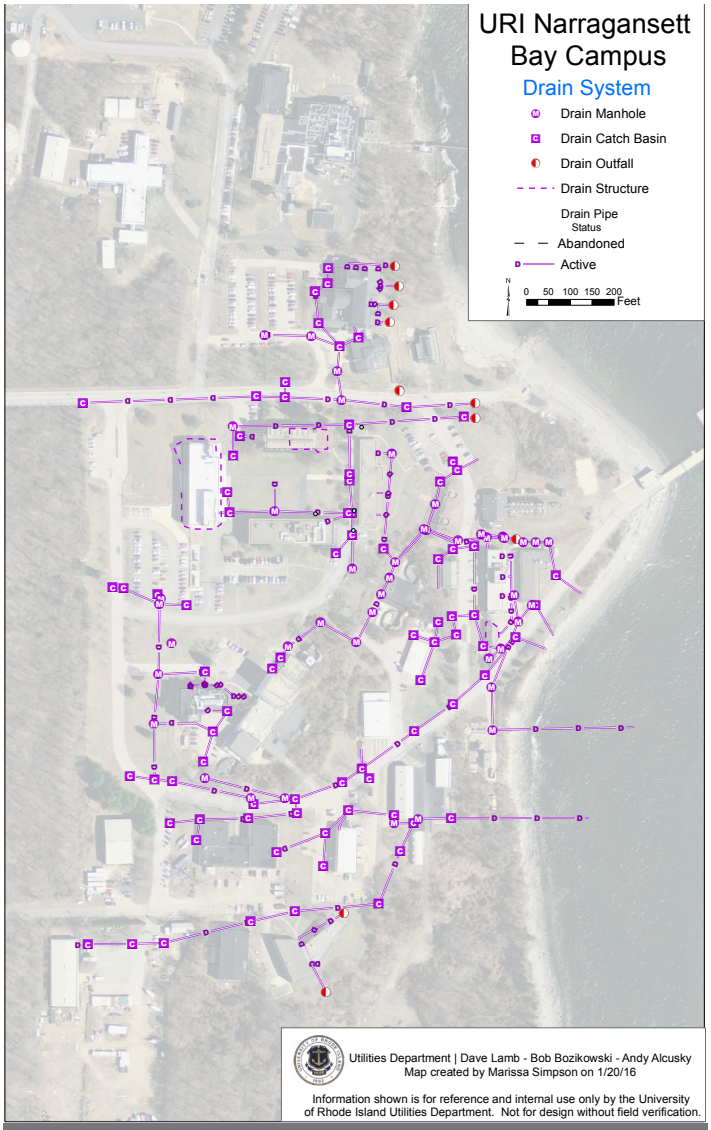
There are opportunities to retrofit stormwater management systems to improve water quality and collection. As an example, catch basins located in low points within grass areas that could be adjusted to function as a small scale sediment trap by slightly raising the frame and grate.

Gas

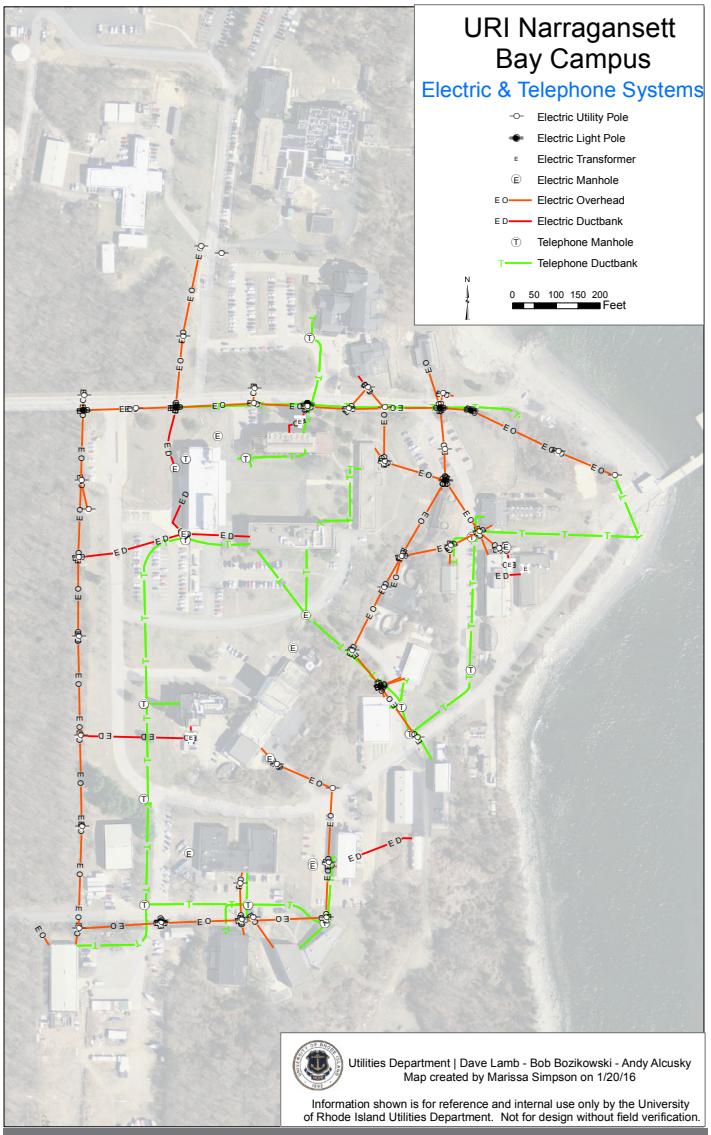
Gas service to the campus is provided by National Grid. There are mains located in South Ferry Road, adjacent to the western section of Pier Road, in a portion of the southern section of Pier Road, and in the northern section of Aquarium Road, as well as spurs off of these primary distribution mains for individual services. There is a gap in the gas distribution system at the intersection of Pier Road and Aquarium that would complete a campus loop. The missing section in the loop is part of current campus plans but has not been funded.

Electric and Telecommunications

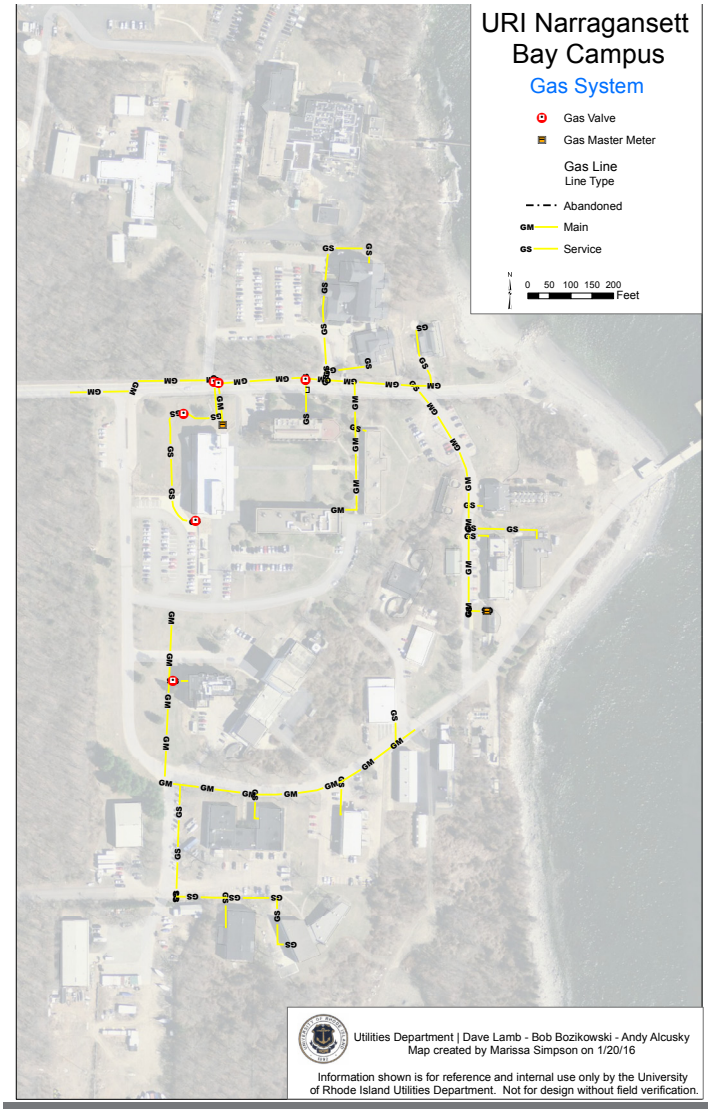
Electrical and telecommunications services are provided by National Grid and Verizon respectively. Electrical service is three phase. Both services are overhead on South Ferry Road and on the west side of the western section of Pier Road. Overhead electric service continues through the southernmost portion of campus in a haphazard manor adjacent to Aquarium Road. There are overhead services with limited clearance over the historic artillery battery. There is a significant network of underground telecommunications services throughout the campus connecting most campus buildings. Portions of the electrical distribution system is underground in the campus core and for many individual building services.



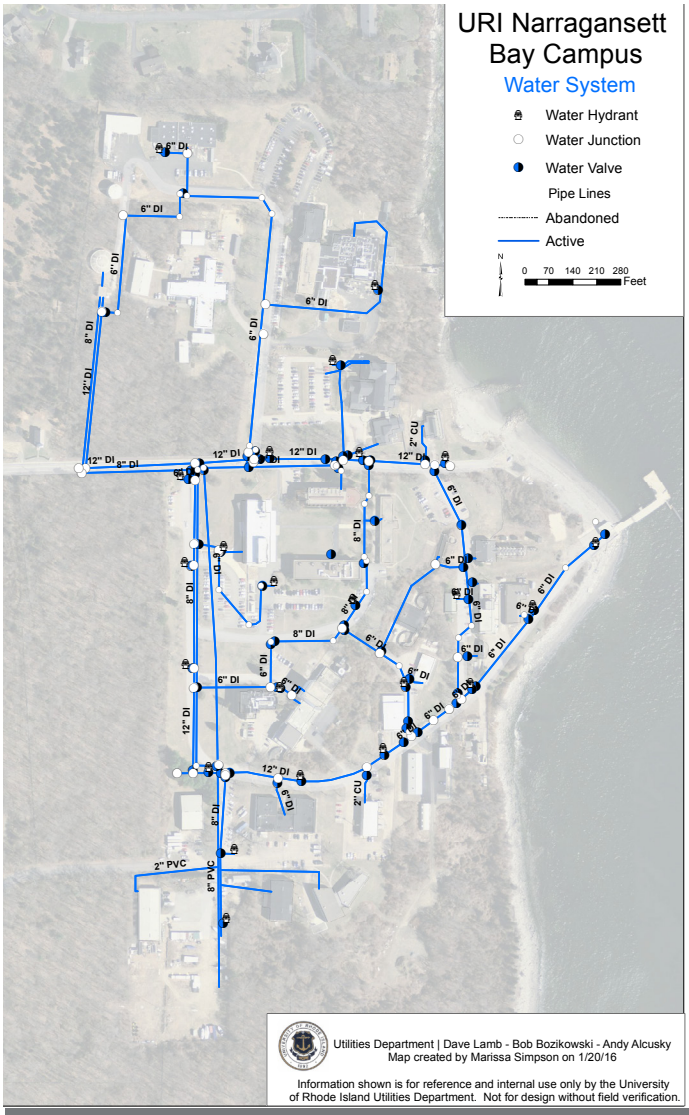
Campus Drain Utilities



Campus Electric and Telephone



Campus Gas System



Campus Water System

Campus Sewer System

4.2.3 Campus Traffic and Circulation

Traffic Volumes

Traffic volumes along South Ferry Road have been manageable for the Bay Campus. The campus location at the dead end of South Ferry Road is an important contributing factor to the relatively low traffic volumes. Traffic generated by the Bay Campus is generally random with some concentrations in entering/exiting when classes or tours occur. Traffic generated by the EPA Atlantic Ecology Division and NOAA/NMFS/Northeast Fisheries Center are generally concentrated during a two hour morning period (7:00 a.m. to 9:00 a.m.) and two hour evening period (3:30 p.m. to 5:30 p.m.) when employee arrivals and departures occur. During the summer there is some traffic related to people accessing the beach area.

Vehicular Access

The majority of students, researchers, and staff accessing the Bay Campus are arriving by automobile. South Ferry Road is the only route that is used to access the Bay Campus. An emergency access driveway exists to the southwest corner of the campus from Dean Knauss Drive that is currently gated.

Parking

Four primary parking areas serve the campus south of South Ferry Road: one located off of Pier Road, one located off of Fish Road, one located along Aquarium Road, and one located on Receiving Road off of Pier Road. Overall parking capacity appears to be adequate to meet parking demands, however, the majority of the parking areas are inefficient and have excessive areas of pavement per parking space.

Parking on the Bay Campus is less regulated than it is for the Kingston Campus or other campuses in the URI system. In general there are no parking passes issued to park on the Bay Campus for students or employees, and there is no enforcement/monitoring of parking. Although there is sufficient parking on the campus, the drawback to this system is a potential lack of security. Vehicles have unregulated access to the campus, parking, and resources at all hours of the day and night. Two specific areas of concern are the unregulated access to the campus during the nighttime hours and unregulated access to the beach area. Regulating parking access to these facilities and others around the campus could be better managed. Better lighting and security should also be considered.

Transit

Currently, the Bay Campus has one public transit route serving the campus. The Rhode Island Public Transit Authority (RIPTA) operates Route 64 from Kingston Station to Newport via the URI Kingston Campus, the URI Bay Campus, Route 138 Park and Ride, and Jamestown, RI. This route runs on headways that vary, averaging about every 90 minutes. The bus stop for the campus is located on Pier Road south of South Ferry Road.

The campus lacks dedicated transit connections to the URI Kingston Campus, other area destinations such as Wickford, Quonset, or Providence, and to the airport (T.F. Greene in Warwick or Logan Airport in Boston, Massachusetts).

Bicycle and Pedestrian Access

There are no marked or signed bicycle accommodations currently provided to access the Bay Campus. Bicycles must share the roadway with vehicles and access the campus similarly. There is generally a lack of bike racks and other amenities to promote bicycle usage.

There are also currently no sidewalks along South Ferry Road to provide pedestrian access to the campus. Additionally, the roadway shoulder is one foot or less with no curb, further limiting pedestrians from comfortably traveling along the roadway.

Internal Campus Mobility

The URI Narragansett Bay Campus is a relatively small campus; therefore, mobility within the campus is primarily a pedestrian issue. There are sufficient roadways provided for vehicular or bicycle connections from one parking area or building to another when needed.

No formal bicycle accommodations are provided for cyclists to move around the campus. Bicycles are permitted to share the roadways with automobiles.

Pedestrian mobility in the Bay Campus is not facilitated by sidewalks or clearly designated walking paths. Sidewalks or walking paths between buildings and parking areas should be considered to enhance safety and accessibility.

In addition to the lack of sidewalks there is also a lack of Americans with Disabilities Act (ADA) compliance for pedestrians throughout the campus. As future work is completed on the campus consideration must be given to accommodating individuals with mobility, visual, hearing disabilities and the like. This is especially critical with accommodating accessible access for the 100 foot change in elevation across the east west axis of the campus.

A critical mobility need for pedestrians is connectivity across South Ferry Road to access the Coastal Institute. Currently, one faded crosswalk is located across South Ferry Road at the Coastal Institute. The poor quality of the markings and the grade of the roadway make visibility of the crosswalk challenging. Additionally, approximately 70 feet east of this crossing is a staircase approaching South Ferry Road. Due to vegetation, there is no obvious walking path from the staircase to the crosswalk.

The Bay Campus is in use during most hours of the day and night. Lack of lighting within the campus impacts pedestrian and bicycle mobility and visibility during evening and night time hours.

Signage

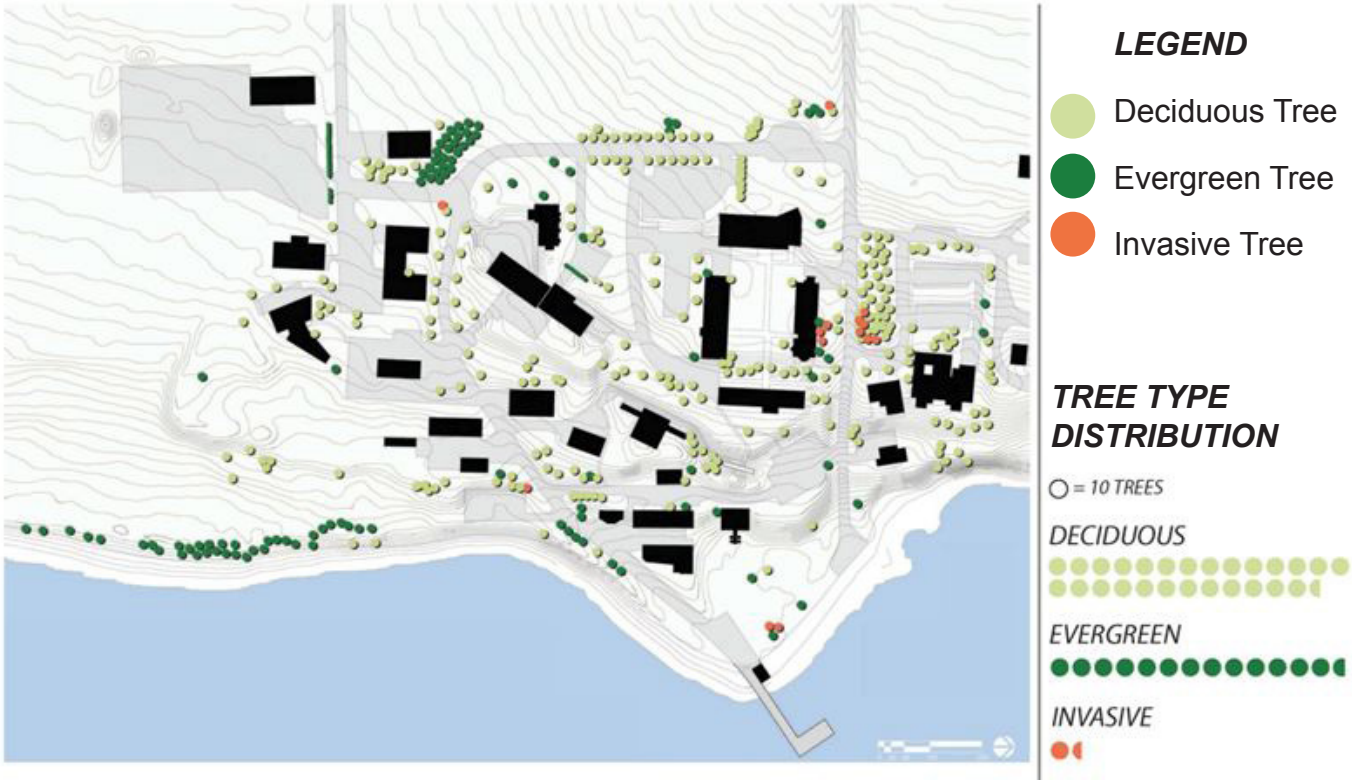
Signage is key to campus mobility for all modes. Without providing clear guidance to all users individuals may struggle to locate their destination while visiting the campus. As this campus has developed incrementally in the past, signage and guidance has not been implemented. Beyond providing guidance to roadway users, signage can also help to define the campus and potentially deter unintended use from entering the campus

4.3 Existing Landscape Conditions

The existing landscape analysis is comprised of the following sections:

- Existing tree inventory
- Ecological Communities
- Circulation
- Open Space Network
- Hardscape and Softscape
- Landscape Image and Views
- Site Features
- Pavements
- Landscape Materials
- Historic Bunkers
- Noise Pollution

Tree Inventory



Tree Types

Site Plan- Tree Types

As part of the existing conditions analysis, the Master Plan team prepared an inventory of all existing trees on campus. The campus tree inventory took stock of the existing tree assets and their overall condition. The detailed inventory may be found in Appendix D.

The Master Plan team inventoried 421 trees over four days at the beginning of January 2016. The species distribution of the 421 trees included 68 unique species. Of the 68, four are invasive species, 18 are non-native and 47 are native species. Roughly 2/3 of the trees on campus are deciduous and 1/3 are evergreen or coniferous.

Data collected for each tree included:

- Diameter at Breast Height
- Planting constraints – Adjacent Paving, Power lines, Building or Other
- Damage to Surrounding caused by tree or roots
- Planting Location Type – Maintained or Unmaintained
- Pruning Required – Yes or No
- Tree Condition – Excellent, Good, Fair, Poor, Dying, or Dead
- Type of Maintenance Required
- Latitude and Longitude of each tree
- Common Name
- Genus and Species

There has also been a practice of planting memorial trees on the campus. Most of the memorial trees are in good condition but lack any markers to identify who the tree is planted for or genus and species. In many areas on campus, trees have been planted or maintained in very intentional groupings to either frame favorable views, screen unfavorable views, create seasonal interest, and/or reinforce an axis. Tree plantings of this type help to lend significance and intentionality to the landscape, enhance sense of place and also help bring scale to large, wide-open spaces.

Ecological Communities

The bay campus is characterized by three major ecological communities moving from West to East across the landscape. Ruderal Forest makes up the western-most portion of the campus. The center of the campus is characterized by Ruderal Shrub-land and the eastern-most part of the campus is Rocky Intertidal Shore (Rhode Island Ecological Communities Classification, RIGIS, 2014).

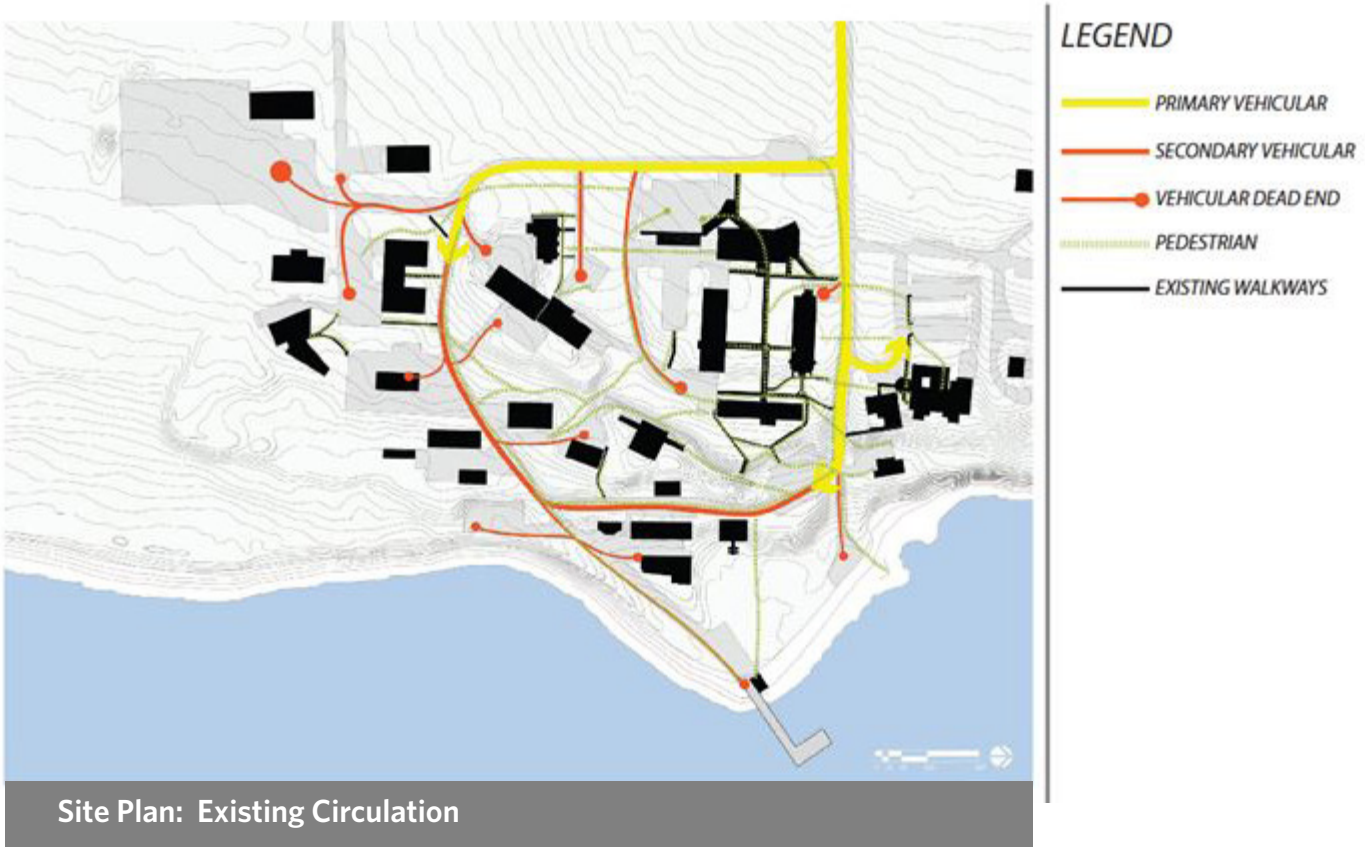
Ruderal Forest - Low diversity forest that resulted from clearing for agricultural uses no longer in place. Soil alteration by agriculture use causes these forests to be dominated by opportunistic species and an under-story of exotic and invasive species. Ruderal forests do not resemble natural forest systems and lack ecological value. Trees in these forest are generally uniform in age. Prevalent tree species include Prunus, Malus, Juglans, Robinia, Sassafras, Juniperus, Pinus, Acer, and Betula.

Ruderal Shrubland - Anthropogenic communities of herbaceous or mixed shrub vegetation resulting from clearing for agricultural or other purposes. Later stages include higher percentages of shrubs and scattered tree saplings. These areas are characterized by unnatural combinations of native and alien species; later shrubby stages often include exotic invasives.

Rocky Intertidal Shore - Intertidal zone of solid rock that experiences extreme exposure to wind, waves, currents, and ice-scour. Often covered with seaweeds with blue-green algae common in the high zones, barnacles are found in the mid zones, and mussels in the lower zones. Tide pools are frequently found in these habitats.

While the ecological value and diversity of the Ruderal Forest and Shrubland as a whole is relatively low in comparison to a naturally occurring forest ecosystem, there are individual components of the forest that are valuable. Within the forest on campus are wolf trees and historic stonewalls. Wolf trees are old growth trees which pre-date farming operations and possibly colonial settlement on the site. They are very large and provide ecological value in terms of habitat creation and prolific seed setting, and cultural value in the way they tie people to the cultural and natural history of a site. Likewise, the historic stonewalls crisscrossing the forest on-site provide ample nooks and crannies for small mammal habitat and tie present day users to the past use and users of the site as well as providing a tangible tie to the land's geologic make-up.

Circulation



Site Plan: Existing Circulation

4.4 Site Plan- Existing Circulation

Paved roadways and parking areas dominate the campus circulation system. This is due to the topography of the site as well as the somewhat haphazard placement of buildings on the site.

The amount of parking lots serving individual buildings creates a disconnected landscape experience and impacts the overall visual quality of the campus.

Analysis of pedestrian circulation patterns and direct observation of where people walk revealed that the campus lacks an adequate pedestrian circulation system.

Pedestrians are often forced to walk on the road or across lawns. The lack of an efficient and comprehensive pedestrian circulation system hinders efficient and meaningful connections between different parts of campus and impacts campus ADA accessibility, pedestrian safety, and the overall pedestrian experience and impression of the campus.

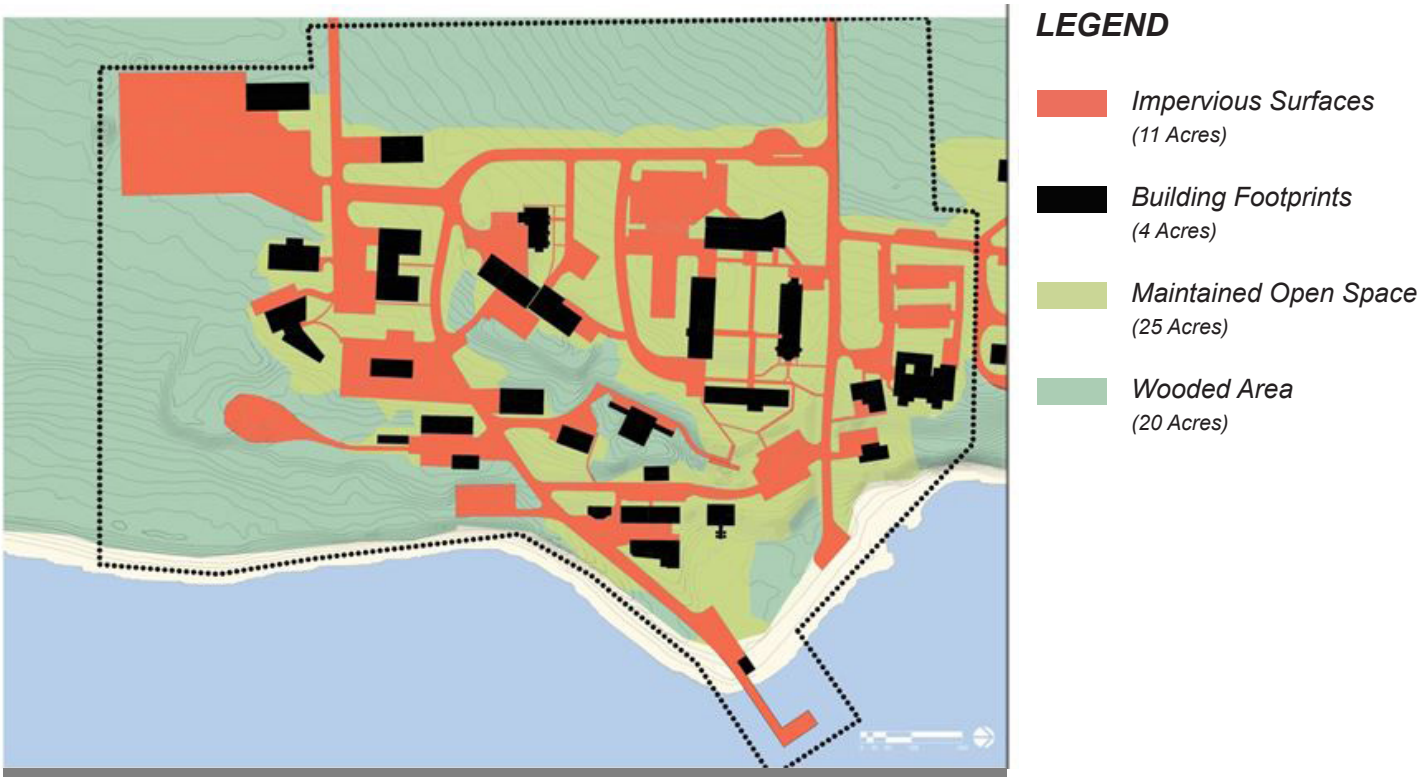
There is also lack of defined crosswalks at roadway crossings which could help to slow traffic, increase pedestrian safety and peace-of -mind and improve pedestrian experience when traversing the campus.

Open Space Network

While there is ample open area on campus, there is a lack of an open space network with clear uses and defined relationships to buildings. Other than the Knauss Quad, the majority of open space is either undifferentiated or left-over from building development.

Provision of an overt and legible network of open space on campus is a missed opportunity for strengthening campus identity, providing an exemplary campus's experience with multiple options for outdoor gathering, and emphasizing the importance of the campus' majestic and inspirational coastal location.

Hardscape and Softscape



Site Plan - Surfaces

Analysis of hardscape and softscape areas within the study area of approximately 60 acres found that 11 acres are impervious paved surfaces, 4 acres are roof area, 20 acres are maintained open space, and 20 acres are wooded area.

67% percent of the campus is area that requires some sort of maintenance at all times of the year. This takes the form of lawn cutting, re-paving parking areas and roads, snow plowing and general clean-up as well as building maintenance.

The amount of maintained area comes at a monetary cost to the University as well as an ecological cost to the environment.

Additionally, the extent of paved areas detracts from the overall sense of place at the Bay Campus and does not present an ecologically conscious impression to visitors, faculty, or prospective students, which a research institution of this type and size should be foregrounding in both the landscape and buildings.

Landscape Image & Views

The Bay Campus is characterized by six distinct landscape typologies which greatly impact the overall image of the landscape. These typologies are:

- Forest
- Parking Lots
- Open Lawn
- Heavy Use Dirt Lots
- Unmaintained/Scrub Areas
- Rocky Shoreline

These areas are well defined and delineated by pavement, maintained edges where mowing and trimming occurs, fences, planted landscape screens, or topography.

The positive visual quality of all of these areas except for the shoreline, is greatly dependent upon seasonality. In simplest terms, the late fall and winter landscape is rather stark and barren, while the late spring and summer landscape is lush and green, allowing many of the undesirable areas screening by vegetation.

The rocky shoreline is the strongest defining landscape feature of the campus, yet access to it is limited both visually and physically due to the distribution of buildings, lack of connecting and accessible pathways and topography.

Views

Views on campus can be a tool for choreographing an experience of place that ties students faculty, staff and visitors to the Mission of the Narragansett Bay Campus and to the water in a more overt, visceral and meaningful way.

In mapping views on the campus, it was discovered that the longest views, generally to the water, are the most favorable, and as the length of the view becomes shorter the favorableness of the view becomes less. Shorter views are characterized by more clutter within the view. Clutter takes the form of utility areas, HVAC equipment, dumpsters, and unmaintained or overgrown areas.

Generally campus-wide, all views are impacted by the presence of power lines.

Site features

A photographic inventory of all site features was conducted. Site furnishings and handrails throughout the campus are inconsistent in style and quality. A consistent family of benches, bike racks, trash receptacles, and pedestrian lighting can contribute to an overall sense of place and help to establish a stronger campus character and identity.

Handrails campus-wide are also inconsistent in quality and style. Many are in a deteriorating condition and do not meet accessibility guidelines.

Handrails

Lack of a consistent design standard for site amenities also hinders efficient, timely, and cost effective repair and maintenance of items that need fixing.

Pavements

Pavements

Pavements on campus consist of broom-finish concrete, exposed aggregate concrete, asphalt, and small areas of specialty paving or unit pavers at several building entrances.

There is a lack of standard details for pavements campus-wide. This includes width of walkways, expansion and control joints in concrete, edge treatments and curbs, and concrete finishes and mix designs. The lack of standard details is a missed opportunity to help the University realize cost savings when repairs are needed and promote ease of maintenance and snow removal. Site-wide the use of consistent pavement treatments as an identity building tool is a missed opportunity for the campus. Likewise, the lack of significant pavement treatments at building entrances, important campus thresholds, or outdoor gathering areas also detracts from the campus user experience.

Landscape Materials

Walls

While the majority of landscape materials on campus are ordinary or insignificant, the use of native stone on site provides an important tie to the rich cultural, geologic, and natural history of the site. The retention and maintenance of the historic stone walls on the site provides a tie to the past and has been the impetus for the deployment of a similar material language elsewhere on the site in more contemporary ways. This use has been successful and should continue as it helps to create a strong campus identity and relate the Bay campus to the Kingston campus.

Historic Bunkers

The concrete bunkers on campus are important cultural and historical artifacts but they are poorly integrated into the fabric of the campus. They currently serve as impediments to movement and views on the campus and have been the impetus for the pattern of disorganized building placement that has occurred. The bunkers are a missed opportunity to build upon the unique cultural and historic qualities of the site while reinforcing the unique sense of place and identity of the Bay Campus.

Noise Pollution

There are areas on campus where equipment servicing buildings create an exorbitant amount of noise. This is most notable adjacent to the OSEC building entrance onto the Knauss Quad. Lack of screening of utility areas not only creates visual clutter but also prevents noise mitigation.

5.1 Introduction

The programming process was intended to provide a concrete, verifiable square foot target for Master Plan facility recommendations. That is, the proposals for new and renovated buildings of various types were to fulfill a very specific set of space requirements for all campus functions, developed in detailed programming discussions with various users.

The programming effort was guided by the overall goals of the Master Plan:

1. **Support Research and Teaching Mission**
    - 21st Century Research Facilities
    - Long term flexibility and efficiency
    - Interdisciplinary collaboration
    - R/V *Endeavor* replacement
    - Student space

2. **Promote Regional Development**
    - Public outreach
    - Incubator activities/private sector engagement
    - Ocean technology

3. **Enhance Resiliency and Ecological Function**
    - A marine campus model of sustainability
    - Energy efficiency and infrastructure
    - Land use and building consolidation
    - Campus quality

4. **Integrate Plan Components**
    - Buildings
    - Site
    - Energy

The URI Bay Campus is home to two distinct entities: the Graduate School of Oceanography (GSO) and the Department of Ocean Engineering (OE), a part of the School of Engineering. Within the GSO are a number of diverse functions, including research labs, faculty offices, teaching labs, a number of outreach and educational entities, GSO administration and library, Marine Operations, Shops, Seawater Tank facilities, Rock Storage, Facility Operations, and other campus support functions. The Department of Ocean Engineering functions include large water tank facilities, research space, teaching labs, and faculty and administrative space. Accordingly, the programming effort necessarily involved engaging all of these diverse groups in a series of meetings to understand current and future needs.

The implementation of these program recommendations is represented in the final Master Plan, but the rationale for the specific programming initiatives is spelled out here.

5.2 Process

At the start of the programming process, the planning team toured representative spaces of all types across campus to become familiar with the current state of campus facilities. The team then met with over 15 separate user groups, to discuss current conditions and develop a future-oriented space program. These discussions focused on defining optimized space types and adjacencies, rather than modifying current facilities or spaces. The discussions did not address how or where to accommodate the required space, but addressed only the definition of space needs in the abstract.

The programming process generally involved three sequential meetings with each group; the first meeting was for general introduction to the process and overview of needs, the second meeting included discussion of an initial space program for each group and often review of similar spaces at other institutions, and the third meeting generally settled on the final list of appropriate space types and areas. Each session included review of a detailed list of spaces, as well as a review of layout diagrams suggesting a possible layout of each important space, to confirm the appropriate area allocation.

The list of programming groups is as follows:

- GSO Research
- Ocean Engineering
- Ocean Technology and Robotics (new program)
- Outreach and Education
- GSO Administration
- Marine Operations
- Seawater Tank facilities
- Classrooms and lecture halls
- Student spaces
- Food service
- Campus Facilities Operations
- Allen Harbor

Discussion of the programming parameters and final program recommendations for each group are summarized below; the full space program is included in the Appendix. The discussion follows the order of the groups listed above.

5.3 Parameters and Recommendations

5.3.1 GSO Research

GSO research activities are nominally organized around certain research themes: Biological Oceanography, Marine and Atmospheric Chemistry, Marine Geology and Geophysics, and Physical Oceanography. In reality, there are no distinct departmental boundaries, and research affinities exist between and among these groupings. Research affinities are aligned more by specific research methodology (computational, fume-hood intensive, etc.) than by the broad thematic descriptors.

Research activities are currently scattered across campus. While there are a number of research-focused buildings, such as Horn Lab and the Center for Atmospheric Chemistry Studies (CACS), research also takes place in buildings with other functions, such as the Coastal Institute Building, Watkins Lab, etc. As research activities have grown, space in the designated “research” buildings has become scarce, and new research activities have had to find a home in any available corner of the campus, further dispersing research activities. As a result of this somewhat haphazard growth, research labs vary greatly in size and configuration, determined by the idiosyncrasies of each building layout.

The programming of space for GSO research evolved from an open-ended discussion regarding the nature of research on campus, now and into the future. Emphasis was placed on flexibility and enhancing interdisciplinary collaboration. Space allocation in the “research” category includes research labs, lab support space, faculty offices, grad student office space, and space for administrative support.

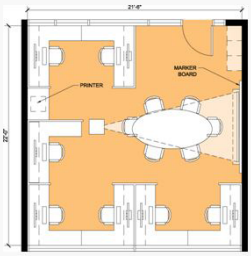
These discussions led to some important recommendations and outcomes:

- A common lab module was developed for all faculty, across all research activities; this common lab module can accommodate a variety of research types, from computational to dry lab and wet lab models.
- There should be a common approach to space allocation, across all faculty: each faculty member will be allocated a “primary lab” of standard size; faculty will be allocated a “secondary lab” as lab activities, research group size, or instrumentation requires expand.
- Location of research lab types in future accommodations should support the goal of interdisciplinary collaboration.

The diagrams immediately below show how the common module (the “primary lab”) can be modified to suit different research activities. “Secondary Labs” are ½ the area of the primary labs, also indicated in different layouts.

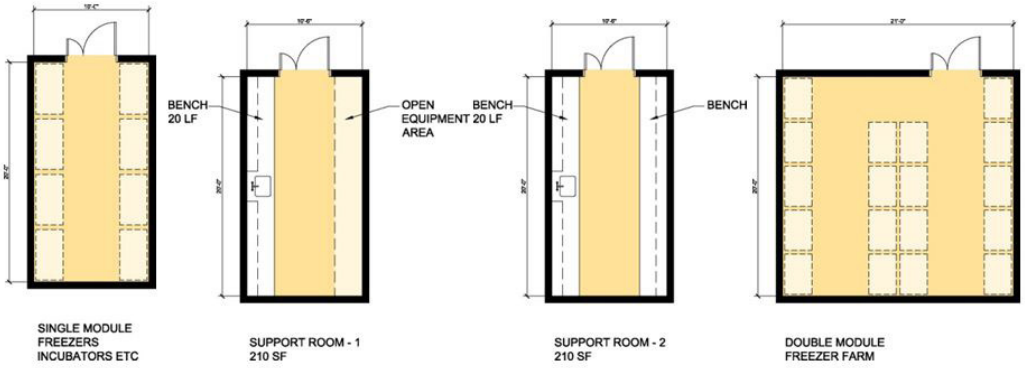
Fume Hood Lab

Flexible Wet Lab



Computational

Primary Labs



Secondary Labs

Lab Support

In addition to the Primary Labs, Secondary Labs, and Faculty Offices, faculty share equally in the spaces labeled “Shared by Group” (see below). These include various lab support spaces (freezer farms, cold rooms, autoclave, instrument rooms, etc.), research storage, conference and lounge space, space for grad students, post docs, technical staff, and administrative support. The “Group” in “Shared by Group” refers to the loose association of faculty by discipline: Biological Oceanography, Marine and Atmospheric Chemistry, etc.

	Space	Square Footage
Area/Faculty	1 Primary Lab	420 sf.
	1 Secondary Lab*	210 sf.
	1 Office	130 sf.
Shared by Group	Lab Support	500-1200 sf.
	Storage	800 sf.
	Conference	400 sf.
	Lounge	350 sf.
	Admin Support	200 sf.
	Staff Office	5-10 @ 100 sf.
	Grad Student	10-40 @ 50 sf.
	Post Docs	2-4 @ 80 sf.

*Secondary labs are allocated according to demonstrated need

There is a general lack of storage for research gear. This equipment takes up space in existing research labs, which is an inefficient use of research space and misrepresents area per researcher when those tallies are made. Some dedicated storage space for research gear is required.

Given these lab module sizes, the total amount of research lab space in the recommended program was based on an assumption of the numbers of faculty, grad students, post docs and staff that need to be accommodated for the foreseeable future. These figures are provided below.

	Faculty	Grad	Post Doc	Staff
Biological Oceanography	15	45	4	7
Chemical Oceanography	6	15	2	3
Geological Oceanography	12	20	4	11
Physical Oceanography	10	20	2	10

After totaling all of these factors, the overall area allocation for each group is as follows:

Net Square Feet		Existing	Proposed
Research	Biology	22,623 sf.	18,365 sf.
	Chemistry	11,874 sf.	7,915 sf.
	Geology	17,478 sf.	13,920 sf.
	Physics	16,254 sf.	10,080 sf.
	Shared	6,998 sf.	17,717 sf.
TOTAL		**75,227 nsf**	**67,997 nsf**

"Shared" space in the chart above includes space for visiting faculty, the rock storage facility, and research storage space.

As this chart shows, the overall area for GSO research space has been reduced somewhat from 75,227 to 67,997 nsf. This reduction in space is due to several factors:

- Existing office space often exceeds the University standard of 130 sf per office; the adjustment to the University standard reduced overall area allocation considerably.
- Efficiency in research lab area allocation was achieved through a standard space allocation per faculty.
- Space efficiency was also gained through utilizing shared spaces for lab support functions such as storage and freezer farms, where currently these functions are housed in dedicated faculty laboratory space.

Teaching Labs

The Bay Campus has a small number of teaching labs, utilized mostly by the various scientific groups for lab classes for graduate students. These spaces are generally undersized and under-equipped for the current needs.

The proposed space program for teaching labs includes right-sizing the existing number of teaching labs, as well as adding two more labs to accommodate the anticipated increase in teaching load on campus, both for undergraduates and graduate students.

5.3.2 Ocean Engineering

The Department of Ocean Engineering is a component of URI's School of Engineering, based in Kingston. The Department conducts undergraduate classes and labs as well as faculty research on the Bay Campus.

Facilities for Ocean Engineering (OE) are currently located on the far south side of campus, housed in two metal buildings that are outmoded and generally substandard.

The activities of OE will continue to utilize large wave and acoustic tank facilities for teaching and research, and these functions are required in any new facilities for OE; see layout diagram below.

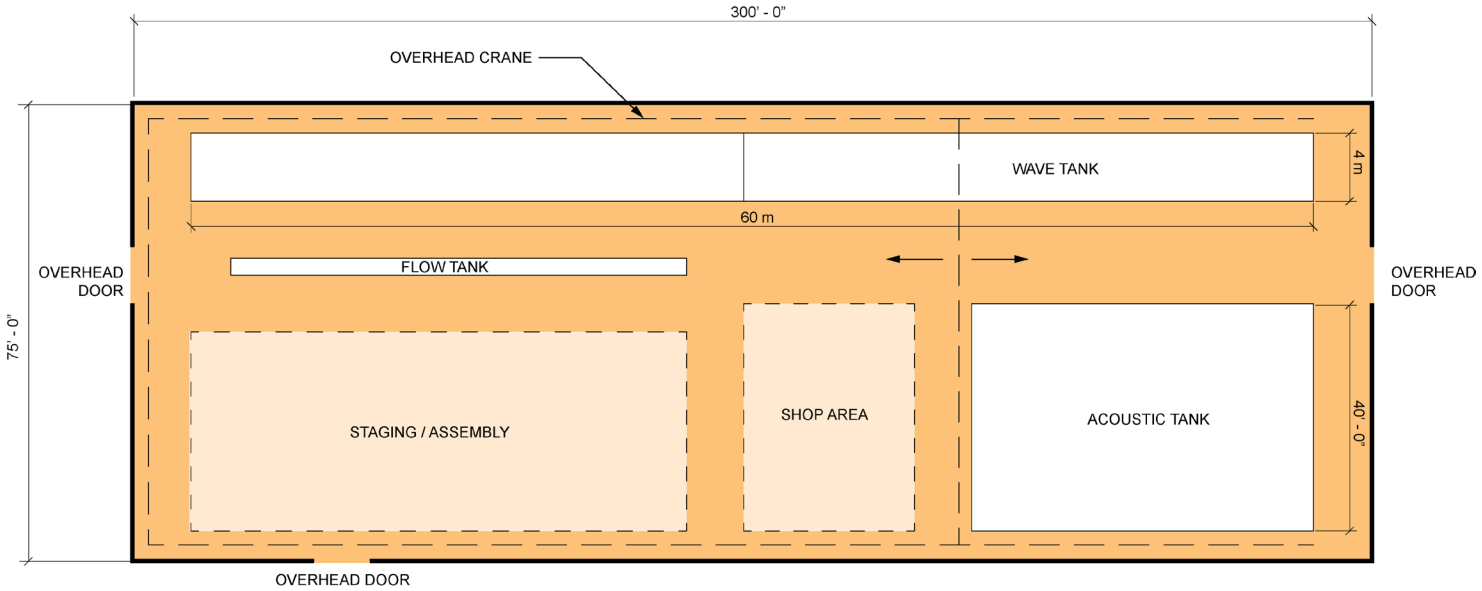
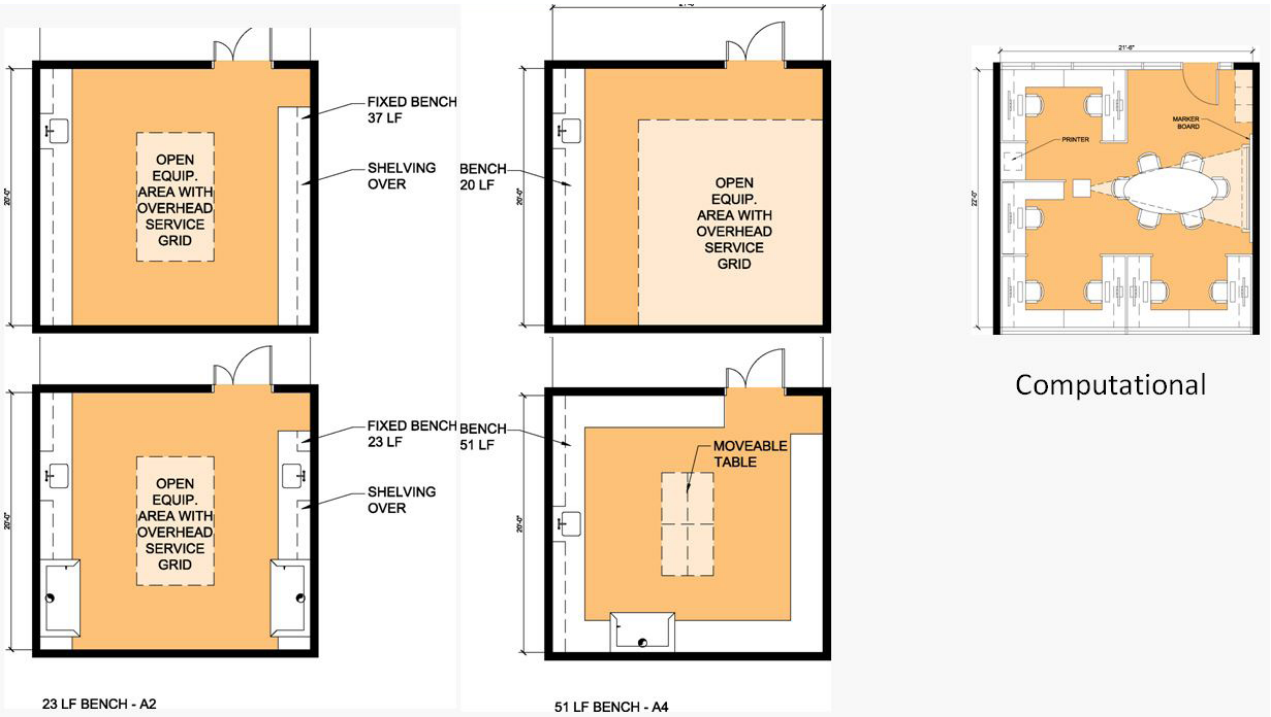


Diagram of OE Tank facility

Individual space for faculty research is currently lacking, and this shortfall is addressed in the new space program. The model for faculty research is to allocate a "primary" lab (approximately 420 nsf) for each faculty member; see diagram of flexible research lab module below.



Flexible Lab Module for OE research

Summary of proposed space for OE at the Bay Campus is as noted below. The increase in proposed research space reflects the fact that currently no space exists for individual faculty research, which is addressed in the proposed space program. The increase in space for the tank facilities reflects the desire of faculty to increase the size of both the wave tank and the acoustic tank to enable experiments and testing not possible currently. It is assumed that the tank facility can be housed in a simple economical building.

O.E. Facilities (N.S.F.)	Existing	Proposed
Research	1,607 sf.	5,040 sf.
Teaching	3,237 sf.	4,800 sf.
Tank Facility	6,112 sf.	15,900 sf.
Office/Admin.	6,929 sf.	5,600 sf
TOTAL	**17,885 sf.**	**31,340 sf.**

5.3.3 Ocean Technology and Robotics Center

The Ocean Technology and Robotics Center represents a new initiative on campus to provide space for emerging areas of research and development related to ocean technology. This initiative will provide space for:

- Robotics research space, to be shared by the GSO and OE. Robotics is a growing area of research for both entities, and providing this space in a shared facility promotes economy as well as interdisciplinary collaboration; robotics research space includes a significant amount of high-bay space, intended to be utilized by researchers as well as for staging of research experiments en route to seagoing research vessels.
- Incubator space, to allow regional industries to partner with the Bay Campus in various initiatives; space allocation includes high bay and office/administrative space.
- I-Core space for development of new equipment and instrumentation.
- Engineering Design Lab (EDL), space dedicated to development of new technologies in this realm.

	Existing	Proposed
Robotics		
• High Bay/Staging	-	4,000 sf.
• Tank Area	-	1,575 sf.
• Primary Research Labs	-	2,520 (6) sf.
• Secondary Research Labs	-	840 (4) sf
Incubator	4,700 sf.*	6,000 sf.
I-Core	-	2,000 sf.
Engineering Design Lab	-	4,000 sf
TOTAL	**4,700 sf.**	**16,935 sf.**

*Currently housed in O.T.C

Space for robotics includes high bay/staging area (4000 nsf), testing tank, and primary and secondary research labs for both GSO and OE.

5.3.4 Outreach and Education

Outreach and education form a key component of the GSO's mission and these activities are carried out by a large and diverse number of entities. The activities and programs sponsored by these groups constitute a major source of funding for the overall GSO program. Individual outreach and educational entities are listed in the chart below.

In the programming discussions with these groups, it was generally acknowledged that the most critical space shortfall was appropriate meeting and conference space. The recommendations for the proposed space program for these groups, therefore, generally maintained the current area for administrative functions, but suggested increased areas for meeting and conference functions.

One significant exception is for the Inner Space Center, a special program that maintains sophisticated technology for the remote tracking and control of various research vehicles. Due to the growth of this group, the space program provided additional space for various technical and support functions.

	Existing	Proposed
Center for Ocean Exploration	895 sf.	895 sf.
Coastal Institution	1,103 sf.	1,103 sf.
Coastal Resource Center	5,825 sf.	6,835 sf.
Inner Space Center	4,541 sf.	9,041 sf
Metcalf Institute	259 sf.	259 sf.
Office of Marine Program	1,404 sf.	1,404 sf.
Rhode Island Sea Grant	885 sf.	885 sf.
Ocean Exploration Trust	1,788 sf.	842 sf.*
Shared (Conference and Break Rooms)		1,900 sf

*O.E.T. offices moved to I.S.C. in "Proposed" scenario

Conference and Dormitory Space

Many of the Outreach and Education functions on the Bay Campus sponsor meetings and presentations that require conference facilities of various sizes. Current facilities are either too small for some of these events, or at not available for the durations required. The space program addresses this shortfall.

Another need identified in the programming discussions was for dormitory facilities. These facilities would be used by faculty, students and others for stays of varying durations. The availability of housing for faculty and students is severely limited in the vicinity of the Bay Campus, and providing some limited amount of housing on campus would greatly improve the attractiveness and convenience of the outreach activities, as well as support visiting faculty and students.

Conference and Dormitory program

Conference Facility	Existing			Proposed		
	QTY	AREA	NSF	QTY	AREA	NSF
Auditorium	1	983	983 sf.	1	1,200	1,200 sf.
Meeting Rooms	2	700	1,400 sf.	2	1,000	2,000 sf.
Conference Rooms	1 1	350 790	350 sf. 790 sf.	3	750	2,250 sf.
Amphitheater	1	220	220 sf.			
Break-Out				1	3,000	3,000 sf.
Conference Storage	4	40	160 sf.	1	400	400 sf.
Exhibit	1	1,350	1,350 sf.	1	3,000	3,000 sf.
Staging	3	130	390 sf.	1	500	500 sf.
Conference Offices				6	130	780 sf.
Shop	1	240	240 sf.	1	400	400 sf.
TOTAL						**13,530**

Dormitory	Existing			Proposed		
	QTY	AREA	NSF	QTY	AREA	NSF
Double Rooms				25	250	6,250 sf.
Apartment				4	500	2,000 sf.
Shared Kitchen						150 sf
Storage						400 sf.
Lobby/Reception						400 sf.
Staff Offices				3	120	360 sf.
TOTAL						**9,560**

5.3.5 GSO Administration

Space for GSO administration is housed in the relatively new Ocean Science and Exploration Center (OSEC). This facility also houses the Inner Space Center (addressed above) and the Pell Marine Science Library.

The space in OSEC for GSO administration was deemed generally adequate for current and anticipated functions, and so no major changes were recommended.

The GSO Library occupies the entire third floor of the OSEC building; it was programmed and designed to replace the former Pell Marine Science Library, which was demolished to make room for OSEC. The library has generous space for book stacks and for quiet work activities, as well as for support staff, but seems somewhat underutilized. There appear to be opportunities for consolidation and re-allocation of existing library space to other functions. It is recommended that this exploration occur in the final design stages of the Bay Campus renewal.

5.3.6 Marine Operations

Marine Operations on the Bay Campus is primarily focused on the operation and maintenance of the research vessel (R/V) *Endeavor*; operating an ocean-going research vessel is central to the GSO's mission. The vessel is owned by the National Science Foundation (NSF), scheduled by the University National Oceanographic Laboratory System (UNOLS), and operated by the GSO, for NSF, as part of a five-year Cooperative Agreement (CA). The current five-year CA expires in 2017 and will be renewed to run through 2022 for operation of the R/V *Endeavor*. Additionally, in 2017 GSO will compete to be selected to operate one of the new Regional Class Research Vessels (RCRV) that are being built to replace the R/V *Endeavor* and her sister ship the R/V *Oceanus*. The RCRV will be considerably larger than the *Endeavor* at 198 feet and a much larger sail area. This requires upgrades to the current pier facilities.

Beyond the pier, current Marine Operations support facilities are housed, for the most part, in scattered, older metal buildings.

These considerations were important factors in determining the recommended space program for Marine Operations. These include improved, centralized storage and maintenance facilities and an expanded and upgraded pier facility. The actual program area recommended decreased slightly from current area totals, due to increased efficiency of a centralized approach to facilities.

Details of the recommended improvements to the pier are included in the Appendix B.

Marine Operations

	Existing	Proposed
Storage	4,000 sf.	3,962 sf.
Shops	2,300 sf.	2,200 sf.
Offices	2,175 sf.	1,620 sf.
Support	3,390 sf.	4,350 sf.
TOTAL	**11,865 sf.**	**12,132 sf.**

Dive Program

The dive program provides training for various diving activities. Current facilities are housed in an existing boat storage building, and are generally undersized for the ongoing operations. It was deemed appropriate to increase the area for the dive program as noted below.

Dive Program

	Existing	Proposed
Storage Wash/Down	-	400 sf.
Gear Storage	800	400 sf.
Locker/Shower	-	2 @ 400 sf.
Classroom	-	600 sf.
Offices	-	2 @ 120 sf.
Exterior Wash/Down	-	*(200 sf.)
Exterior Pool	-	*(900 sf.)
TOTAL	**800 sf.**	**2,440 sf.**

*Not included in Total

5.3.7 Seawater Tank Facilities

There is a robust suite of seawater tank facilities on campus, housed in the Durbin Aquarium and the Blount Aquaculture Building. These facilities are currently used mostly by faculty in the College of the Environment and Life Sciences (CELS), but have been used extensively by GSO faculty and students in the past.

The purpose of these facilities is to provide appropriate venues for research of various types into marine life housed in seawater tanks.

The seawater infrastructure of these existing facilities (seawater intake system, pumps, temperature controls, seawater piping, etc) is relatively robust, but certain non-technical aspects of these buildings, such as the condition of the exterior envelope, need improvement. Further, it was agreed that additional space for teaching, outreach and research was needed to take full advantage of the existing facilities.

Seawater Tank Facilities

	Existing	Proposed
Seawater Tank Facilities	8,553 sf.	8,553 sf.
Additional Research Area	-	1,000 sf. (5 @ 200 sf.)
Teaching Lab/Outreach	-	2,400 sf. (2 @ 200 sf.)
Teaching Lab Prep	-	200 sf.
Large Pelagic Fishes Lab	4,200 sf.	4,200 sf.
TOTAL	**12,753 sf.**	**16,353 sf.**

5.3.8 Classroom and Lecture Halls

Currently there is not a sufficient number of classrooms of various types on the Bay Campus to accommodate the current need, and this shortfall is more significant given the projection for an increased number of undergraduate classes for both oceanography and ocean engineering to be held on campus in the future. The discussions about new classroom space also included the desire to provide newer, team-based, technology-rich classrooms, similar to newer learning venues on the main campus.

The large lecture hall facility, in Watkins Hall, is a traditional, tablet-arm chair, steeply raked facility, and the consensus was to replace that facility with a contemporary, flexible lecture and presentation facility that permitted multiple learning and presentation configurations.

	Existing	Proposed
Classrooms	6 @ 600+/-sf.	(2 @ 1,400) 2,800 sf. (5 @ 600) 3,000 sf.
Lecture Hall	1 @ 1,300 sf.	1 @ 3,000 sf.
TOTAL	**4,900 sf.**	**8,800 sf.**

5.3.9 Spaces for Students

There is a general lack of student space on campus. This includes a lack of adequate desk space for graduate students engaged in research, as well as break-out and social space for both undergraduates and graduates.

The recommended space program sought to address both of these shortfalls; space for graduate students is included in the research program for GSO and OE; other student support spaces are summarized in the chart below.

Student Space

	Existing	Proposed
Lounge	-	500 sf.
Study/Meeting	-	1,400 sf. (4 @ 350)
Break - Out / Informal Gathering	-	800 sf. (4 @ 200)
Work - Out	-	1,500 sf.
Shower	-	1,200 sf. (2 @ 600)

5.3.10 Food Service

The only food service facility on campus is housed in OSEC. This facility is somewhat limited in size and in the availability of offerings. Also, because of its location and capacity, the current facility does not adequately serve the Outreach and Education functions.

The proposed program includes the recommendation for a moderately increased food service function, from 2,400 nsf to 3,500 nsf, to serve both day-to-day needs of the Bay Campus community as well as the periodic needs of the Outreach and Education functions.

5.3.11 Campus Facilities Operation

Campus support facilities, such as operations, maintenance, receiving, etc. are generally housed in a number of buildings on the southern and eastern side of campus. Programming discussions with these groups set a goal of consolidating all of these functions in one central area. Space program for these functions is summarized below.

	Existing	Proposed
Maintenance/ Shops		2,900 sf.
Office/Admin		3,520 sf.
Shipping/Receiving		1,940 sf.
Hazmat		200 sf.
Garage (Vehicle Storage)		4,000 sf
Long-term Storage		4,000 sf.
Boat Storage		2,000 sf.
TOTAL	**16,023 sf.**	**18,560 sf.**

5.3.12 Allen Harbor

GSO and the University have access to a waterfront property at Allen Harbor, located north of Kingston. Under the current access agreement, the property is required to have an educational purpose, so any upgrade needs to focus on this goal. One very beneficial use of this site is to allow docking and operation of smaller, close-to-shore vessels.

The current facilities are in a derelict state, and require considerable upgrades, both in terms of bulkhead and pier, as well as facilities for instruction and storage. The area allocations for Allen Harbor facilities are summarized on page 5-17; please refer to Appendix B for documentation of recommended upgrades to pier facilities.

Allen Harbor

	Existing	Proposed
Storage	4,400 sf.	1,000 sf.
Teaching Lab	-	1,200 sf.
Maintenance	80 sf.	500 sf.
TOTAL	**5,200 sf.**	**2,700 sf.**

Space Program Summary

The overall space program in (net square feet) for the Bay campus can be summarized as follows:

Graduate School of Oceanography	Existing	Proposed
Biological Oceanography	22,623	18,365
Chemical Oceanography	11,874	7,915
Geological Oceanography	17,478	13,920
Physical Oceanography	16,254	10,080
Shared Research Facilities (1)	6,998	17,717
Shared GSO Space (2)	28,030	22,744
Outreach, Education and Communication	23,077	46,254
Marine Operations	12,114	12,132
TOTAL	**138,448**	**149,127**

(1) Includes rock storage visiting faculty lab space, and shared research storage.

(2) Includes GSO administration, library, EDL, EPSCOR and shared conference space; in “proposed“ column, EDL space has been moved to the Ocean Technology and Robotics Center.

College of Engineering Department of Ocean Engineering	Existing	Proposed
Research	1,607	5,040
Teaching	3,237	4,800
Shared Tank/Shop Space	6,112	15,900
Offices	6,929	5,600
TOTAL	**17,885**	**31,340**

Campus / Shared	Existing	Proposed
Seawater Facilities	8,553	12,153
Dive Program	800	2,440
Ocean Technology and Robotics Center	800	20,935
Classroom and Student Spaces	7,058	18,321
Facilities Maintenance & Operations	16,023	18,560
Allen Harbor	4,540	2,600
URI NBC Other	3,275	3,275
TOTAL	**197,382**	**258,751**

6.1 Introduction

The proposed Campus Master Plan Recommendations seek to provide an integrated, long term plan for the renewal of the Narragansett Bay Campus at URI. The Plan was developed to support the following overarching goals:

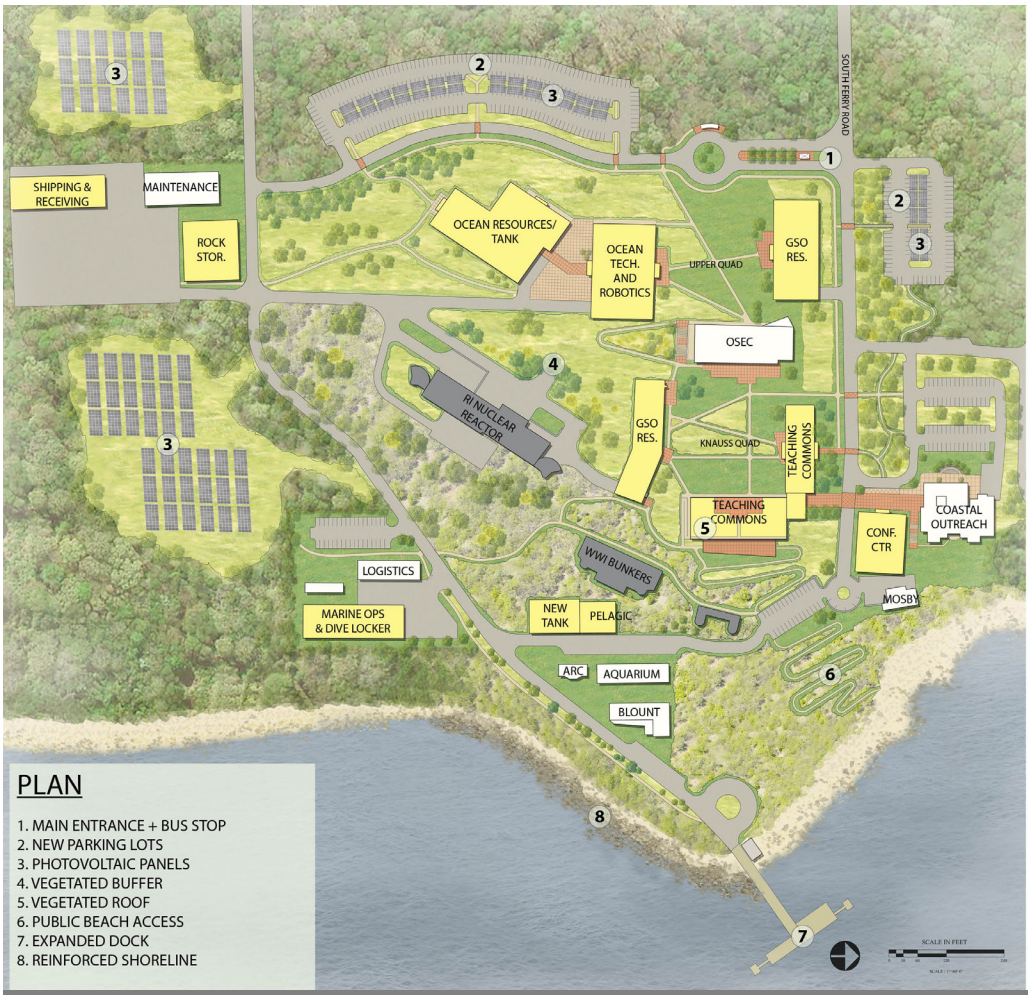
1. **Support Research and Teaching Mission**
    - 21st Century Research Facilities
    - Long term flexibility and efficiency
    - Interdisciplinary collaboration
    - R/V *Endeavor* replacement
    - Student space
2. **Promote Regional Development**
    - Public outreach
    - Incubator activities/private sector engagement
    - Ocean technology
3. **Enhance Resiliency and Ecological Function**
    - A marine campus model of sustainability
    - Energy efficiency and infrastructure
    - Land use and building consolidation
    - Campus quality
4. **Integrate Plan Components**
    - Buildings
    - Site
    - Energy

The Campus Master Plan provides an integrated strategy for complete campus renewal, incorporating recommendations for new and renovated buildings, for site and landscape improvements, and for sustainable and energy-saving building operation systems. The plan is founded on the notion of renewal, meaning the strategy to build on the particular features and character of the existing campus to create a fully re-imagined, transformed campus environment.

The plan makes recommendations for eliminating poor-quality buildings and consolidating functions to create more collaborative, flexible and energy efficient work environments, for separating pedestrian and vehicular circulation, improving service access and creating a pedestrian campus core; for enhancing overall campus landscape quality and coastal resiliency, and improving drainage and other utilities. The Master Plan proposes an integrated, collaborative campus environment to strengthen and further leverage the relationship between the Graduate School of Oceanography (GSO) and Ocean Engineering (OE) faculty, staff and students. Finally, the Plan recommends developing a highly sustainable strategy for campus growth, emphasizing energy efficiency and reduced carbon footprint.

The proposed Master Plan was developed by the planning team in concert with the Steering Committee, in an interactive and iterative process.

The final Master Plan recommendations are summarized in an overall Master Plan diagram, included on the next page. Specific Master Plan recommendations are organized into three segments included in this section:



New Building
Building to Remain
Non - URI Building

Proposed Master Plan Plan

Buildings and Program

- Overall campus concept
- Program for demolition, renovation and new construction
- Location of new buildings
- Accommodating the approved space program in new and renovated facilities

Site and Landscape

- Civil Engineering
- Landscape Architecture

Building Systems and Energy Considerations

- MEP System Recommendations
- Zero Net Energy Analysis

Discussion of suggested Construction Phasing and overall Project Costs and are included in Sections 8 and 9 respectively.

Master Plan Concept - View from the deck of the research vessel, looking East over the extended pier

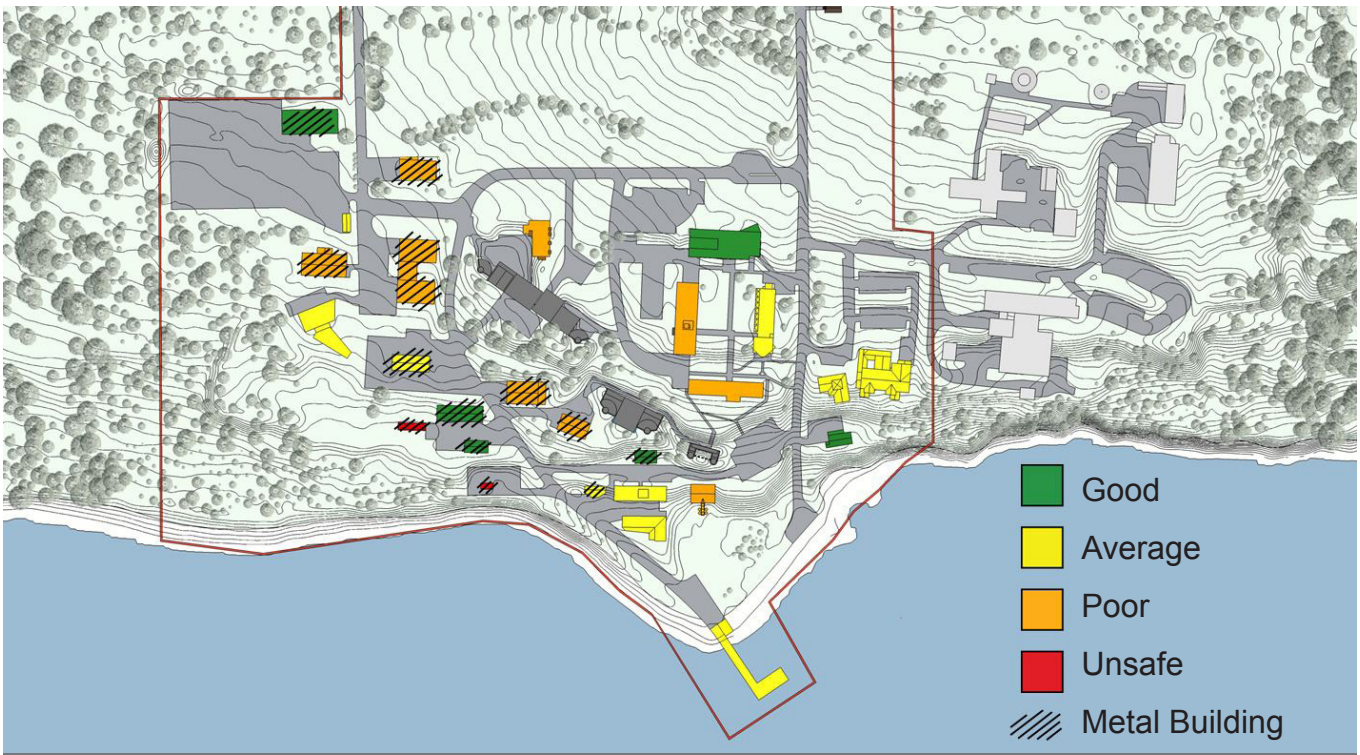
6.2 Buildings and Program

This section describes the recommendations for new construction and renovation of existing buildings, locations of new buildings, and the approach to accommodate the approved space program.

Identifying Buildings for Removal vs Renovation

One important initial task in the planning process was developing a strategy to determine which buildings should remain and which should be removed. This process started with the detailed existing conditions analysis documented in Section 4 of this report. A summary of findings of this process is illustrated below, providing a rating of the existing buildings. This rating system was based on several factors, including the condition of exterior envelope (windows, walls, roof), condition of mechanical, electrical and plumbing systems and energy use, condition of structural system, condition of technical features (e.g., laboratory casework), condition of interior finishes, etc. The team also completed a detailed study of the Horn Lab Building, comparing the costs of renovating this building for lab use vs. building a new lab building. The result of that analysis (documented fully in Chapter 7) was that it was approximately 10% more expensive to renovate that structure than build new. This conclusion was heavily influenced by the particular challenges of renovating this building (e.g., extensive work required to the exterior envelope and the structural system) but did inform the recommendations to remove certain buildings on campus with similar problems.

In addition to building condition analysis, other considerations informed the recommendations for building removal, including the overall goals of the master plan, particularly regarding the interest in consolidation and integration, and developing a campus academic core.



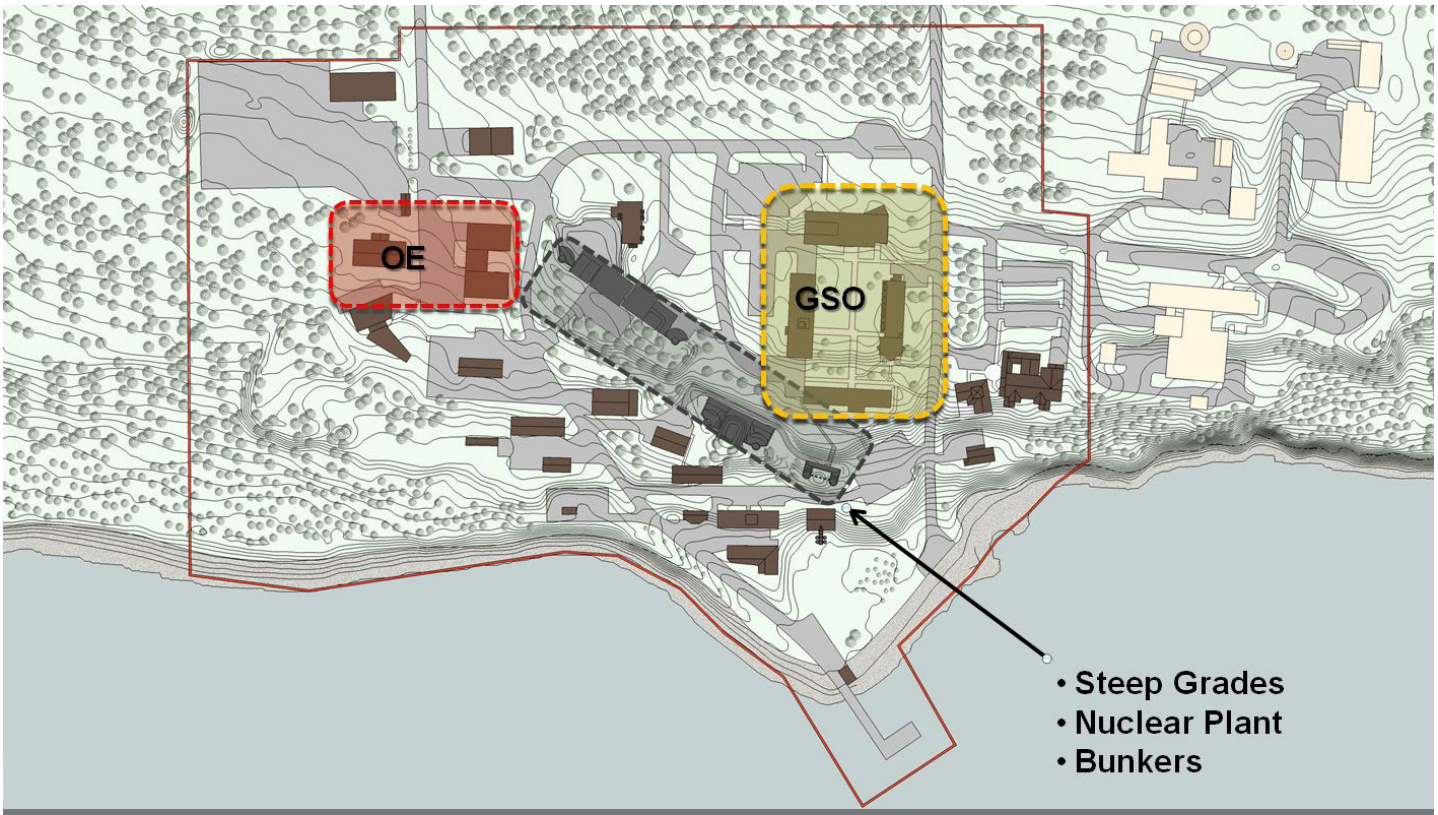
Campus Buildings: Quality rating; Identification of metal buildings

Buildings recommended for removal are indicated in a chart at the end of section 6.2.

Site Analysis: Location of GSO and Ocean Engineering

Another key consideration that affected recommendations for building replacement was the current location of GSO and Ocean Engineering facilities, and the effect of existing site features on the ability to create a unified campus.

This diagram below illustrates the current location of campus facilities associated with the GSO and Ocean Engineering (OE), and shows the barrier formed by campus features in the center of campus: the nuclear facility, the historic gun emplacements and the steep topography. These features form a natural and man-made barrier in the middle of campus that makes integration north-to-south very difficult.



Site Analysis: GSO, OE and campus barriers

Campus Concept

After completing these analyses of site features, building condition and program need, the team developed a proposed site organization diagram for the campus (see below).

Campus Concept Plan

This concept plan illustrates the overall organizational strategy for the proposed Master Plan. It suggests consolidation of the various campus functions into discrete areas for economy and efficiency, and the removal of smaller, less functional campus buildings. More specifically, it proposes:

- A central academic core on the northwest side of campus, including research and administrative space for the GSO, research and tank facilities for the OE and a shared Ocean Technology and Robotics Center.
- A teaching commons facility with classrooms and lecture hall, food service and student spaces and facilities.
- Enhanced facilities for Outreach and Education to the north of Ferry Road.
- A centralized and enhanced Marine Operations area and expanded pier facilities to accommodate the new Regional Class Research Vessel (RCRV) and/or future visiting research vessels.
- Enhanced Seawater Tank facilities.
- Relocated Pier Road, to the west, to provide area for new buildings and for future expansion.
- Centralized campus facilities service area.
- This plan also indicates the potential for ground-mounted photo-voltaic panels to the south, for a source of alternative energy; this is discussed further in the Building Infrastructure Section in this chapter.

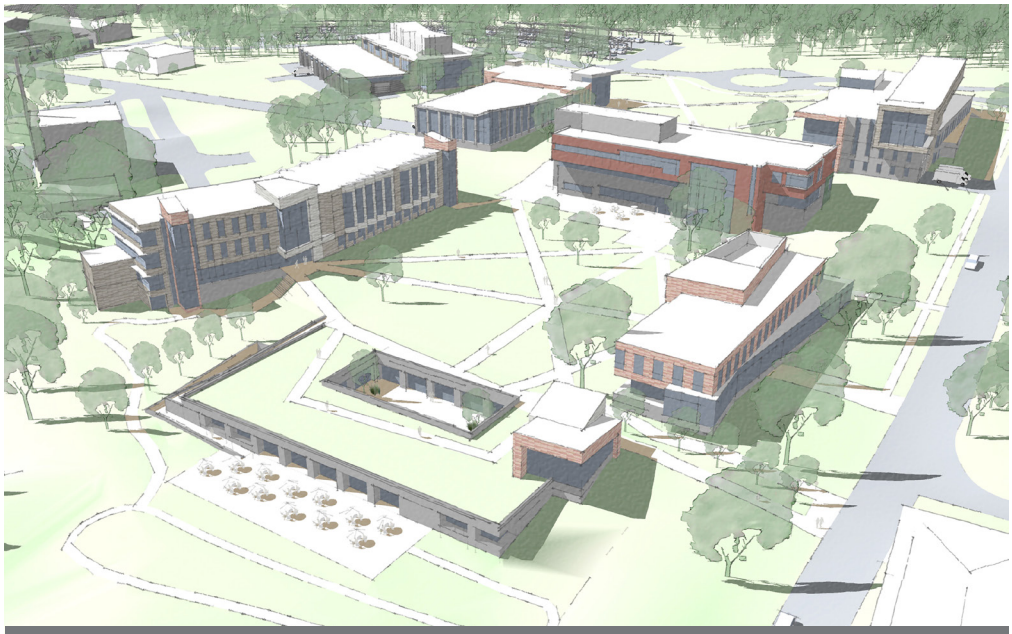
The illustrations below show additional detail of the recommended building projects. Recommendations for site improvements and building infrastructure systems are included in Section 6.3 and 6.4. Charts documenting all recommended new buildings, renovations and demolition projects are included at the end of Section 6.2.

Proposed Master Plan, by building

This plan illustrates more precisely the full build-out of the Master Plan and the location of the campus pedestrian core. It also shows the location of individual new and existing buildings; buildings with similar functions are color-coded accordingly.

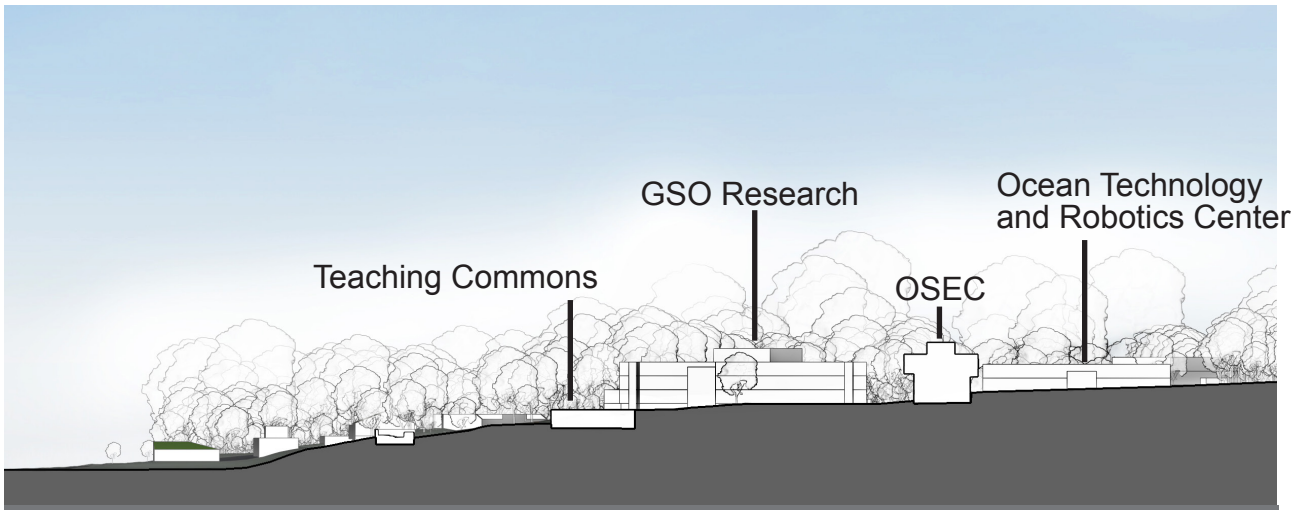
- GSO Research and Admin
- Ocean Engineering
- Ocean Technology
- Teaching Commons
- Outreach and Education
- Seawater
- Marine Operations
- Facilities Maintenance
- Non - URI facilities

This plan illustrates more precisely the full build-out of the Master Plan.



Master Plan Concept - View from East

This view from the West shows the full build-out of the Master plan. The new GSO research facility is in the foreground, the Ocean Technology and Robotics Center to the right, the Ocean Engineering Building in red further to the right; campus service area is to the extreme right. This illustration also shows a relocated Pier Road, with new parking.



Site Section, looking south

This campus cross section shows the water's edge at the left, the new Teaching Commons with a vegetated roof, new GSO Research Building East, the existing OSEC building center right, and the New Ocean Technology Building to the far right.

Specific Improvements

The Master Plan recommends the construction of the following new and renovated facilities for the various aspects of campus operations. These facilities improvements would occur in a phased approach over a ten-year period. Specific Phasing approach is documented in Chapter 8, and Cost information is included in Chapter 9.

GSO Research

The plan recommends two new research facilities, each approximately 50,000 gross square feet, together accommodating all of GSO's research needs. These new facilities will centralize all research activities, create flexible and adaptable laboratory space, promote collaboration among GSO scientists, and accommodate all GSO research in similar planning modules. The new facilities will also allow existing outmoded research facilities to be abandoned. Scientists will be located according to research affinities as opposed to group affiliation. The new buildings include research labs (primary and secondary labs), shared research support spaces, faculty offices, grad student and post doc offices, break and conference space and administrative support. The full space program is included in Appendix C.

The new research buildings are located near the existing GSO administrative home (OSEC), the proposed new Ocean Technology and Robotics Center, and the new Teaching Commons.

Department of Ocean Engineering

Two new facilities will be constructed for Ocean Engineering, a research/office building and a water tank facility. The new research building will provide research lab space for each faculty member, an accommodation currently lacking. The new tank facility will provide expanded acoustic and wave tanks for teaching and research, accommodate a relocated tank from the Ark Building and provide area for shops and high-bay assembly.

These new buildings will replace the outmoded metal buildings currently occupied by the department. The new buildings will be located within the new campus academic core, adjacent to the new Ocean Technology facility, and near the new teaching commons, so as to share student space, food service and classrooms.

New Ocean Technology and Robotics Center

This new 25,000 gsf facility represents a major investment in new technology for the campus, providing shared research facilities for GSO and OE, and providing space for partnerships with outside industry. The new facility will house significant space for robotics research, a growing focus for both GSO and OE scientists; this will include a high bay area and space for a robotics testing tank, as well as a number of faculty research labs. The facility will also include 6,000 net square feet for incubator space, for partnerships with outside industry; equipment development space; and space to support the Engineering Development Lab (EDL), an important new initiative in the state.

Outreach and Education

New facilities for Outreach and Education (O&E) include a new 20,000 gsf conference facility, with expanded meeting and exhibit space; expanded space for the Inner Space Center within OSEC; expanded administrative functions within the CIB; and renovation of existing research space in CIB (relocated to the new GSO research building) into dormitory space. All O&E functions will remain on the north side of Ferry road, with additional parking for large events; a new cross walk will provide access to the large lecture facility in the new Teaching Commons building. The Inner Space Center will be expanded within the OSEC facility to provide expanded technical capabilities for teaching and research, including a new advanced autonomous vehicle mission control room/teaching lab, a telepresence conference room, a new studio, expanded staff areas, and associated technical support space.

Classrooms, Lecture Halls, Food Service, Student Space

A new teaching commons will be constructed in two phases at the campus core; Phase 1 will be a 20,000 gsf facility located at the current quad, embedded in the earth so that its roof matches the current elevation of the quad; its occupied floor is one story down, oriented with a view to the bay. This below grade facility is intended to be a model of sustainability, and will house a new flexible large lecture facility, food service, and active learning, media-rich classrooms. The Phase 2 Teaching Commons will be a new structure on the site of the Watkins Building, housing additional classrooms and student spaces, including small group meeting/study areas, lounge, and work out space with showers.

Marine Operations and Pier Expansion

Marine Operations functions will be centralized in one location, adjacent to the relatively new Marine Logistics Building. The plan calls for a new 12,250 gsf Marine Operations facility, with space for shops, equipment assembly and staff. This facility will also accommodate expanded space for the dive program.

Planned upgrades to Marine Operations also include key improvements that expand the existing pier's capabilities to accommodate the new RCRV and/or future visiting research vessels.

In order to accommodate the new RCRV and/or future visiting research vessels, the planning team worked with Appledore Engineers, a marine engineering consultant, to develop a conceptual design for the pier improvements needed; that recommendation is included in Appendix B.

The scope of the modification of the current NBC pier will allow the upgraded facility to accommodate a 200' vessel on its outboard face, and a 68' boat on its inboard (shore-side) face. In addition, in an effort to further expand access to the bay for graduate and undergraduate students, the pier will be equipped with a 10' square moon pool and a davit, with a 2-ton working capacity to allow easy launching and retrieval of research equipment and instrumentation.

Seawater Facilities

The two primary seawater tank facilities, the Durbin Aquarium and the Blount Aquaculture Lab, will be retained, in light of the large investment in seawater systems embedded in those facilities. The Master Plan calls for renovations to the exterior envelope of both facilities, as well as renovation to some of the research labs in the Aquarium Building. The plan also calls for re-purposing the Ark building for an outreach teaching lab, and a small addition for an additional teaching lab and support functions. In addition, the Seawater Facilities will be supplemented by the new Large Pelagic Fishes Lab, currently nearing completion.

Rock Storage

The Master Plan calls for construction of a new 12,000 gsf rock storage facility, including refrigerated high bay space, some high-bay freezer space, sample prep labs and storage.

Campus Facilities Operations

The Plan calls for a consolidated Facilities Operations area in the vicinity of the existing Furtado Building. New facilities will include a new 12,000 gsf facility for shops, maintenance storage and staff, covered vehicle storage, a small hazardous materials storage facility and exterior storage of various maintenance materials.

Allen Harbor

Allen Harbor is a separate marine-oriented property on Narragansett Bay that was purchased from the Department of Education with the understanding that it would continue to be used for educational purposes. The property is currently in disrepair, but the intended use is for a safe harbor facility for smaller vessels, for the dive program, and for related educational purposes. Proposed upgrades include a small new building housing a 20 person classroom and space for boat storage, staging and the dive program. Proposed upgrades to the pier facilities include:

- Replace the existing derelict bulkhead with a new bulkhead and floating dock to provide 130’ of berthing space for the 68’ catamaran research vessel and for smaller vessels.
- Provide a new boat ramp and floating dock with short term berthing facilities.

Program Summary

The charts on the following summarize these facility recommendations.

Summary Chart

	GSF
Current Building Area	329,756
Buildings Removed	198,931
Buildings Retained	129,243
New Building Area	270,850
Total New & Retained Building Area	400,093
Additional GSF	70,337

New Building Area

Building	GSF
GSO Research (Phase 1 and Phase 2)	103,000
Ocean Engineering, Research and Tank Facilities	46,700
Ocean Technology and Robotics	25,000
Outreach and Education Conference Facility	20,800
Marine Operations	12,250
Teaching Commons (Lecture Hall, Classrooms, Food	17,500
Teaching Commons (Classrooms and Student Spaces)	15,000
Rock Storage	12,000
Seawater Addition	6,000
Maintenance	12,000
Haz mat Storage	600

Renovations and Building to Remain

Building	Program	Renovate/Upgrade	GSF
OSEC	Renovation 5,500 SF to expand ISC	X	41,382
CIB	Renovation for Admin + Dorms	X	43,505
Mosby			3,089
Aquarium	Exterior Upgrade	X	16,949
Blount	Exterior Upgrade	X	7,726
Ark	Renovation for Outreach	X	1,802
Furtado			10,470
Marine Logistics			4,320
TOTAL			**137,785**

Campus Program - Demolition (Phased)

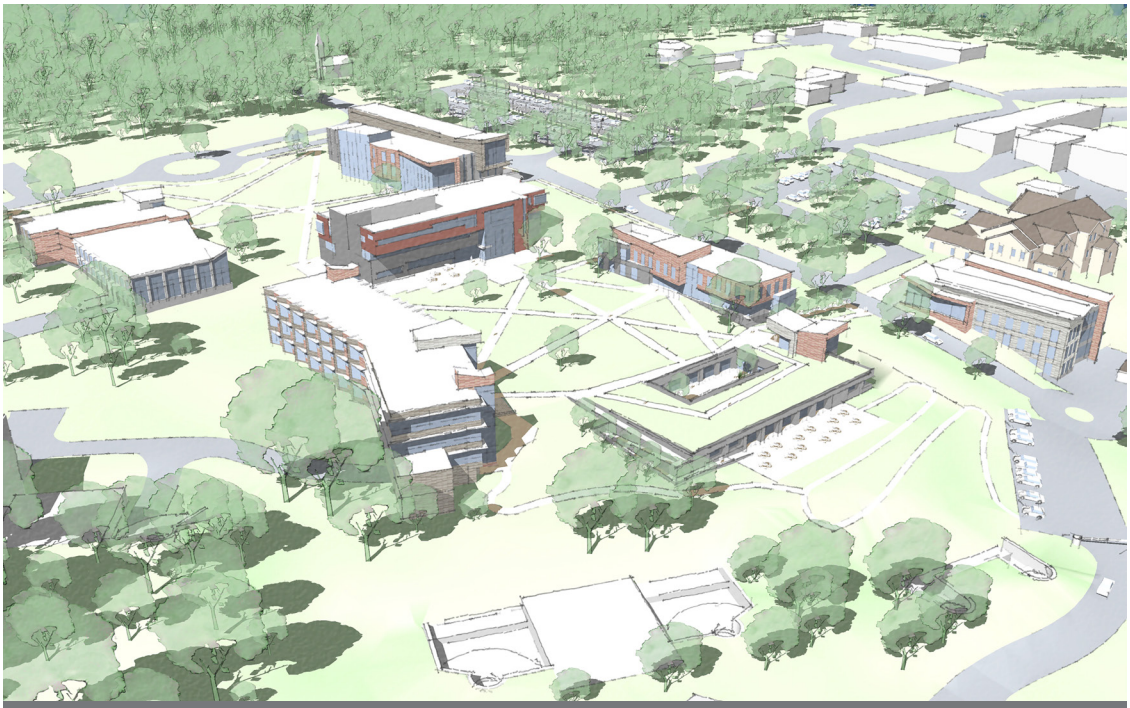
Demolition	GSF
Horn	30,457
Watkins	32,797
MRB	9,231
Sheets	11,303
Middleton	29,774
Tech SVCS	8,840
Maintenance	6,315
MERL	6,141
Lagoon Meso.	449

Demolition	GSF
CACS	29,291
Rock Storage	7,000
Aquarium Annex	1,815
Fish	7,505
OTC	10,246
Marine Lab	3,332
Perkins Small Boat	1,842
Small Boat Maintenance	1,041
Quonset Hut	1,552
TOTAL	**198,931**

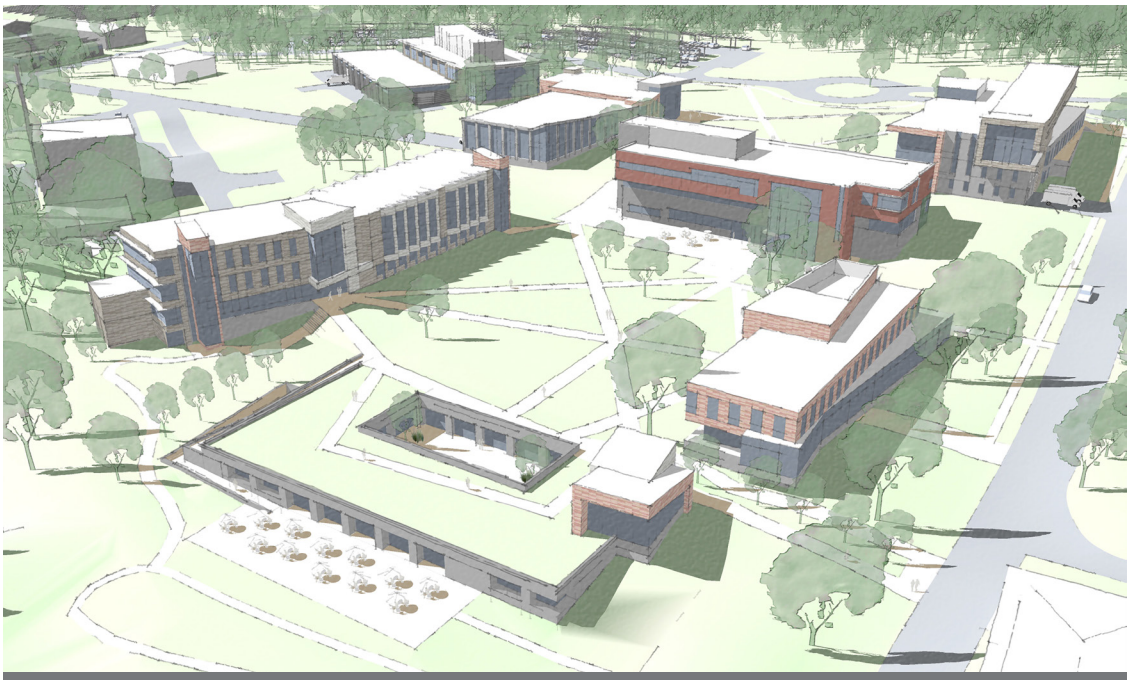
The images on the following pages provide a sense of what the realized campus plan might look like from various key vantage points.

Master Plan Concept - View from East

Master Plan Concept - View from the deck of the research vessel, looking East over the extended pier

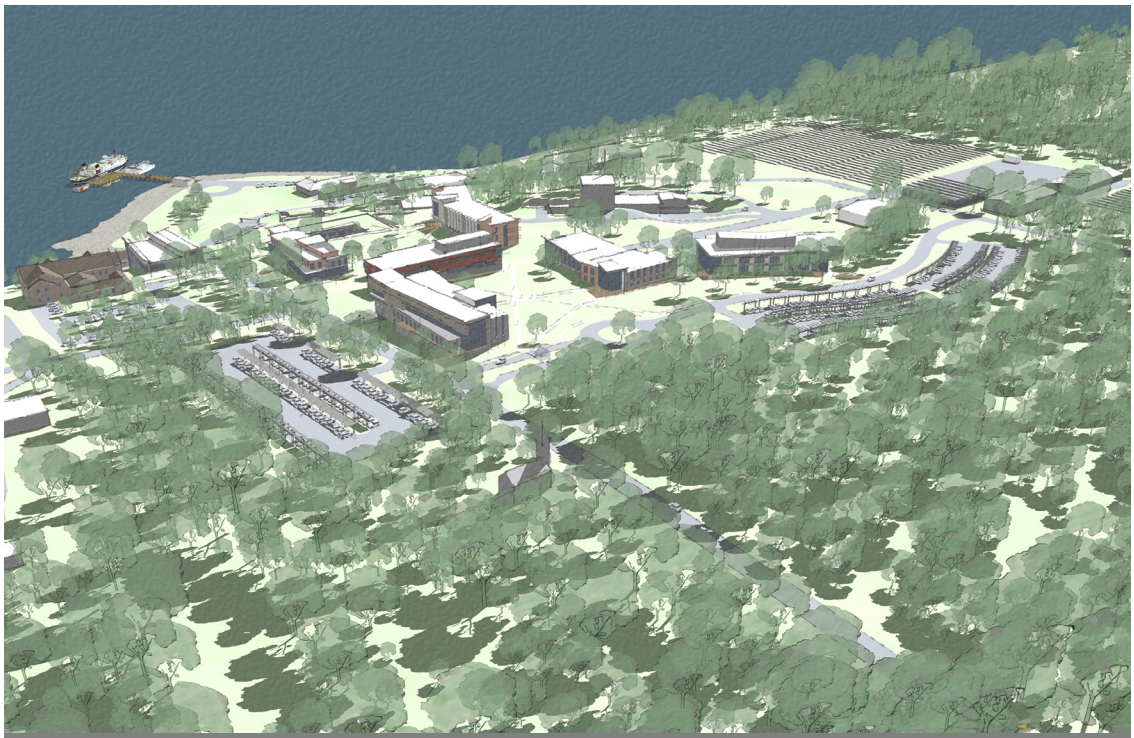


Master Plan Concept - View from South



Master Plan Concept - View of Knauss Quad from East

Master Plan Concept - View from North West



Master Plan Concept - View from West

6.3 Site and Landscape

6.3.1 Civil Engineering

The Master Plan recommendations include improvements to campus infrastructure, lighting, way-finding, accessibility, circulation, and parking to support to the proposed building program, reduce impacts to the environment, and improve circulation and resiliency. The most significant infrastructure improvements proposed in support of the campus master plan include campus wide storm water improvements, the relocation of the western portion of Pier Road, and improvements to infrastructure in Aquarium Road and South Ferry Road. The following is a summary of recommendations for improvement to the Campus, traffic and circulation, storm water, South Ferry Road, Aquarium Road, and Pier Road.

Recommended Campus Site Improvements

- Promote pedestrian mobility within the campus through the introduction of sidewalks and clearly designated walking paths. Provide sidewalks or walking paths between buildings and parking areas to enhance safety and accessibility. The proposed circulation plan provides guidance to ensure compliance with the Americans with Disabilities Act (ADA). In particular, the Master Plan provides accommodations to provide east/west pedestrian circulation across the campus.
- Provide a standardized lighting within the campus to improve pedestrian and bicycle mobility and visibility during evening and night time hours. There should be a hierarchy of lighting to accommodate both pedestrian and vehicular circulation. Dimmable fixtures should be considered.
- Implementation of a blue phone system is recommended throughout the campus.
- Provide marked or signed bicycle routes and accommodations. Provide bike racks and other amenities to promote bicycle usage.
- Provide new utility infrastructure within the Campus Core to support new building program. These improvements should include underground electric and telecommunications infrastructure for services to new buildings to improve resiliency and minimize visual clutter.
- The remaining gap in the gas main at the intersection between Aquarium Road and Pier Road should be completed to provide a complete loop around the Campus.
- Extend the 8-inch water main at the south side of Horn Lab and OSEC to the west to the adjusted location of Pier Road to maintain a secondary loop around the campus core buildings. This loop will provide redundancy and allow for maintenance and repair with minimal disruption to the campus.

Traffic and Circulation Recommendations

- Provide campus wayfinding to provide clear guidance for all users to locate their destination while visiting the campus.
- Consolidate parking adjacent to the campus entrance at the western edge of Pier Road and along the north side of South Ferry Road to limit vehicular traffic within the core academic and research areas of the campus. The exception to this being a smaller parking lot near the Marine Research, Pier, and Small Boat facilities.
- Provide a campus bus stop that is accessible to the campus core.
- Provide bus parking and drop off for visitor groups.
- Allow secondary gated access to campus from Dean Knauss Drive for emergency, delivery, and maintenance vehicles. Security camera and remote access control from the security building is recommended.
- Provide accommodations for bicycle access and bicycle racks throughout the campus.
- Convert the southern portion of Aquarium Road to a limited access road for service and emergency vehicles to promote this area as a pedestrian zone. The northern section of the road with the beach area parking would be separated by a gate or other means to restrict access. Security cameras are also recommended at this location.
- Reduce the length of South Ferry Road to minimize steep slopes and reduce impervious areas within the coastal buffer zone. Provide a terminus at the end of South Ferry Road.
- Opportunities to improve transit between the Kingston Campus, Kingston train station, Providence, and the surrounding community should continue to be considered.
- Measures to make the Campus self-sufficient from the Kingston Campus should be considered including a fueling facility and a waste and recycling transfer station.
- Driveways, parking lots, and roadways should be configured to minimize vehicular/pedestrian conflicts.
- All pedestrian crossings should be located to ensure adequate sight distance and shall include signage and striping.

Recommended Stormwater Improvements

The recommended stormwater improvements include:

- All improvement projects proposed as part of the campus master plan will be required to comply with the requirements of the Rhode Island Stormwater Design and Installation Standards Manual. This manual requires the implementation of Low Impact Development (LID) systems to provide water quality treatment. LID systems that are appropriate for the campus include bioretention areas, bioswales, and sand filters. These systems may require underdrains in some locations if required based on soil conditions or seasonal high ground water elevation. LID systems are intended to be an integral part of the campus landscape and will be a visible indication of URI's goal to reduce environmental impact from the built environment.
- Three primary stormwater corridors are proposed, including the existing stormwater main in South Ferry Road, a second stormwater corridor through the campus core, and a third stormwater corridor along Pier Road (see stormwater corridor plan). Portions of the existing stormwater infrastructure may be designed to remain utilizing detention systems. Alternatively, replacement of the stormwater trunk line in Pier Road and South Ferry Road may be considered to accommodate increases in runoff from the master plan building program in coordination with stormwater quality and collection improvements.
- Offline water quality treatment systems are preferred in locations for larger watershed areas and in areas of steep slopes to bypass heavy flows and limit erosive conditions.
- Areas adjacent to South Ferry Road, Aquarium Road, Tarzwell Drive, and the eastern end of Pier Road, and along the eastern edge of the service yard and reactor are suitable locations to retrofit water quality systems. These stormwater improvements can be implemented without impacting the future building program included in this master plan (see stormwater quality improvement plan).
- New drainage and collection system improvements throughout the campus should include the introduction of catch basins upstream of each intersecting driveway and at a minimum interval of 300 feet along each campus roadway. High capacity grates should be used where slopes exceed eight percent, in particular along South Ferry Road, and the eastern portion of Pier Road.
- Catch basin to catch basin connections which allow for resuspension of sediment should be phased out as campus improvements are implemented.

South Ferry Road Recommendations

- Provide enhancements to stormwater collection, conveyance, and treatment. Off line water quality systems may be introduced along South Ferry Road utilizing by-pass manholes to divert lower flows to these systems. Veined catch basin grates are recommended along the length of South Ferry Road within the extents of the campus. Additional catch basins are recommended upstream of intersecting driveways and adjacent to the east end of Watkins Lab at the uphill side of the steepest section of South Ferry Road. (see stormwater quality improvement plan).
- Provide curbing on each side of South Ferry Road within the campus to address erosion issues at each edge of the road.
- Relocate electric and telecommunications infrastructure within South Ferry Road to provide campus resiliency improvements and reduce visual clutter.
- Provide an extension of gravity sanitary sewer main to collect services from the proposed GSO and Teaching Commons buildings.
- Provide improvements to pedestrian circulation and crossings, including curbing and sidewalks along the southern edge of the road. Regrade a portion of the road between east end of Watkins Lab and the Marine Resources Building to increase the length of the vertical curve and improve stopping sight distances, improving visibility for pedestrian crossings. Utilize the proposed terminus of South Ferry Road to reduce slope and improve transitions into the parking areas on the north and south side of the terminus.
- Provide accessible access from South Ferry Road to adjacent buildings.

Aquarium Road Recommendations

The recommended improvements in Aquarium Road include:

- Provide enhancements to stormwater collection and treatment systems which may include bioretention areas, bioswales, and sand filters.
- Relocate electric and telecommunications infrastructure within Aquarium Road to provide campus resiliency improvements and reduce visual clutter.
- Replace 6-inch water main with 12-inch main to complete 12-inch campus water system loop.
- Provide grading adjustments to reduce steeper slopes from South Ferry Road into the parking areas on the north end of Aquarium Road.
- Provide accessible access to the shoreline from the parking areas at the end of South Ferry Road.
- Limit vehicular access to emergency and service vehicles to promote this as a pedestrian corridor and restrict unauthorized vehicular access from South Ferry Road.

Pier Road Recommendations

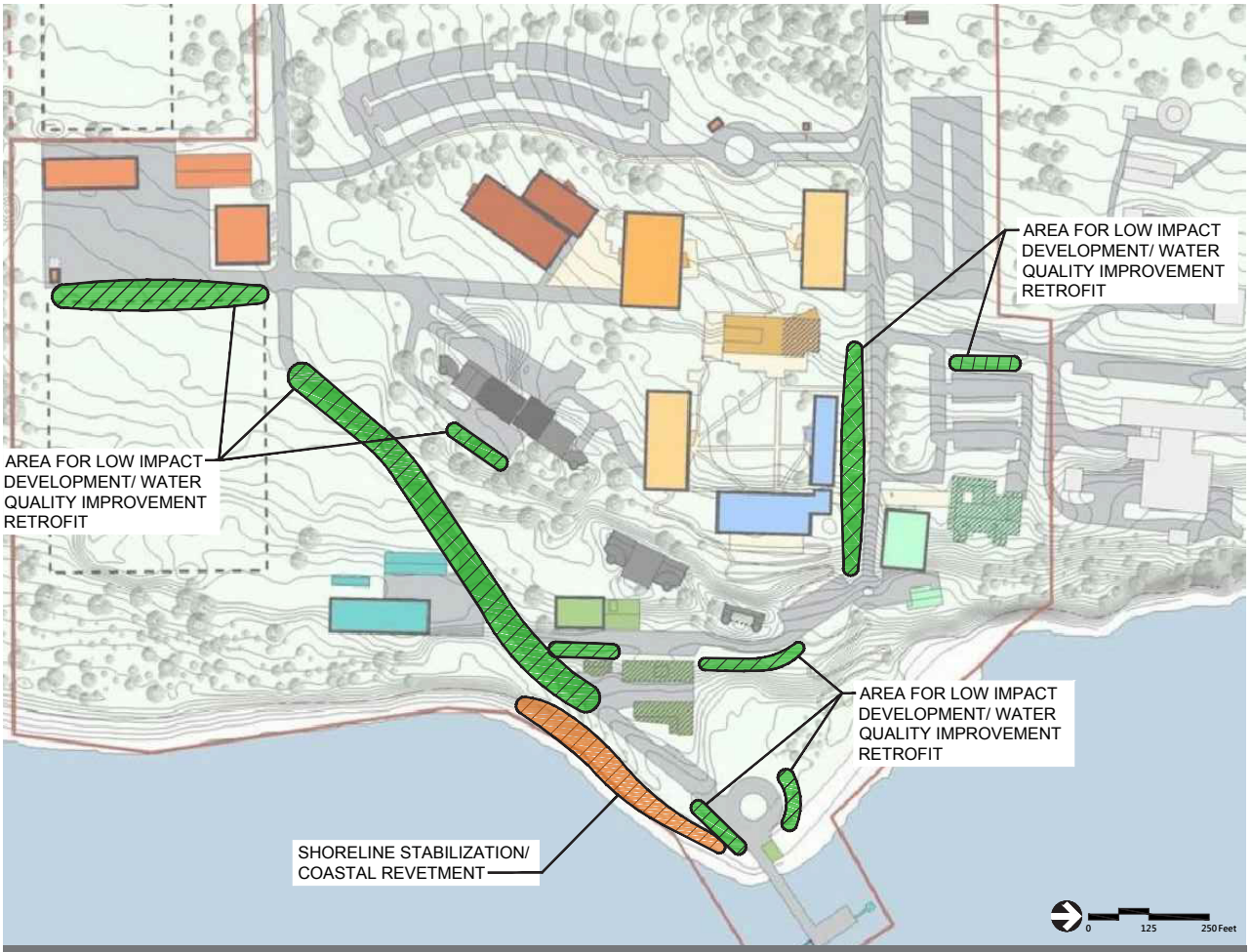
The improvements in Pier Road include:

- Relocation of the western section of Pier Road and associated utility infrastructure including water, gas, electric, and telecommunications services further west to accommodate campus building expansion and consolidation of parking. Electric and telecommunications infrastructure is recommended to be located underground up to the Ocean Engineering Research Tank to provide campus resiliency and reduce visual clutter at the campus gateway.
- Provide a security building at the campus entrance off of South Ferry Road.
- Provide turning circle at the eastern terminus of Pier Road for delivery and emergency vehicles.
- Provide enhancements to stormwater collection and treatment including off line water quality treatment recommended that may include bioretention areas, bioswales, and sand filters. Catch basins should be provided with minimum interval of 300 feet along the length of Pier Road through the campus with catch basins located upstream of each intersecting driveway. Stormwater improvements can be retrofit on the eastern end of Pier Road that is not relocated as part of the master plan (see stormwater quality improvement plan).

Aerial View showing relocated Pier Road and consolidated parking

There is also significant coastal erosion along the southeast facing bluff located immediately southwest of the pier adjacent to Pier Road. The bluff lacks any engineered revetment that would protect the coastal feature from further erosion. Further significant erosion of the coastal feature has the potential to compromise the road and associated utility services.

Stormwater Corridors



Stormwater Quality Improvements

6.3.2 Landscape Recommendations

The quality and character of the Bay Campus landscape and open space plays a crucial role in creating a strong sense of place and identity for the Graduate School of Oceanography and the Department of Ocean Engineering, as well as the University at large. While specific improvements constructed as a result of this Master Plan will each have unique and discrete requirements from a landscape perspective, the establishment of a set of broad landscape goals and strategies to attain those goals can have a profound impact upon future development. The following list of goals and strategies can be the starting point for future landscape changes and can act as a check and balance system, ensuring a unified and ordered campus landscape as redevelopment of the campus occurs.

Landscape Goals:

Increase resiliency
Reduce maintained area
Restore hydrology
Remove cars from the campus core
Entice people to walk
Strengthen Identity of Campus
Establish native plant communities on the site

Landscape Strategies:

Reduce amount of lawn and pavement
Increase pervious area
Establish loop circulation with parking at edges
Create legible, convenient and attractive pedestrian connections
Accentuate relationship to water
Strengthen views
Clear invasive plants/plant native species

By adopting these goals as an essential part of the vision guiding future development, the landscape can become a resilient, environmentally impactful and sustainable campus, reflective of the high ideals and important educational mission of the University.

In the context of these goals and the development of the master plan, the landscape approach centered on creating an ordered, unified and appropriate plan for parking and roadways, pedestrian pathways and vegetation

Parking and Roadways

The Master Plan recommends consolidating the many small parking lots which currently exist and establishing several larger parking areas at the edges of the campus in order to keep cars out of the campus core.

By establishing centralized parking and eliminating many small scattered lots, impervious pavement area on campus will be reduced, which will help to reduce stormwater runoff and simplify and expedite maintenance operations for these areas. Reducing the number of parking lots in the campus core will also improve aesthetics and increase the comfort and safety of pedestrians as they move through campus.

Vehicular circulation will be limited to the edges of the site in order to create a pedestrian centric campus core. The width of campus roadways should be standardized at 22' in order to further reduce impervious Pavement on campus and reduce stormwater runoff. Narrowing of roadways will also help reduce maintenance burden and costs.

Pervious pavement solutions for parking and roadways should be explored wherever the intensity of use and/or the maintenance capacity of the facilities department can support it. Options for this could include pervious asphalt, pervious concrete, grass-pave as well as simple gravel lots, similar to what is currently in use at the Mosby Center.

Pedestrian Pathways:

The proposed pedestrian pathways will provide legible, convenient and attractive routes enticing people to walk and providing a powerful place of respite as well as a resource for exercise, recreation, inspiration and enjoyment for the campus community. The orientation of pathways will provide strong views to the ocean, accentuating the Campus's relationship with its context.

The consolidation of academic and research buildings at the core of the campus allows for pedestrian walkways to provide convenient connections in both the north-south and east west direction between buildings. Switchback pathways can provide a way to navigate the slopes as one moves west to east across the site, towards the water. These switchback pathways would replace the need for steep stairways that hinder handicap accessibility and are difficult to maintain.

Pedestrian connections across South Ferry Road should be provided that are safe, visible, and attractive. Crossing locations should be located to provide convenient crossing points at multiple locations. A strong connection from the new Teaching Commons to the North Campus across South Ferry Road would connect the Universities outreach functions to the core of the campus, and create a safe pedestrian route from one location to the other.

At the core of the campus, where pathways connect buildings, pathways should be constructed of durable and attractive hardscape materials such as exposed aggregate concrete, natural stone pavers or concrete unit pavers. Pathways on the periphery of the site could be constructed of compacted stone dust or asphalt to provide a cost effective, durable and easily maintained walking surface. The use of compacted stone dust pathways is highly recommended for use in the coastal buffer zone.

Vegetation:

The use of vegetation on campus can provide a myriad of positive impacts in terms of resiliency, sustainability and environmental health, creation of a sense of place and identity, and reduction in required maintenance. The way in which vegetation is used in the proposed Master Plan will also help to create a highly relevant campus landscape in relation to current issues of climate change and sea-level rise while also relating to the mission of Campus occupants and the University.

All of these outcomes can be achieved by utilizing native plants throughout the campus to create a cohesive and impactful campus landscape. Plants native to the area are well suited to the particular climate, the soils and the proximity to the coast. They can provide an overt connection to the natural history of the area while helping to create an aesthetically pleasing and functional Campus.

Planting and vegetation in the context of this Master Plan will create an interwoven matrix of plant communities supporting a resilient, native landscape. By re-colonizing the site with native plants the biodiversity and habitat potential of the campus can be maximized as well.

The master plan proposes the renewal of the vegetated portion of the campus landscape through the creation of six main plant communities in support of the landscape goals. These six plant communities provide a broad framework within which landscape planting improvements can occur.

Due to the wooded character of this campus and high population of Deer Ticks carrying Lyme disease in the area, it is recommended that the University explores tick management techniques that can be employed on campus to increase the health and safety of users. The use of mouse-targeted devices, or “Tick Tubes” is highly recommended due to its targeted application of pesticides on mice, which are the main hosts of infected ticks. A secondary approach would be perimeter spraying. More information on both techniques can be found by visiting the University of Rhode Island’s Tick Encounter Resource Center Website:

http://www.tickencounter.org/prevention/mouse_targeted_devices

http://www.tickencounter.org/prevention/perimeter_spray

Low maintenance meadow. Characterized by native meadow grasses and wildflowers these areas require mowing once a year. Meadows support a variety of insect, bird and small mammal species and will help accentuate the rural seaside character of the site. These native meadows are an excellent plant community to establish around the photovoltaic panel installations on the south side of campus. The wide variety of wildflowers will attract and support pollinators, which are currently experiencing decline throughout the nation. This lends to a unique opportunity for the university to maintain bee hives within these meadows as part of the sustainability initiative, or for research.

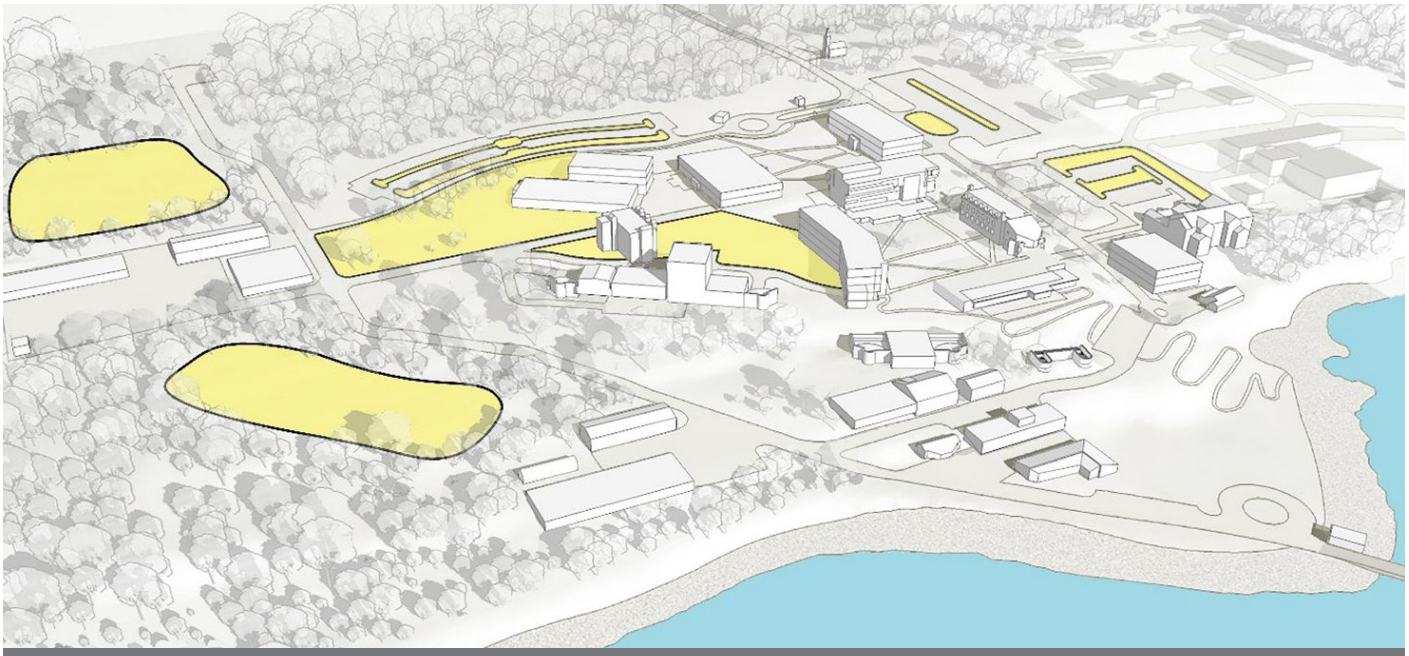


Diagram showing the location of proposed low maintenance meadow areas in the context of the proposed Master Plan.

MEADOW

PERRENIALS AND GRASSES

Schizachyrium scoparium (Little Bluestem)
Andropogon gerardii (Big Bluestem)
Zizia aurea (Golden Alexanders)
Festuca rubra (Creepig Red Fescue)
Sorghastrum nutans (Indiangrass)
Panicum virgatum L. (Switchgrass)
Eutrochium purpureum (Purple Joe Pye Weed)
Verbena hastata (Blue Vervain)
Aster Novae-angliae (New England Aster)
Elymus virginicus (Virginia Wild Rye)
Chamaecrista fasciculata (Partridge Pea)
Panicum clandestinum (Deer Tongue)
Helenium autumnale (Common Sneezeweed)
Heliopsis helianthoides (Ox-Eye Sunflower)
Asclepias syriaca (Common Milkweed)
Aster umbellatus (Umbrella Aster)
Solidago juncea (Early Goldenrod)

Illustrative cross-section of low maintenance meadow areas

Managed Woodland. There are existing woodland areas within the campus that are overrun with invasive plants, lack diversity or are otherwise unmanaged and would add to the overall campus character and sense of place if the understory was cleared of undesirable plants and the edges of these areas were planted with native understory trees, shrubs and grasses.

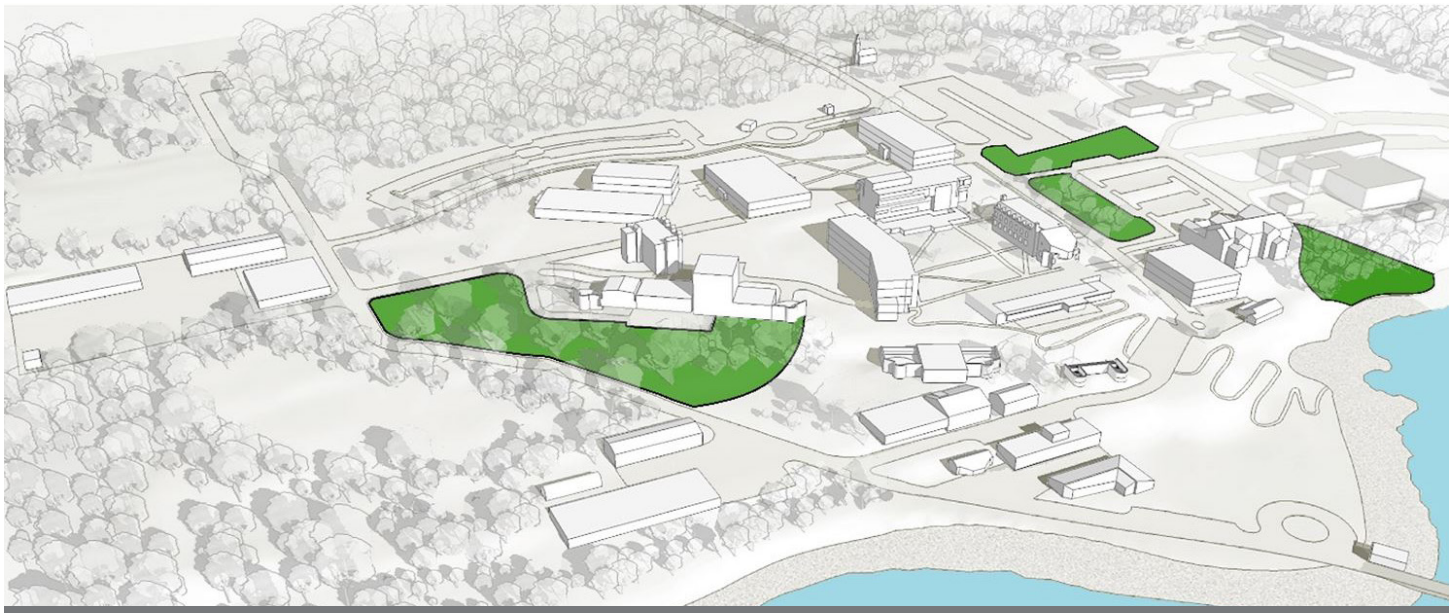
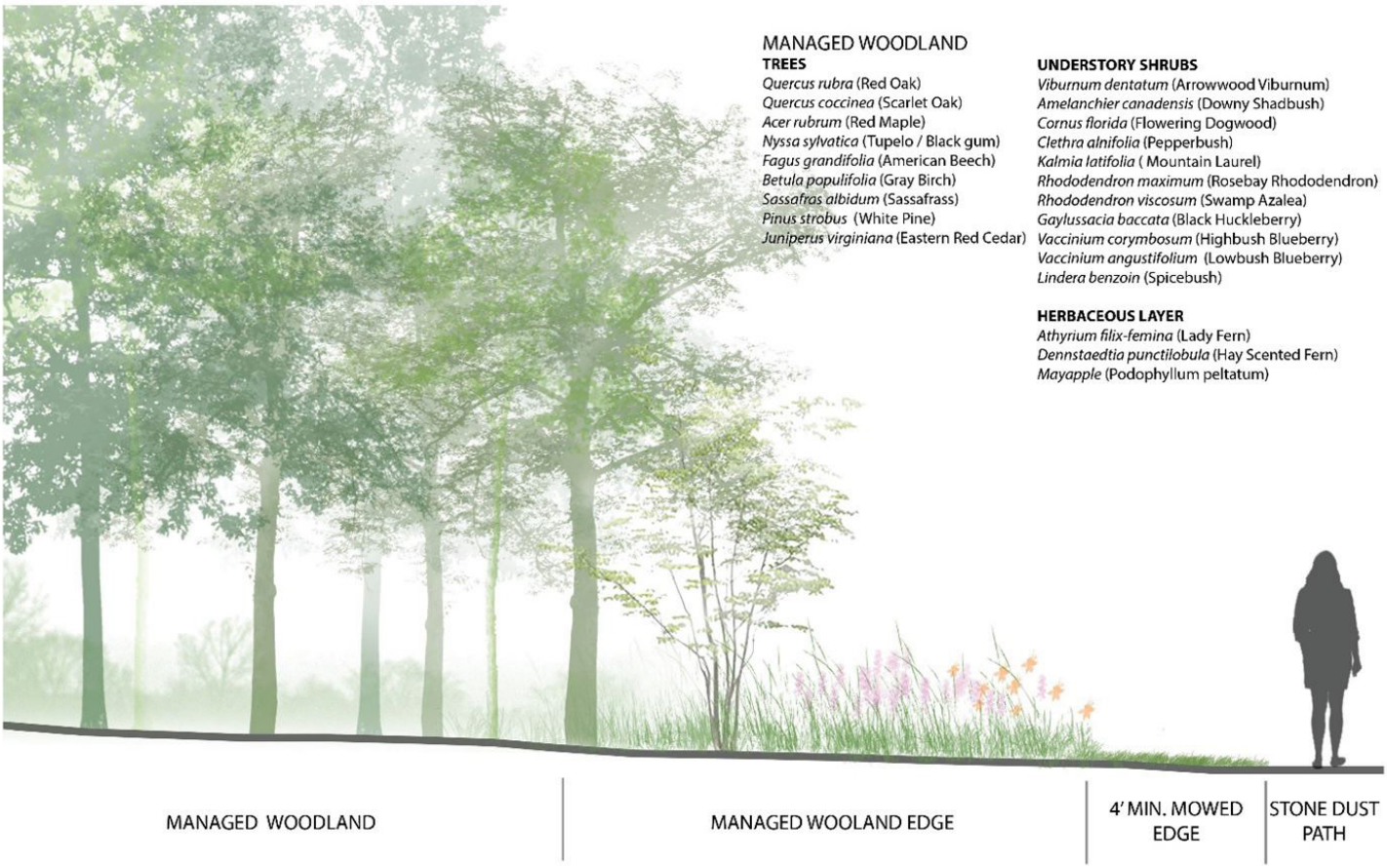


Diagram showing the location of proposed managed woodland areas in the context of the proposed Master Plan.



Illustrative cross-section of managed woodland area

Low Maintenance Campus Core. The campus core would be characterized by a combination of maintained lawn areas for gathering and activity and a less maintained combination of native trees, shrubs and grasses.

The plant choices in this area should accentuate the coastal setting and the campus' relationship to the water. Plantings should help create both intimate spaces for one or two people and open spaces for gathering in groups. Lawns and less maintained areas should be framed by pathways so as to provide a clear delineation of where maintenance is to occur. Other than existing trees to remain, trees planted in this area should either be placed appropriately or of small enough mature size so as not to block views to the ocean.

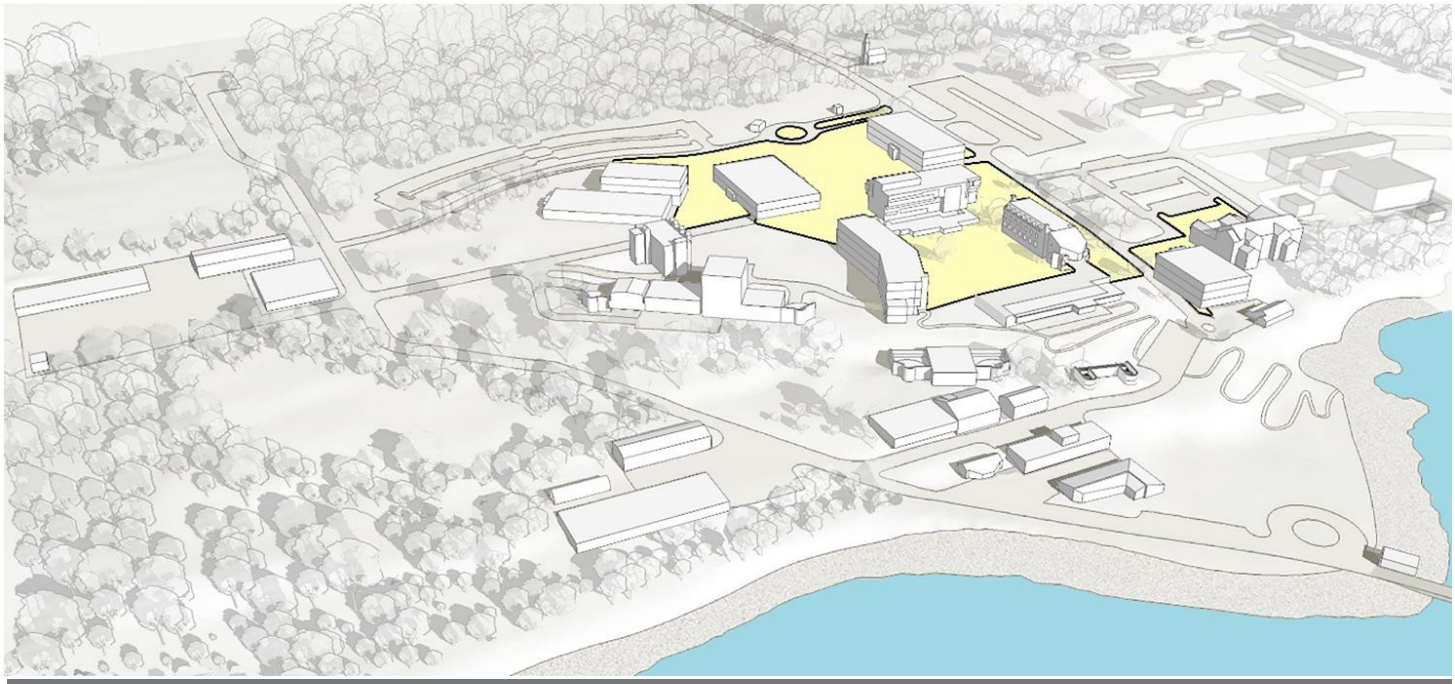


Diagram showing the location of proposed low maintenance campus core in the context of the proposed Master Plan

Illustrative cross-section of low maintenance campus core

Maritime Shrubland

The maritime shrubland can contribute to coastal resiliency and strengthen the identity of the campus by utilizing native maritime plant species. This area will require minimal maintenance once existing invasive plants are cleared and a native plant community is established. Pathways crossing through this area could provide a rich multi-textured experience of the landscape and create an overt connection to the coastal setting.

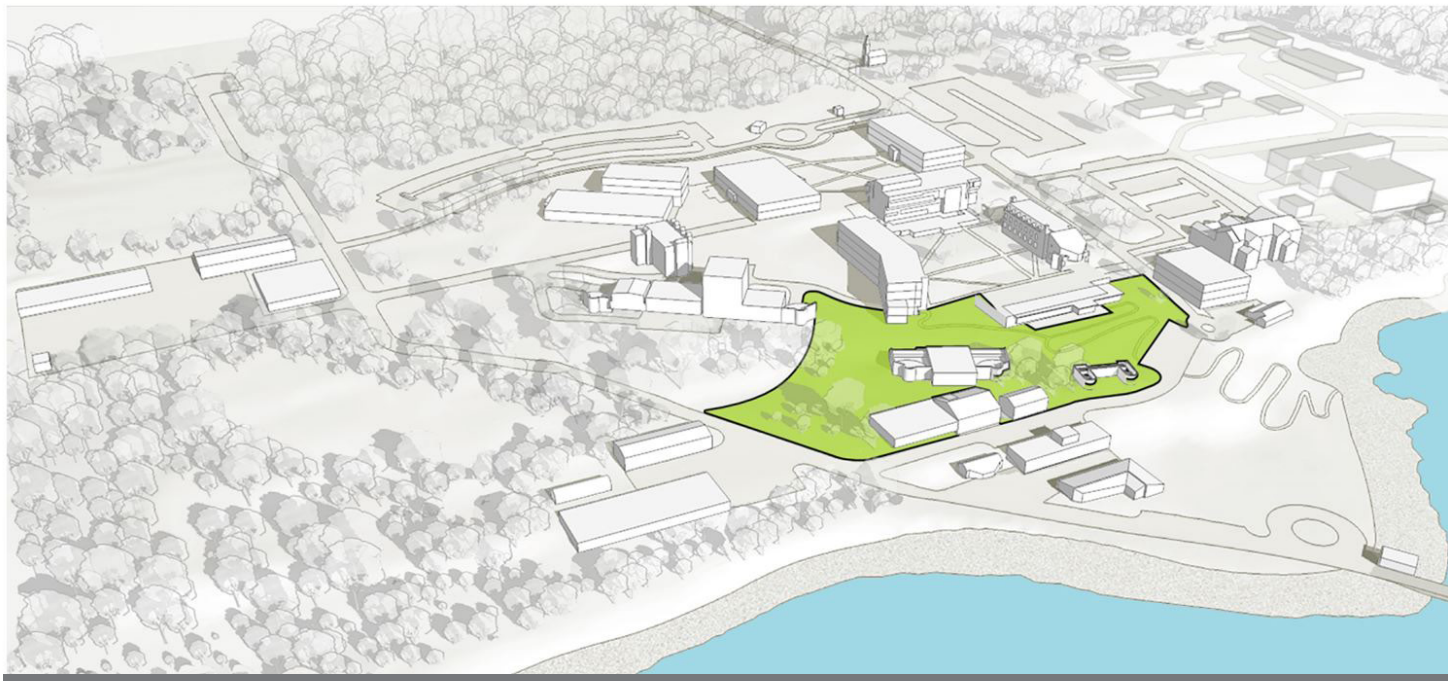
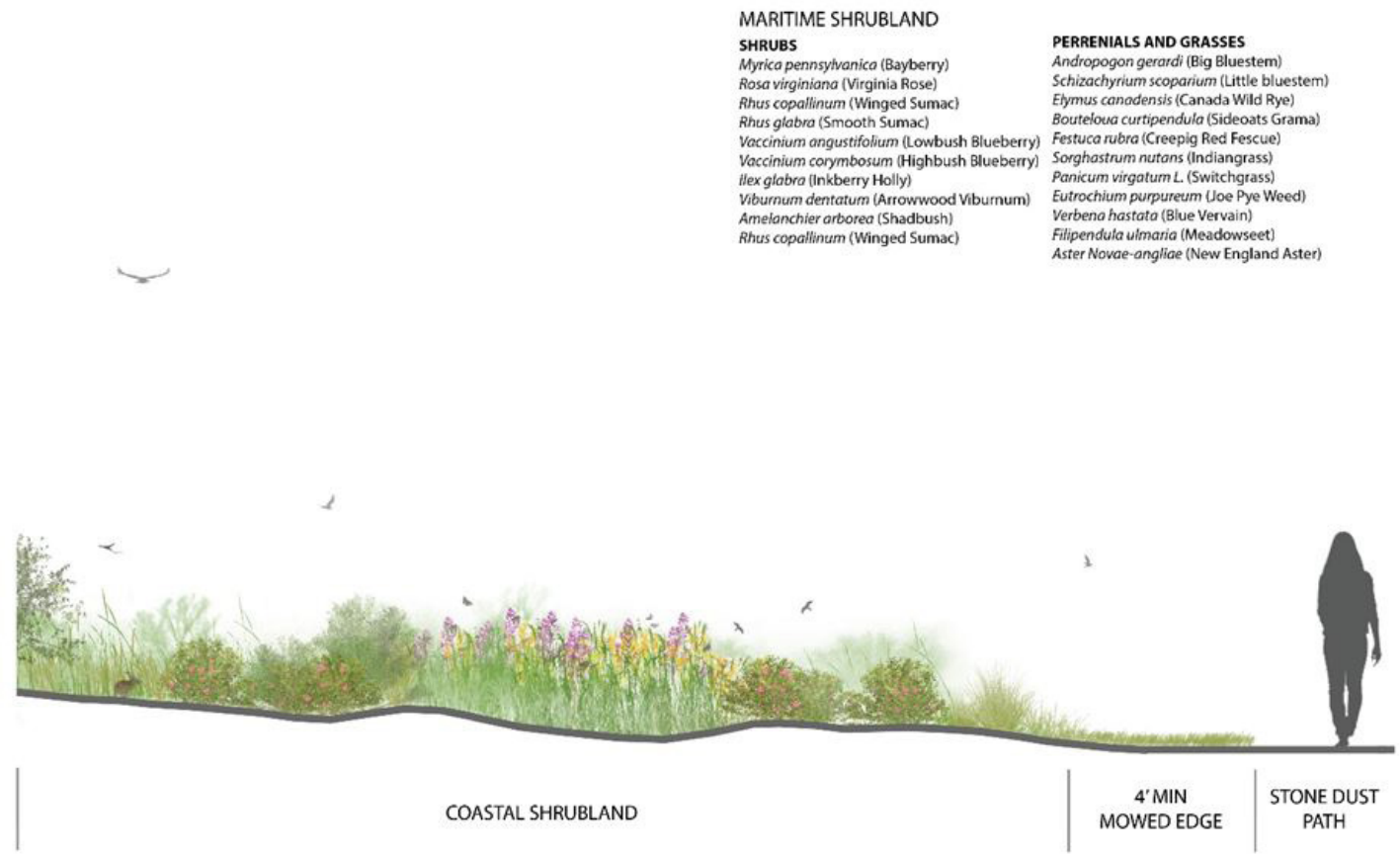


Diagram showing the location of proposed maritime shrubland in the context of the proposed Master Plan.



Illustrative cross-section of maritime shrubland area

Coastal Buffer

A coastal buffer area should be established as the first line of defense to any coastal flooding that may occur, to increase campus resiliency, and to create a sustainable and low maintenance plant community. This will be a densely planted native plant community able to withstand periodic flooding and providing important habitat value. Pathways crossing through this area will provide access to the beach area as well as provide a unique and memorable experience of the landscape.

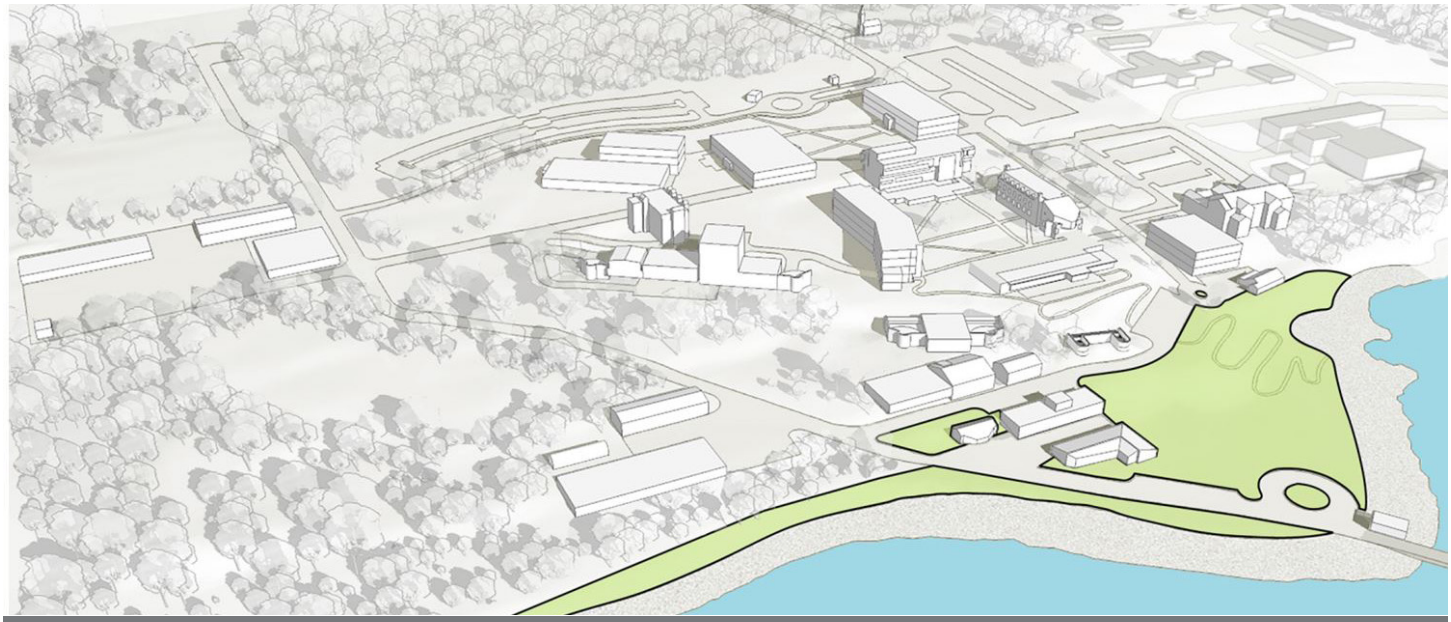
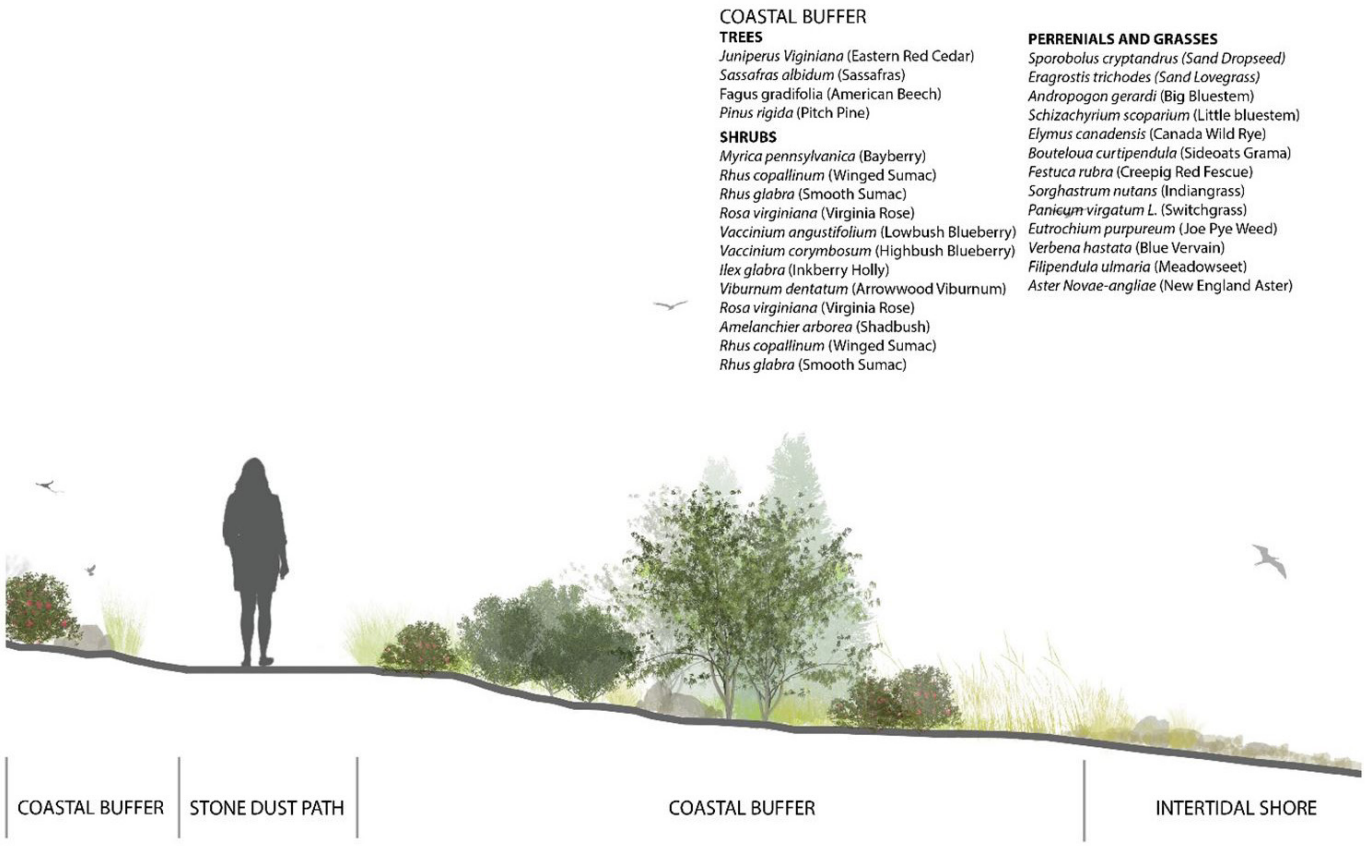


Diagram showing the location of proposed coastal buffer in the context of the proposed Master Plan



Illustrative cross-section of coastal buffer area

6.4 Building Systems

6.4.1 Master Plan MEP Recommendations

The Master Plan recommends eliminating poor-quality buildings, replacing failing systems, and investing in new cost-effective ultra-low energy buildings, powered by renewable electricity.

The first step in securing on-site renewable electricity for the campus is to secure a power purchase agreement, allowing a solar photo voltaic array developer to install a ground-mounted +/-2MW array to the East and West of the existing facilities storage yard. This will allow the array to move forward, ahead of the rest of the master plan, in order to take advantage of the federal tax incentives that will begin to expire at the end of 2019.

The HVAC systems for the two new GSO wet lab buildings are proposed to utilize both geothermal wells and the new campus PV array to fuel a hybrid ground-source, air-source heat pump system for space heating and cooling. New teaching and student occupied buildings including dry lab, workshop, classroom, office, teaching commons, and outreach spaces will utilize Variable Refrigerant Flow (VRF) air-source heat pump systems for heating and cooling.

Both approaches will pair the VRF systems with Dedicate Outside Air Systems (DOAS) with dual energy recovery wheels for air tempering and delivery to the spaces. Refrigerant piping will connect the roof mounted heat pump condensing units with evaporator units throughout the occupied spaces. The new GSO wet lab buildings will have a more traditional air handling unit approach with chilled water and hot water coils fed by boilers and chillers that supplement the ground source loop.

The HVAC systems for other building types including high-bay, warehouse, and seawater tank spaces will utilize fossil-fuel based unit heaters and natural or fan assisted ventilation systems, but no active cooling.

Plumbing systems for new buildings following the renewable energy strategy will utilize solar hot water and/or air source heat pump water heaters on a building-by-building basis. Other building types including high-bay, warehouse, and seawater tank spaces will utilize fossil-fuel or electric based water heating systems. New buildings will include new water service, new sewer service, new gas service (where building only requires heating only), and new lab waste service (for lab buildings only), and new storm drain service. Existing site/civil utilities (domestic water, sewer, natural gas, storm drainage) to be evaluated for capacity for new building requirements.

Each new building will include a DDC system for the implementation of control sequences, energy conservation strategies, and monitoring of actual energy use. Each individual system will communicate data with a new campus wide building management system that would replace existing outdated systems by several different providers.

Fire protection systems for new and renovated buildings will include a complete NFPA 13 automatic sprinkler system throughout each building. All classroom spaces, common areas, corridors, offices, and lounges shall be considered light hazard occupancy. All mechanical spaces, kitchen areas, storage areas, and lab spaces shall be considered ordinary hazard. Fire department valves shall be located in egress stairwells per NFPA 14 requirements. New fire department inlet connections to be provided for each building and their locations to be coordinated with the fire department. New sprinkler systems shall be zoned per floor and shall be tied into the building's fire alarm system. Existing site/civil utilities (fire protection water) to be evaluated for capacity for new building requirements.

Electrical systems for new buildings will include new utility provided electrical services and power distribution system to serve the ZNE selected building systems. Lighting will generally utilize LED lighting fixtures for maximum energy efficiency, long service life and ease of controllability. Lighting controls will be based on the latest distributed digital control methods incorporating daylight harvesting, multi-level lighting control, night setback and nighttime spill light control. Emergency and optional standby systems will be provided by building gensets using a diesel (emergency units) or natural gas (optional standby units) fuel source and emergency power distribution system to supply back-up power to emergency (life safety) loads and selected standby loads. Where multiple buildings are located in close proximity, a centralized generator plant will be considered to reduce installed cost and annual maintenance and testing. An integral lightning protection system with coordinate surge protection will be provided. All buildings will be equipped with a new NFPA compliant fire alarm system with remote radio based reporting to the town fire department.

Electrical systems for renovated buildings will generally follow those described for new buildings except existing systems that meet the proposed use and are determined to have the necessary service life expectancy will be retained for reuse.

It is anticipated that recent major infrastructure improvements such as emergency/standby generators, new electrical service equipment and new fire alarm head end equipment will be candidates for reuse but that all lighting, lighting controls and interior branch circuits will require replacement to meet the new use and current energy code requirements.

Site lighting systems will be planned to provide building appropriate, pedestrian scale light sources exhibiting dark sky qualities and spill light control to replace the current utility owned flood lighting. All light sources will be energy efficient LED. Non-essential exterior lighting will be turned off or turned down during hours of darkness to minimize surrounding light pollution.

The planning team assumes that the master plan will constitute the conceptual and strategic framework for the final design phase of the project. Many of the specific details and plans included in this report will need to be further developed to meet the final needs of the project. Refer to the MEP Master Plan Basis of Design Report/Appendix for preliminary recommendations.

6.4.2 Net Energy Feasibility Study

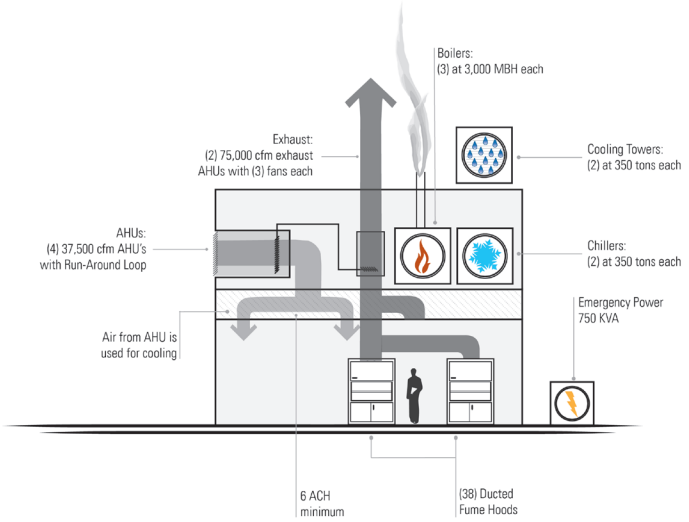
Zero Net Energy Feasibility Study

Energy data was collected, including natural gas consumption for the campus and electricity consumption for each building. This data was used to identify the energy intensity and consumption of the existing buildings to help inform master plan decisions.

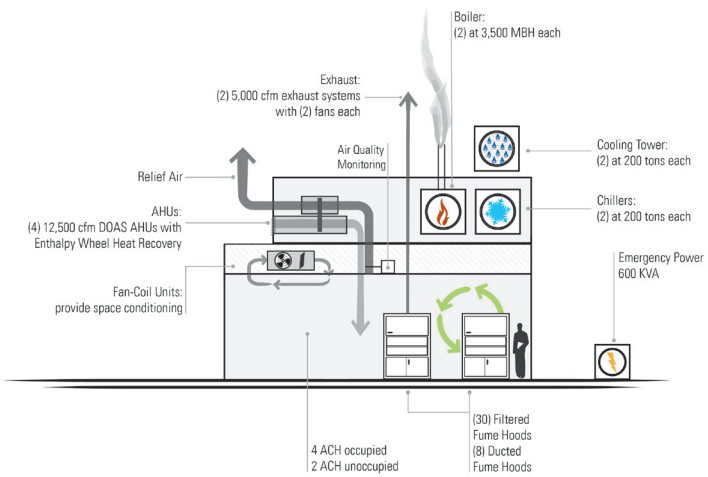
In order to streamline the zero net energy feasibility study, the team agreed to focus on the two new proposed 50,000 square foot GSO wet lab buildings. Four basis of design options were developed for these buildings, with associated construction, maintenance, energy and replacement costs over a 20-year time frame. Option 1 was “Standard Best Practice,” utilizing variable air volume with reheat system, run-around heat recovery, condensing boilers, and high-efficiency air cooled chillers. Option 2 was “Load Reduction + Fan Coil Units,” utilizing filtered fume hoods, air quality monitoring, reduced minimum air change rates, enthalpy wheel heat recovery, fan coil units, condensing boilers and high-efficiency air cooled chillers.

Option 3 “Load Reduction + Ground Source Heat Pump” matches Option 2, except that a hybrid ground-source / air-source heat pump system replaces the conventional boiler and chiller plant. Option 4 “Load Reduction + Variable Refrigerant Flow” is similar to Option 2, but replaces the fan coil units and conventional boiler and chiller plant with a variable refrigerant flow system. Options 2 and 3 maximize energy efficiency, eliminate fossil fuel consumption and allow the building to rely solely on renewable energy.

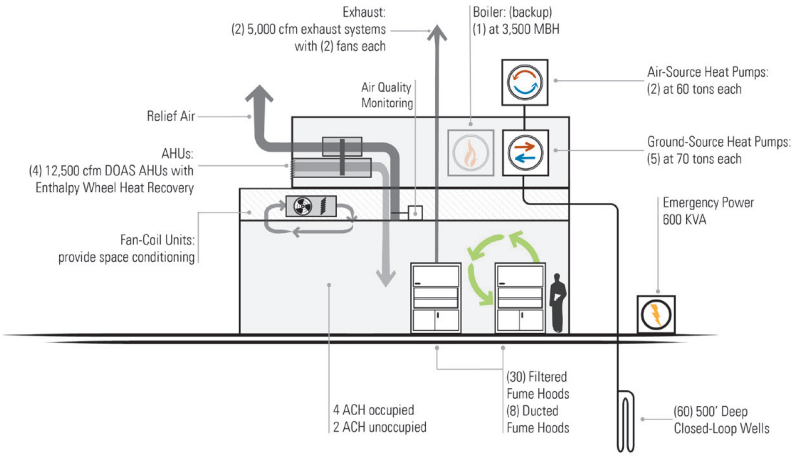
OPTION 1



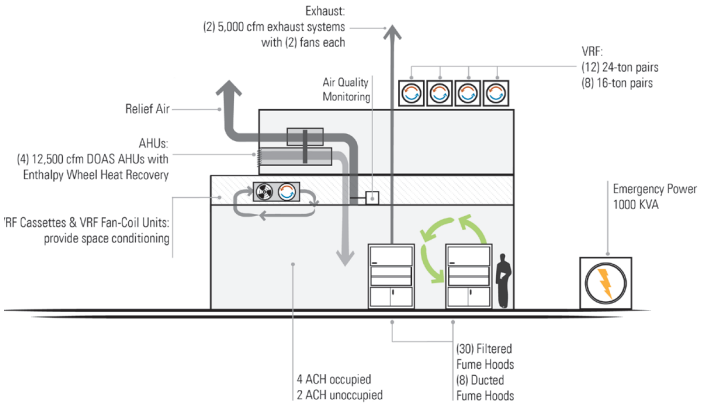
OPTION 2



OPTION 3

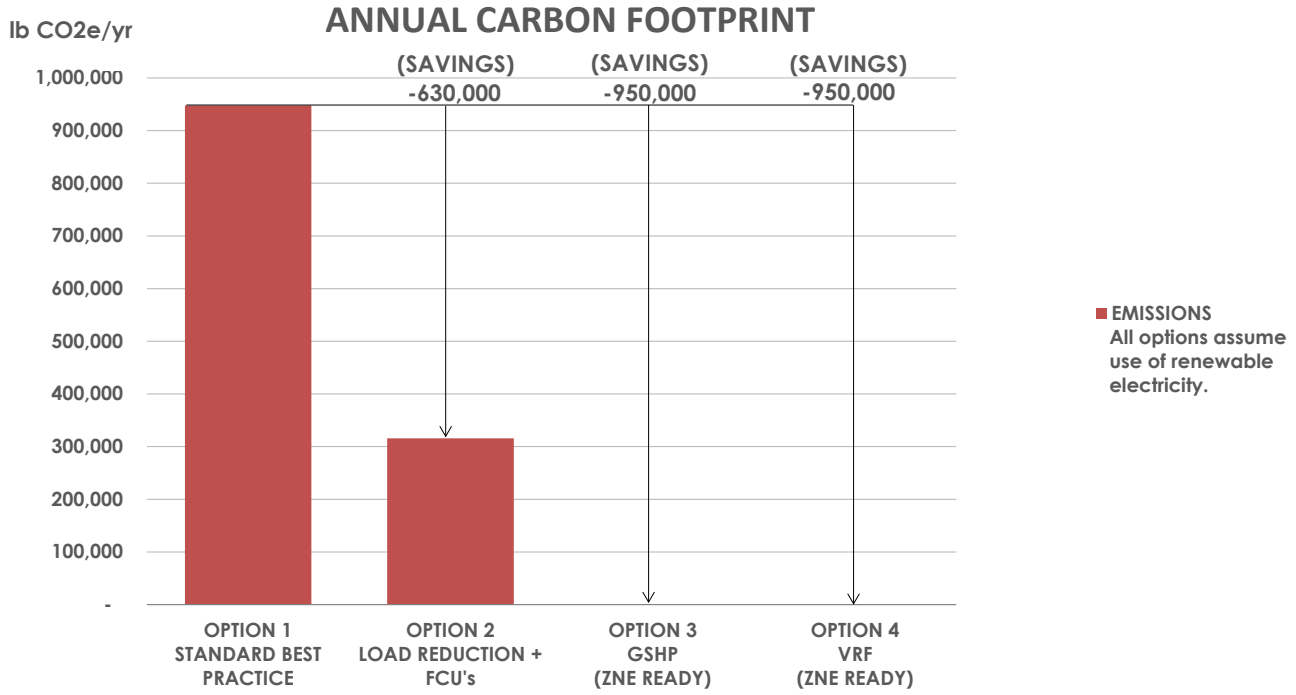


OPTION 4



Wet Lab Buildings Energy Approach

The life cycle cost analysis results showed that Options 2, 3 and 4 provide life cycle cost savings compared to Option 1. Given URI's commitment to achieving the energy and greenhouse gas emissions reduction targets set by the state, it was decided that the master plan would proceed with the use of Options 3 and 4. Based on the design team's recent successful application of Option 3 to similar wet lab buildings, this became the basis of design for the two new GSO wet lab buildings. Other buildings with less intense mechanical system demands were based on Option 4, as this option provided additional first cost savings.



Wet Lab Buildings Options: Annual Greenhouse Gas Emissions

The options outlined above cannot be applied to every building type on campus. The high-bay, warehouse and seawater tank spaces do not warrant the application of mechanical cooling. Without cooling, the addition of heat pump technology is not a cost-viable option. Therefore, the master plan basis of design for these spaces remains fossil-fuel based heating systems. Fossil fuel consumption will remain a component of the campus energy consumption, but will be significantly reduced as the master plan is implemented.

Once the building-level approach to move toward zero net energy was developed, the 2014 electrical data provided by URI was combined with estimates based on the master plan, to determine the potential renewable energy system demand to target zero net energy. As a reference-point, to offset 100% of the 2014 electrical energy consumption a solar photo voltaic array of roughly 4.4 MW would be required.

Given the anticipated increase in total building square footage, a higher intensity of research lab, machine shop, data center, dining, and other programs, increased ventilation, improved thermal comfort and humidity control, and the shift from fossil fuels to renewable electricity, the campus may increase electricity consumption by 30% to 100%. Ultimately, this could warrant an array in the 6 MW to 9 MW range. A number of locations will be required to achieve this total amount, including ground-mounted, parking canopy, roof-mounted, and off-site.

7.1 Introduction

The Narragansett Bay Campus Master Plan study included a detailed feasibility study of the Horn Lab Building to determine whether it should be repurposed or replaced as part of the overall Master Plan.

The Horn Lab is a typical regional example of mid 20th century modernism, designed by Bill Warner as the first of his many designs for the bay campus. It enjoys a prominent location on the Knauss Quadrangle, and has served the University's needs for over 50 years. Like many of its contemporaries, it has reached an age where its infrastructure is in various degrees of failure and it is a somewhat inflexible and energy inefficient facility. It is perhaps more of a familiar fixture on campus than a cherished landmark, and is in need of total repurposing or replacement.

7.2 Existing Conditions Analysis

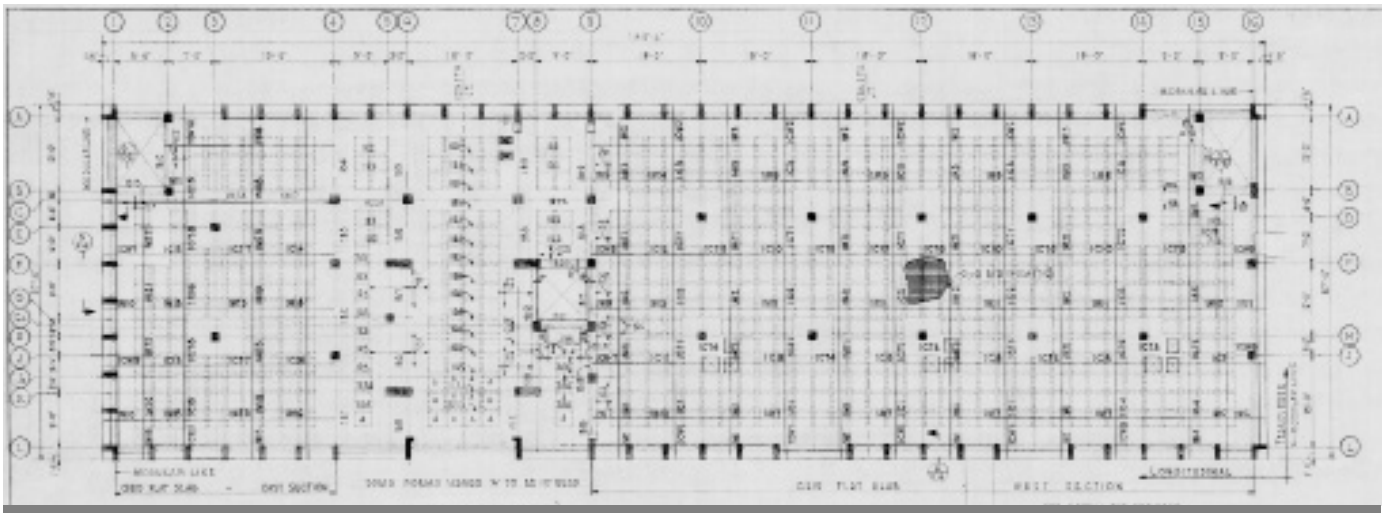
Horn Lab - West end loading dock

The planning team began the evaluation of Horn by assessing the existing building in detail. This included a review of the original construction documents and an onsite assessment of the building's infrastructure, including the building envelope as well as its structural, mechanical, electrical, plumbing, and fire protection systems. Additional architectural analysis was carried out to review the state of interior finishes and lab casework, as well as the building's compliance with current building code and accessibility requirements. The existing conditions analysis (included in Section 4 and Appendix D of this report) documented the following issues:

- **Building envelope:**
  - The inverted membrane roof has reached the end of its useful life and despite multiple repairs is not water-tight.
  - The building's concrete frame and exterior structural fins create a thermal bridge between the interior environment and exterior conditions that would be expensive to remediate.
  - The exterior windows have failed seals, with fogged glazing units, and have reached the end of their useful life.
- **Finishes and casework:**
  - Finishes are generally dated and past their useful life.

Horn Lab Typical Research Space

- **Hazardous Materials:**
  - The owner reports hazardous materials throughout the building (haz mat detection was not part of the current project scope).
- **Structural System:**
  - The building's design predates current building codes, and seismic upgrades are likely to be required by a major renovation.
  - The concrete waffle slab is somewhat inflexible in terms of adding new mechanical risers.
  - The structural grid is inefficient and limits layout options for new classrooms or teaching lab spaces, with column locations compromising efficient layouts and sight lines.
  - The building's low floor to floor height (12'-4") hampers the mechanical upgrades required to renovate Horn as a lab building.



Original structural plan showing waffle slab design

HVAC:

- In general, the system has benefited from a 2008 upgrade and remains in reasonable condition.
- Exhaust and cooling systems have code issues (no heat recovery, use of corridor for return air transfer, lack of make-up air for fume hoods).

Horn Lab - ductwork above corridor

Electrical:

- Power: The building is fed normal power underground from a utility-supplied pad-mounted transformer to an interior basement electrical service switchboard rated at 2000 amps. Voltage is 208/120 volt, 3 phase, 4 wire. There is adequate normal power capacity in the building. The system is original to the building.
- Emergency/Standby Power: There is no working generator in the building. Life safety lighting is provided by emergency battery units in strategic locations. Generator power from the OSEC building generator serves selected loads, undefined at this time.

- Lighting: the building is generally illuminated using suspended fluorescent fixtures with T8 lamps. There are also a number of recessed grid mounted fluorescent fixtures. The building includes occupancy sensors that were added in the 2008/2009 ESCO retrofit project. Lighting levels appear adequate for the tasks in each space. There are LED retrofit lamps in some incandescent style fixtures.

Fire Alarm:

- The building is served by a working fire alarm system employing smoke and heat type detectors. The previous system was replaced in 2009.

Plumbing:

- Water: The building is fed by a 4" domestic water service, having a full size water meter and pressure regulator. Domestic hot water is heated by an electric heating coil inside a horizontal storage tank. There does not appear to be a dedicated non-potable water system for laboratory fixtures, or a dedicated tempered water system for emergency eyewash/showers. The water distribution system is only partially insulated throughout.
- Drainage: The building drainage system is comprised of borosilicate glass which appears to connect to laboratory waste, as well as PVC for any sanitary and roof drainage. A pH neutralization system could not be located in the building.
- Natural gas: is fed into the building for building heat.

Fire Protection:

- There is no sprinkler system.

Accessibility:

- The facility predates the Americans with Disabilities Act (ADA) and any compliance with the requirements of this legislation is purely coincidental. Non-compliant features include.
  - Entries to the building are inaccessible, with multiple steps up from grade. Ramped access is provided at the east entry, adjacent to the loading dock.
  - Bathrooms are inaccessible.
  - Labs are not equipped with accessible benches or fume hoods.

Horn Lab - inaccessible main entry at left

7.3 Renovation Cost

In order to evaluate the cost and feasibility of repurposing Horn, the design team studied two scenarios for the reuse of the Horn Lab; one as a biology laboratory use and the other as a mix of classrooms and student facilities. The following items were noted in the analysis:

- The structural grid is less than ideal for both uses, with column locations compromising efficient layouts and sightlines, and the waffle slab complicating the vertical distribution of mechanical systems.
- The building's footprint is small, and this limits the programs that can be accommodated in the existing building.
- The building's concrete frame and exterior structural fins create a thermal bridge that will be expensive to remediate.
- The building would require hazardous material abatement.
- Other upgrades are required, such as envelope replacement and accessibility upgrades.

Given all of these factors, the cost assessment showed that the cost of renovation would be equal to or higher than the cost of new construction, for a less than ideal facility. The cost is estimated as a range since the precise scope of structural seismic upgrades cannot be determined without a more detailed design.

The table below shows a cost summary of renovation versus new, for both the classroom/student use and the Biology Labs use, in a 30,500 GSF building (based on the existing Horn Lab area):

		Classroom/Student Building	Biology Labs
Horn Lab	Cost/SF	$400-475/SF	$500-600/SF
	Estimated Construction Cost (2016 costs)	$12.2 - 14.5 M	$15.25 - 18.3 M
New Construction	Cost/SF	$425-450/SF	$500-550/SF
	Estimated Construction Cost (2016 costs)	$13.0 - 13.75 M	$15.25 - 16.75 M

The recommendation of the Master Plan is therefore to replace Horn with a new, larger, state-of-the-art lab building.

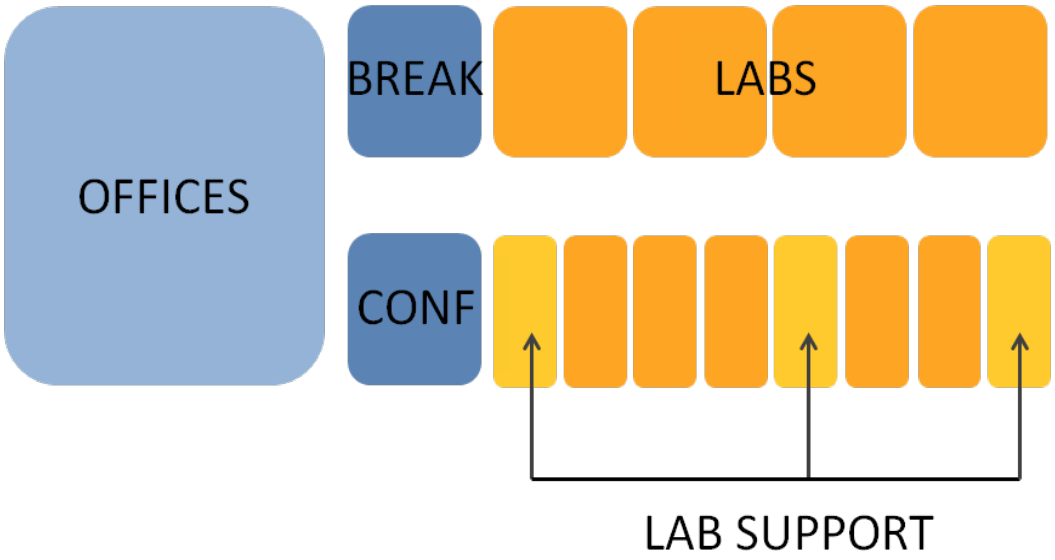
7.4 New Horn Lab

One of the deliverables for the Horn Lab study was to develop a conceptual design for a new lab building on campus. A program for a new 50,000 gsf facility was developed in order to prepare a conceptual design for this new lab building, as follows:

Program	Number	Area (NSF)
Primary Labs	18 @ 420	7,560
Flexible Secondary Labs	18 @ 210	3,780
Lab Support	10 @ 210	2,100
Staging/Storage	10 @ 200	2,000
Teaching Lab	1 @ 2,100	2,100
Teaching Lab Support	1 @ 210	210
Faculty Offices	21 @ 130	2,730
Grad Student Offices	50 @ 50	2,500
Post Docs	6 @80	480
Staff Offices	15 @120	1,800
Meeting/Break/Interaction		2,300
Building Support		1,800
Total Net Sq Ft		**28,450**
Total Gross Sq Ft (55% Efficiency)		**51,727**

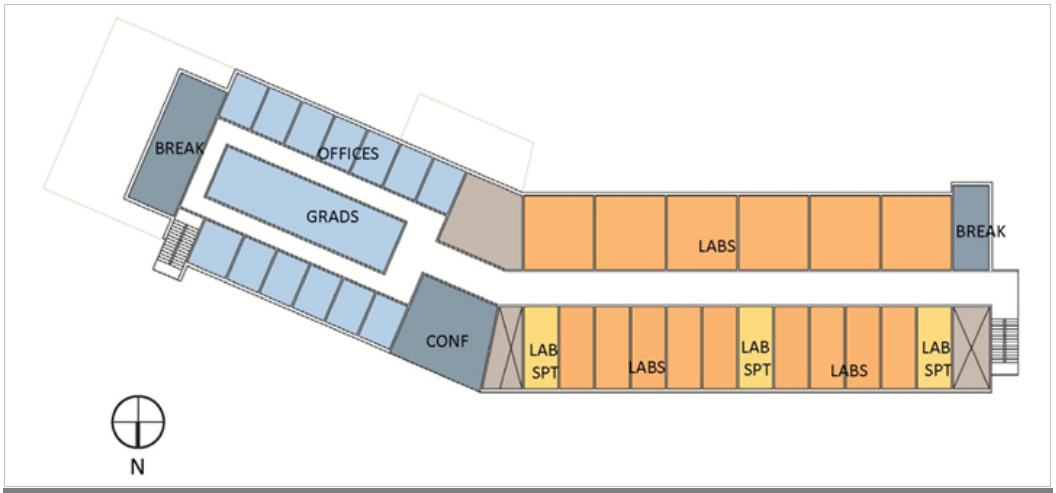
Planning Approach:

The suggested planning approach groups primary and secondary labs together at one part of the building, with offices, break and conference space located together at the other end. This organization allows for an efficient layout and the economical distribution of mechanical systems by concentrating the wet lab spaces together and locating the dry office spaces together.



GSO East: Adjacency Diagram

The adjacency diagram above was used to develop a conceptual layout plan as shown below. The offices and break space are located at the east end of the building to take advantage of the water views, with transparent office walls allowing light and views into the central graduate student open offices. Conference space is located at the "hinge" of the building, with lab and support space located in the west wing of the building.



GSO East: Conceptual Layout

The siting of GSO East is indicated on the site plan on page 8-8.

GSO East: Site Plan

The proposed location of the Horn Lab replacement, ("GSO East") is just south of the current Horn lab. This is suggested in order to maintain the current quad, and to facilitate phasing by allowing the new construction to be completed before the demolition of Horn and the relocation of its occupants into the new building. The east end of the new building is canted to provide enhanced vistas from OSEC and the quad towards the bay.

GSO East Cost:

The estimated construction cost of GSO East as described above (in 2016 dollars) is $28,325,000.

8.1 Phasing Approach

The implementation of the Master Plan is a long term project, with various internal and external drivers influencing the phasing strategy.

An important consideration is the ability of the State of Rhode Island to provide the necessary funding through General Obligation Bonds, which must be approved by the citizens of Rhode Island. A secondary, although significant, schedule consideration is the implementation of various Marine Operations upgrades required to support the University's upcoming bid for the replacement of the RV *Endeavor*.

In close coordination with the Steering Committee and University Leadership, a two-phased scheduling approach has been developed.

It is anticipated that Phase One will begin in 2019, will be completed by the end of 2024. Phase Two is anticipated to begin in 2025 and to be complete by the end of the year 2028.
The phasing approach is summarized below.

Phase One:

The following buildings and campus upgrades are included in Phase One (new construction unless noted as renovation)

- GSO Research Facility - East
- Ocean Technology and Robotics Center
- Ocean Engineering Research
- Ocean Engineering Tank Facility
- Marine Operations Facility
- Site/Utilities
- Haz Mat Facility
- Pier Expansion
- Photovoltaic Array
- OSEC/Inner Space Center Renovations
- Teaching Commons (Phase 1)
- Education Outreach/Coastal Institute Building Renovations
- Rock Storage Facility

Phase One Site Plan

Phase Two:

The following buildings and campus upgrades are included in Phase Two (new construction unless noted as renovation)

- GSO Research Facility - West
- Teaching Commons (Phase 2)
- Outreach and Education Conference Center (including lodging)
- Site / Utilities Completion
- Seawater Tank Addition
- Aquarium Renovations
- Maintenance Building
- Allen Harbor Upgrades

Phase Two Site Plan

9.1 Cost Estimate

The Narragansett Bay Campus Master Plan for Renewal and Horn Laboratory Feasibility Study included the following components:

- Existing conditions analysis
- Program of existing and proposed spaces
- Campus renewal site landscape and utilities planning
- Horn Lab feasibility study

Once these activities were completed, a campus planning and phasing approach was developed to study the optimum approach to accommodating the program in a sustainable, cost effective manner that meets the Universities vision and goals. In parallel, a basis of design document was prepared and, in close consultation with the design team cost estimator, a cost/phasing matrix was developed to determine the optimum approach to implementing the master plan. The basis of design information is included in Appendix E.

The overall project cost[1] of the proposed Master Plan totals $285M; Phase One project cost is estimated at $147M, and Phase Two is estimated at $138M; these costs include escalation.

The cost of each phase is summarized below, and the detailed cost estimate is included in Appendix F.

Cost summary:

Phase One	Construction Cost (2016)	Project Cost1
GSO East	$28,325,000	$43,327,000
Ocean Technology and Robotics	$12,500,000	$19,270,000
Ocean Engineering and Wave Tank	$20,545,000	$31,454,000
Marine Operations	$3,981,000	$ 6,105,000
Dock Upgrade	$4,500,000	$ 6,799,000
Site/ Utilities/Haz Mat Facility	$ 3,210,000	$4,909,000
Photovoltaic Array[2]	$ 0	$0
OSEC/Inner Space Center Renovations	$2,000,000	$ 3,063,000
Teaching Commons (Phase 1)	$7,438,000	$11,389,000
Education Outreach/Coastal Institute Building Renovations	$8,483,000	$13,007,000
Rock Storage	$3,300,000	$ 5,066,000
Building Demolition	$1,229,000	$ 1,858,000
TOTAL	**$95,511,000**	**$147,000,000**

Phase One Funding:

Project Cost: $147,000,000
G.O. Bond 2018: $118,000,000
Private Funding: $29,000,000

Phase Two	Construction Cost (2016)	Project Cost1
GSO West	$28,325,000	$52,868,000
Teaching Commons (Watkins Replacement)	$6,750,000	$12,607,000
Conference Center	$8,840,000	$16,514,000
Site/Utilities	$5,940,000	$10,897,000
Seawater Addition	$1,650,000	$3,089,000
Durbin, Blount, Ark Aquarium Renovations	$6,345,000	$12,255,000
Maintenance Building	$3,300,000	$6,177,000
Allen Harbor	$6,100,000	$11,253,000
Building Demolition	$722,000	$1,328,000
TOTAL	**$67,972,000**	**$127,000,000**
Lodging (in Conference Center)	$5,650,000	$11,000,000

Phase Two Funding:

Project Cost: $138,000,000
G.O. Bond 2024: $127,000,000
Private Funding: $11,000,000 (for Conference Center Lodging)

1 As noted in the estimate, the estimated construction costs (ECC) were developed by the design team, and the project costs were developed by the University. The project cost for each component of the Master Plan includes all non-construction costs, as well as escalation. The ECC was escalated to its anticipated construction date and assumed duration using an annual escalation rate of 4%. The project cost and funding information provided in this report is based entirely on information provided by URI.

2 Potentially funded up to 100% of cost by electric utility provider. In order to secure a power purchase agreement the system would need to be operational before the end of 2018, in order to take advantage of 30% federal tax credit.

10.1 Next Steps

The Master Plan Report will guide the University of Rhode Island's renewal of the Bay Campus for the next 20 years, building on the growth of its first half century. It provides a vision and spells out concrete steps to achieve the stated goals, and to elevate GSO into the first tier of oceanographic institutions world-wide.

In addition to forming the basis for a state bond application to renovate the campus, the Master Plan will:

- Facilitate the University's bid for the RV *Endeavor* replacement in 2017
- Demonstrate the University's commitment to sustainability
- Underpin the proposed rebranding of the institution as "The Ocean University"

Next Steps:

- Preparation of an Economic Impact Statement, to be completed by the Fall of 2016, that will support the bond application by demonstrating the economic benefits of the proposed renewal of the campus to the region and the state.