CHARTING A WAY FORWARD

RESEARCH AT MONIE BAY

SCHOOL OF
ARCHITECTURE,
PLANNING & PRESERVATION

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FOREWORD

The Maryland Commission for Climate Change's 2018 Annual Report imparted a sense of urgency regarding the need for the State to step up as leaders at this "decisive juncture" as we not only need to act to increase of mitigation of Carbon emissions, but we need to implementing adaptions now. This includes becoming a model for carbon neutrality, implementing stricter building codes, and utilizing energy sources that do not rely on traditional fossil fuels. Although this report focuses on one particular location and infrastructure need, this effort represents a first step in a new way of thinking about State facilities: leading by example, raising the bar as an attainable model for other, and engaging a new generation of sustainable thinkers. The holistic approach of marrying the natural and built environment and a structure as a teaching tool are ideas that can be transferred throughout the State. Utilizing policies like Maryland's Coast Smart Construction Guidelines as an existing framework, the process of moving the concepts presented here though the design and construction phases will allow the State to recognize inefficiencies and barriers in the procurement process and to help reevaluate existing policies or develop new ones to ensure all future buildings are built with climate change in mind. By changing the way we do business at the State level in regards to infrastructure, will be a continued showcase of Maryland's commitment as climate leaders.

It has been a privilege to work with the Department of Natural Resources and the Chesapeake Bay National Estuarine Research Reserve to design a field research station along the eastern shore of Maryland. It is projects like these that deal with sea level rise, climate change, sensitive ecosystems, and remote locations foster opportunities for architecture that not only engage with the community but also serve a learning opportunity for ways our buildings can minimize harmful effects on the environment.

- Taina Peters, Student

1 EXECUTIVE SUMMARY

This research study began with the assumption that people and nature can co-exist in a mutually beneficial relationship.

Jennifer Raulin, the director of the Chesapeake Bay National Estuarine Research Reserve-Maryland (CBNERR-MD), part of the Maryland Department of Natural Resources (MD DNR), found a convincing embodiment of that vision in the University of Maryland's 2011 Solar Decathlon project that won the international Department of Energy Solar Decathlon competition. This project, WaterShed, is an adaptable, resource-efficient house that weaves together biological knowledge and cutting-edge technology. Designed and built to test the viability of true interdependence with a Chesapeake Bay site, WaterShed demonstrates what happens when bio-inspired design savvy, traditional know-how, and 21st-century technology are intentionally integrated. Raulin's vision was to employ the principles embodied in WaterShed to inspire a new standard for State structures in coastal areas. As such, the University of Maryland (UMD) was selected to conduct a study through the School of Architecture, Planning and Preservation to develop this vision using a field station located in Princess Anne, MD as a pilot (Monie Bay Field Station).

The University of Maryland team for this Monie Bay Field Station study is founded on the same principles as WaterShed: how to foster mutually beneficial relationships between the building and the site, between researchers and the wider community, between science and the mysteries of natural systems, and between this generation and the next. The UMD team worked backward from this vision to explore various design strategies and technologies. And then forward again, to derive a set of principles to inform the process of designing and building the Monie Bay Field Station and be a template for other state owned facilities.

Sections 2 and 3 of this report detail the project goals and the process followed by the University of Maryland team for their investigation. Section 4 discusses the building program requirements and includes an analysis of the site's resources, limitations, and opportunities. Eight of the seventeen student team projects are included as case studies to illustrate the possibilities as well as the findings. The final section highlights themes and principles derived from the students' work to support the daily life of the building's inhabitants: water collection and use, orientation, view, energy, culture, architectural character, envelope, structure, materials, environmental control systems, daylighting, program organization, site impact, height above grade, number of stories, and storm preparedness.

This is a bold vision: a building that not only demonstrates, but facilitates, a mutually beneficial relationship between people and nature. And it is, in the estimation of this research team, completely achievable. Success depends upon everyone who touches the project contributing to the vision and weaving their expertise into this new way of thinking and building.

What was unique for me was having a real client as a check and balance for what works and what doesn't work. And also having a plethora of experts available to be the voices of reason and real-life scenarios.

- James Jesmer, Student

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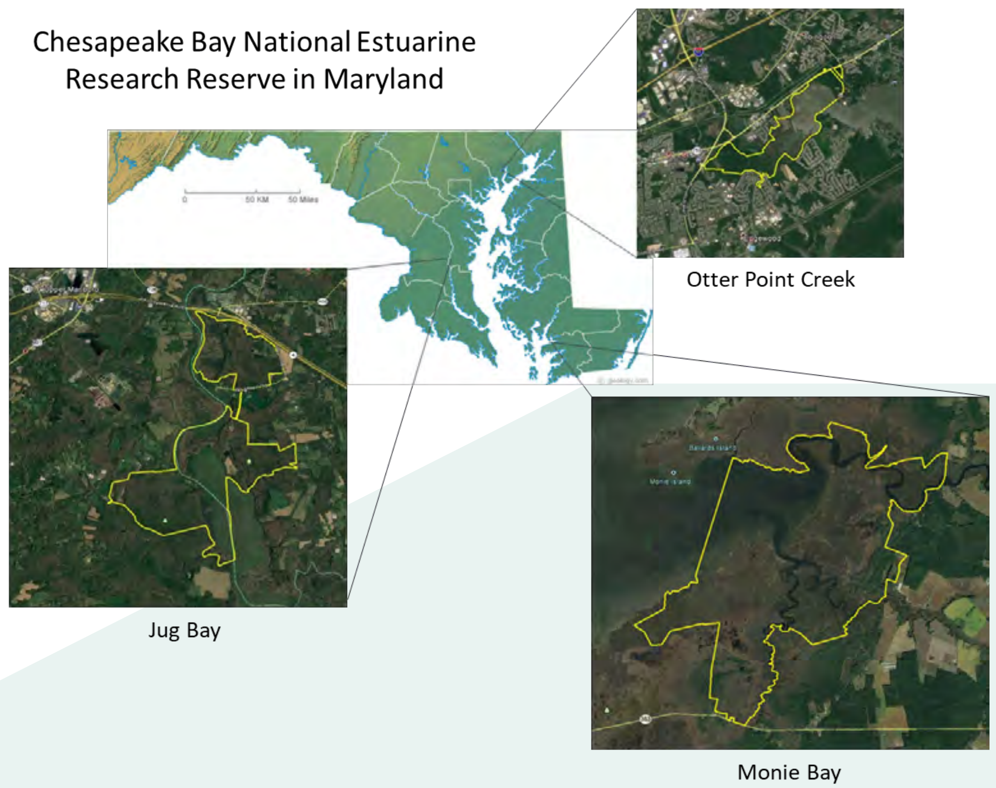
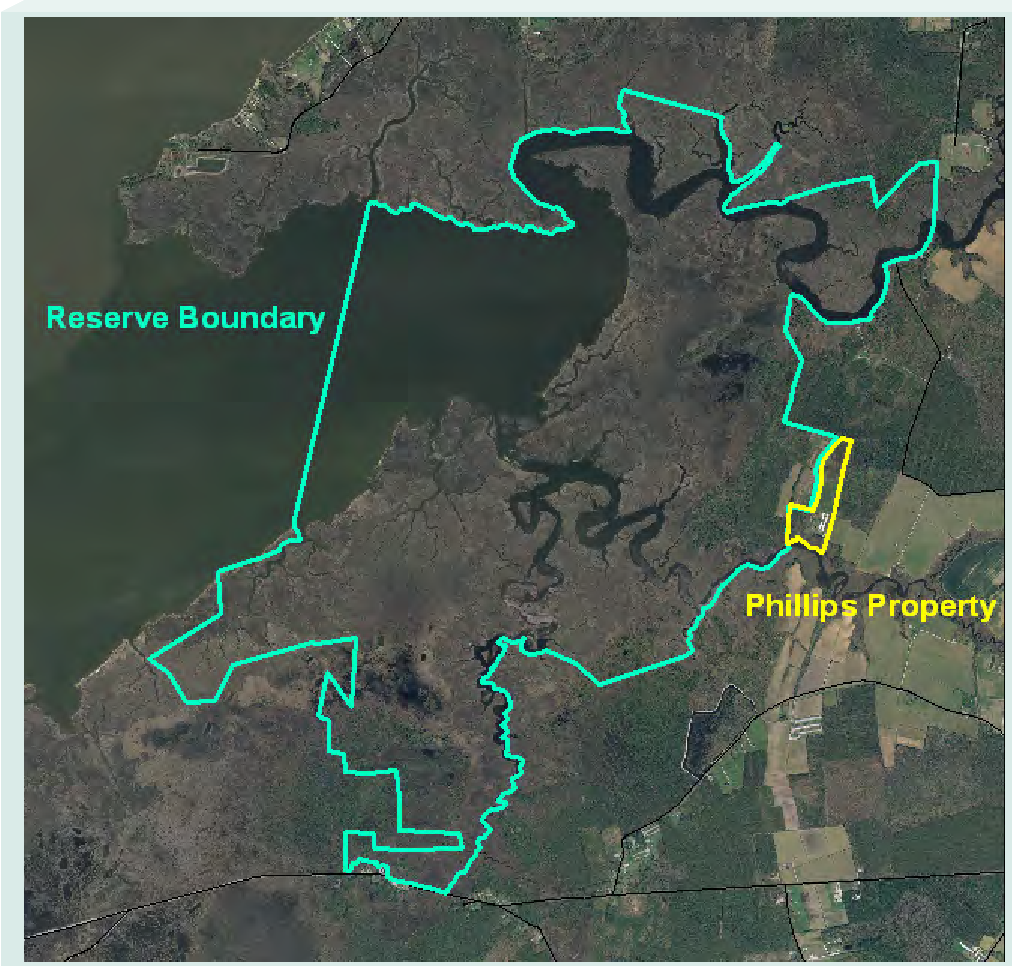
A HOME ON MONIE BAY



CBNERR-MD sites in Maryland



Extent of CBNERR-MD Monie Bay Component

View of Little Monie Creek from existing dock at Drawbridge Farm

HISTORY & CONTEXT

Maryland's intricate coastline spans 3,190 miles, and has long provided Marylanders with protection from coastal storms and a strong cultural connection to the rivers and bays. However, processes such as erosion and sea level rise have been degrading our shorelines and weakening the important protective services they provide. The Maryland Department of Natural Resources and its sponsored program, the Chesapeake Bay National Estuarine Research Reserve in Maryland (CBNERR-MD) is involved in efforts to increase coastal resilience to reinvigorate our shorelines and enhance protection for our coastal communities.

In 1985, 3,426 acres of MD DNR's Deal Island Wildlife Management Area in Somerset County were established as part of CBNERR-MD. In 1990, two additional sites were added: Otter Point Creek in Harford County and Jug Bay in Prince George's and Anne Arundel Counties. These are part of a total of 29 federal- and state-funded Research Reserves in the U.S. The Research Reserve system protects estuarine habitats as a natural field laboratory for research and living classrooms for education, and also provides training to improve coastal resource management. The Maryland Reserve's vision is a healthy, productive, and resilient Chesapeake that is valued and enjoyed.

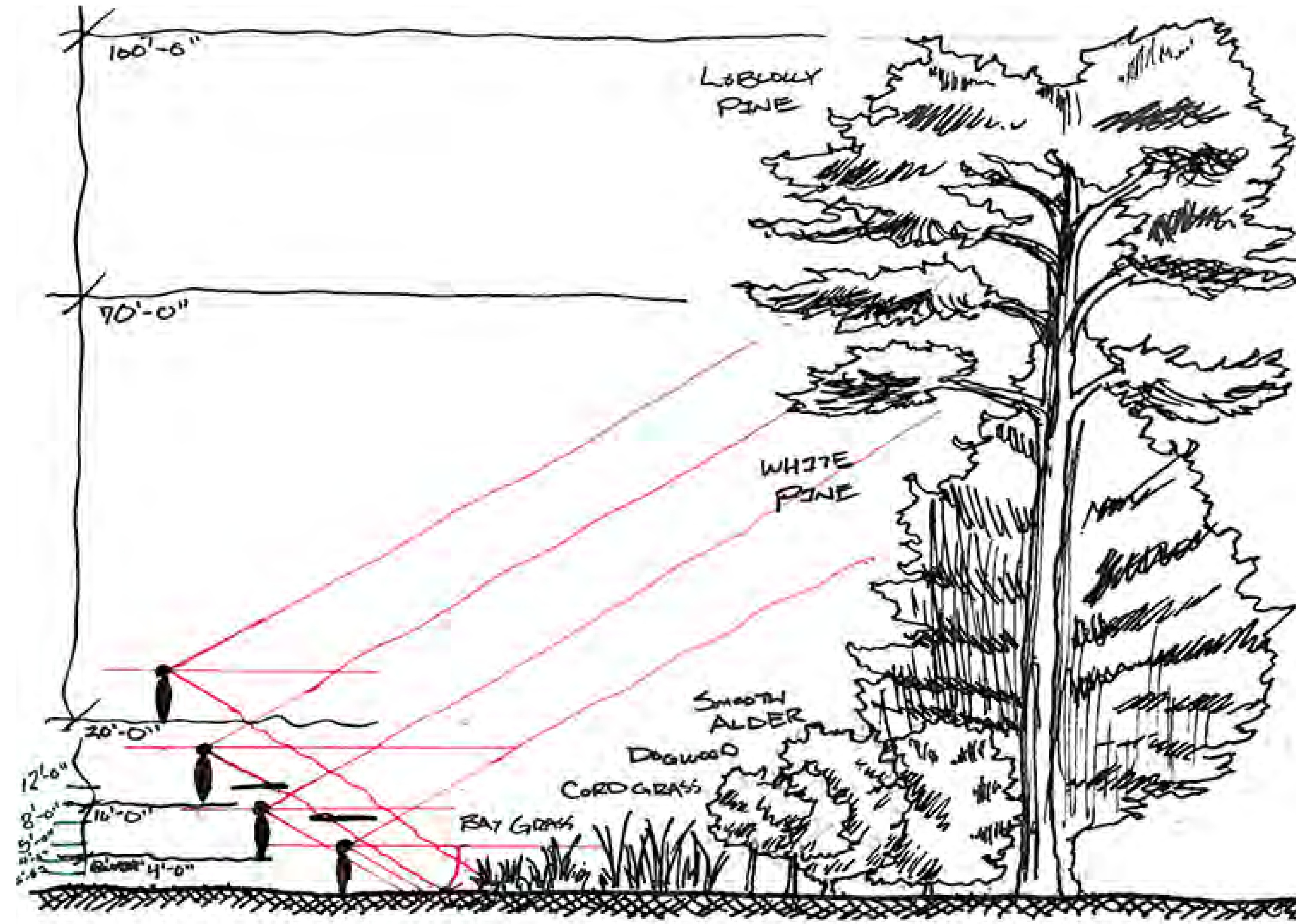
The parcel of land located on Little Monie Creek near Princess Anne, MD was acquired in 2011 by MD DNR. Known as Drawbridge Farm, it provides marsh access and a field station location. The old farmhouse, chicken sheds, and several outbuildings located on the property are either in poor condition or currently do not support the program.

As part of its 2018-2023 Strategic Plan, CBNERR-MD has chosen to direct additional efforts to increasing its presence at Monie Bay. Monie Bay, the Research Reserve's oldest and most remote location, lies in an under-served area highly vulnerable to environmental stressors. It is an important location to direct research and outreach in the marshes and the communities in the area. By developing educational programming, installing additional monitoring efforts, and site and access improvements—including the future construction of Monie Bay Field Station, the program moves towards achieving those strategic goals set out in the plan. To begin work on the field station, funds were awarded in 2018 from a competitive grant from NOAA for access and safety improvements and the preliminary design of a new field station at the Drawbridge Farm property (12140 Drawbridge Road, Princess Anne, MD).

As part of the commitment to Monie Bay, Reserve staff monitor the elevation, water quality, and marsh vegetation. Though they monitor and research other marsh characteristics as well, these three monitoring tasks are the core research that is done at the Monie Bay Field Station.

Marshes fringe the coast, serving as a buffer to wave action and storm surge. To provide this important shoreline protection, marshes must maintain a healthy height, or elevation, above the adjacent water. Reserve staff monitor marsh elevation using Surface Elevation Tables (SETs), linked to benchmarks located within the marsh. These benchmarks are long thin stainless steel rods that are driven deep into the ground. The benchmarks remain stable over time, unlike the sediment that moves around them, allowing the SET "reader" to measure millimeter level changes. Using these measurements, the long term changes in how the marsh is gaining or losing elevation can be calculated. When combined with local rates of sea level rise, these measures of elevation change can help predict the rates of marsh gain or loss over time.

CLOCKWISE FROM TOP:
University of Maryland students learn about the daily rituals for reserve staff; Kyle Derby, CBNERR-MD staff, shows a benchmark to University of Maryland students; Coreen Weilminster, CBNERR-MD staff, demonstrates water quality testing during a site visit by the University of Maryland students.



Field sketch illustrating typical plant materials and height gradients in a vegetation monitoring transect. (Townsend)

Every other year, Reserve staff survey vegetation monitoring transects located adjacent to the SETs. Monie Bay has six vegetation transects, each with multiple plots along a gradient from the marsh shoreline to the marsh interior. Reserve staff record the species present in each vegetation plot, as well as their abundance and the height of the tallest individual of each species. These measurements allow researchers to evaluate the vegetation community over time. In tidal marshes, vegetation species and abundance can indicate the overall health of the marsh, now and into the future.

The Deal Island Peninsula is representative of many communities in Maryland that are rich in cultural heritage, independent in spirit, and deeply tied to the landscape and waters that define these coastal communities. However, these landscapes and waters are changing rapidly in the face of environmental change. With an average elevation only three feet above sea level, this area has been stricken with noticeable flooding and erosion issues which is only expected to intensify in the coming years.

Somerset County is one of the most vulnerable to sea level rise in Maryland and therefore the State feels an urgency to better understand these impacts in this region. The Monie Bay Field Station is a sentinel site that bridges scientific study with the economic and social impacts of climate change. Embracing the motto, "Love Where you Live", it is as important to CBNERR-MD to understand the concerns and wants of the Deal Island Peninsula community as it is to understand and preserve the marshes that support these communities. Through Education, Stewardship, and Coastal Training programs and partnerships, staff strive to learn from the area's residents and further a collective understanding of the environmental challenges that Marylanders face.

As a resident of the eastern shore of Maryland, I often tend to overlook it. Working with CBNERR-MD and the numerous consultants, it is really reassuring to know that not only are there "outside" forces that are genuinely concerned with the health and preservation of the Chesapeake Bay watershed, but also how they are invested in nurturing and educating the connection between nature and humanity for generations to come.

- Deane Townsend, Student

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THE PROCESS

THE PROCESS

Faculty & students discuss a design proposal

FROM THE WATERSHED TO MONIE BAY

As previously introduced, in the spring of 2018, the Chesapeake Bay National Estuarine Research Reserve - MD (CBNERR-MD) made contact with the University of Maryland School of Architecture, Planning and Preservation. As part of the process of planning for the new field station at their Monie Bay site located in Princess Anne, plans for the new facilities include better access to the marsh systems of the Deal Island Wildlife Management Area, which CBNERR-MD uses as living laboratories and classrooms.

The staff were quite taken by the School's Solar Decathlon 2011 project, WaterShed. Something in the spirit of WaterShed seemed to be an excellent fit in this remote, vulnerable, and underserved area. CBNERR-MD, with support from Maryland's Coastal Zone Program engaged the School to do a study that would help inform a vision, program, and viable approaches for the new field station.

The University of Maryland team studied the ways that the design of this facility can support long term monitoring and field research. In order to do this, the study looked at how the Monie Bay Field Station could comply with Maryland's Coast Smart Construction Program. House Bill 615 Section 3-1001-3-1004 of the Natural Resources Article established the Maryland Coast Smart Council in the Department of Natural Resources in 2014 for the purposes of adopting specific Coast Smart siting and design criteria to address impacts associated with sea level rise and coastal flooding on future capital projects. The Council's Coast Smart Construction Program, detailing its siting and design criteria and implementation procedures, was approved on June 26, 2015. Maryland State Finance and Procurement Code Ann. § 3-602.3, requires that beginning on July 1, 2015, if a State capital project includes the construction of a structure or reconstruction of a structure with substantial damage, the structure shall be constructed or reconstructed in compliance with the siting and design criteria established by the Council. In addition to complying with the Coast Smart Construction Program, the Monie Bay Field Station aims to be an energy-efficient building model for future projects, and provide spaces for research and education that are intimately connected with the site.

The study was executed through two graduate level courses described below, focusing on the following four areas:

- Clearly articulate the principles and strategies that contributed to the success of WaterShed
- Explore similar principles and strategies on the Monie Bay site, via architectural design studies and integration of technology and environmental systems
- Extract lessons learned from the study, including challenges and opportunities, specific recommendations for foundations, energy systems, architectural form and materiality, and resilience
- Provide resilient design education to UMD students

MATCHMAKING: QUALIFICATIONS & EXPERIENCE

The University of Maryland School of Architecture, Planning and Preservation graduate curriculum includes a pair of co-requisite courses ARCH 600 and ARCH 611 called Integrated Design Studio and Advanced Technology, respectively. The field station study was developed in the context of this pair of courses.

Design studio typically focuses on the study of architectural form and space in relationship to intention, meaning, and problem solving. The study of material, assembly, and performance of buildings is typically the focus of technology courses outside the studio. This pair of courses is rooted in the conviction that, for buildings to achieve true excellence and highest value, there is a necessary interdependence between design and technology. Together, both design and technology play a front and center role in this combined course, producing the maximum value for the field station study.

In this era of environmental challenges, design and technology are not alone in the larger constellation of measures by which architecture achieves value. For this study, the classes also sought to balance many other competing objectives including cultural, historical, environmental, social, and economic criteria. Ultimately all of these factors rest on the integrity and craft of sound design and technological performance.

Students and consultants discuss projects in a round-robin format

The underlying premise of the studio is that the same level of creativity, enthusiasm, and personal initiative must be applied at every level and scale of detail in the realization of architectural design. This premise helped to tease out for CBNERR-MD staff the most salient and critical of issues for the new field station.

Typically in this pair of courses, students design a relatively small building to a high degree of detail. To create such a building in any studio setting, whether academic or professional, requires an organized process that allows the design tasks to move logically from one phase or scale to another, as well as allowing for ample iteration within each phase. Students' projects are the material realization of rigorous design inquiry, exploration, research, and solid architectural thinking all along the way.

University of Maryland's WaterShed, 2011 Solar Decathlon Entry

WATERSHED

Another facet of UMD's experience relevant to the performance of this study can be found in its work on the US Department of Energy Solar Decathlon (SD). UMD's SD efforts are a natural extension of the School's history of success in integrated, innovative design. While there are many significant accomplishments and awards for UMD's efforts from 2005 through 2017, its 2011 entry WaterShed, has the most direct relevance.

The Solar Decathlon is an unparalleled opportunity to educate future leaders in the process of integrated design; to inform the public about environmentally sound, sustainable construction; and to promote the role of efficiency and solar technologies in achieving energy independence. As was its predecessor, the 2007 entry, LEAFHouse, WaterShed was born of the elegant marriage of biological knowledge and cutting-edge technology, and this adaptable resource-efficient house demonstrated what happens when bio-inspired design savvy, traditional know-how, and 21st-century technology join as integral parts of a sustainable lifestyle. The architectural design for Watershed was developed in the ARCH600 studio. The role of ARCH611 in the process was to integrate engineering and "living systems" considerations with the architectural design in cooperation with parallel courses in Engineering and Bioengineering, as well as with the studio and seminar courses in Architecture. This team-based approach informed the method of the study employed for the CBNERR-MD State of Maryland study.

University of Maryland's LEAFHouse, 2007 Solar Decathlon entry

PROJECT BENCHMARKS AND COMPONENTS

Following on its traditions in delivering integrated design, UMD's students and faculty engaged in the following activities as part of the two graduate level courses:

- **Program research** - the survey of reserve stations of similar types, and a visit to the Delaware Reserve in the NERR system;
- **Kick-off site visit** - students visited the site, and were introduced to the project stakeholders, critical aspects of the kinds of research that CBNERR-MD does, and the processes of project development and Maryland Coast Smart Council and local government interactions;
- **DNR Representative interviews** - students worked directly with CBNERR-MD staff and participated in lectures from and discussions with experts from DNR, MDE, NOAA and the Assateague State Park;
- **Student research** - program analysis, precedent studies, site analysis, energy analysis, material analysis;
- **Building Design Exercises** - a sequence of sketch problems, each focusing on different components of the Monie Bay Field Station project;
- **Workshops** - students engaged with architects, specialized consultants (structural, HVAC, energy, sustainability) and the client team;
- **Final Building Design Project**- study of the Monie Bay Field Station itself as a culmination of the research and exploration.

UMD students learn about water sampling on site

The experience of sitting in with students was both fun and invigorating. They don't have any preconceptions and come out of left field with ideas. While not all are workable, some of them are within the bounds of possibility and led to some unique designs.

- Ben Roush, Mechanical Engineering Mentor

THE BUILDING 4

THE BUILDING

Skyler Ballard/Chesapeake Bay Program

GUIDING PRINCIPLES - VISION, PURPOSE, INTENT

Since the Reserve program functions to collect, disseminate, and share information, there is an opportunity for this field station to have a larger impact beyond just the site itself. The Monie Bay Field Station will work with the State and its partners to engage with the community in new ways, including special events, exhibits, and classrooms for hands-on learning. The building, as a model of energy and resource efficiency, will itself be a teaching tool. Researchers both within the Reserve system and from external institutions will have improved access and state of the art labs to study the marsh systems of the Reserve.

By partnering with Maryland's Coastal Zone Program and the Coast Smart Council, the design, construction, and occupation of this project can serve as real-life illustrations of how to build in a dynamic coastal area that is also in line with local and state regulations. It will become a demonstration in scale and affordability for what others can do who live in similar vulnerable locations. This project can test design strategies for a net-zero energy, resource-efficient, low-impact field station located in the Critical Area of the Chesapeake Bay watershed.

CBNERR-MD PRIORITIES

The Monie Bay Field Station should feel like a home, providing both outdoor and indoor places for spontaneous gatherings, impromptu discussions, and relaxation. The building should provide visual connections between inside and outside, accommodations for overnight stays for researchers, and classroom and laboratory space, as well as support spaces such as offices, storage, and a mudroom.

The NOAA document dated November 2004, "National Estuarine Research Reserve System Standard Reserve," is to be used a guide for The Monie Bay Field Station. LEED Certification is not a requirement, but using similar principles is encouraged.

BUILDING PROGRAM OVERVIEW

The space allocation program for the Monie Bay Field Station was developed from several sources. First, from a wish list developed from CBNERR-MD/DNR staff internal discussions with the UMD team. Secondly, from two NOAA documents for NERR field stations. Third, from a site visit members of the UMD team took to the Delaware Reserve on 15 August 2018. A final consideration was for building size and complexity to meet the University of Maryland Integrated Design Studio course requirements.

BUILDING CONSIDERATIONS

The following list is a compilation of the Reserve staff's original list with clarifications made during the course of the study. Total enclosed area needed was estimated by CBNERR-MD to be around 6,500 square feet.

ADMINISTRATIVE & LIVING SPACES

- Flexible main space to accommodate community meetings, small scale exhibits, classroom space for 20-30 people including break out capabilities.
  - Storage for tables and chairs
- Office Space
- Dorm space for researchers (long and short term stays) as well as small student groups.
  - To house 12 to 24 people
  - At least 3 or 4 separate rooms
  - Caretaker suite with private bath
- Living room with comfortable seating that can be used as meeting space
- Clean kitchen
- More than one bathroom with shower
- Lockable and secure storage area for expensive field gear
- Mudroom
  - Not just any old mudroom! This can be an honorific place, worthy of marsh scientists

LAB SPACE

- Deionized water system
- Chemical disposal method (carbon filtered drain)
- Secure chemical storage
- Muffle furnace
- Drying oven
- Freezer
- Fridge
- Filter rack
- Sediment sieves and shakers

Boot storage at Delaware National Estuarine Research Reserve

- Weather station with rain gauge that can be checked remotely (possibly on the roof of field station with access) - for System-Wide Monitoring Program (SWMP) lab
- Flow through tanks
- At least two large lab benches with sufficient space for things like plant biomass sorting
- Storage accessible from inside and outside

OUTDOOR SPACE

- Equipment cleaning/maintenance area including hanging racks for waders and hoses etc.
  - Storage for field trip equipment accessible from the deck
- Outdoor shower
- Outdoor living areas (patio, elevated deck, porch) for collaboration and marsh observation
  - Screened porch
  - Deck seating for field trips
- Greenhouse, possibly with tanks and grow lights
- Demonstration oyster cages
- Boat lift
- Kayak launch
- More convenient boat trailer maneuvering area
- Marsh corridor demonstration habitat
- Rain barrels
- Osprey platform
- Bat/bluebird boxes
- Bee hives
- Native/rain garden demonstration areas

GENERAL

- Renewable energy options
- Structure on pilings
- Gray water system
- Composting toilets

Delaware National Estuarine Research Reserve

NOAA STANDARD RESERVE GUIDELINES

The program was supplemented by study of two NOAA documents. First, the program guide, "National Estuarine Research Reserve Standard Reserve." Second, "National Estuarine Research Reserve Sustainable Design Guidelines." Both documents are dated November, 2004. The program guide is intended as a base for new reserves to plan their vision and for existing reserves to evaluate their facilities. Recommended space allocations are as follows:

- Research: 3,100 sf
- Education: 3,350 sf
- Support: 8,830 sf
- Total: 15,280 sf

A student review of the NOAA guidelines determined that all of the 18 reserve field stations represented in the report are connected to municipal utilities for power. The Monie Bay Field Station has the opportunity to set a standard for on-site energy production, towards the goal of net-zero energy.

The NOAA Sustainable Design Guidelines document contains strategies that seek to minimize and even reverse negative environmental impacts of research facilities. There are recommendations for all stages of the design and construction process, as well as for post-occupancy operations, maintenance, and education. The document recommends, but does not require, use of the LEED rating system although engaging a Green Building Consultant is required to determine if a project will seek a LEED rating. Additionally, someone on the design team must be a LEED AP or consult the LEED Reference Guide, whether a rating is pursued or not.

DELAWARE RESERVE FIELD STATION COMPARISON

A third resource for the building program was a visit to the facilities at the St. Jones Reserve near Dover, Delaware. On 15 August 2018, our team toured their labs, classrooms, offices, dormitories, and conference center to photograph and measure the spaces. We were able to meet with researchers and staff, who offered recommendations for improving the functionality of their work environment.

PROGRAM FOR UNIVERSITY OF MARYLAND STUDY

Projects for the University of Maryland's Integrated Design Studio have an ideal size between 6,000 and 11,000 square feet, which was a final consideration for this study. The program was organized into three distinct parts: public and administrative spaces, research spaces, and dormitory. Qualitative notes helped students to key in on priorities unique to the field station.

LABORATORIES

- Will be used for research and education. Primary use is for research, because environmental scientists need precision, and often the two uses do not mix well. This room will have two sinks along with base cabinets and countertops along at least two walls for equipment. May sometimes be used as a classroom for visiting school groups.

"SWAMP" LAB

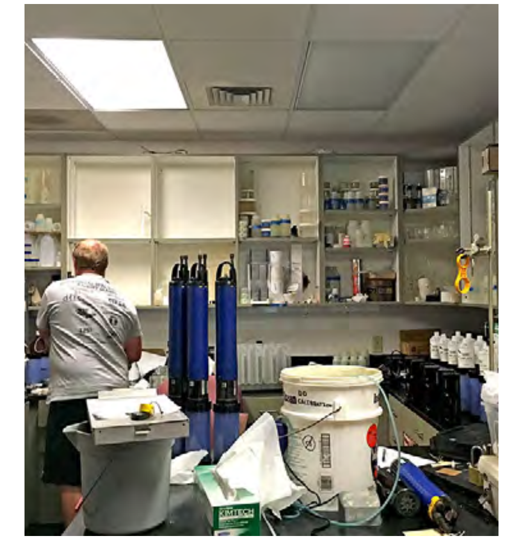
- SWMP, otherwise known as "swamp," is the System-Wide Monitoring Program. All 29 reserves collect the same data: water quality monitoring, weather data, vegetation mapping, and habitat mapping. The Building Considerations on the previous spread includes detail about how field labs are outfitted.

OUTDOOR SPACES

- To be most functional, should be shaded. A screen porch is required. One of the outdoor spaces should be large enough to accommodate six picnic tables.

ORIENTATION & VIEWS

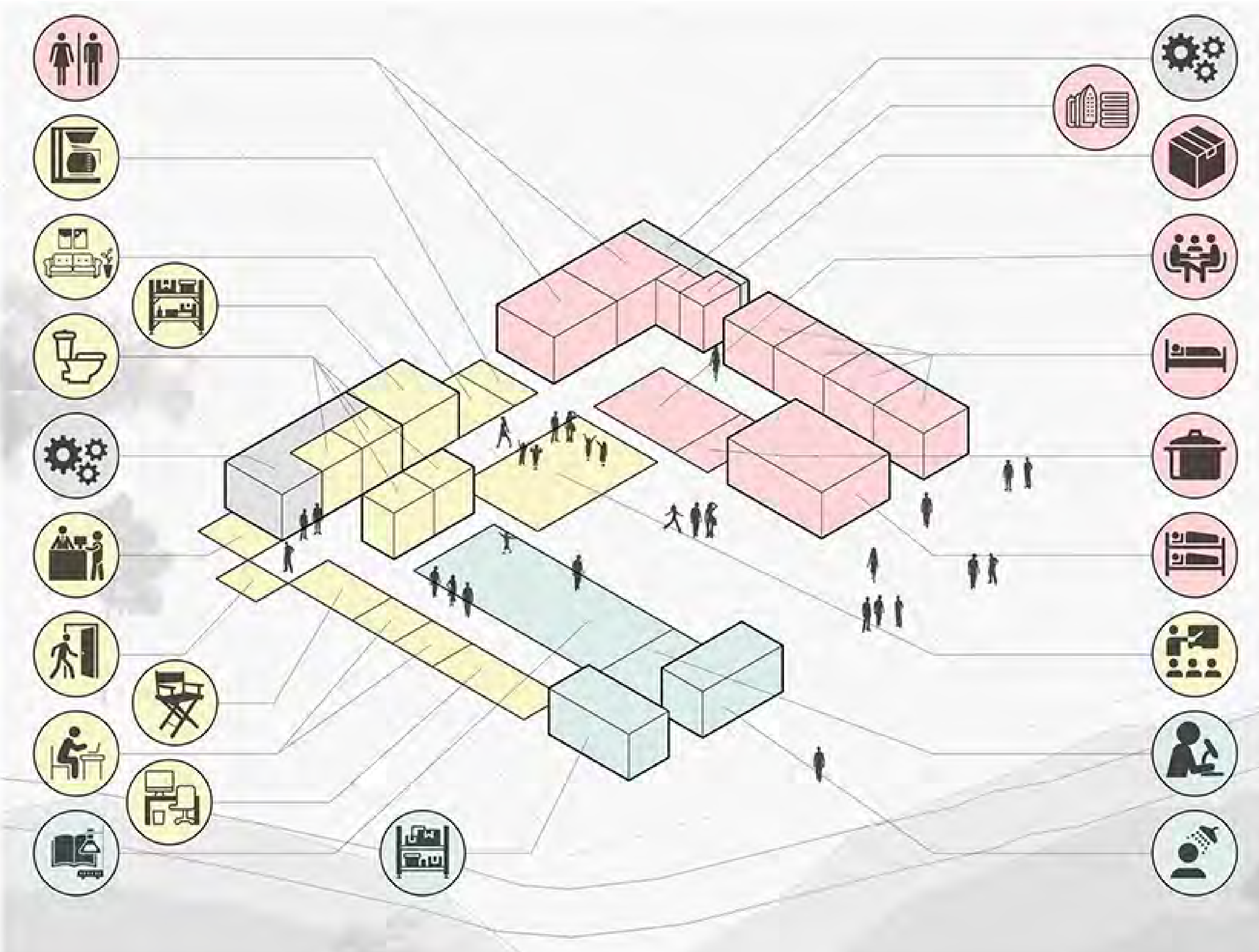
- Active, public spaces should orient to the marsh and water views
- Private dorm spaces do not necessarily need to focus on views to the south. They may orient north, away from busy work and gathering spaces.



SWMP Lab at Delaware National Estuarine Research Reserve

Lab equipment at the Delaware National Estuarine Research Reserve

Weather Station at Delaware National Estuarine Research Reserve



The building program can be broken down into three different uses

SINGLE / DOUBLE BEDROOM
140 SF each
Dormitory Space

WOMEN'S/MEN'S BATHROOM
225 SF each
Dormitory Space

LIVING ROOM
200 SF
Public / Admin Space

MUDROOM
200 SF
Research Space

DORMITORY
400 SF
Dormitory Space

MECHANICAL
500 SF
Mechanical Utilities & Storage

OPEN OFFICE
230 SF
Public / Admin Space

RESEARCH STORAGE
200 SF
Resarch Space

GATHERING ROOM
350 SF
Dormitory Space

DIRECTOR'S OFFICE
160 SF
Public / Admin Space

RECEPTION / ADMIN OFFICE
100 SF
Public / Admin Space

SWMP LAB & OFFICE
340 SF
Research Space

KITCHEN
140 SF
Dormitory Space

ENTRANCE VESTIBULE
80 SF
Public / Admin Space

RESEARCH OFFICE
100 SF each
Public / Admin Space

WET LAB
900 SF
Research Space

LAUNDRY CLOSET
40 SF
Dormitory Space

GATHERING / CLASS / EXHIBIT
600 SF
Public / Admin Space

STORAGE
200 SF
Public / Admin Space

STORAGE
60 SF
Dormitory Space

KITCHENETTE
140 SF
Public / Admin Space

UNISEX TOILET
600 SF / 4 Bathrooms
Public / Admin Space

As agreed upon by CBNERR-MD and UMD, the quantitative building program used for this study is as follows:

Space	Total SF	Remarks
Public and administrative spaces		
Entrance vestibule	80	
Gathering / classroom / exhibit	600	Seating (not fixed) for 20-30; Includes AV room; may have exhibits and small events
Living room	200	w/comfortable seating, can be used w meeting space
Kitchenette	80	
Storage	200	Tables, chairs, seasonal
Reception / admin office	100	
Director's office	160	
Research office 1	100	
Research office 2	100	
Open office	230	
Unisex toilet	600	4 WCs, 4 sinks (to accommodate 300 ppl)
Subtotal	**2450**	
Research spaces		
Wet lab	900	May at times be used as a classroom
SWMP lab and office	340	
Research storage	200	Accessible from outside
Mudroom	200	Accessible from outside; include shower and sink
Subtotal	**1640**	
Dormitory		
Gathering room	350	Living / dining space, access to outdoor porch ideal
Kitchen	140	May be shared between dormitories and public gathering spaces
Dormitory	400	Flexible space for camps or teacher training, to sleep 16. Lockers.
Double room	140	2 beds, 2 dressers, 2 closets, lockers - medium-term stays
Double room	140	2 beds, 2 dressers, 2 closets, lockers - medium-term stays
Double room	140	2 beds, 2 dressers, 2 closets, lockers - medium-term stays
Single room	140	1 bed, closet, private bathroom (shower) - caretaker suite
Women's bathroom	225	2 WC, 2 sink, 3 showers
Men's bathroom	225	2 WC, 2 sink, 3 showers
Laundry closet	40	Stacking washer/dryer
Storage	60	
Subtotal	**2000**	
Mechanical, utilities, storage		
Mechanical room	300	Water, heating, A/C
Janitor closet	60	
Electrical, telephone, cable, internet closet	80	
I.T. closet	20	
Lockable & secure storage for expensive field gear	40	
Subtotal	**500**	
Total net square feet	6590	
Structure, circulation at 25%	1647.5	Circulation may be used for exhibits in some places
Total gross square feet	**8237.5**	Maximum allowable overage is 10% over
Outdoor spaces and features		
Entrance space		Gardens, gathering areas, terraces per designer
Screened porch		
Deck or terrace		One of the outdoor spaces should accommodate six picnic tables
Fire pit or grill area		
Elevated viewing deck and/or porch		Facing toward marsh and bay
Private porch or deck		For dormitory space
Equipment cleaning/maintenance area		Including hanging racks for waders and hoses etc.
2 outdoor showers		
Rain barrels if compatible with water mgt. system		
Weather station with rain gauge		To check remotely, possibly on accessible flat roof area

BUILDING CODES AND STANDARDS

This study took into account building codes related to the site as well as the building's construction, fire protection, and energy use. These are key standards that must be considered for any building project. Note that, with the exception of net-zero energy design, codes represent minimum values. There are many ways that a project can exceed these code minimums, especially in the context of a vulnerable area.

THE SITE

Somerset County Zoning is AR (Agricultural Residential).

Height Limit: 35 feet, measured from the ground

Coastal Flood Zone designated by FEMA's base flood maps as AE. Key points:

- 1% probability of flooding every year (also known as 100-Year Floodplain)
- National Flood Insurance Program (NFIP) designates site as high risk for flooding
- Base Flood Elevation (BFE), defined by FEMA National Flood Insurance Program (NFIP): 7'-0"
- Design Flood Elevation, per County zoning: 1'-0" above BFE and per Coast Smart code: 2'-0" above BFE
- BFE's are shown on FEMA's Flood Insurance Rate Maps (FIRMs)
- 100' buffer required from Mean High Water Line (MHW)

BUILDING CONSTRUCTION & FIRE PROTECTION

International Building Code 2015

Occupancy type: A-3, Assembly

Applicable Construction types for this site and building type, depending on program size and levels of fire protection are:

- Type II (unprotected non-combustible)
- Type IV (heavy timber)
- Type V (wood frame), which includes Type V-A (protected) or Type V-B (unprotected)

Building will likely be sprinklered. For an 8,000 sf wood building, estimate 120 minutes of flow x 1,000 gallons per minute, which equals 120,000 gallons of water storage needed on-site.

See Section 5, Water, for further discussion.

ENERGY GOALS & PERFORMANCE

2015 IECC Energy Code Minimum requirements.

Maryland is in Climate Zone 4A, Mixed-Humid

Two possible compliance paths:

- Prescriptive - may limit design freedom and foster the view that the building is composed of separate, non-related assemblies and systems
- Performance-based - provides more design freedom and can lead to innovative design, but involves more complex energy simulations and tradeoffs between insulating, material, and environmental control systems.

Target energy goals in one of several ways:

- Energy Use Intensity (EUI), which measures kBtu/ft2/year. The U.S. Energy Information Administration (EIA) tracks the national average as 45 to 50 EUI for similar buildings.
- Efficiency of 50% or better than the 2015 IECC code minimum requirements
- Or, meet all 18 LEED Energy points. Using the ASHRAE 90.1-2010 baseline, this is about 40% better than 2015 IECC.

Stretch energy goal: net-zero energy:

- High performance energy design to 15-25 EUI, integrating a high performance envelope, high performance mechanical systems, occupant engagement, and maximizing solar potential.
- Lower energy use means fewer PV panels or windmills needed to meet all energy needs on-site.

BUILDING IN A COASTAL AREA

Maryland has detailed, restrictive codes for coastal sites. Accessibility, flooding, views, and vulnerability need to be addressed. In addition to Critical Areas legislation, this project is subject to Federal guidelines, Maryland Coast Smart design criteria, and local zoning. One of the purposes of this report is to highlight select key criteria of these codes -- in particular the Maryland Coast Smart criteria -- into one comprehensible overview.

Monie Bay Watershed System (Sim and Schmitz)

COAST SMART DESIGN CRITERIA

Section 3-1001 - 3-1104 of the Natural Resources Article - entitled "Coast Smart Council" was enacted into law in 2014. This law established the Maryland Coast Smart Council in the Department of Natural Resources for the purposes of adopting specific Coast Smart siting and design criteria to address impacts associated with sea level rise and coastal flooding on future capital projects. The Council's Coast Smart Construction Program, detailing its siting and design criteria and implementation procedures, was approved on June 26, 2015.

The Coast Smart Construction Program includes guidelines and other directives applicable to the preliminary planning and construction of proposed capital projects to address sea level rise and coastal flood impacts; a requirement that the lowest floor elevation of proposed structures located within a Special Flood Hazard Area be built at an elevation of at least 2 feet above the base floor elevation; and provisions establishing a process to allow a Unit of State Government to obtain a categorical exception and/or waiver from complying with specific implementation requirements. These guidelines will also integrate the requirements of FEMA standards for designing a watertight structure or portions of the building located below the base flood elevation which are substantially impermeable to the passage of water and capable of resisting hydrostatic forces and hydrodynamic loads, as well as effects of buoyancy.

Monie Bay Research Reserve and Monie Bay Field Station site (Hess and Zuber)

OTHER SITE CONSIDERATIONS

This section provides the context for the student project case studies that follow in this section. It does not represent all of the site analysis performed as part of the study. It is expected that a comprehensive site analysis would be done as part of full design and construction of the Monie Bay Field Station.

Site considerations that informed the UMD student designs include the larger context of the Chesapeake Bay; site access and views; ecology, climate, and resilience; CBNERR-MD's site inventory; potential for salvage and reuse; cultural history and heritage of the area; and site footprint and orientation.

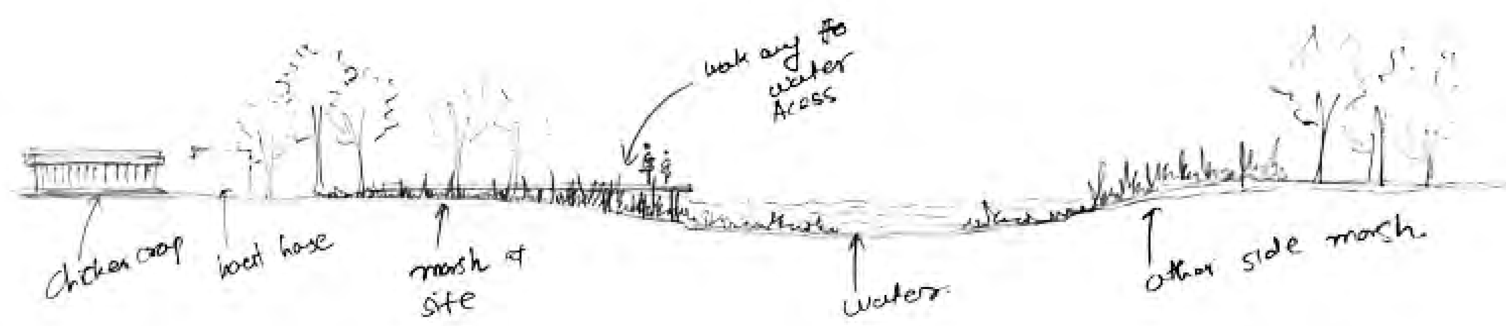
Coast Smart Design Criteria: Elevating a Building Above BFE (University of Maryland)

Coast Smart Design Criteria: Structures Built Below BFE (University of Maryland)

Coast Smart Design Criteria: Structures within the Limit of Moderate Wave Action (LiMWA) (University of Maryland)

SITE ACCESS AND VIEWS

The building is to be approachable from both north and south. There is the possibility of organizing vehicular and service access on the north, leaving a direct connection on foot from the building to the marsh and water to the south.



Site transect exploring relationship of land and water (Dobariya)

View from existing dock looking north on site to existing structures

View looking south to existing boat shed in foreground and Little Monie Creek beyond; photograph taken from on top of existing grain silo

View looking southwest to existing structures on site, Little Monie Creek visible to the south; photograph taken from on top of existing grain silo

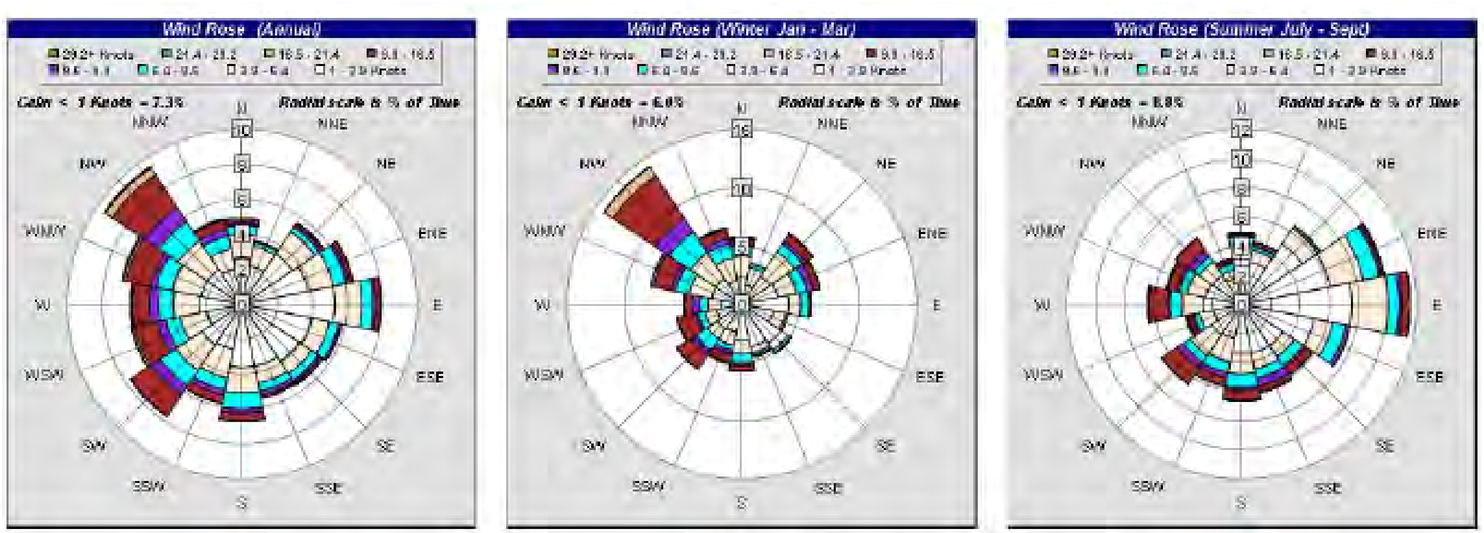
ABOVE: *View looking west to marshland and Little Monie Creek from existing dock;* **BELOW:** *Panoramic view looking east to marshland and Little Monie Creek from existing dock*

SITE ECOLOGY, CLIMATE, AND RESILIENCE

Climate

- Yearly average rainfall in Somerset County is 41 inches of rain
  - Most rain events have historically been 1 to 2 inches
  - Frequency of heavy downpours is projected to continue to increase
  - Yearly average of snowfall is 6.5 inches
  - 66 precipitation days
  - 212 sunny days per year
- Temperatures in Somerset County
  - July high 87 degrees
  - January low 31 degrees
- Sperling Comfort Index for Somerset County = 46 out of 100
  - Expresses total number of days annually within comfort range of 70-80 degrees
  - Penalty applied for days of excessive humidity
  - U.S. average is 54
- Prevailing winds (see wind rose illustrations for more detailed information)
  - Annual - NW and E
  - Winter - NW
  - Summer - E, ENE, and ESE

Climate Data	Somerset, MD	United States
Rainfall (in.)	41.0	39.2
Snowfall (in.)	6.5	25.8
Precipitation Days	66.2	102.0
Sunny Days	212	205
Avg. July High	86.7	86.1
Avg. Jan Low	30.6	22.6
Comfort Index (higher = better)	46	54
UV Index	4.5	4.3
Elevation ft.	9	1443



Wind roses for the site: annual, winter, summer (Green Building Studio)

MARSH MIGRATION

Marsh grasses and plants protect the water's edges. In the right conditions, marshes can migrate inland. This phenomenon may inform the building's design response.

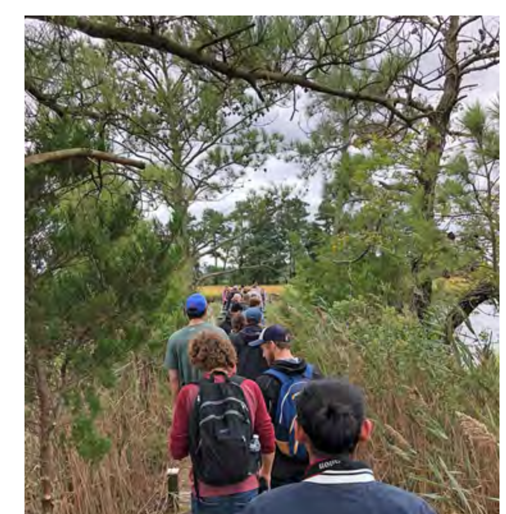
EXISTING PLANT LIFE

Trees

- Loblolly pine
- White pine
- Smooth alder
- Dogwood
- Oak
- Walnut
- Mimosa (non-native)

Grasses

- Cordgrass
- Bay Grass
- Black Needle Rush juncus roemerianus
- Common Reed (non-native; invasive) phragmites australis



CLOCKWISE FROM TOP: *UMD student Deane Townsend dons waders and walks among the marsh grasses during a site visit; Students explore the native marsh during a site visit; Where the marsh grasses meet the water*

Overview of existing site conditions at Monie Bay Field Station (DNR)

DNR SITE INVENTORY AND MASTER PLAN

In addition to an inventory of all existing structures and utilities, a site master plan which details the elements that are to be preserved, renovated, improved, deconstructed, salvaged, or scrapped. It also describes new structures and landscapes that will be built in the future, including the Monie Bay Field Station.

INVENTORY OF EXISTING BUILDINGS FOR POSSIBLE DECONSTRUCTION

Deconstruction has great potential on this site. Not only are there several structures destined for deconstruction; it is also an excellent way to minimize truck traffic from haulers and to avoid sending valuable construction materials to a landfill. While this is certainly within the overall project vision of resource-efficiency, it may require some creativity with State procurement requirements. Also, for budget considerations, salvage and reuse are not necessarily a cost savings. For example, old structural wood may have to have nails pulled and be planed in order to reuse it for interior trim. If reuse as a structural component is contemplated, an engineer will have to inspect and grade the salvaged wood.

HISTORY AND CULTURAL HERITAGE

The Eastern Shore is rich in cultural history and heritage, which informed student projects. The original farm was owned by the Price family. The farm evolved from tobacco to food crops and finally poultry. In the early 1800s, the family identified as sailors, shipping goods across the Chesapeake Bay. The surrounding region has similar histories and livelihoods. Some nearby farms are also involved with harvesting pine trees.

FOOTPRINT AND ORIENTATION

For the purposes of this study, the site was limited to a footprint of 150' x 150' at the south end of the existing chicken sheds. Building in a previously-disturbed area will reduce impervious surfaces and prevent further damage to the delicate ecosystem. At approximately elevation 5.0 above sea level, it also happens to be a highpoint of the site. The chicken-shed site faces southwest, which provides excellent views of the marsh, Little Monie Creek, and the landscape beyond at an elevated height.

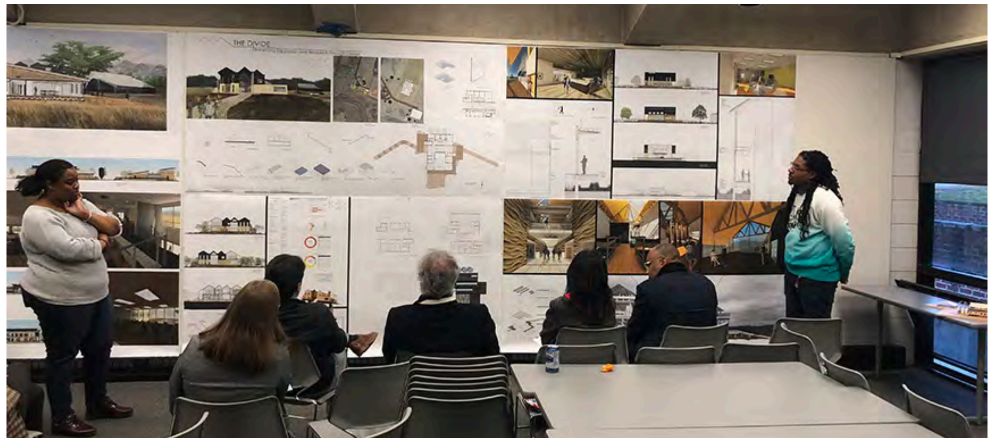
CLOCKWISE FROM TOP: *52,740 sf of corrugated galvanized steel is available from existing chicken sheds on site; Additional view of chicken shed on site; Existing grain silos on site may be re-purposed*

Team	ZUBER + HESS	DELASH + WOOD	SCHMITZ + SIM	COMBS + TOWNSEND	ROBBS + PETERS	DAVIES + KNOEBEL	BOS + JESMER	AHMED + HAM
Number of floors	1	2	2	1	1	1	1	2
Building Org.	3 Buildings Connected by deck	2 Buildings, U-Shape	2 Buildings, U-Shape	2 Bar Buildings with Connector at Middle	2 Buildings with Breezeway	3 Buildings Connected by Enclosed Walkway around Water Treatment	1 Building of 2 Overlapping Forms	1 Building, Programs Separated by Floor
Roof Form	Gable Roof	Shed	Shed	Gable	Butterfly	Shed	Gable Roof	Gable Roof
Gross Square Footage	8,716 SF	10,917 SF	8,988 SF	8,184 SF	11,900 SF	7,841 SF	9,000 SF	9,000 SF
Height of First Floor Above Grade	7'	6'	5'	6.3'	5'	7.3'	9'	8'
Height Above Base Flood Elevation	5'	4'	3'	4.3'	3'	5.3'		6'
Window %	20%	18.60%	24.40%	12.50%	17.20%	18.30%	23.6%	16%
Structural System	Timber Piles, Heavy Timber, Gluelam Trusses	Timber Piles, Gluelam, Steel Framing Roof	Timber Piles, Dimensional Lumber, Gluelam	Concrete Piles, Dimensional Lumber, Wood Trusses	Timber Piles, Dimensional Lumber, Gluelam	Concrete Piers, Steel, Dimensional Lumber	Timber Piles, Dimensional Lumber, Scissor Trusses	Wood Piles with Concrete Caps, Heavy Timber
Environ-mental Strategy	PV Panels, Rainwater Collection Silos	PV Panels, Southern Building Orientation, Daylighting, Ground Source Heat Pump, Green Roof	Constructed Wetland, Southern Building Orientation, Ground Source Heat Pump	PV Panels, Vertical Access wind Turbines	PV Panels, Southern Building Orientation, Daylighting, Rainwater Collection	PV Panels, Water Filtration, Natural Ventilation	Natural Ventilation, Water Collection, Daylighting	PV Panels, Southern Building Orientation, Daylighting
Insulation/ Envelope	Spray Foam & Rigid Insulation	XPS and Spray insulation	Fiberglass Insulation, XPS, Spray Foam	SIPs Panels	Spray Foam & Rigid Insulation	Wool Insulation, SIP Panels	Cellulose Fill, XPS	Rigid Insulation
Water Strategy	Constructed Wetlands, Re-purposed Silos	Green Roof Directs Water to Silos for Use in Building	Roof Directs Water into Constructed Wetland	Gutters Direct Waters to Silos and Reused in Building as Greywater	Roof Collects Stormwater, Filtered and used as Greywater	Wastewater Treatment Living Machine	Rainwater Retention Pond, Cistern, Green Roof	Connection and Treatment in Constructed Wetlands

Working in pairs, the students developed their building proposals to a high degree of detail including program layout and adjacencies, building form, building enclosure and envelope, structural system, mechanical system, landscape and site strategy, and material selection. This section contains eight representative projects. These projects were selected from among the seventeen total projects completed in order to demonstrate the depth, range, and variety of strategies explored. All of the projects were presented and reviewed in a public format with CBNERR-MD staff, DNR representatives, invited faculty members, and building professionals.

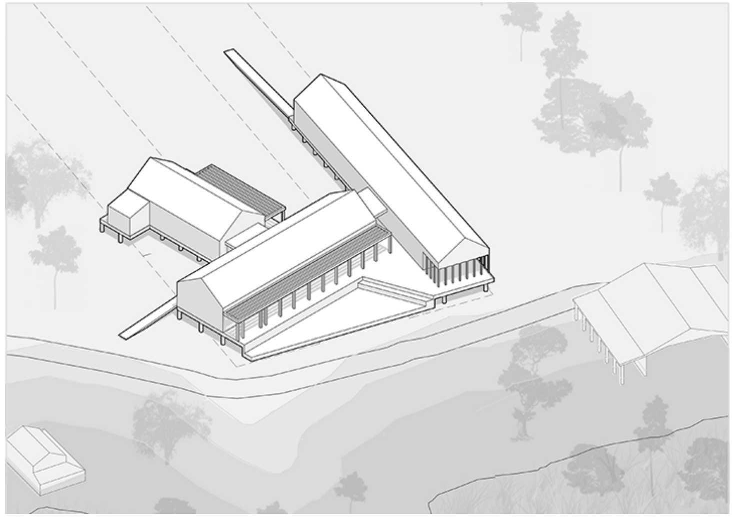
Most of the projects took careful consideration of the site, using building orientation and views to the landscape as important factors in the design. Sustainability was a primary factor in all of the designs, with many projects using solar panels on the roofs, reusing stormwater and using many other sustainable strategies to create buildings that are energy efficient and sit lightly on the site.

> Two co-requisite graduate level courses produced seventeen building projects demonstrating the range of options for the Monie Bay Field Station.



FROM TOP: *Samantha Zuber and Joanna Hess presenting their final work to a group of invited guests; Rachel Caine and David Moore discuss their proposed structural strategy during the final review of their work.*

PROJECT DESCRIPTION



Campus in the Marsh

Using a vernacular form seen throughout the eastern shore, a series of three interconnected buildings create a field station that fits within the context while functioning as a modern facility. The program is divided into three gabled building volumes connected by outdoor decks, which create open air rooms for researchers and visitors to enjoy the environment.

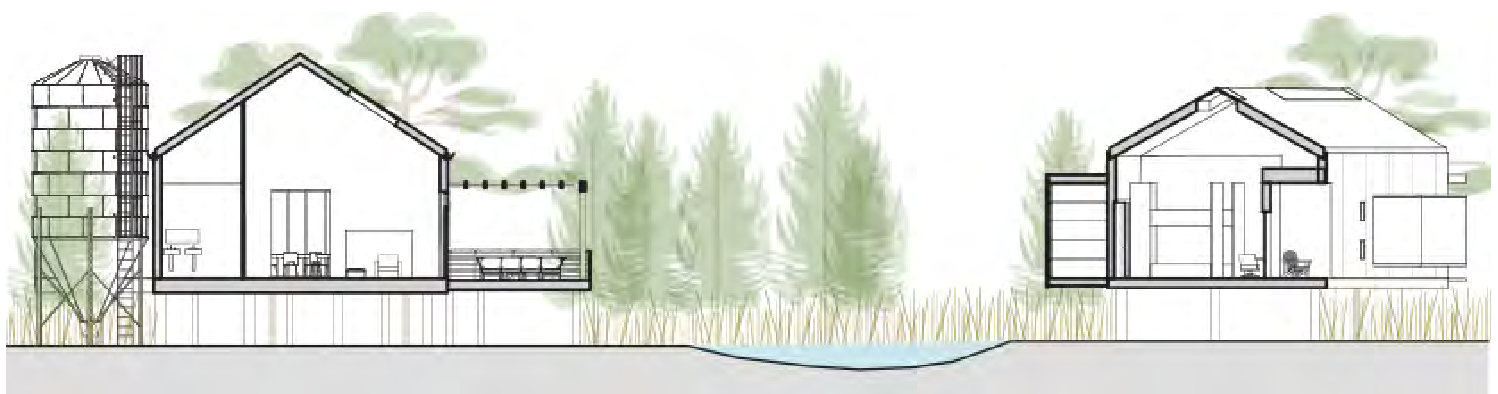
DATA

# Floors	1
Building Organization	3 Buildings Connected by Deck
Roof Form	Gable Roof
Gross Square Footage	8,716 SF
Height of First Floor Above Grade	7'
Building Height from Grade	30'
Window Percentage	20%
Structural System	Timber Piles, Heavy Timber, Gluelam Trusses
Environmental Strategy	PV panels, Rainwater Collection Silos
Insulation/Bldg Envelope	Spray Foam & Rigid Insulation
Water Strategy	Constructed Wetlands, Re-purposed Silos

Three separate buildings create pathways that wind through the marsh grasses and bring visitors outdoors during their daily life.

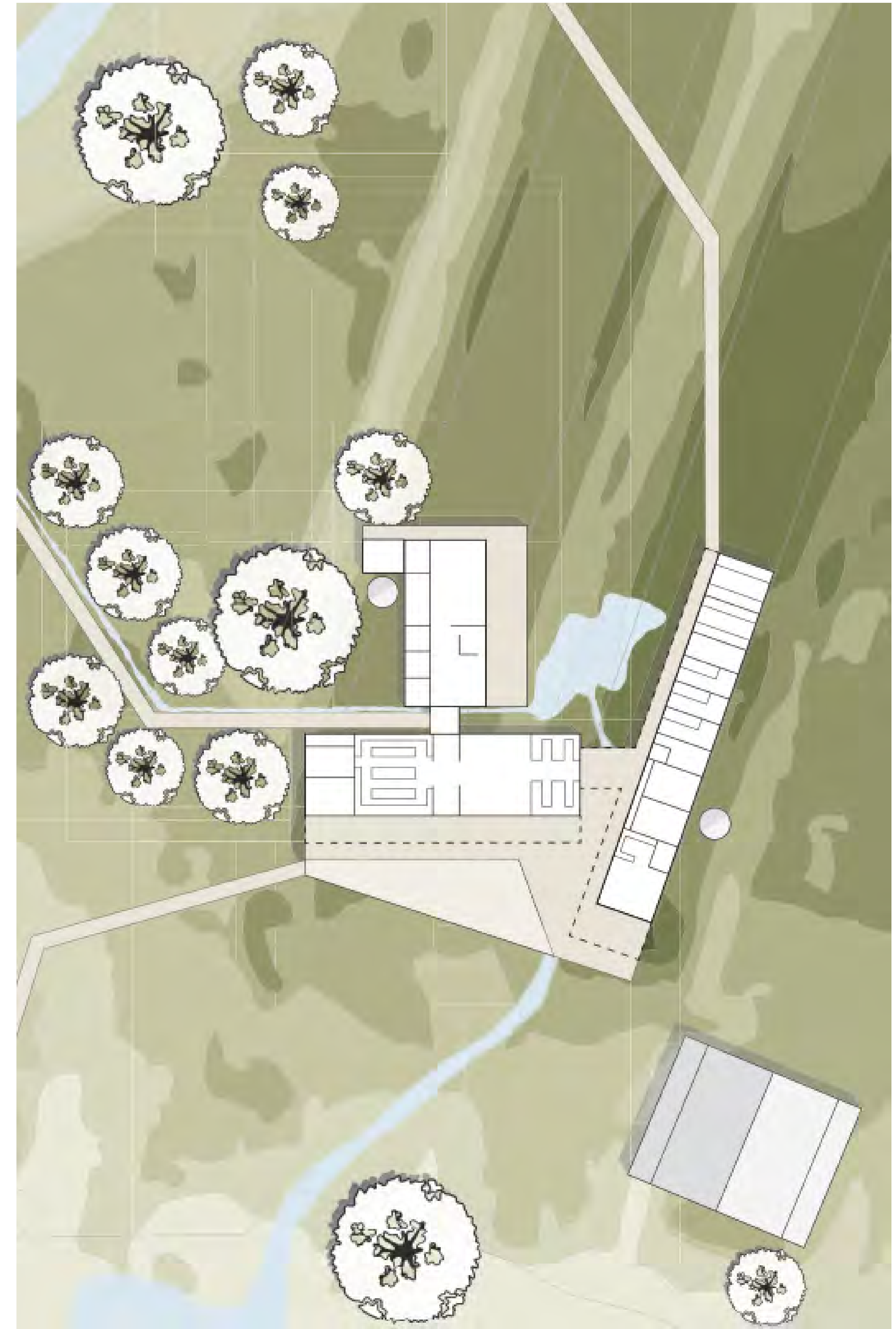
FROM TOP
Wall Section Perspective; View of Building Entry

SAMANTHA ZUBER AND JOANNA HESS



East/West Building Section

Building Plan



Site Plan

SAMANTHA ZUBER AND JOANNA HESS

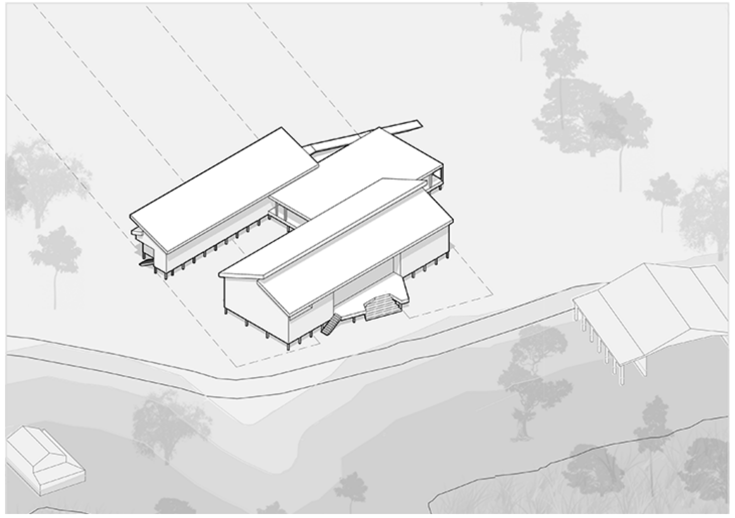
South Elevation

West Elevation

View of South Facade

View of Entrance Pathway

PROJECT DESCRIPTION



Wetlands Courtyard

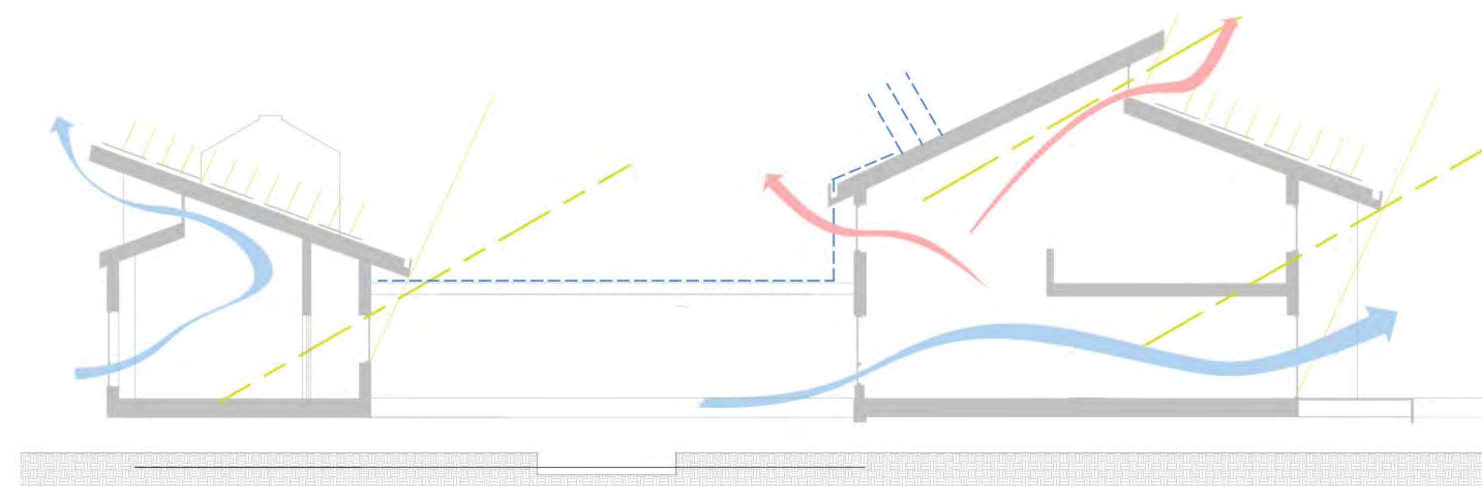
Organized around a courtyard, this building, like the marsh itself, is composed of intersections of space that create rooms for education, dormitories, and gathering. Starting in the centralized screen porch, visitors and researchers experience the building by weaving between the indoors and out, the conditioned and unconditioned, and the built and natural.

DATA

# Floors	2
Building Organization	2 Buildings, U-shape
Roof Form	Shed Roof
Gross Square Footage	10,917 SF
Height of First Floor Above Grade	6'
Building Height from Grade	33'
Window Percentage	18.6%
Structural System	Timber Piles, Glulam, Steel Framing at Roof
Environmental Strategy	PV panels, Southern Building Orientation, Daylighting, Ground Source Heat Pump, Green Roof
Insulation/Bldg Envelope	XPS, Spray Insulation
Water Strategy	Green Roof filters water into wetlands for filtering and silos for reuse

Northeast Approach Perspective

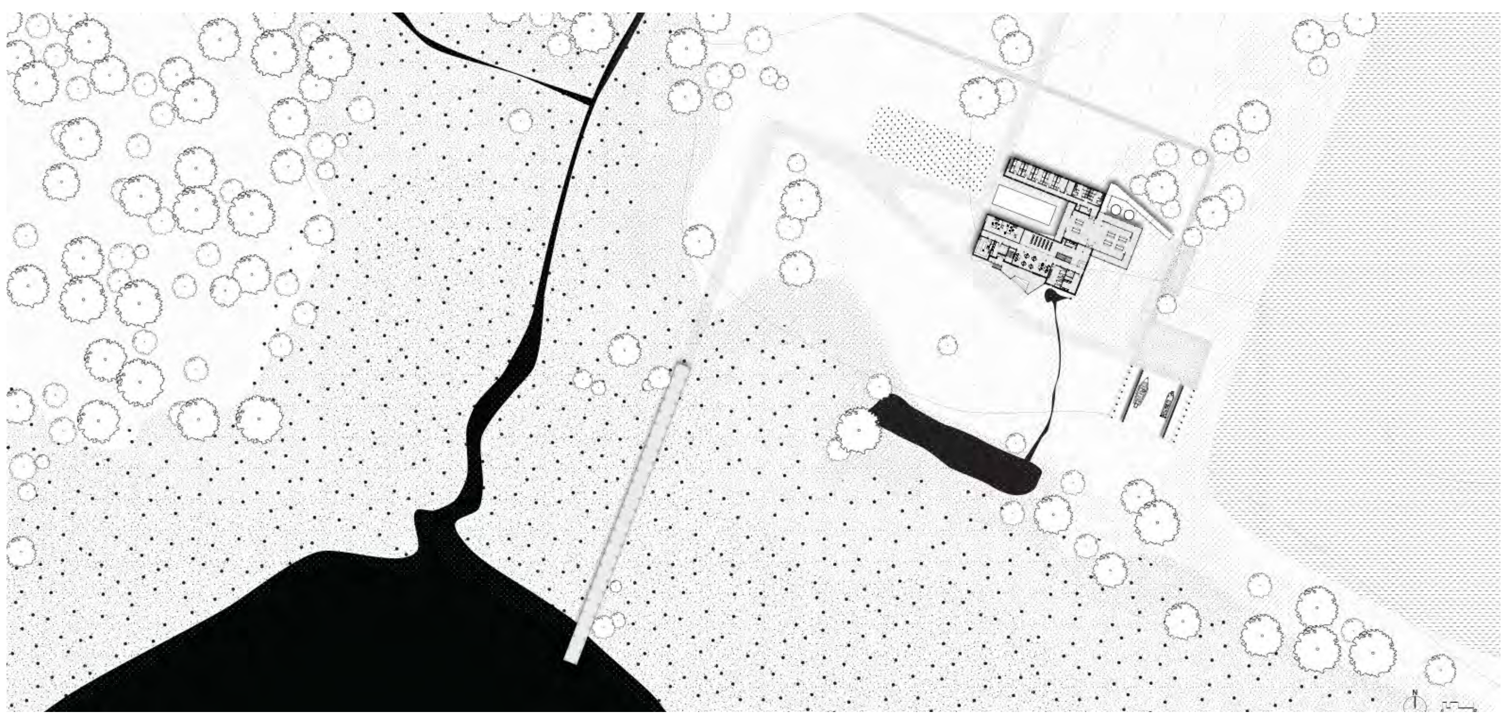
The screened porch is a welcoming area for visitors, as well as a gathering space for researchers, oriented around the constructed wetland.



Passive Systems Diagram

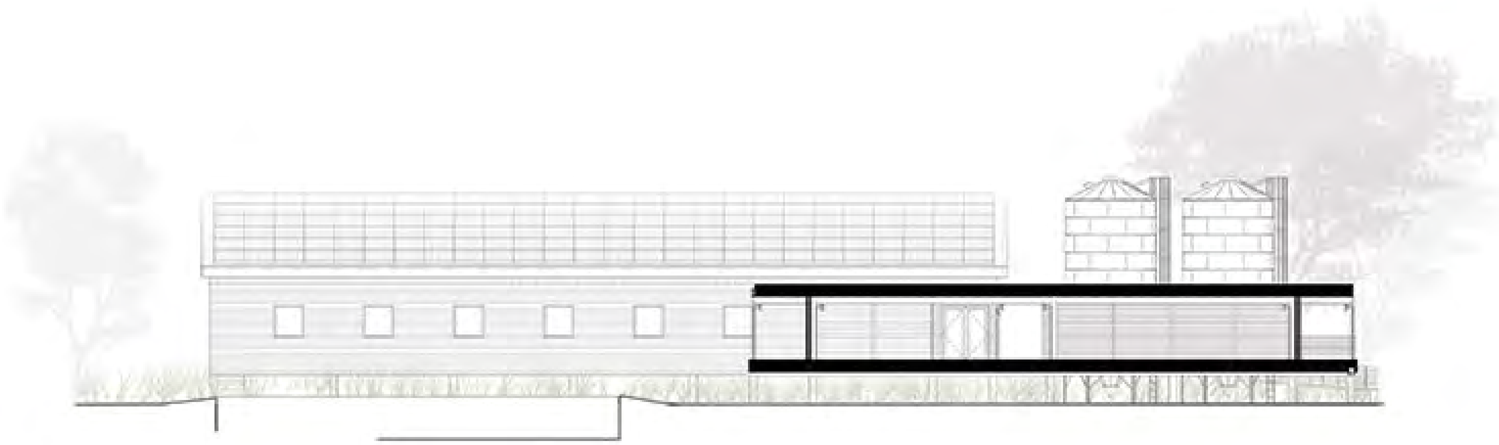
MICHAEL DELASH + TREVOR WOOD

Site Overview

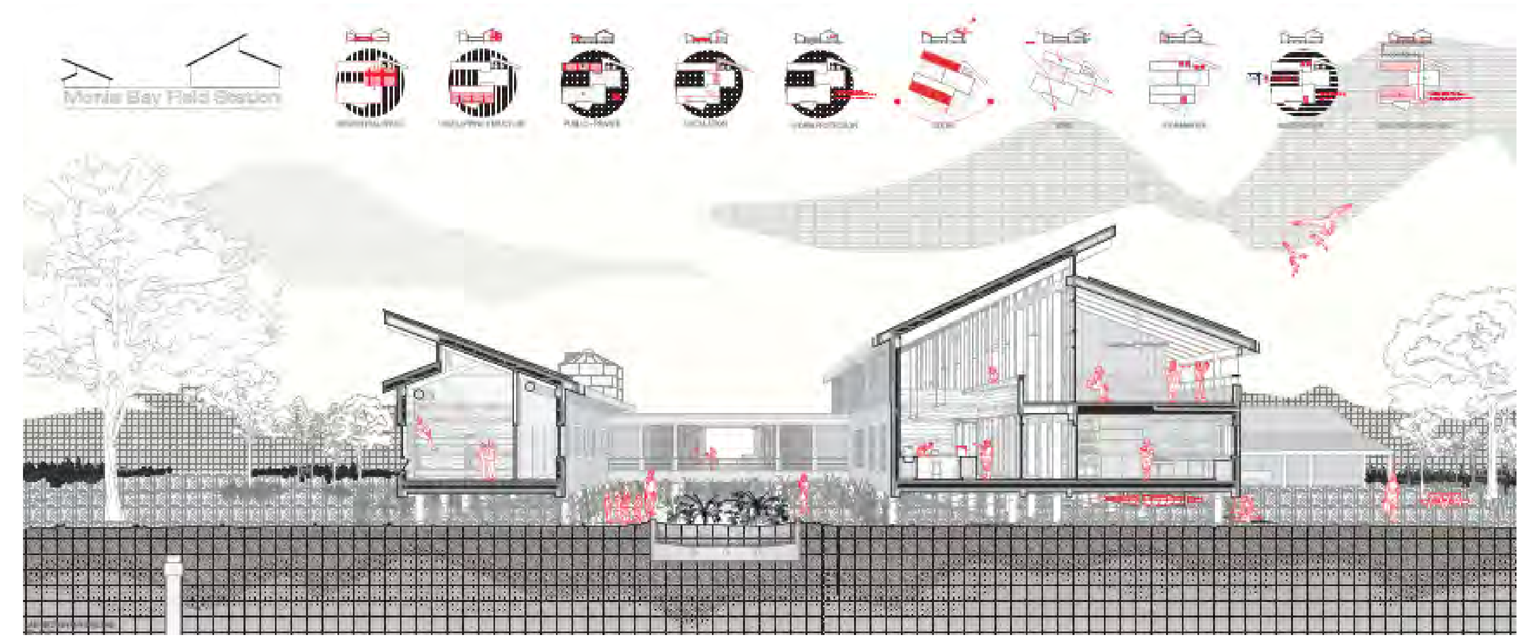


Site Plan

Contextual plan showing site benchmarks



Building Section

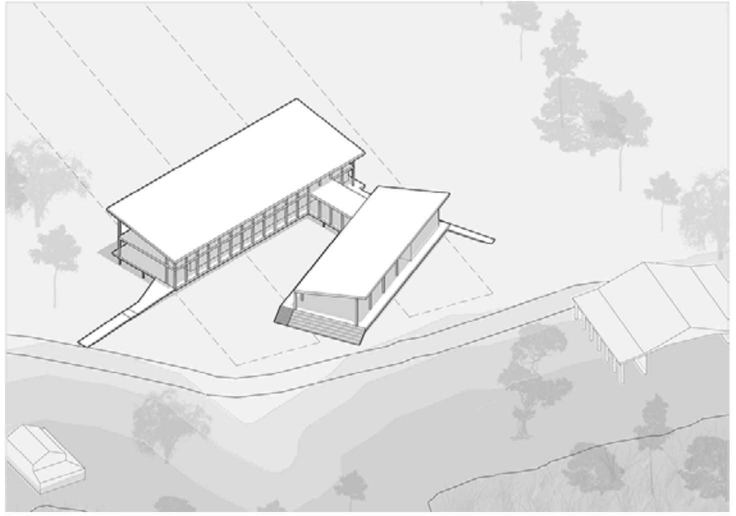


Wall Section Perspective

East Elevation

Building Section

PROJECT DESCRIPTION



Marshland Connections

Centered around a constructed wetland, the building acts as an intermediary water purification element between the built environment and the marsh. The staggering of programs in the two separate buildings allows for close up connections to the marshlands from areas of research, and elevated views of Monie Creek from the living and sleeping spaces.

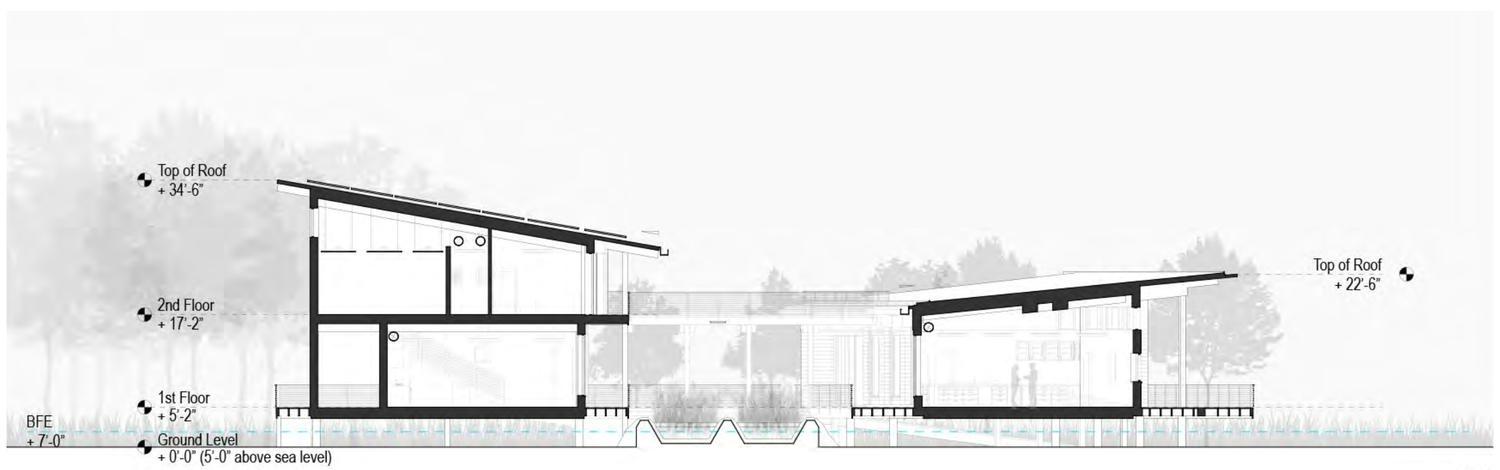
DATA

# Floors	2
Building Organization	2 Bar Buildings
Roof Form	Shed Roof
Gross Square Footage	8,988 SF
Height of First Floor Above Grade	5’
Building Height from Grade	34’ 6”
Window Percentage	24.4%
Structural System	Timber Piles, Dimensional Lumber, Glulam
Environmental Strategy	Constructed Wetland, Southern Bldg. Orientation, Ground Source Heat Pump
Insulation/Bldg Envelope	Fiberglass Insulation, XPS, Spray Foam
Water Strategy	Roof Directs Water to Constructed Wetland

Exterior Perspective

Dormitories are placed on the upper level so visitors can wake up to spectacular views of the estuary.

Wall Section Perspective

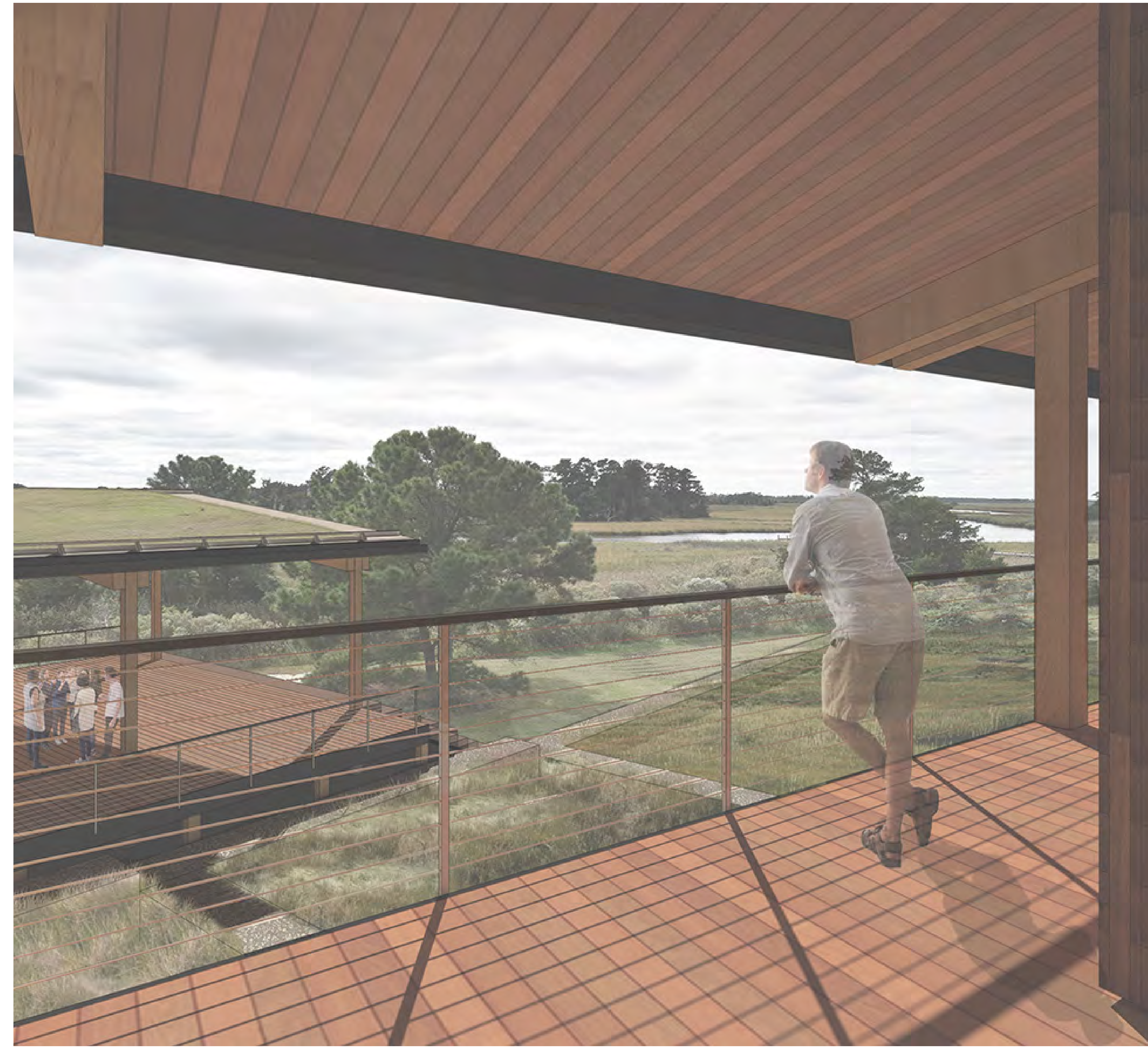


Building Section

Site Plan

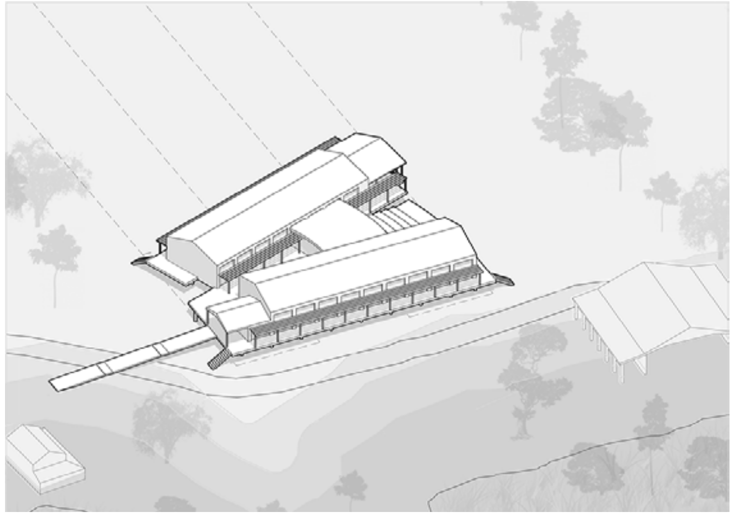
North Courtyard Elevation

South Courtyard Elevation



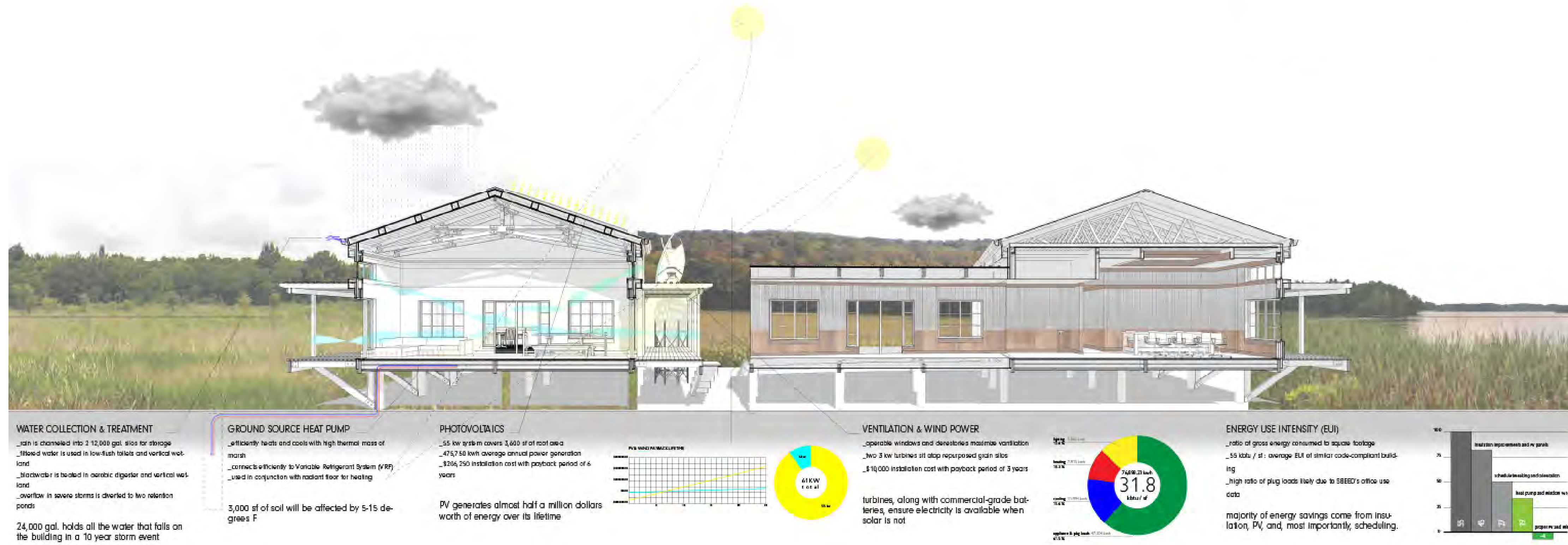
View From Dorm Rooms

PROJECT DESCRIPTION



Vernacular Ecology

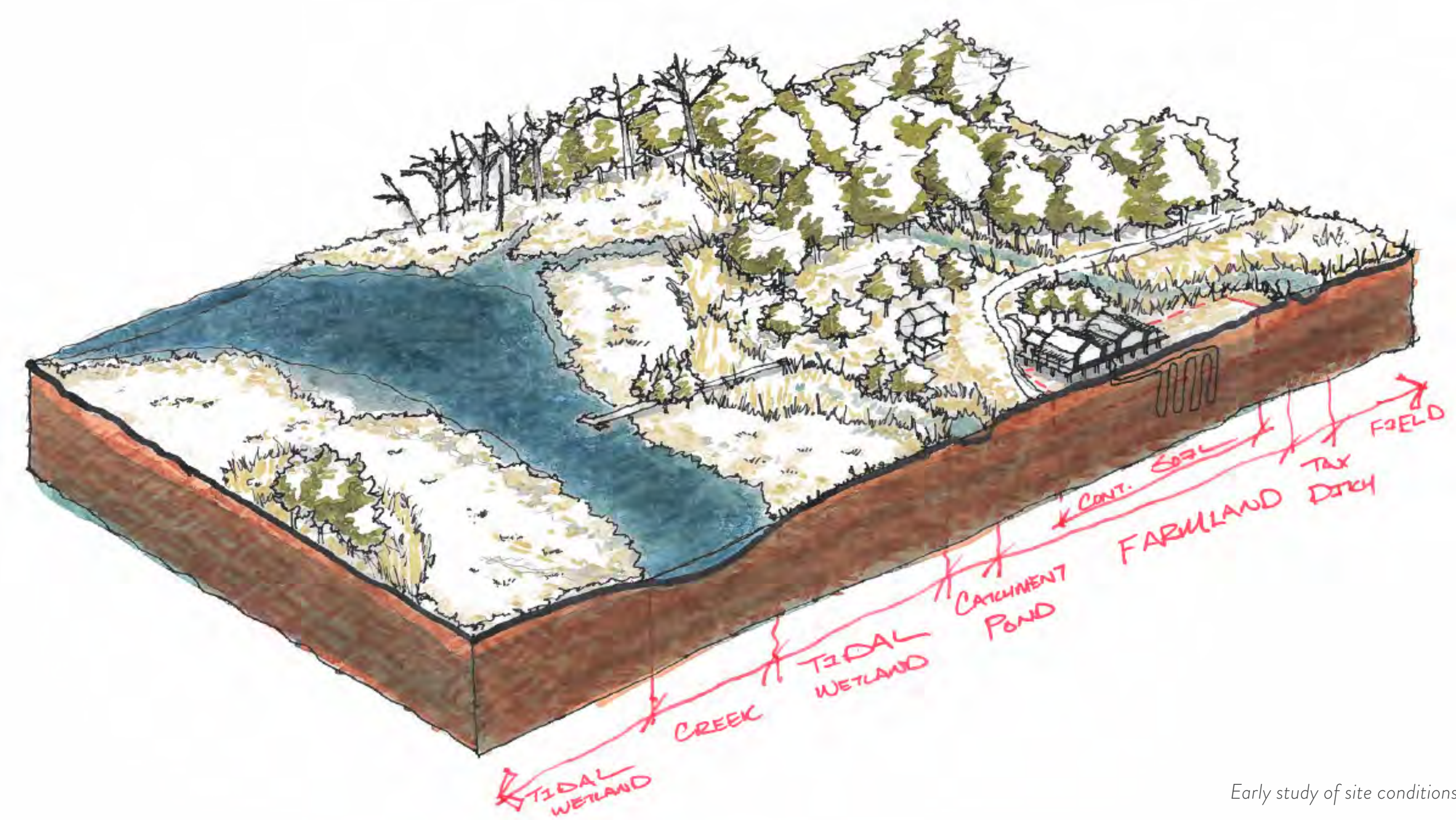
In this context-inspired building, residential and research programming are separated into two gabled volumes connected by a mediating volume. Crossing from one space to another, visitors are taken through a corridor with views to the marshlands and the central learning amphitheater, which will serve as a gathering space for visitors of all ages.



DATA

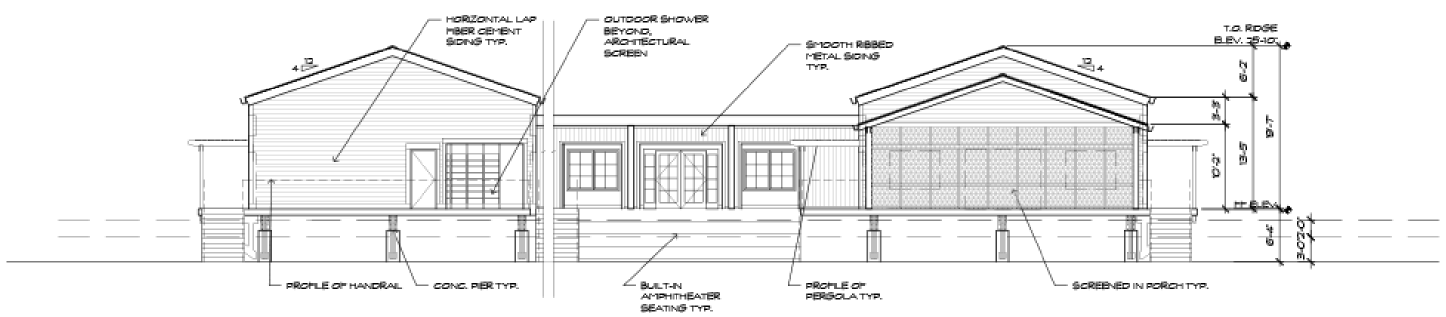
# Floors	1
Building Organization	2 Bar Buildings
Roof Form	Gable Roof
Gross Square Footage	8,184 SF
Height of First Floor Above Grade	6.3’
Building Height from Grade	26.5’
Window Percentage	12.5%
Structural System	Concrete Piles, Dimensional Lumber, Wood Trusses
Environmental Strategy	PV panels, Vertical Access Wind Turbines
Insulation/Bldg Envelope	SIPs Panels
Water Strategy	Rain Gutters Direct Water to Silos to be Reused

The south facing screened porch provides a social space bathed in sunlight that faces the marsh.

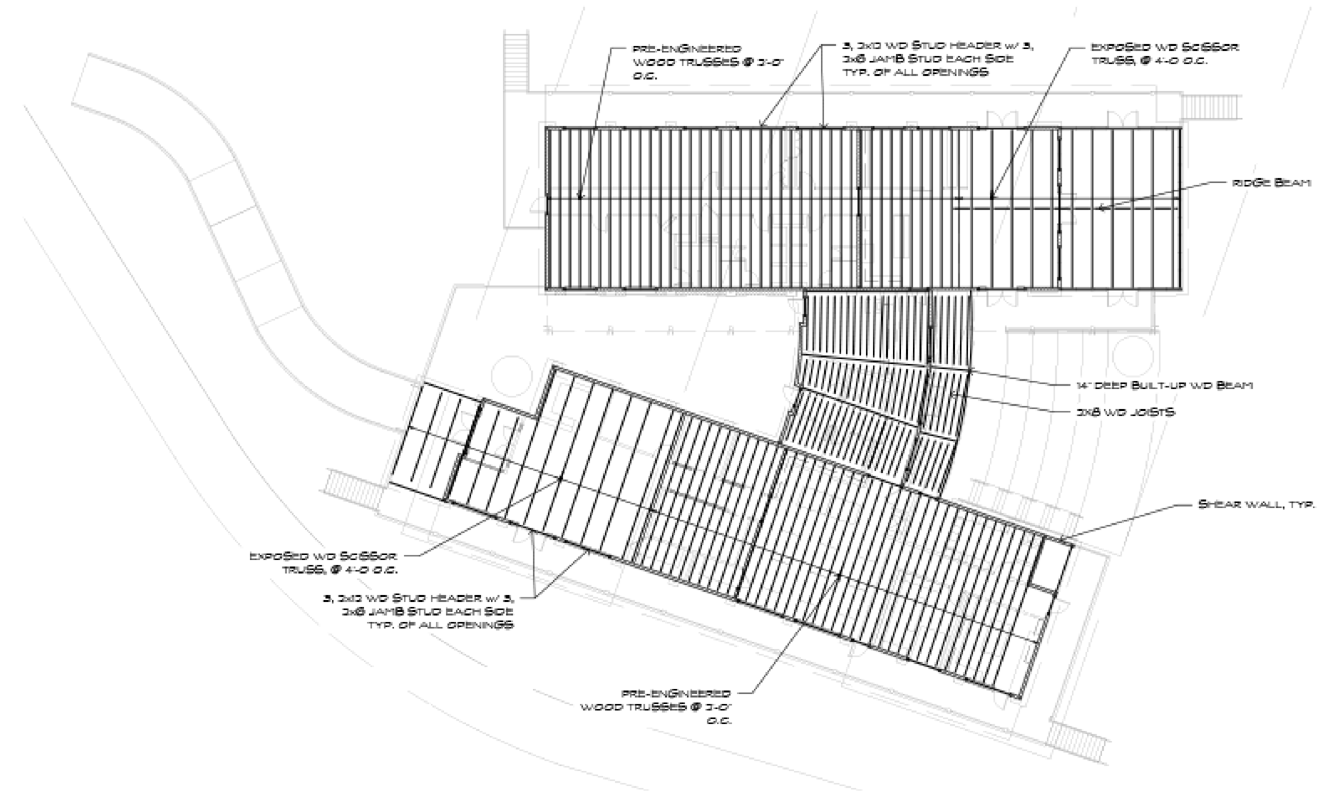


Early study of site conditions

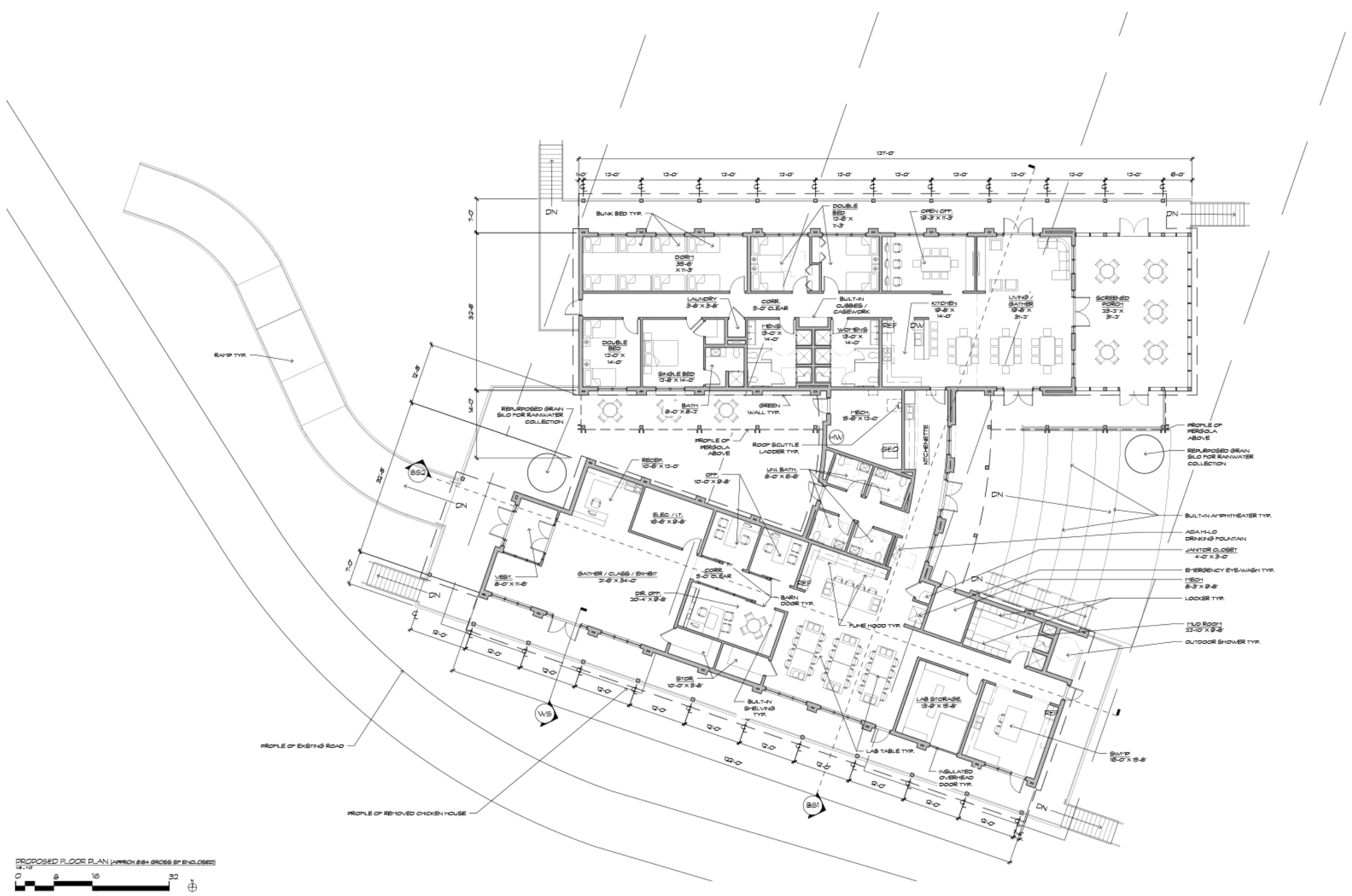
North Elevation



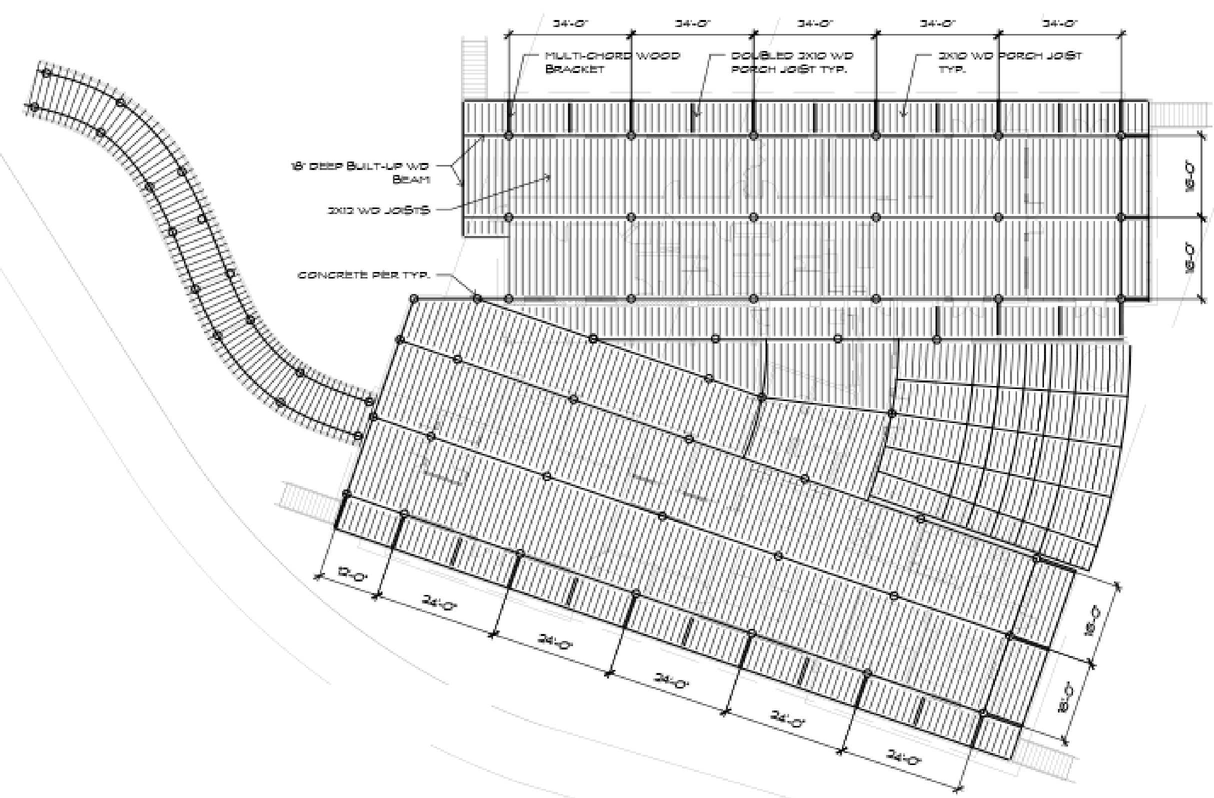
East Elevation



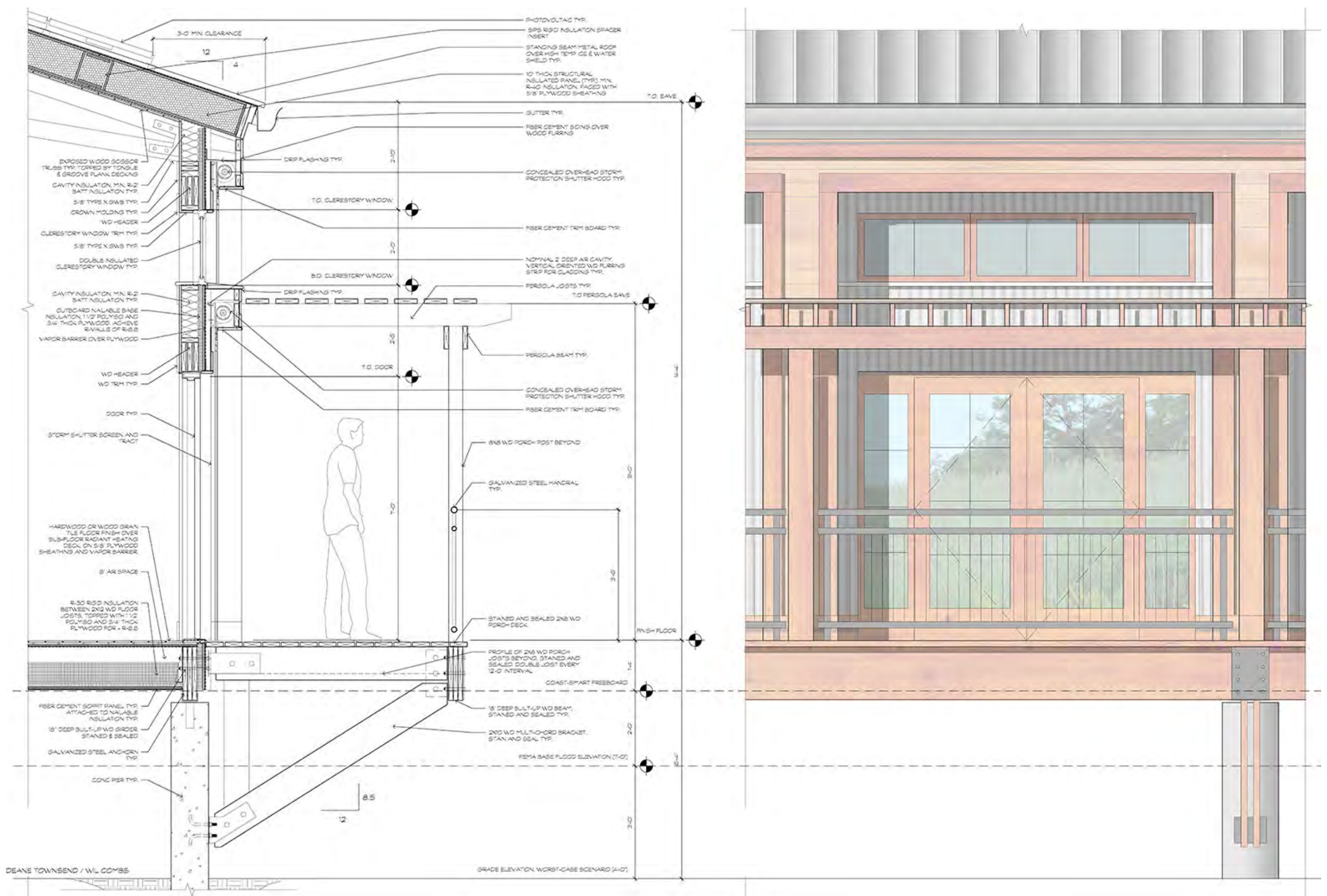
Structural Framing Wall & Roof Plan



First Floor Building Plan

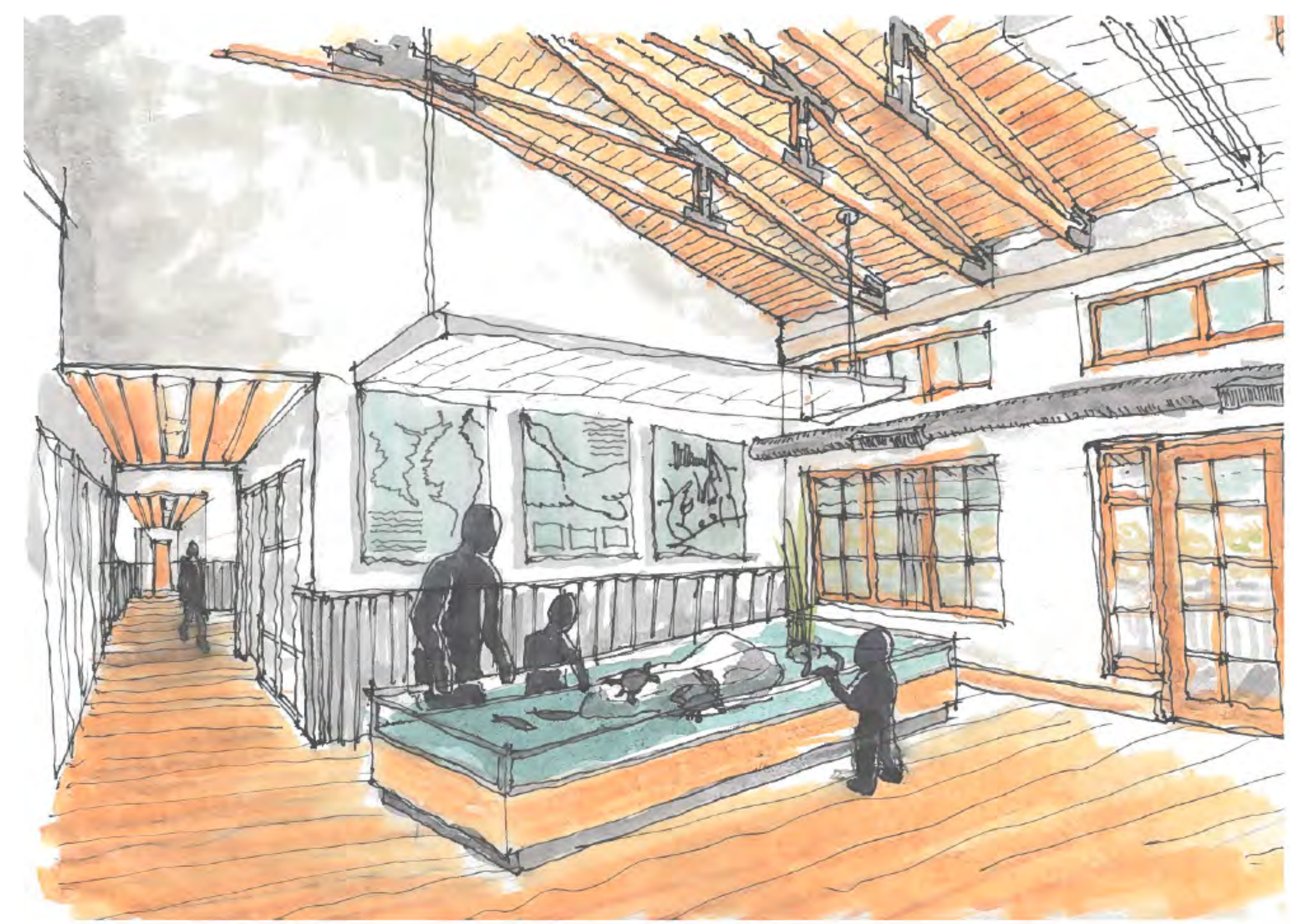


Structural Framing Floor Plan



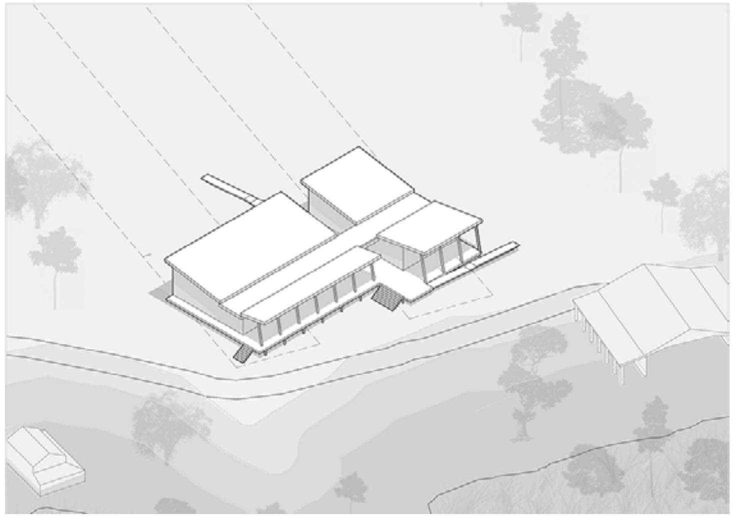
Wall Section and Bay Elevation

Deck Perspective



Interior Perspective

PROJECT DESCRIPTION



Butterfly on the Bay

This building captures views of the marsh by treating both the north and south facades as fronts. The butterfly roof also allows for photovoltaic panels and rainwater collection. A central breezeway is the point of entry for visitors, and also functions as a gathering and educational space.

DATA

# Floors	1
Building Organization	2 Buildings with Breezeway
Roof Form	Butterfly Roof
Gross Square Footage	11,900 SF
Height of First Floor Above Grade	5'
Building Height from Grade	25'-6"
Window Percentage	17.20%
Structural System	Timber Piles, Dimensional Lumber, Glulam
Environmental Strategy	PV panels, Southern Building Orientation, Daylighting, Rainwater Collection
Insulation/Bldg Envelope	Spray Foam & Rigid Insulation
Water Strategy	Roof Collects Stormwater, Filtered and used as Greywater

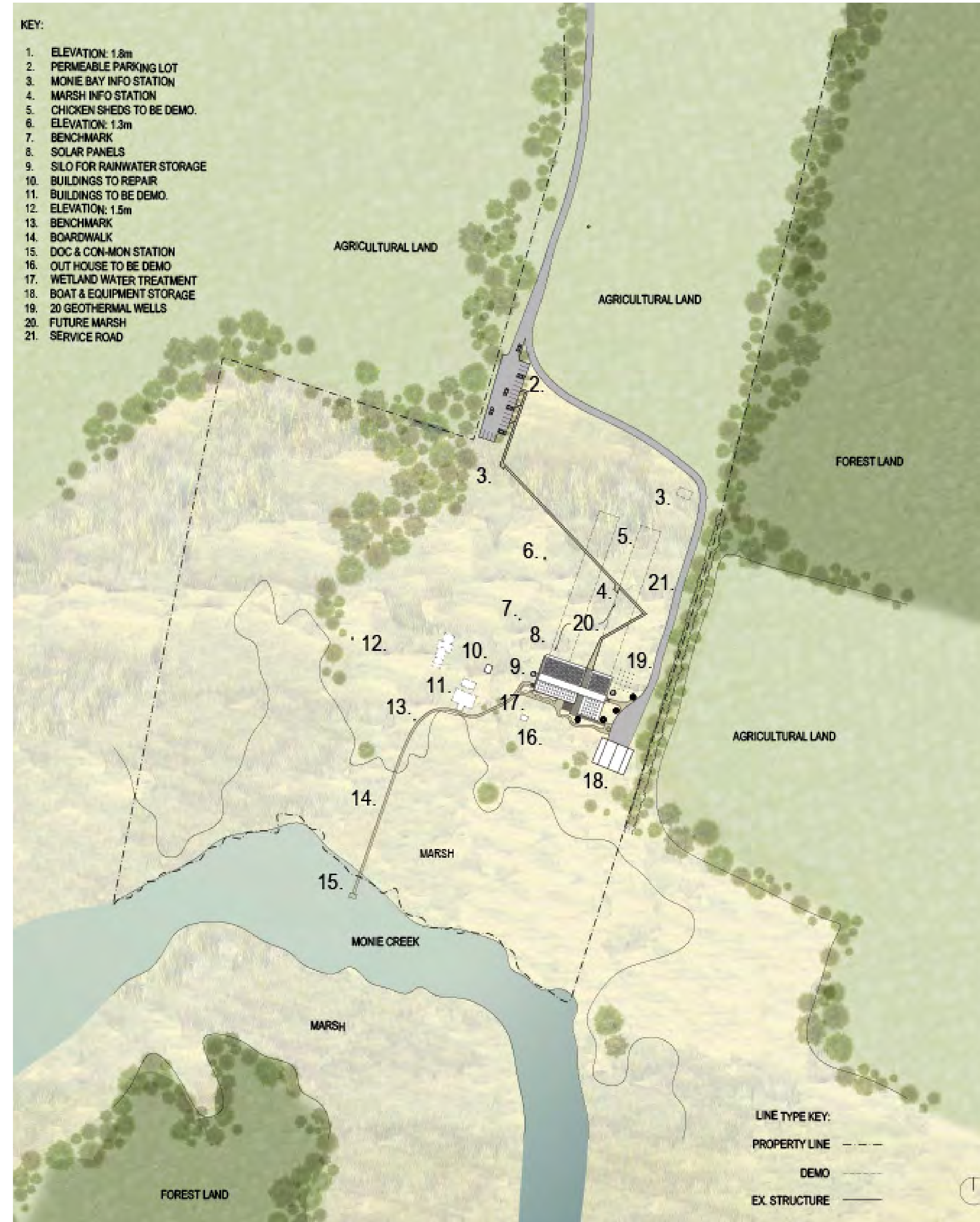
The breezeway that separates the programs is a multi-functional outdoor space that can be used as a classroom, laboratory or casual gathering space.

Exterior Perspectives

TAINA PETERS + AMBER ROBBS

Building Section Perspective

Breezeway Perspective



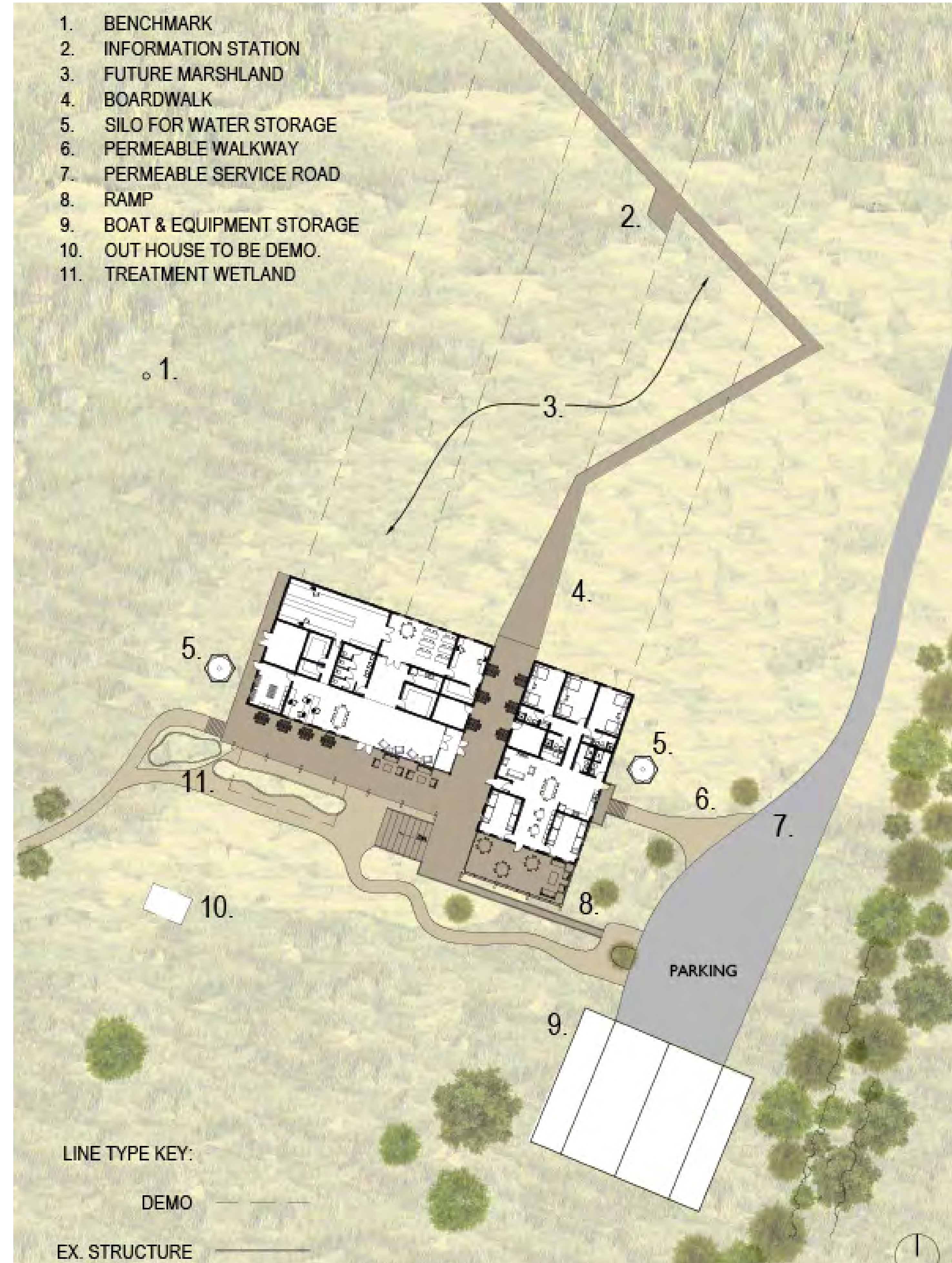
Site Plan

Southwest Elevation

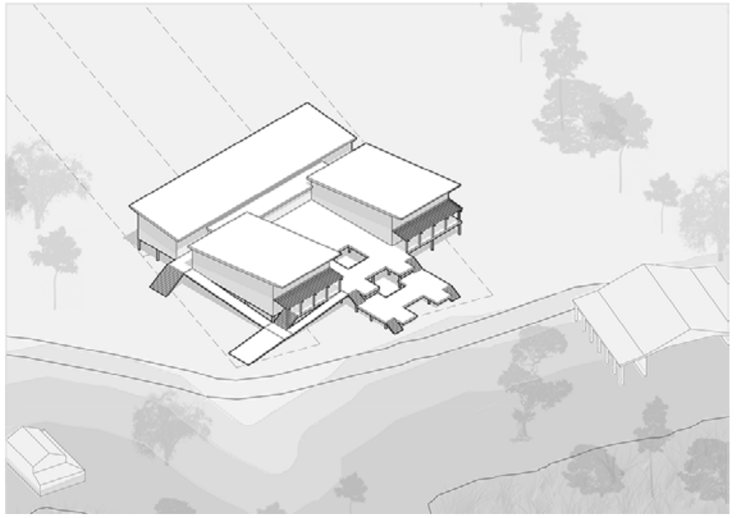
Northeast Elevation

Northwest Elevation

Southeast Elevation



PROJECT DESCRIPTION



Return to the Marsh

At the intersection between human experience and the marsh ecosystem, the building acts as a water filtration facility. Educational wastewater filtration terracing serves as the central organizing element, ultimately returning the water to the wetlands. The dormitory, research, and gathering spaces are connected by a linear porch space and organized around a decked courtyard to maximize views and access to the marshlands.

DATA

# Floors	1
Building Organization	3 Bldgs. Connected by Enclosed Walkway around Water Treatment
Roof Form	Shed Roof
Gross Square Footage	7,841 SF
Height of First Floor Above Grade	7.3'
Building Height from Grade	29'
Window Percentage	18.3%
Structural System	Concrete Piers, Steel, Dimensional Lumber
Environmental Strategy	PV Panels, Water Filtration, Natural Ventilation
Insulation/Bldg Envelope	SIP Panels & Wool Insulation
Water Strategy	Wastewater Treatment with Living Machine

Wall Section Perspective

Outdoor space surrounds the water treatment element, while connections between buildings remain indoors for less-than-ideal weather conditions.

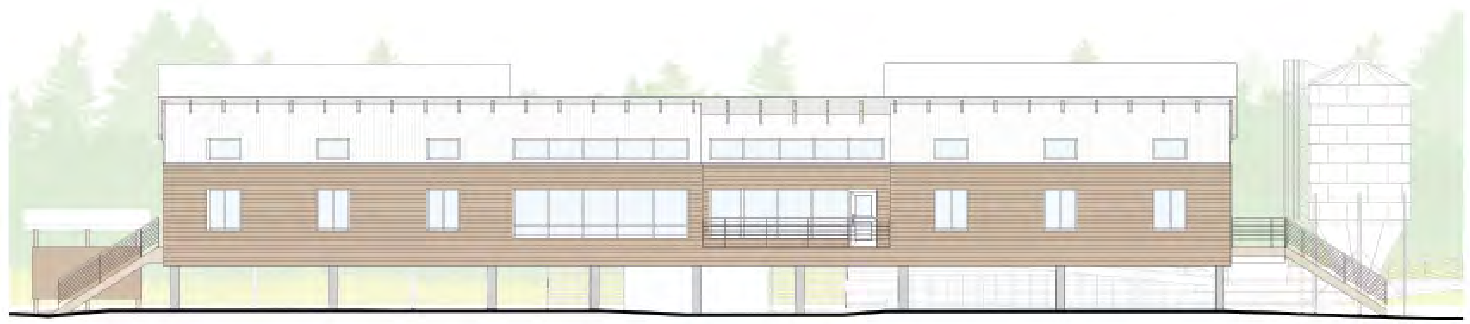
Exterior Perspective

ANDREW DAVIES + ADAM KNOEBEL

Exterior Amphitheater Perspective

Wall Section and Bay Elevation

Site Plan



North Elevation

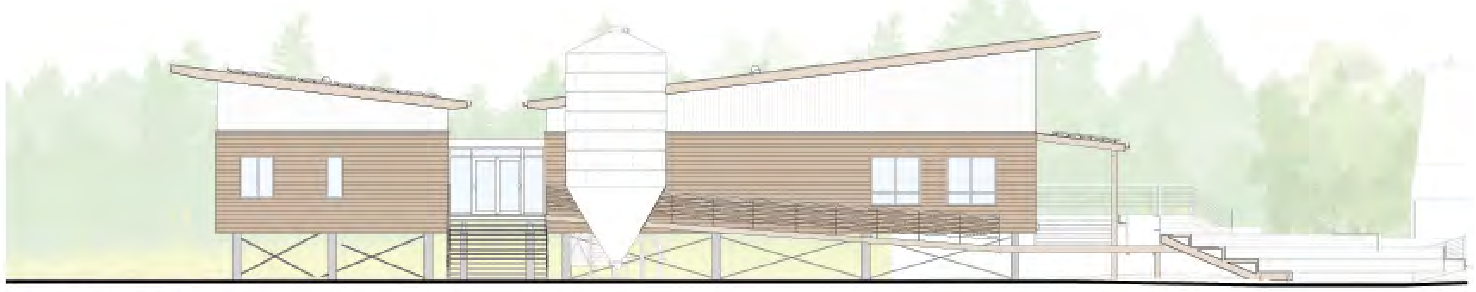
North Elevation

South Elevation

South Elevation

East Elevation

East Elevation

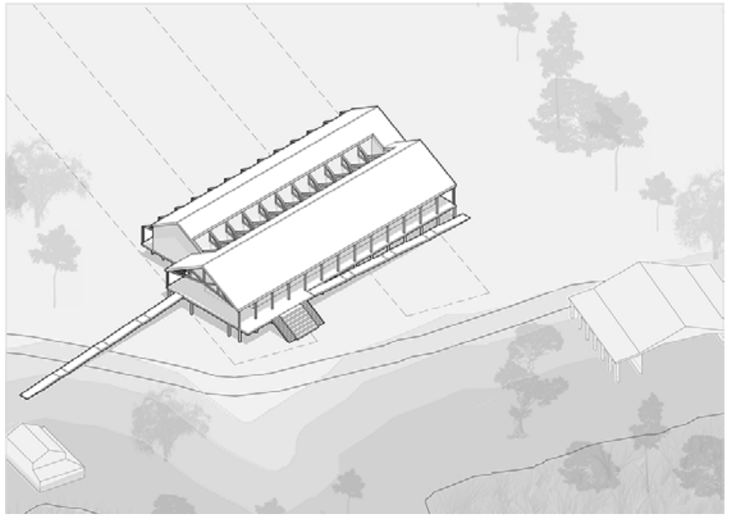


West Elevation

West Elevation

Building Plan

PROJECT DESCRIPTION



Intersections

The two vernacular forms intersect to create the entrance and focal point to this building, much like freshwater meets saltwater to create the estuary. Residential, educational, and research spaces intersect in a public gathering space that runs the full length of the building, demonstrating what can be created when two elements intersect.

DATA

# Floors	1
Building Organization	1 Building of 2 Overlapping Forms
Roof Form	Gable Roof
Gross Square Footage	9,000 SF
Height of First Floor Above Grade	9'
Building Height from Grade	33'
Window Percentage	23.6%
Structural System	Timber Piles, Dimensional Lumber, Scissor Trusses
Environmental Strategy	Natural Ventilation, Water Collection, Daylighting
Insulation/Bldg Envelope	Cellulose Fill, XPS
Water Strategy	Rainwater Retention Pond, Cistern, Green Roof

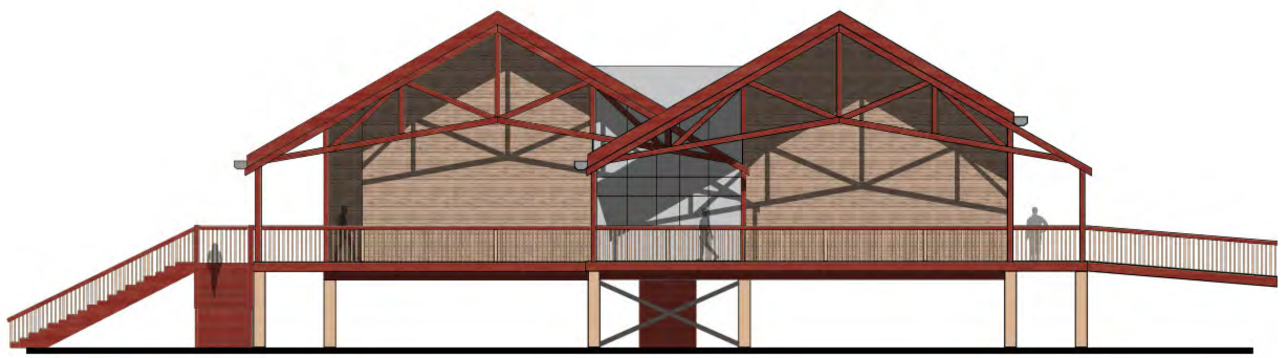
Wall Section Perspective

The intersecting forms create a central space filled with light that can serve as a gallery to educate visitors upon arrival.

Site Plan

ERIC BOS + JAMES JESMER

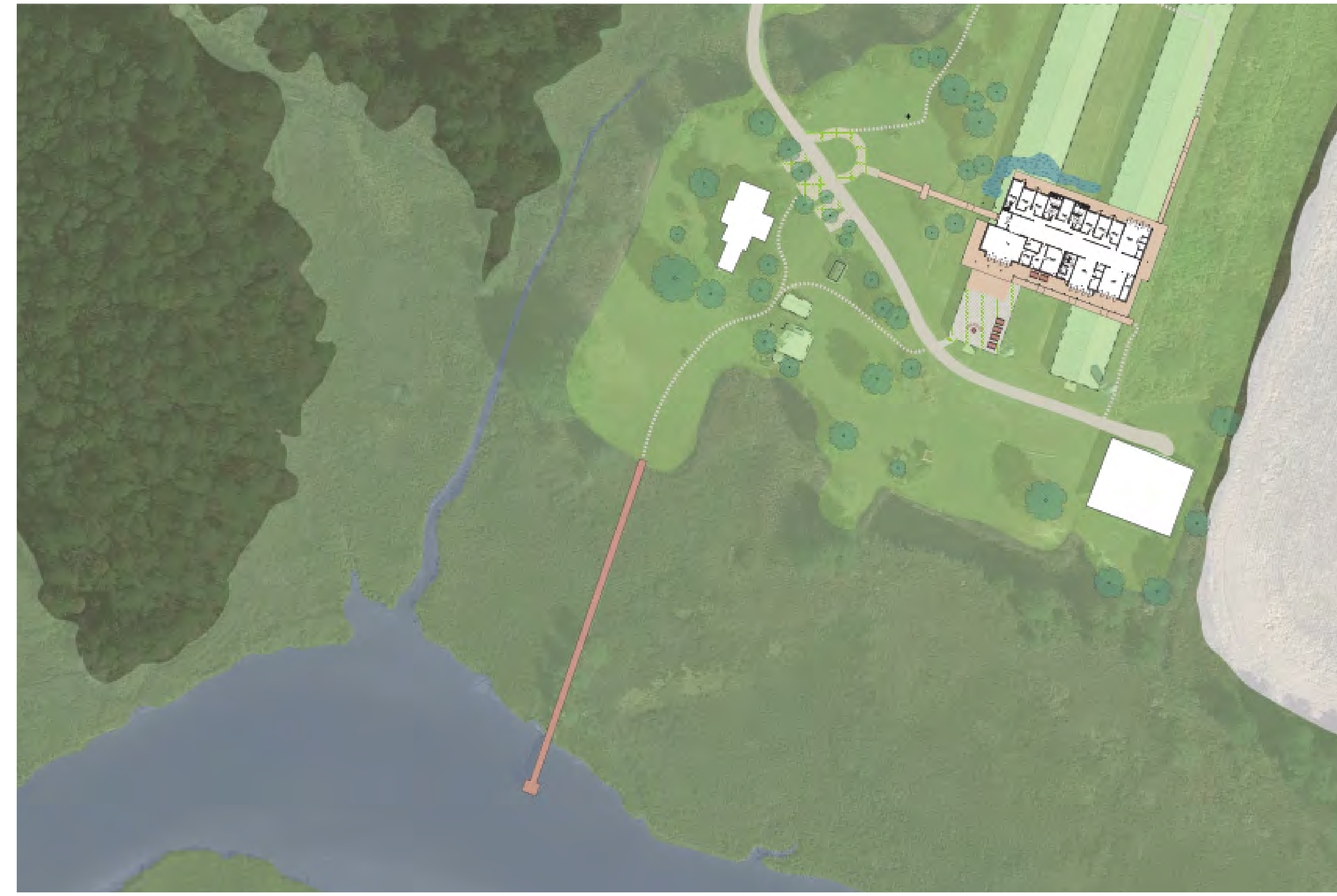
South Elevation



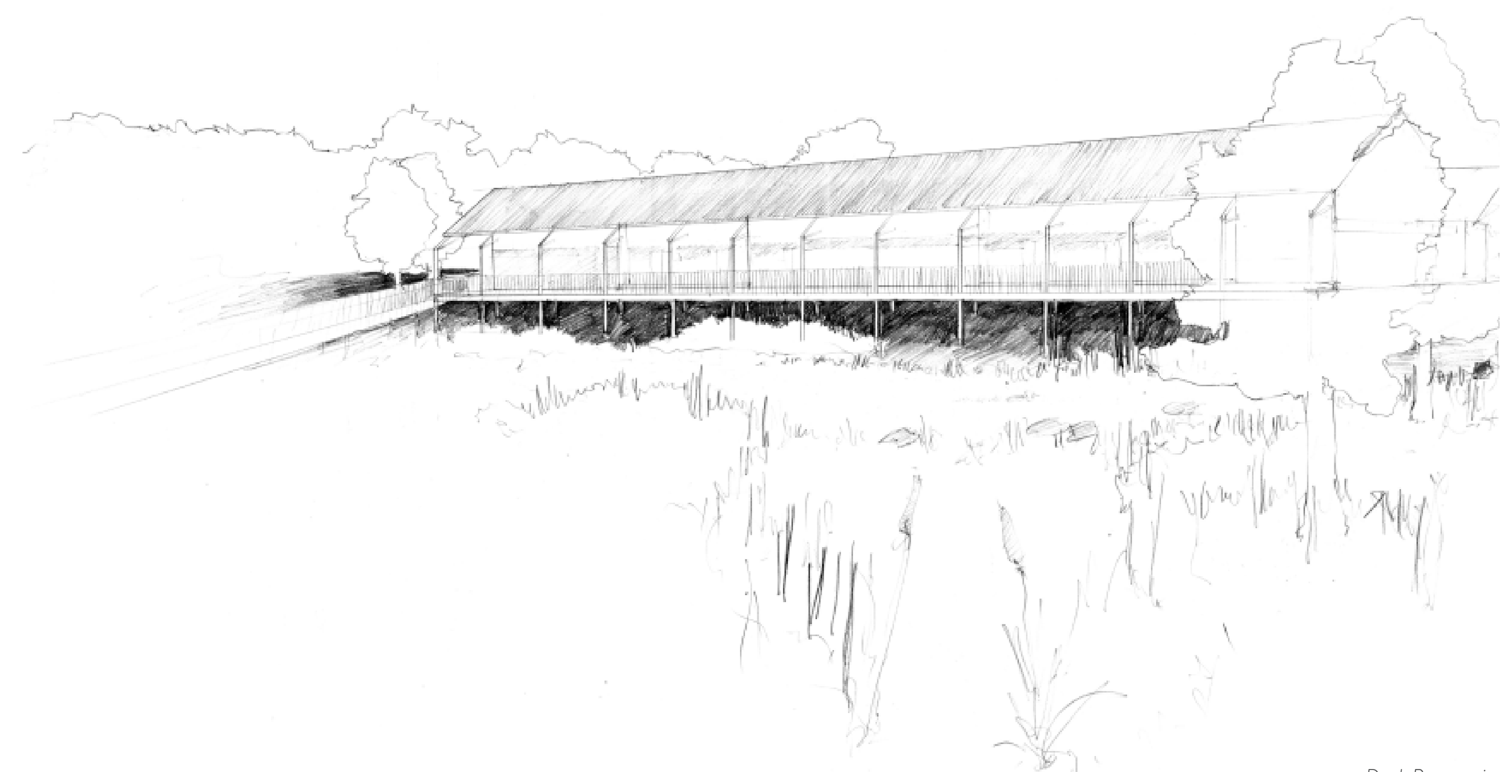
East Elevation

North Elevation

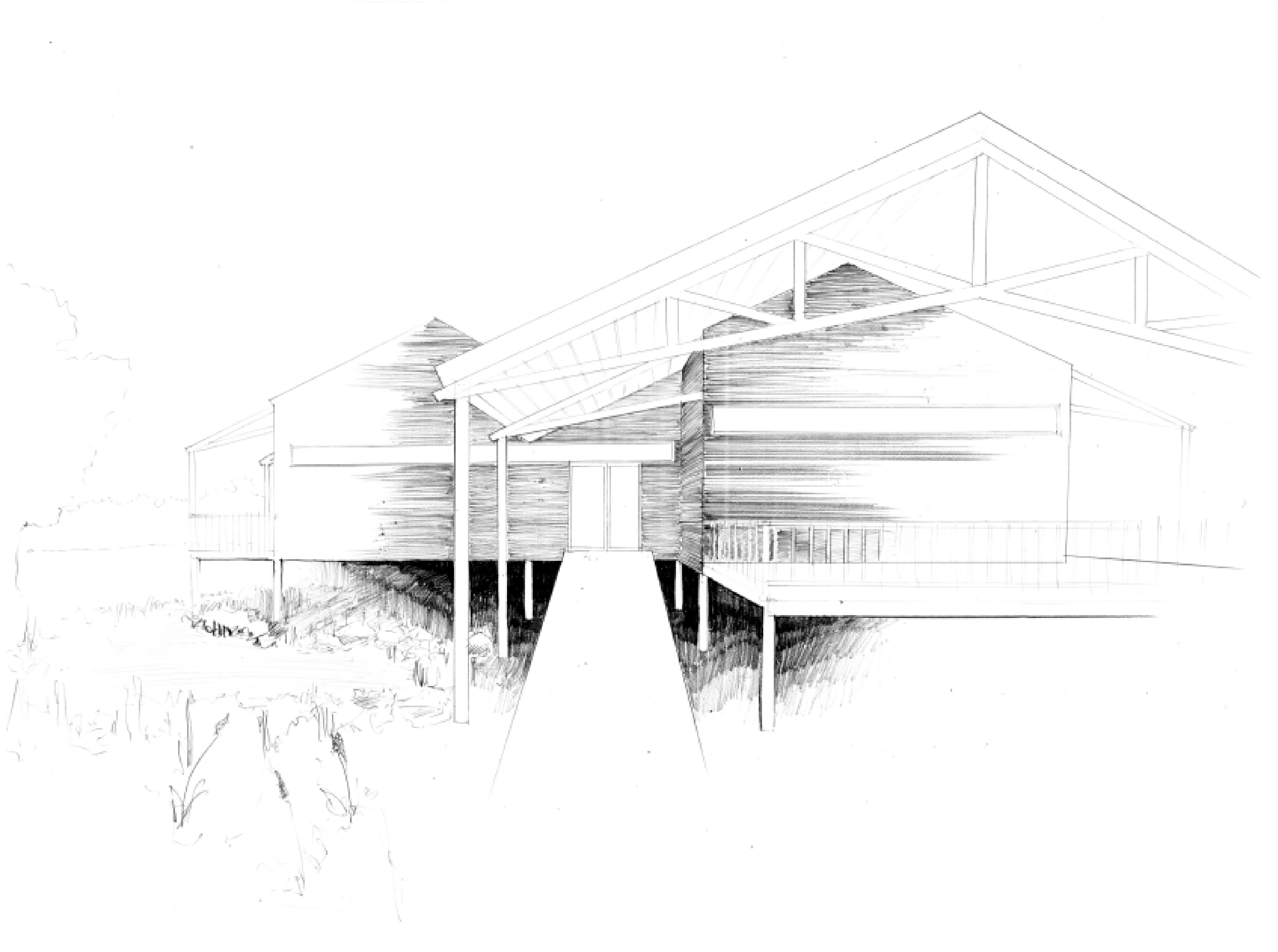
West Elevation



Building Plan



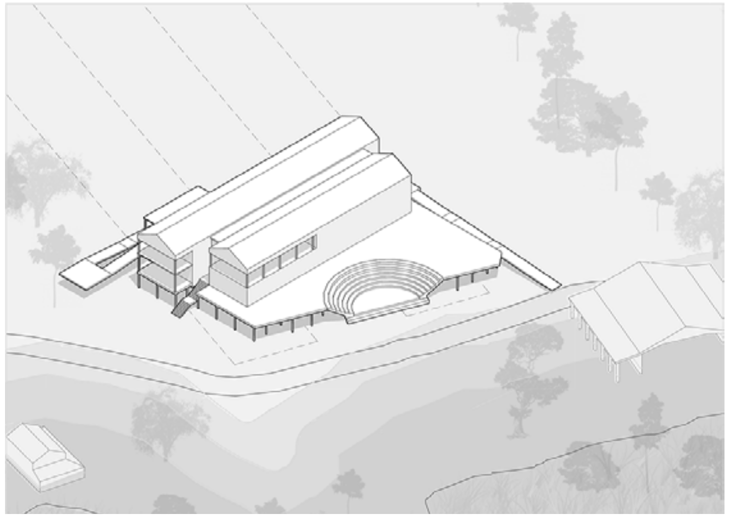
Deck Perspective



Entry Perspective

Wall Section and Bay Elevation

PROJECT DESCRIPTION



Creating Connections

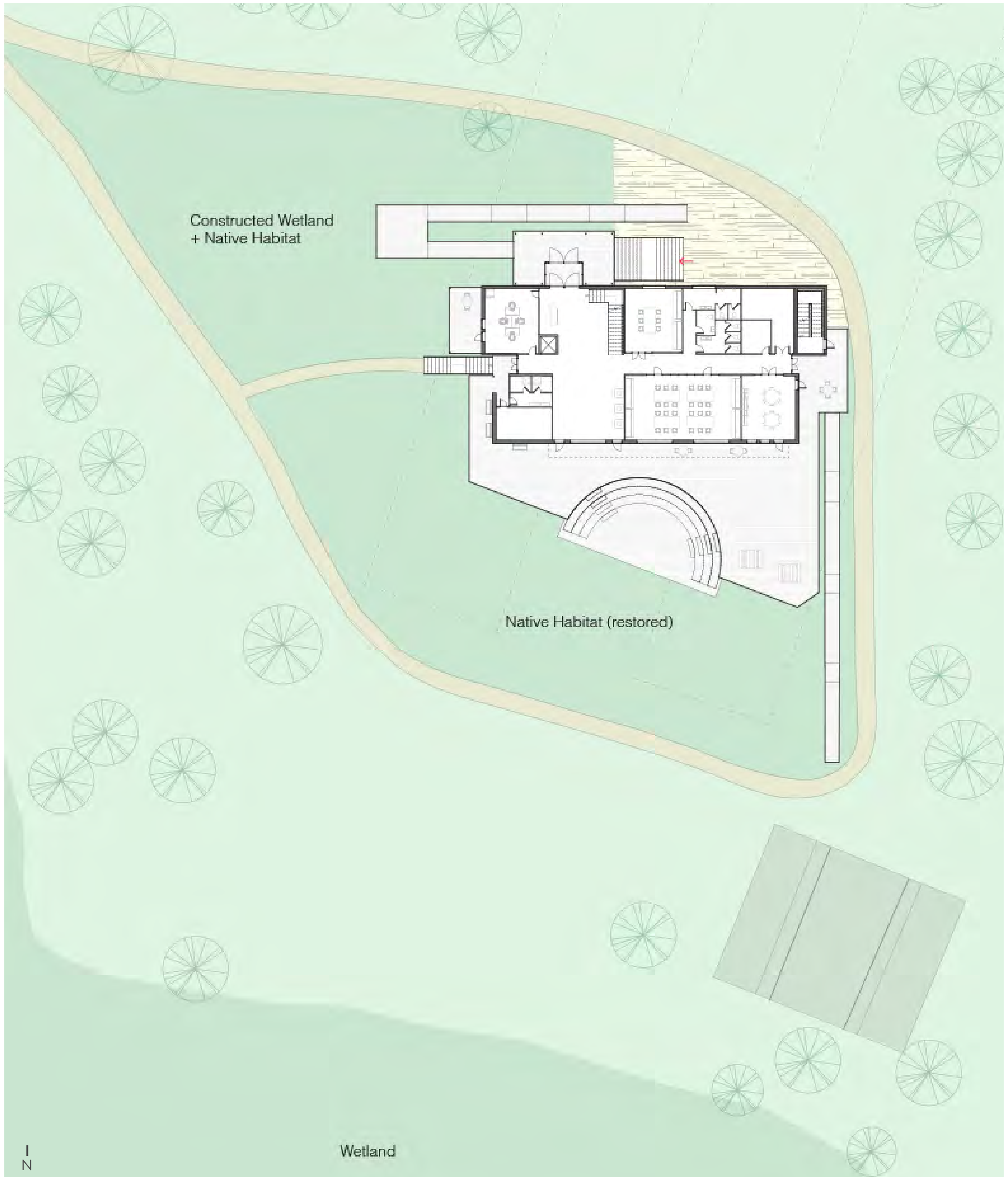
This net-zero building is two stories, minimizing the footprint and providing sweeping views of the site, while welcoming visitors and creating connections between people and the land. Located between a constructed wetland and the restored marshes, the form is derived from local barns.

DATA

# Floors	2
Building Organization	1 Building, Programs Separated by Floor
Roof Form	Gable Roof
Gross Square Footage	9,000 SF
Height of First Floor Above Grade	8'
Building Height from Grade	25'-6"
Window Percentage	16%
Structural System	Wood Piles with Concrete Caps, Heavy Timber
Environmental Strategy	PV Panels, Southern Bldg. Orientation, Daylighting
Insulation/Bldg Envelope	Rigid Insulation
Water Strategy	Connection and Treatment in Constructed Wetlands

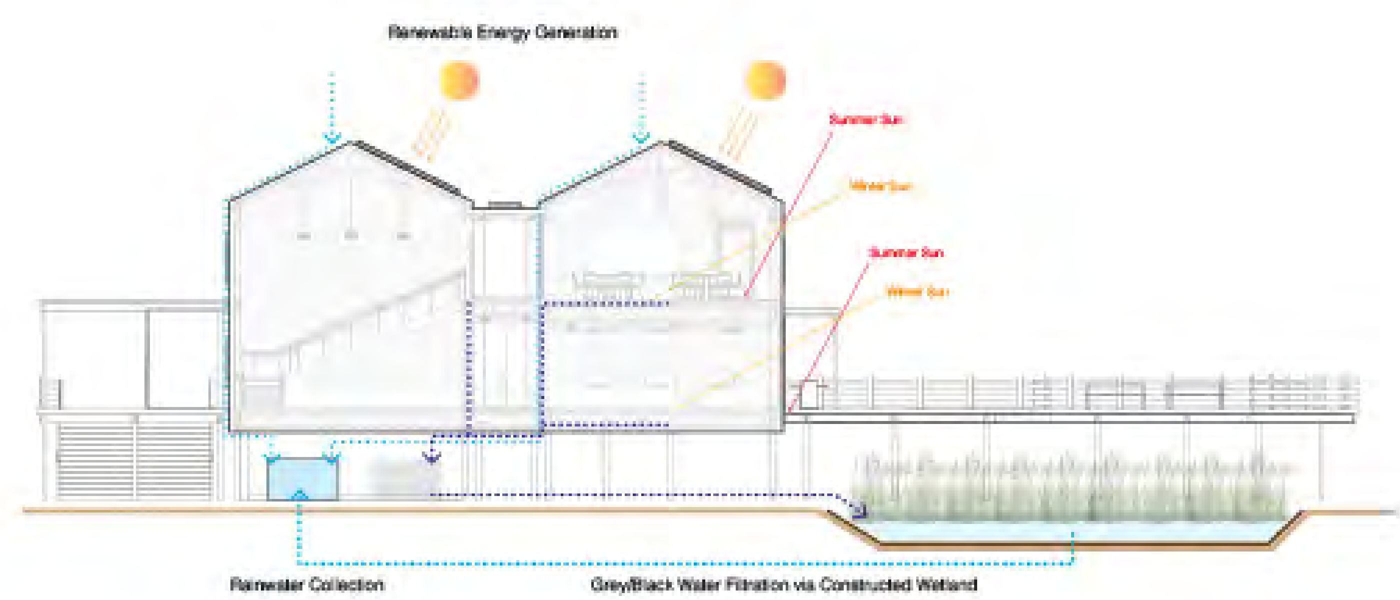
Wall Section Perspective

The building leads out to a large deck and amphitheater, where researchers can gather and students can learn about the estuary.



Site Plan with First Floor Plan (1/32" = 1'-0")

Second Floor Plan



Systems Diagram

Deck Perspective

View of South Side of Building

West Elevation

South Elevation

Students had to grapple with balancing a project's ambitions in a remote location that is vulnerable to the effects of sea level rise. For many, it was the first time they were exposed to feedback from so many different individuals—professional consultants, studio faculty, the clients and other climate change experts.

Julie Gabrielli, ARCH600/611 faculty

5 SUMMARY OBSERVATIONS

PROJECT THEMES

Over the course of the study, several themes emerged as critical to the success of the project as a new home for CBNERR-MD.

Daily Life
As a tangible symbol of CBNERR-MD's purpose, the field station should celebrate a clear connection to the water. That connection should manifest itself throughout the daily activities for the researchers and guests.

The building and its site are learning tools for all who visit -- whether home or guest researchers, the lay public, the greater community, or school children from 2nd to 12th grades. The pressing issues that challenge our environment are front and center.

The new field station is quite remote. Field researchers may stay for a few days at a time. Students may come for overnight trips or summer camp programs. Visiting researchers may be in residence for weeks. While being lean and light on the land, the building nevertheless should feel like home, and include varied places to work, research, relax, and celebrate connection with colleagues as well as the landscape.

With researchers periodically living on-site, this will be a 24-hour facility. It is expected to have heavier use during spring, summer and fall, and less occupancy during the winter.

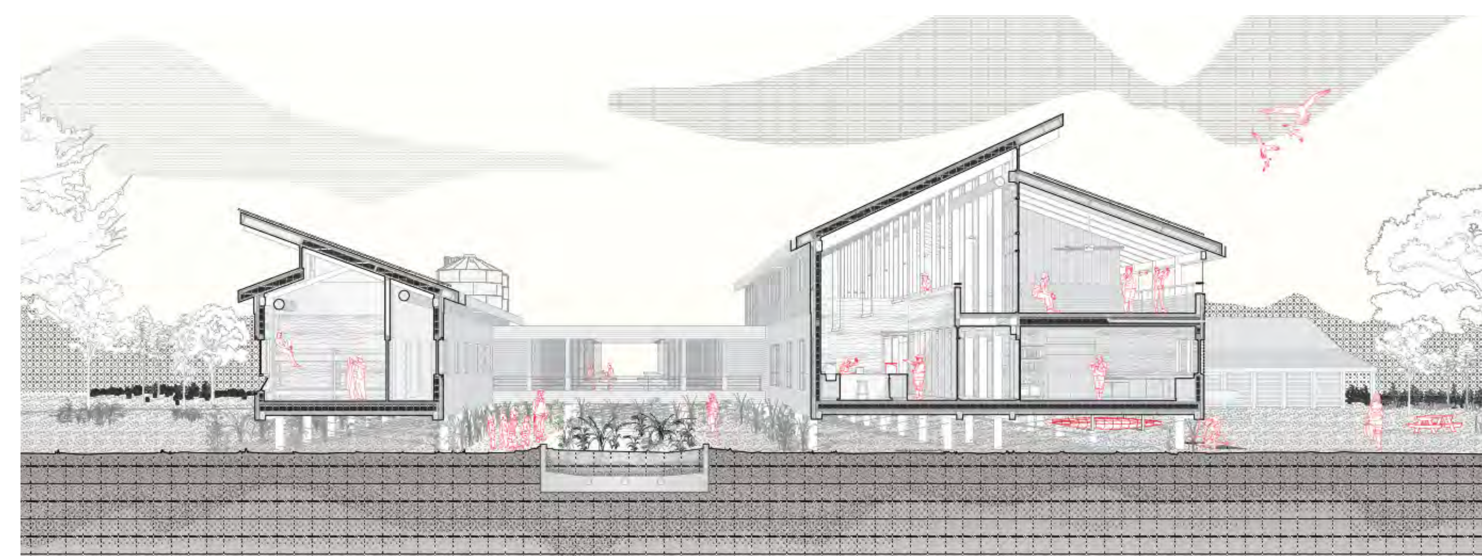
Water
From sea level rise to subsidence, from life-sustaining to storm threat, water is a centerpiece of CBNERR-MD's focus. The fragile marshes where land and water meet are where the researchers do their work. The ultimate configuration of the new field station should celebrate the myriad ways in which it maintains a constant connection to the water -- through views, the operation of the building, water capture and reuse, stormwater management, conservation -- and of course as a research topic.

View
The site for the new field station has prominent views in all directions. The view to the south at ground level features the marsh grasses, while the elevated view to the south extends to the water. Views to the north and east celebrate trees and unused agricultural lands, which CBNERR-MD hopes will be restored into marshland in the future. Views to the west frame trees which in turn frame existing structures. All views are a central feature, their landscapes cradling the space of the future field station.

Orientation
Solar access for on-site energy generation, natural ventilation, daylighting, and generating desirable viewsheds are all important to CBNERR-MD, and all rely on optimizing the orientation of the field station. The site and boundaries selected and tested in this study necessitated prioritizing among the above mentioned aspects, especially in combination with addressing the program needs.

Energy
Important strategies include minimizing demand and maximizing opportunities for passive energy-saving. Similarly, configurations that allowed for on-site energy generation -- whether solar, wind, or both -- were encouraged as important to achieve. Most schemes attempted to reach the ultimate goal of net-zero energy.

Culture
CBNERR-MD feels a deep responsibility to the community in which the new field station will reside. Researchers, staff, schoolchildren, and visiting scientists from around the country will need to be accommodated in a way that is respectful to the landscape and its inhabitants. A core characteristic of the building is that it be in itself an educational exhibit for all who work and visit.



IMAGES FROM TOP: *A strong connection to the outdoors will enhance research and living at the Monie Bay Field Station (Hess and Zuber); Daily life at Monie Bay Field Station centers around water (Delash and Wood)*

PROJECT ORGANIZATION

This section presents an overview of the various organizational strategies that students explored over the course of the study. The case studies in Section 4 provide specific examples and the diagrams that follow represent all seventeen building organization strategies explored within the study.

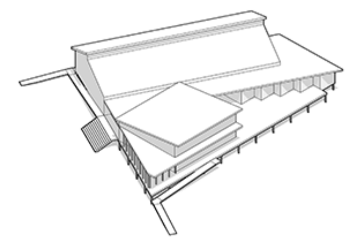
Building Organization

The formation of the overarching building organization is guided by many program needs. These include but are not limited to:

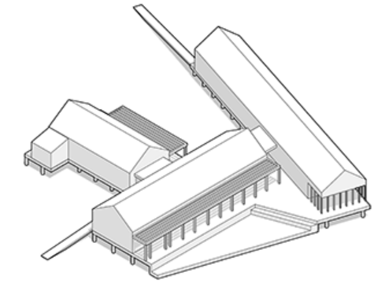
- A breakdown of uses by type (research, living spaces, and public/administrative)
- The potential for phasing the project over several years and funding cycles/opportunities
- The sorting of building functions by whether they are public or private
- The creation of efficient and meaningful circulation -- clear paths of movement through the building, its components, and the site
- The use of the circulation as an organizational element. For instance, a screen porch might double as an access way from one part of the building to another, as well as a place in and of itself
- Accommodations and access by both individuals and groups. Group use necessitates parking and close proximity to an accessible path that can negotiate varied terrain and slope

Variations

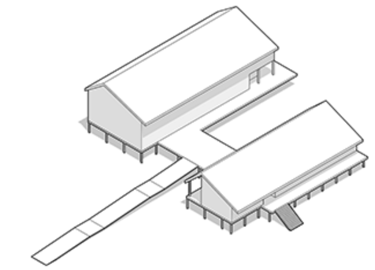
Our studies focused on the viability of schemes that comprised a single building, two separate buildings, and three separate buildings. Student projects also explored the utility of different configurations -- for instance “U” shape with courtyard, parallel wings with a link, “L” shaped with breezeway. Finally, our studies explored the opportunities and challenges associated with a single-story and a two-story configuration.



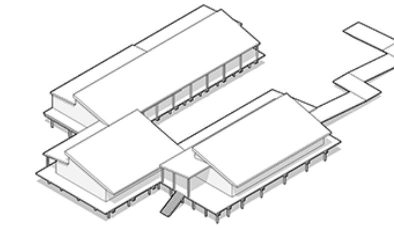
Haslup and Urdaneta



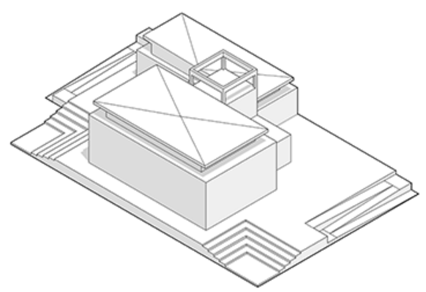
Hess and Zuber



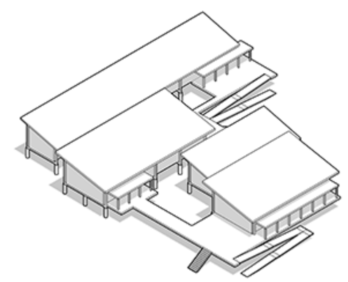
Lorenzana and Montecinos



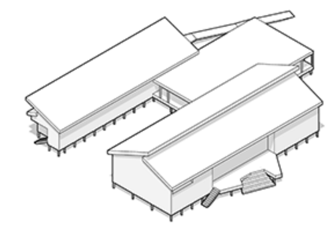
Brown and Mazer



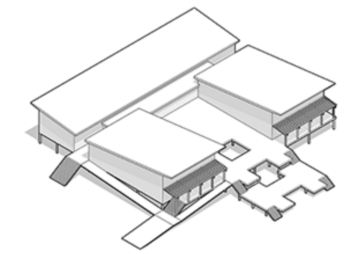
Yeniceli



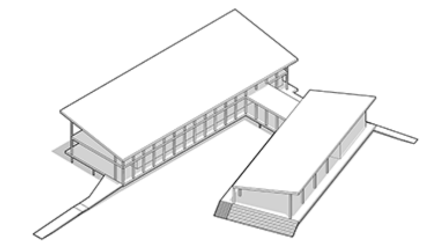
Sparks and Winters



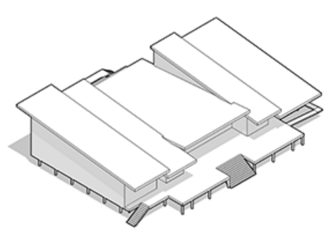
Delash and Wood



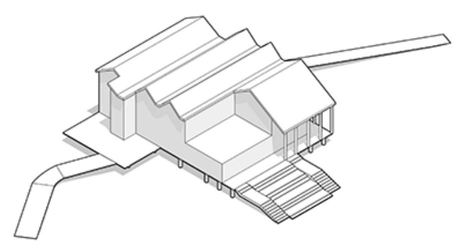
Davies and Knoebel



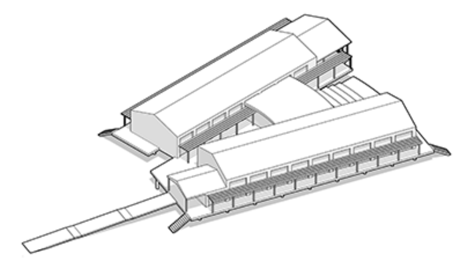
Sim and Schmitz



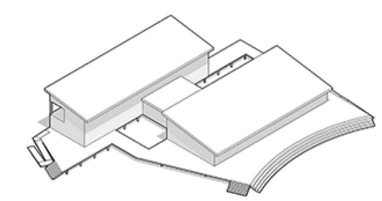
Summers and Grady



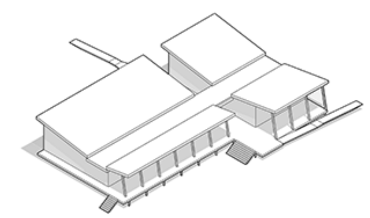
Cain and Moore



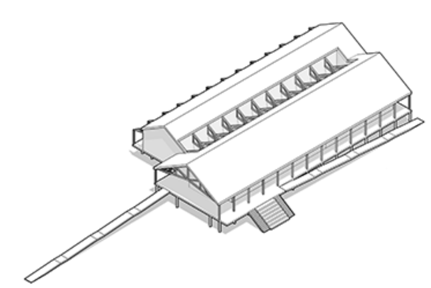
Townsend and Combs



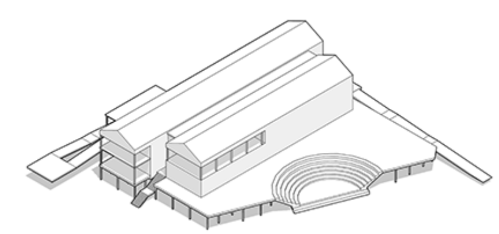
Dobariyah and Rissmiller



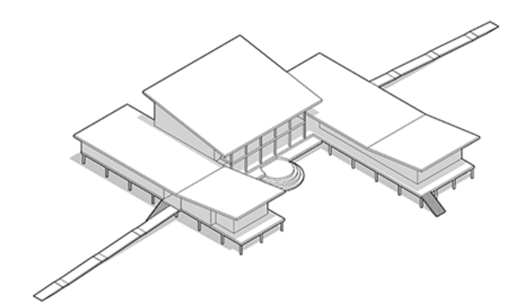
Robbs and Peters



Bos and Jesmer

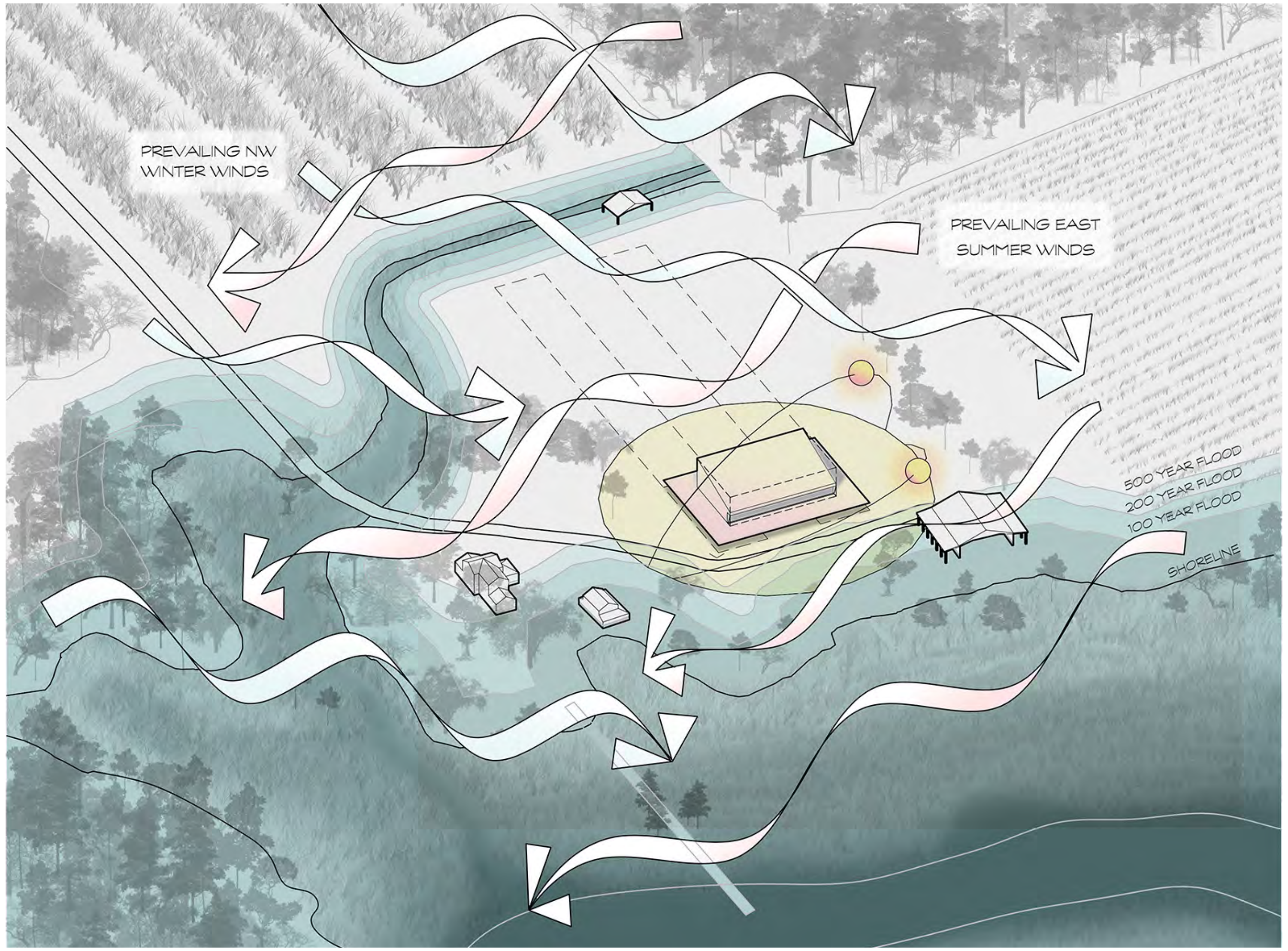


Ham and Ahmed



Walker and Ohakawa

These seventeen diagrams represent all of the organizational strategies explored within the study.



Many factors affect the site. The site is susceptible to inundation due to flood waters. The prevailing winds shift depending on the season. The Monie Bay Field Station will be constructed at the southern end of the existing chicken shed footprints (shown here as dotted lines) to minimize site disturbance.

SITE IMPACT

CBNERR-MD proposed that the site area imagined for the building is in the footprint of the southerly end of the chicken coops slated for deconstruction. With this as the cornerstone of all of the site studies, several related issues needed to be addressed.

Site Disturbance
As mentioned in the section on Structure, the construction process is affected by site access -- the roadways leading to the site, the turn-in configuration to the site, and the remoteness of the site. Further, disturbance of the fragile marsh and marsh-adjacent land also led our studies to eschew high impact construction systems that might otherwise be successful for other reasons, such as site-cast concrete.

Site Circulation
Several kinds of vehicular movement need to be accommodated on the site.

- Construction activity
- Once occupied, daily traffic of employees
- Guests, both individual and groups
- Service vehicles, daily and weekly
- Movement of boat trailers

Outdoor Spaces for Work & Relaxation
Our studies recognized that the educational aspects of the field station extend to the out of doors. The site design must allow for tours, child-friendly demonstration activities, and also spaces for researchers to work, clean up, and relax.

Configuration of Building/Exterior Spaces
All spaces, interior and exterior, should be arranged so that they benefit from the spectacular views of the marshes, waterways, and vegetation.

Planting Strategies
Ideally, invasive species are removed, and new planting strategies implemented that support clear paths of circulation, gathering, work, research, and relaxation.

Restore the Marsh
It is CBNERR-MD's intent to return the areas north of the proposed location of the field station to marshland. This will have particular significance to site circulation, outdoor spaces for work and relaxation, and potential planting strategies.

Solar Orientation
Optimal orientation of the field station buildings for solar access will have an affect on site design.

BUILDING HEIGHT RELATIVE TO GRADE AND SEA LEVEL

One of the more complex set of design and technical issues involved heights: heights of the first floor of the building above grade, height above the Base Flood Elevation, and the impact of these heights on accessibility for people and vehicles. Our studies surfaced the following issues.

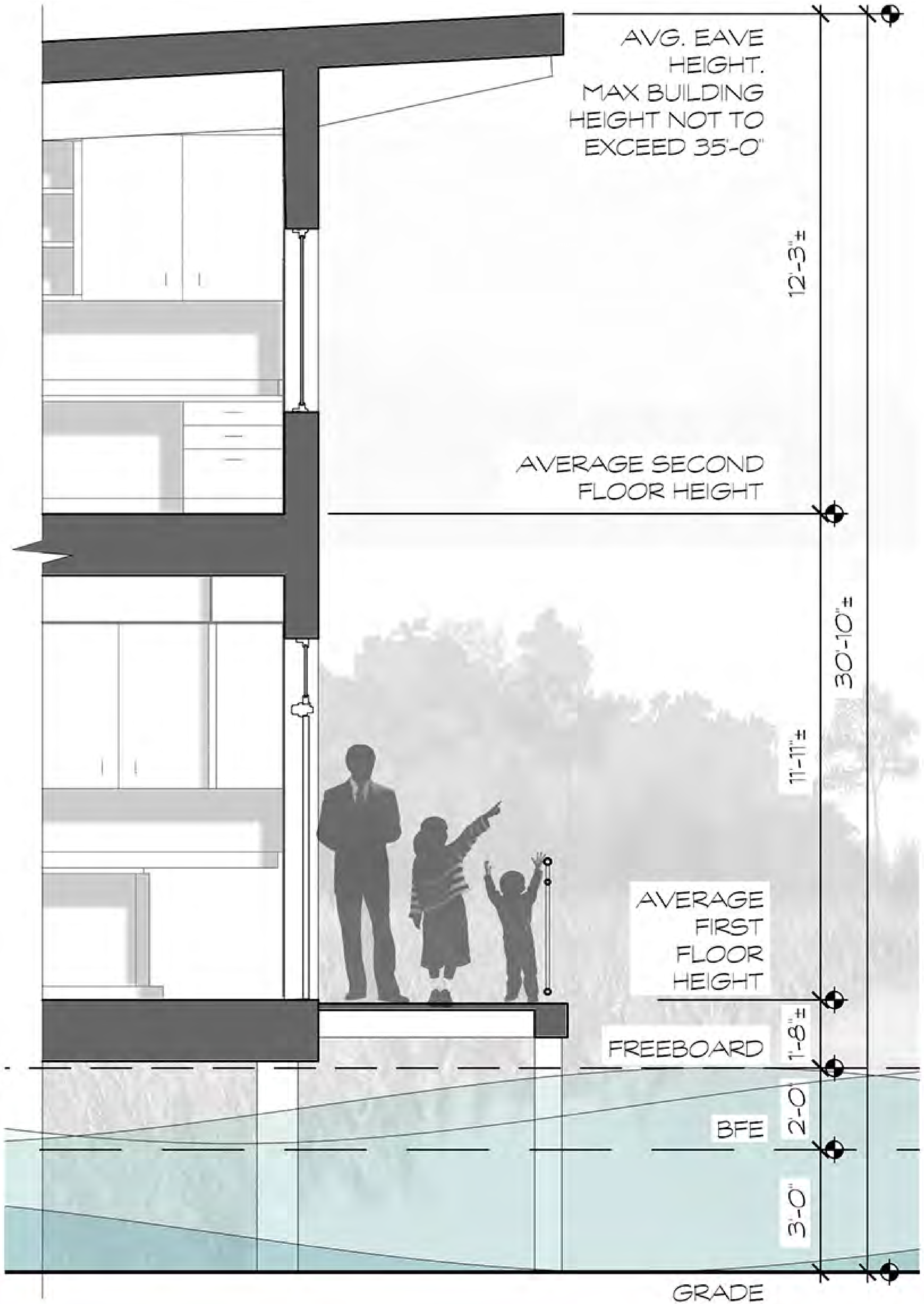
Requirements guiding the design
The Building Code and Coast Smart Design Criteria information in Section 4 delineates the FEMA and State of Maryland requirements for the Monie Bay Field Station. Coast Smart requires that the underside of the first floor structure be at least two feet above the Base Flood Elevation (BFE). The high point of the grade at the selected site is at elevation 05 (5' above sea level), and the BFE for the site is elevation 07. Since the underside of the first floor structure must be a minimum of 2' above BFE, which is elevation 07, the underside of first floor framing will be a minimum of 4' above grade.

Potential use under building at different heights (storage, parking)
At a minimum of 4' clearance, there is space under the building for limited storage, parking of kayaks, and the like. However, CBNERR-MD's preference is to consider further raising the building not only to address future sea level rise and consequential raising of the BFE, but also for more kinds of storage including vehicles. Our studies include a range of solutions at different elevations above grade to test the opportunities and challenges of this equation, from projects that just meet the minimum Coast Smart requirements to projects that raise the first floor a full level so that cars can be parked underneath. Of the Case Studies included in this report, the first floor elevations ranged from 5' to 9' above adjacent grade.

Accessibility
The building must meet the Americans with Disabilities Act physical criteria. For access, for a every foot above grade that a building is raised, a ramp with a minimum of 12' of run will be required. For a building that is positioned at the minimum Coast Smart requirement, a ramp with a minimum of 60' of run, plus landings, will be required. This requirement ties into the site design and site access discussed in the Site Impact section.

Height Above Grade Finished Floor	Required Ramp Length	5' Rest Platforms Required	Height Above Grade Structure	Kayak Storage	Parking
5 feet	65 feet	1	3 feet		
6 feet	82 feet	2	4 feet		
7 feet	94 feet	2	5 feet	✓	
8 feet	111 feet	3	6 feet	✓	
9 feet	123 feet	3	7 feet	✓	✓

Comparison of building finished floor elevation to ramp lengths, required rest platforms, and type of storage under building



BUILDING HEIGHT BENCHMARKS

STUDENT TEAM	NUMBER OF FLOORS	HT. ABOVE SEA LEVEL (FT.)	HT. ABOVE GRADE (FT.)	HT. ABOVE BFE (FT.)	CEILING HEIGHT 1F (FT.)	CEILING HEIGHT 2F (FT.)	BLDG. HT. FROM F.F. (FT.)	ROOF PROFILE
BOS/JESMER	1	14	9	7	16	---	33	
BROWN/ MAZER	1	13.5	8.5	6.5	13.5	---	34	
CAIN/MOORE	2	11	7	3	10	12	40	
DAVIES/ KNOEBEL	1	12.33	7.3	3.3	8	---	40	
DELASH/ WOOD	2	10.5	6	2	13.5	16	33	
DOBARIYA/ RISSMILLER	2	9	4	03	9	9	30	
HAM/AHMED	2	13	8	6	9	9	27	
HASLUP/ URDANETA	1	11	7	3	---	33	---	
HESS/ZUBER	1	12	7	5	22	---	30	
LORENZANA/ MONTECINOS	2	11	7	3	7	13	27	
ROBBS/ PETERS	1	10	5	3	11	---	25.5	
SIMS/SCHMITZ	2	10	5	3	11	12	34.5	
SPARKS/ WINTERS	1	12	7	5	8	---	18.5	
SUMMERS/ GRADY	1	4	7	3	26	---	34	
TOWNSEND/ COMBS	1	10.33	6.3	3.3	13.3	19	26.5	
WALKER/ OHAKAWA	2	11	7	3	11	14.5	36	
YENICELI	2	11	7	3	15	15	65	
AVERAGE	1.5	10.9	6.8	3.7	12	9	30.76	

Building Height Benchmarks - A comparative illustration showcasing the average range of heights from all of the teams, and distilling their averages into one simple diagram.

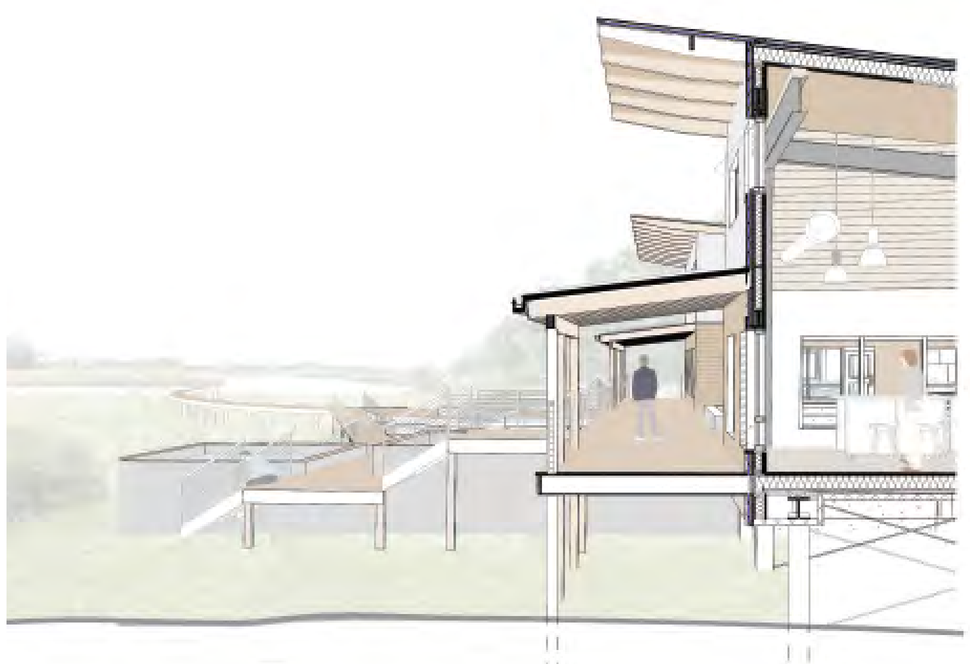
NUMBER OF STORIES

Another set of issues to balance involves the question of site coverage and building height.

One Floor, Two Floors
If the program were to be accommodated all on one floor, the cost and complexity of including an elevator could be avoided, and there would be easy opportunities for egress. However, the greater the amount of floor area, the greater the site disturbance, and the opportunities for views may become more limited. Conversely, if the program is to be accommodated over two or more floors, the building can be more compact and have less impact on the site once completed, offer opportunities for more distant and expansive views of the marshes and waterways, but will require an elevator in order to be fully accessible. The building footprint of a one story project may range from 7,500 to 9,000 square feet while the building footprint of a two story project could range from 4,500 to 8,500.

Other Trade-offs
There are other architectural trade-offs to be considered as well. A collection of one story building elements can accommodate the program divisions, and relate to the vernacular condition of farmhouses and outbuildings in the region. This strategy may also allow the project to be built in phases. That said, this strategy will increase the amount of building envelope and might involve a more complicated environmental controls strategy.

Program Divisions
Whether a one story or two story building is implemented, we found that the accommodation of public and private program elements can be made to work with varying interpretations of the uses.



View to the Little Monie Creek from elevated 1st floor

A building elevated two stories provides ample views to Little Monie Creek (Schmitz and Sim)

ARCHITECTURAL CHARACTER AND ICONOGRAPHY

Our observations for a field station in a sensitive, remote context led us to explore a visual character that would, rather than asserting itself as a research facility, highlight its connection to the land and a sense of home in this fragile and remote setting. We focused on the following aspects.

Vernacular Forms
Barns, sheds, outbuildings, farmhouses -- these formed the basis of our inspiration for the field station.

Roof Forms
The study focused on roof forms that related to the vernacular of the region, and that were compatible with options for rainwater collection and solar photovoltaics. For instance, gable, shed, butterfly, and saltbox roofs were exploited for their ability both to relate to the community and to collect water and sun.

Structure
Our explorations led us to implement structures comprising a range of systems including concrete or wood pilings, a wood or engineered wood primary structure, and roof spanning structures such as engineered wood or trusses. The primary and roof structures were exposed when possible, linking to the objectives outlined in Vernacular Forms, above.

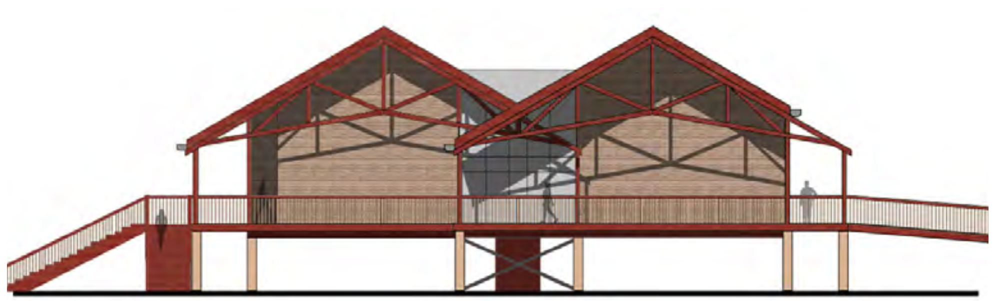
Exterior Materials
Storms, wind, salt, and humidity are formidable elements that will form the context of the field station. In keeping with our explorations of Vernacular Forms, exterior materials were selected for their sympathy with local and regional siding choices while being hardy in order to withstand the demands of the climate. (For more discussion of materials, see Building Envelope and Material.)

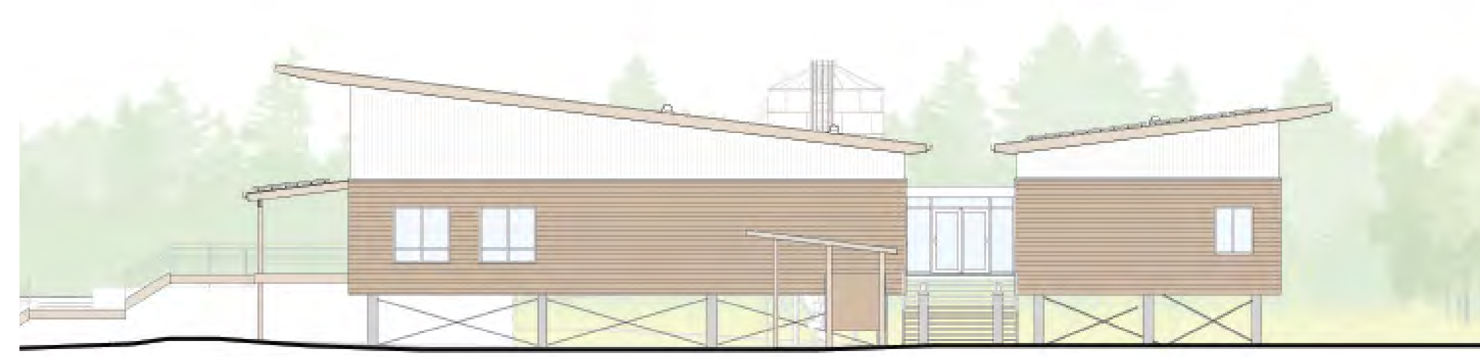
Example of gable roof forms (Hess and Zuber)

Example of shed roof forms (Dobariya and Rissmiller)

Example of saltbox roof forms (Lorenzana and Montecinos)

Example of shed roof forms (Ohakawa and Walker)





Example of butterfly forms (Davies and Knoebel)

BUILDING ENVELOPE

Of all the elements and systems that go into an environmentally responsible building, a well-conceived and executed building envelope is a top contributor to high performance. Among the features that our teams researched and implemented, several stand out.

Build tight, ventilate right
The building envelope should be airtight, the tighter the better, and the building should be well ventilated through various means - natural ventilation, environmental control systems, and variations such as creating spaces that draw hot air up through the building and out through clerestories or skylights.

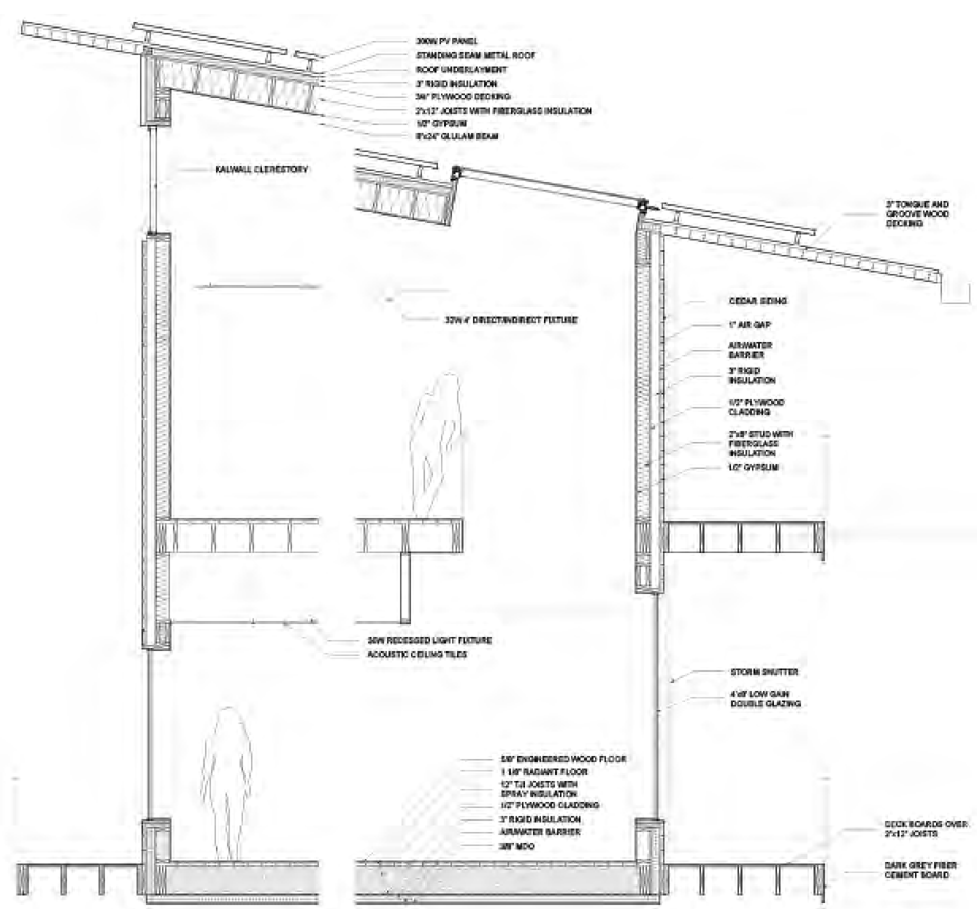
Insulation types
Whether blanket type, loose fill, blown in or rigid foam, the building should be well insulated without being over-insulated. Guided by energy models, our studies suggested insulation strategies that would optimize performance and cost. The design team for the final building will need to balance the environmental impacts of specific insulation materials with their performance long-term.

Relationship of structure to enclosure, location of insulation
For this building in the Mixed-Humid climate zone, our studies showed it is desirable for the structure to be contained within the enclosure. At the same time, creating deep overhangs requires the structure to penetrate the enclosure, and in some cases to be exposed when doing so. For wood buildings, this breach is not as compromising to performance than were the same condition executed in steel, thus many projects included this condition. Another central principle was to, wherever possible, include a layer of insulation outside the exterior wall sheathing, so that the building was "wearing a sweater." Including insulation on the exterior and in the wall cavity led to impressive R-values for the envelope -- a measure essential for high energy performance.

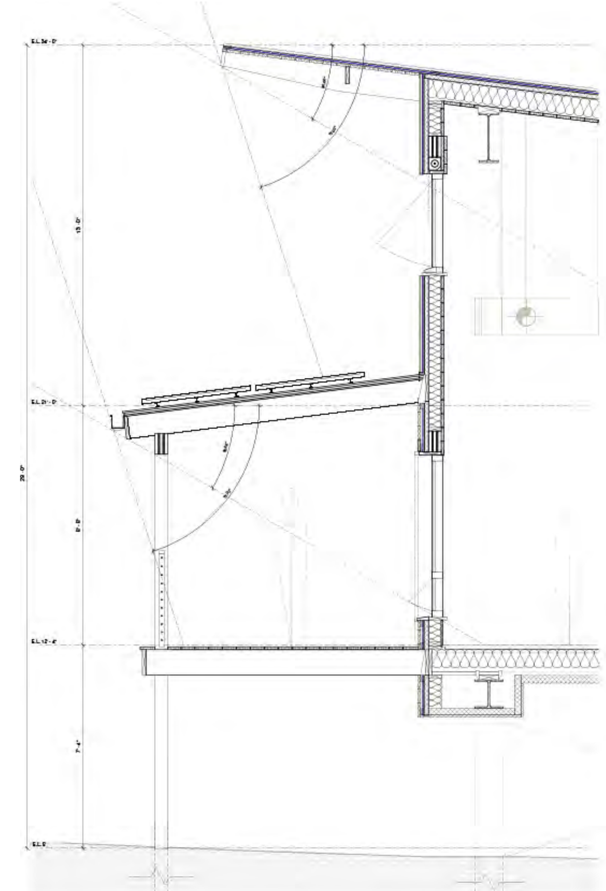
Overall envelope assembly - percent glazing and R-value
Overall R-values were also affected by fenestration type and quantity. Our studies had a maximum goal of a 20% window to wall ratio, contributing to a high performance building envelope. Of the case studies included in this report, the lowest value was 12.5% and the highest was 24.4%.

The following sample projects illustrate some of the common configurations of structure, enclosure, and insulation:

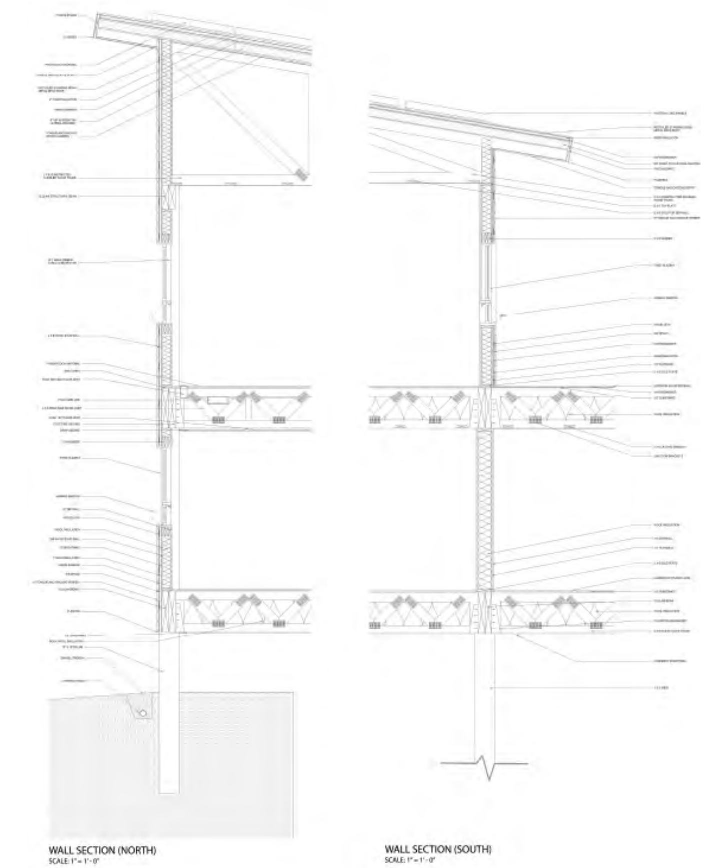
- Wood frame with insulation in the wall cavity plus exterior insulation;
- Wood frame with Structural Insulated Panels (SIPs) outside of a post and beam structure, and the latter with SIPs just at the roof.



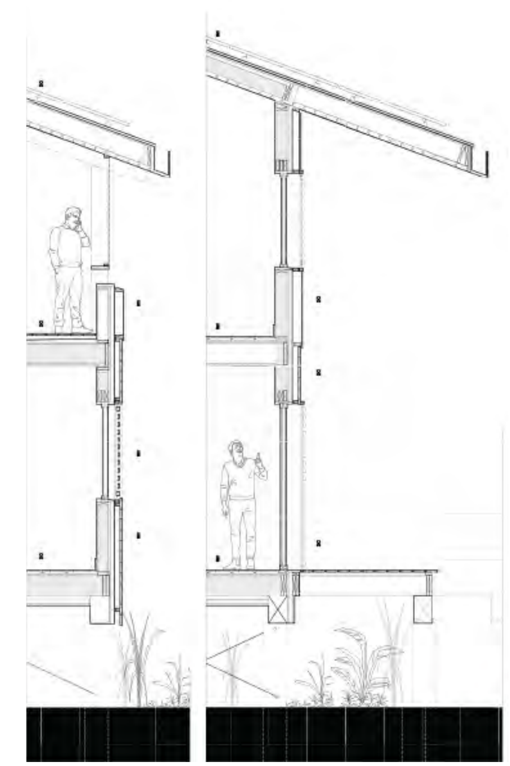
Wall section illustrating wood frame and glulam roof construction (Schmitz and Sim)



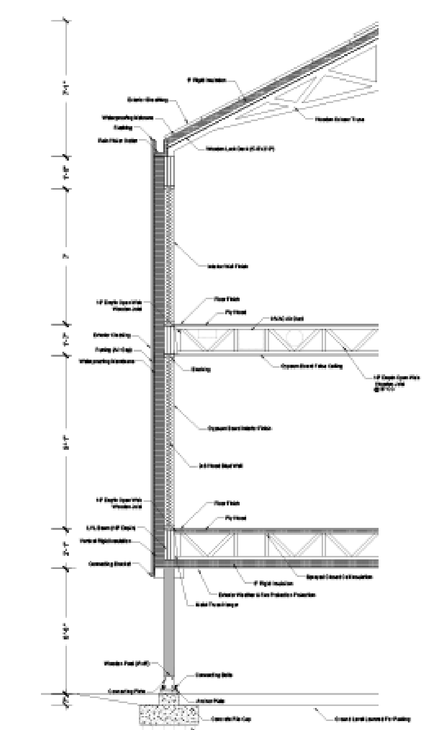
Wall section illustrating wood frame and steel construction (Davies and Knoebel)



Wall section illustrating wood frame truss construction (Dobariya + Rissmiller)



Wall section illustrating wood frame and glulam substructure construction



Wall section illustrating wood frame truss construction with no roof overhang (Ahmed and Ham)

ENERGY AND ENVIRONMENT

CBNERR-MD has expressed a goal of creating a high performance building, and if possible, getting to net-zero. Our studies implemented a variety of strategies, in the order listed below, to get to or approach a net-zero field station.

For each student project, the team established an EUI (Energy Usage Intensity) goal, and employed different strategies, testing the building through energy modeling to evaluate performance against the goal.

Reduce loads
The first step in creating a high performance building is to reduce the energy demands on the building. Teams balanced competing demands (for instance a compact building form versus a substantial perimeter from which to harvest daylight) in order to optimize for reduced energy demand. Target 15-25 EUI, as defined in Section 4.

Passive Methods
Teams made strategic choices about building orientation for passive solar gain, harnessing daylight, prevailing breezes, collecting stormwater, etc., in order to make the most of the passive means by which energy demand could be reduced.

Envelope
As has been discussed, teams, guided by energy models, proposed insulation strategies that would optimize performance and cost.

Daylighting and Powered lighting
Daylighting, the use of fenestration to bring sunlight into a building, was balanced against maximum permissible percentages of glass in order to reduce the demand on powered lighting systems. For exterior lighting, "dark sky" cut-off fixtures were favored.

Systems
Given the variety of program uses -- from residential to research lab -- and the variety of overall building organizational strategies, our studies implemented a number of high efficiency systems. These are discussed in the Environmental Control Systems section to follow. Several of the student projects utilized solar hot water systems, to further reduce energy loads.

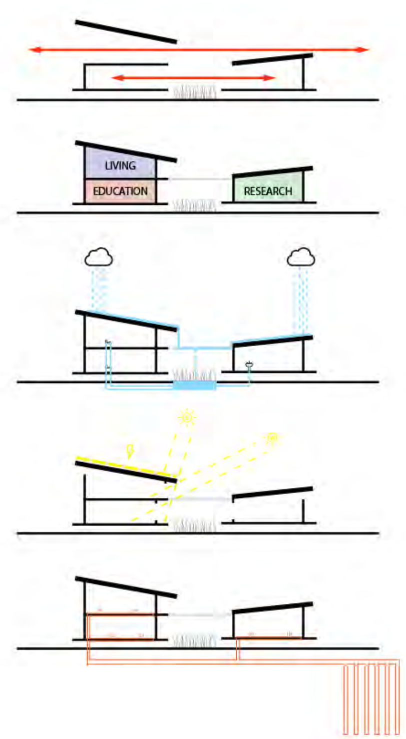
On-site power generation
Our studies show that once the building is oriented for optimal passive benefit, the building envelope is similarly optimized for best response to climate, and lighting and environmental controls systems are integrated with the building design, on-site power generation such as solar photovoltaic and wind power systems can be implemented with the goal of achieving a net-zero energy balance on the site.

ENVIRONMENTAL CONTROL SYSTEMS

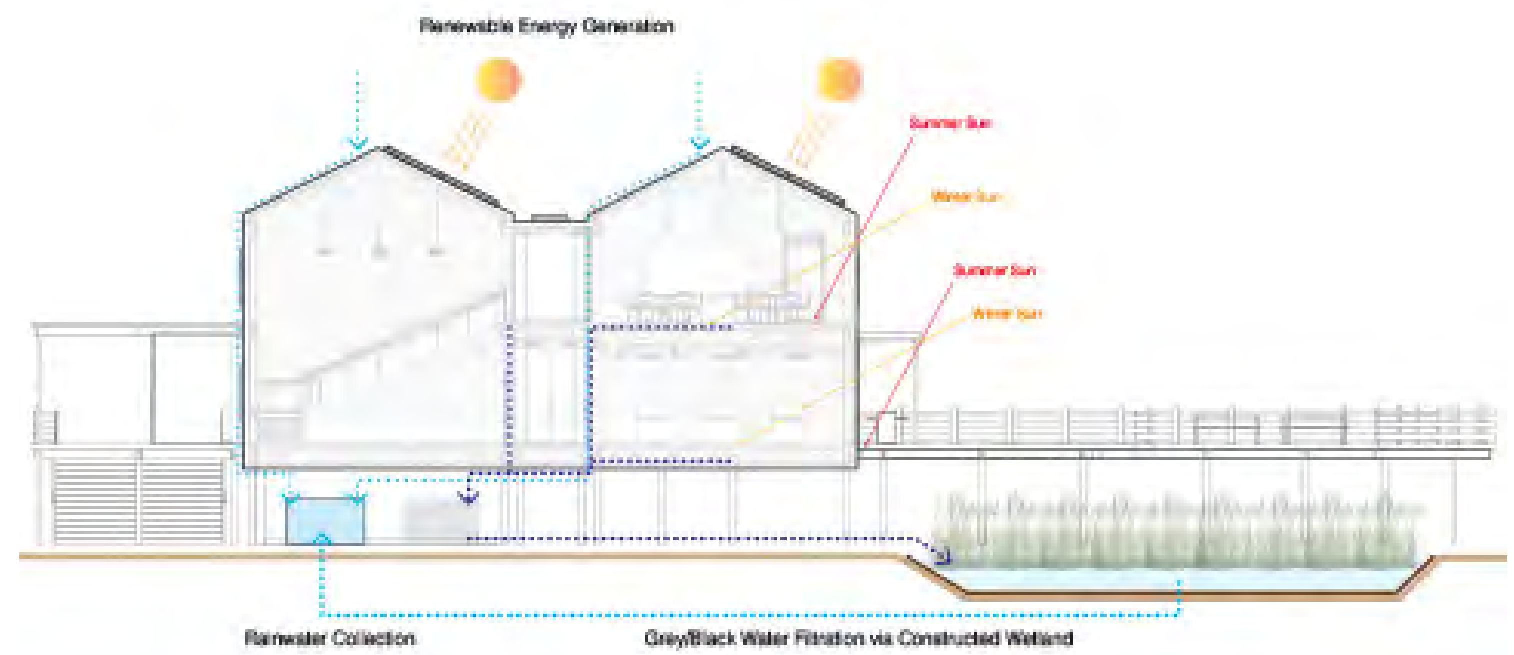
As discussed in Energy and Environment, the particular nature of this project on this site led to a selection of systems that would be optimal for this use-case. Additionally, projects that employed a strategy of several buildings rather than a singular building may have implemented more than one type of system, allowing for scheduling and operational efficiencies. Organizing the program by use type allows for different HVAC systems to serve each distinct area, allowing for scheduling and operational efficiencies. Systems include:

1. Ground source heat pump (closed loop, deep vertical wells)
2. Electric heat pumps instead of ground source heat pump (avoiding the impact of deep vertical wells on ground temperature)
3. Forced air systems, in particular Variable Air Volume systems
4. VRF (variable refrigerant flow) fan coil systems
5. PTAC (package thermal air conditioning) systems
6. Radiant floor heat
7. Natural ventilation strategies

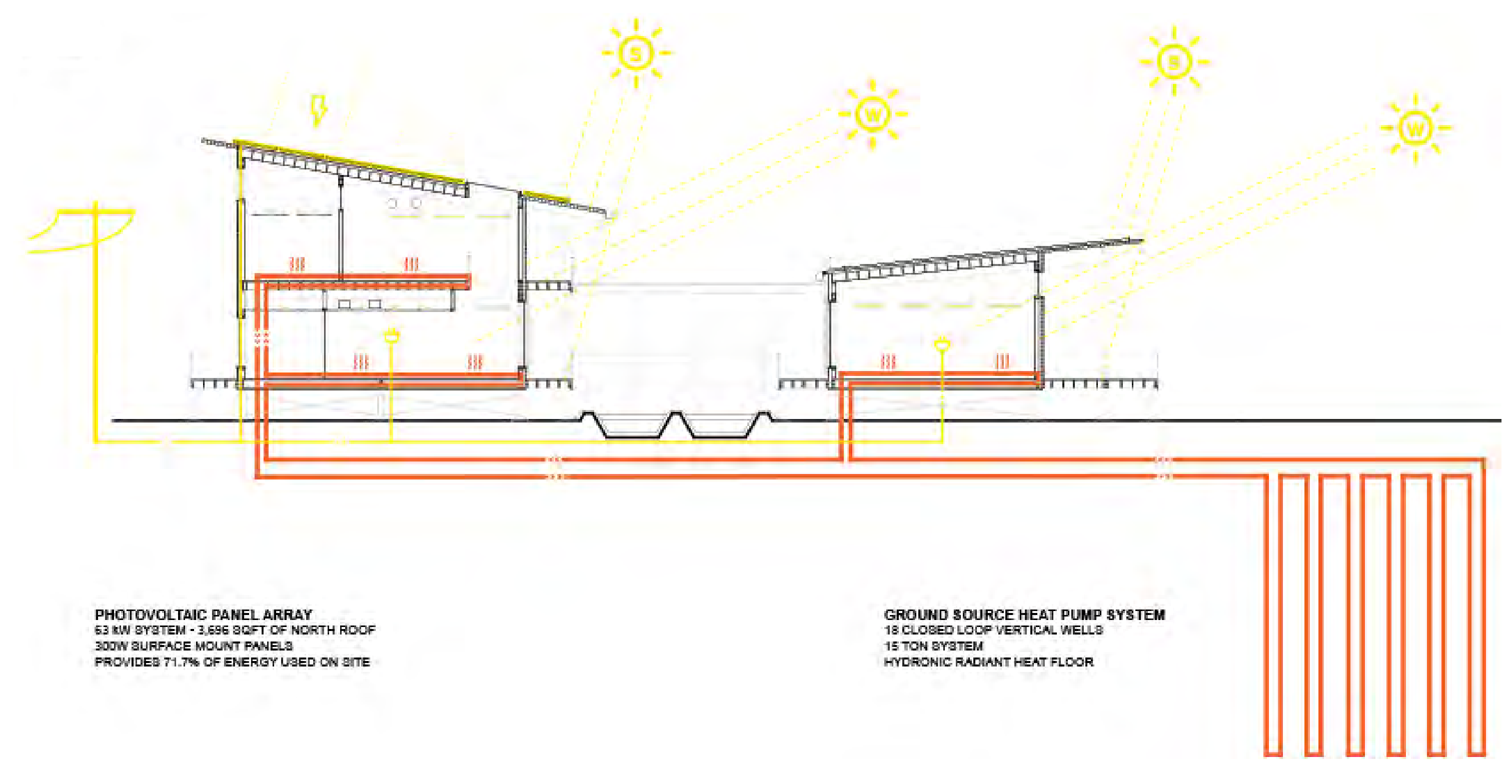
Building technologies bring up a further consideration of the remoteness of this site. To satisfy the ambition of a highly energy efficient, possibly net-zero energy building, it may be tempting to specify sophisticated, complex environmental control technologies. In the spirit of this project being a demonstration for the local community, it may be wiser to design around readily-available or easily serviced equipment.



Water, daylighting and energy diagrams (Schmitz and Sim)



Energy generation, daylighting strategies, and water reuse diagram (Ahmed and Ham)



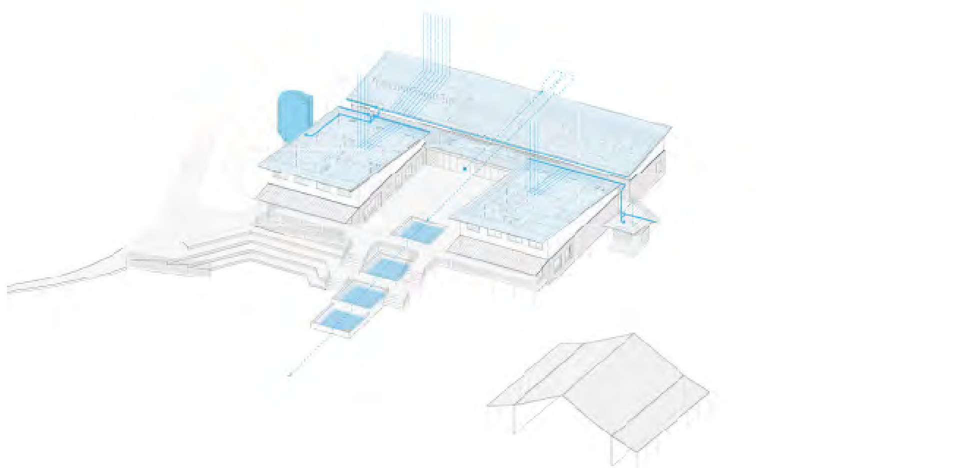
Passive and active systems diagram (Schmitz and Sim)

WATER

Water, water, everywhere..... This site's strength and vulnerability come from water -- water from the sky, groundwater, water in the marshes, stormwater, creek water, process water from the building. Our design teams deployed several strategies to control, collect, and manage the various kinds of water. A central goal was to reduce the amount of runoff and the amount of wellwater needed. Many of the designs integrated water features into the everyday life of building occupants to serve an educational purpose. Some examples included organizing a courtyard around constructed wetlands, reusing silos as significant site features, or making green roofs visible.

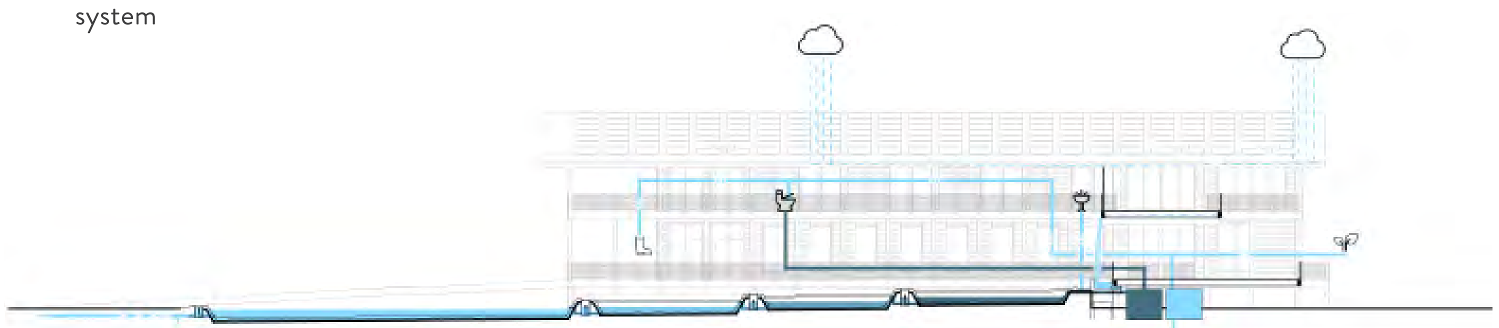
Stormwater management, water reuse, and water collection were addressed in several ways, including the following.

- Rainwater capture and storage in cisterns (reclaimed silos)
- Filtration and treatment using UV light prior to re-distribution and re-use
- Greywater collection for re-distribution and re-use
- Living machines to filter water for reuse
- Drainage ponds
- Constructed wetlands
- Green roofs to mitigate storm water quantities
- On-site holding tank for sprinkler system



A Living Machine acts as a primary visual focus, a wastewater treatment facility, and a deep connection to the site ecosystem. The reused grain silo becomes a visible part of a non-potable water collection system. This water can then be used for the outdoor shower and garden irrigation. (Knoebel and Davies)

The roof form captures rainwater and stores it in the re-purposed silos. It is then filtered and treated using UV light and distributed back into the labs, bathroom and kitchen sinks, showers and toilets. The greywater from sinks and showers is piped into a living machine on the southwest side of the building that uses native plants to filter the water. (Robbs and Peters)

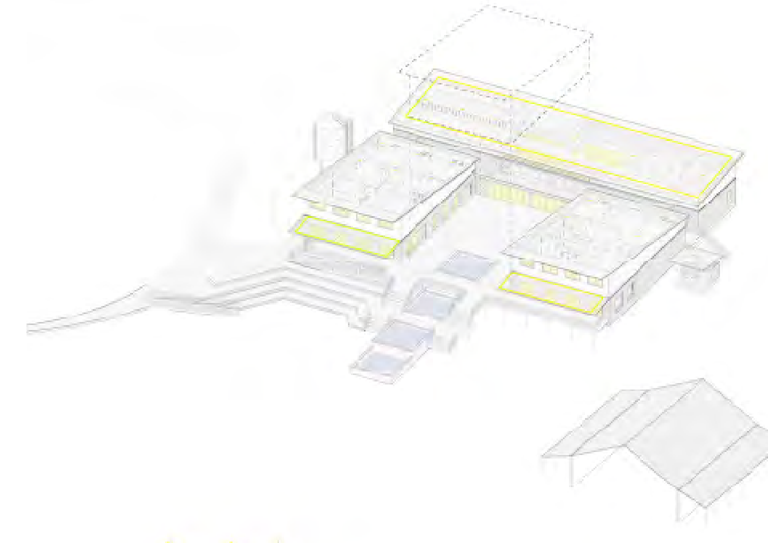


All water that is used in or falls on the buildings is collected and filtered through the constructed wetland. Rainwater and greywater can be reused on site to water plants, flush toilets, or for other non-potable uses. The blackwater from toilets is treated to the point that it is safe to use to water plants and act as an auxiliary supply for the revitalized wetland to the north. Rainwater flows off of the roofs, drains in a series of visible steps to a spout at the center of the space, and empties into the constructed wetland below. (Sim and Schmitz)

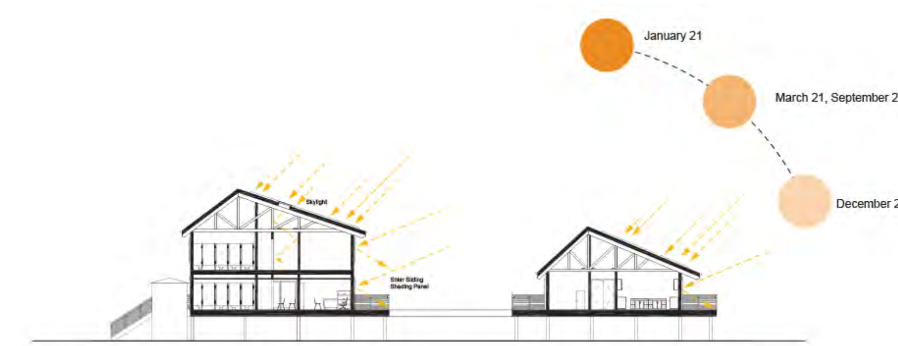
DAYLIGHTING

Connection to the out-of-doors through strategically located spaces and windows was a central interest for CBNERR-MD. As with many aspects of the study, competing interests needed to be brought into balance. For instance, while there are light and views in every direction, an orientation to the south or slightly southeast or southwest brought ample opportunities for daylight. However, working within the footprint of existing buildings on the site -- a CBNERR-MD desire -- made a southerly orientation tricky to achieve. Other examples of issues that can inhibit the collection of daylight follow.

- Storm preparedness -- for every window or glazed door there needs to be a hurricane shutter or other solution to allow the building to be closed in the event of a storm.
- Large expanses of glass -- every glazed surface is a hazard for birds. Strategies are needed to address bird strikes.
- South and west facing glass -- balancing optimal glazing for passive solar benefit in the winter requires solar control for the summer. Control methods our teams employed included roof overhangs, trellises, and adjustable exterior shades.
- Roof configuration to maximize daylighting -- every roof complexity increases cost, so our teams worked to balance simplicity of form with roof daylight collection.



The south facing volumes include clerestory windows to allow winter daylight to penetrate into the space. In summer, roof overhangs provide shading from direct sunlight. The covered walkway allows higher glazing percentage on the south façade while lessening the amount of direct sunlight in summer. (Davies and Knoebel)



The movable wall system has a double function that protects the windows from high winds and allows the users to block out unwanted sunlight. Though protected, visitors are still connected to the outside, experiencing filtered daylight and natural ventilation in every space of the project. (Lorenzana and Montecinos)

BOTTOM RIGHT: *The movable wall system as seen from the south (Lorenzana and Montecinos)*

STRUCTURE

Structural systems for the new field station were chosen for their ability to be deployed while minimizing site disturbance, maximizing durability and resilience given the climate zone and vulnerability to storms, and ability to contribute to the character of the field station. The systems largely comprised wood and engineered wood. Concrete was not employed for the primary systems, and steel was employed in limited cases.

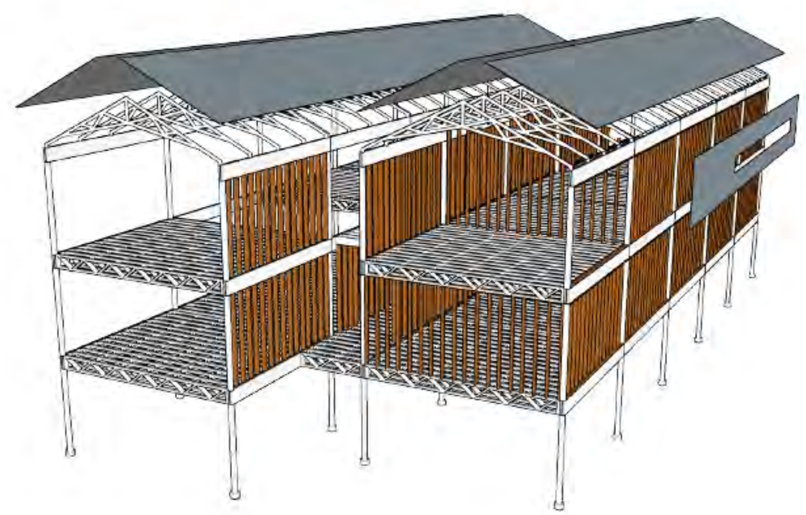
Structural Systems
Steel framing systems were not widely employed for the primary structure or foundation, due to vulnerability to salt, cost, construction logistics, and fit with architectural character goals.

Foundation systems in our study typically comprised driven wood pilings with or without a concrete pile cap, or driven precast concrete piles.

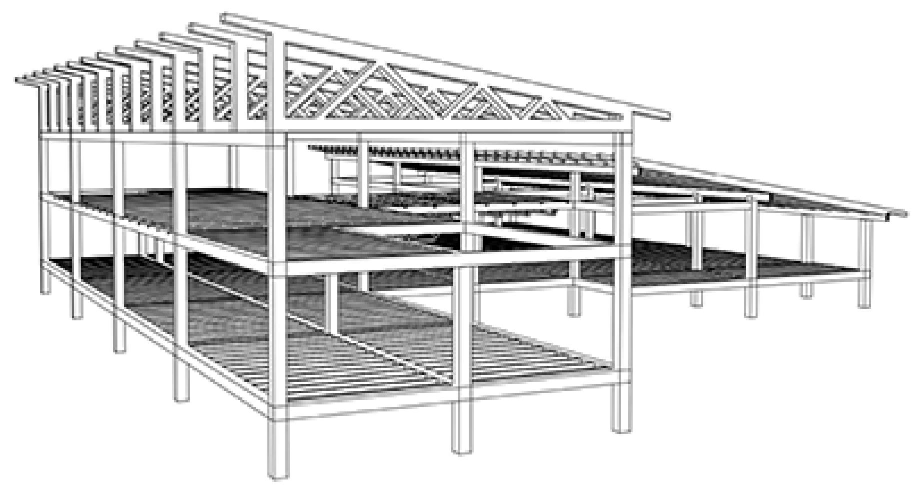
Primary framing systems comprised heavy timber, glulam, wood framing, prefabricated wood trusses and, as mentioned above, limited use of steel framing.

Environmental Concerns
Environmental factors had an impact on the selection and development of structural systems. Site impact during construction, soil type, and propensity for flooding were factors that drove the selection of foundation systems in particular. Disturbance of the fragile marsh and marsh-adjacent land led our studies to eschew systems that might otherwise be successful for other reasons, such as site-cast concrete.

Site Access and Site Disturbance
The selection of structural systems is also affected by the availability of site access -- the narrow, winding roadways leading to the site, the turn-in configuration to the property, and the remoteness of the site led our studies towards systems that were light, could be broken down into pieces, and ideally that didn't require heavy machinery for sustained periods to construct. Some prefabrication of building components may be wise, but there will be size and weight limitations for delivery trucks.



View of structural frame highlighting driven wood piles with wood platform frame and scissor trusses (Ham and Ahmed)



View of structural frame highlighting driven wood piles, glulam frame and wood trusses (Dobariya + Rissmiller)

Studies of hybrid steel + wood structural components (Davies and Knoebel)

MATERIALS

The selection of materials enhanced our studies of organization, form, and structure. Several features stood out:

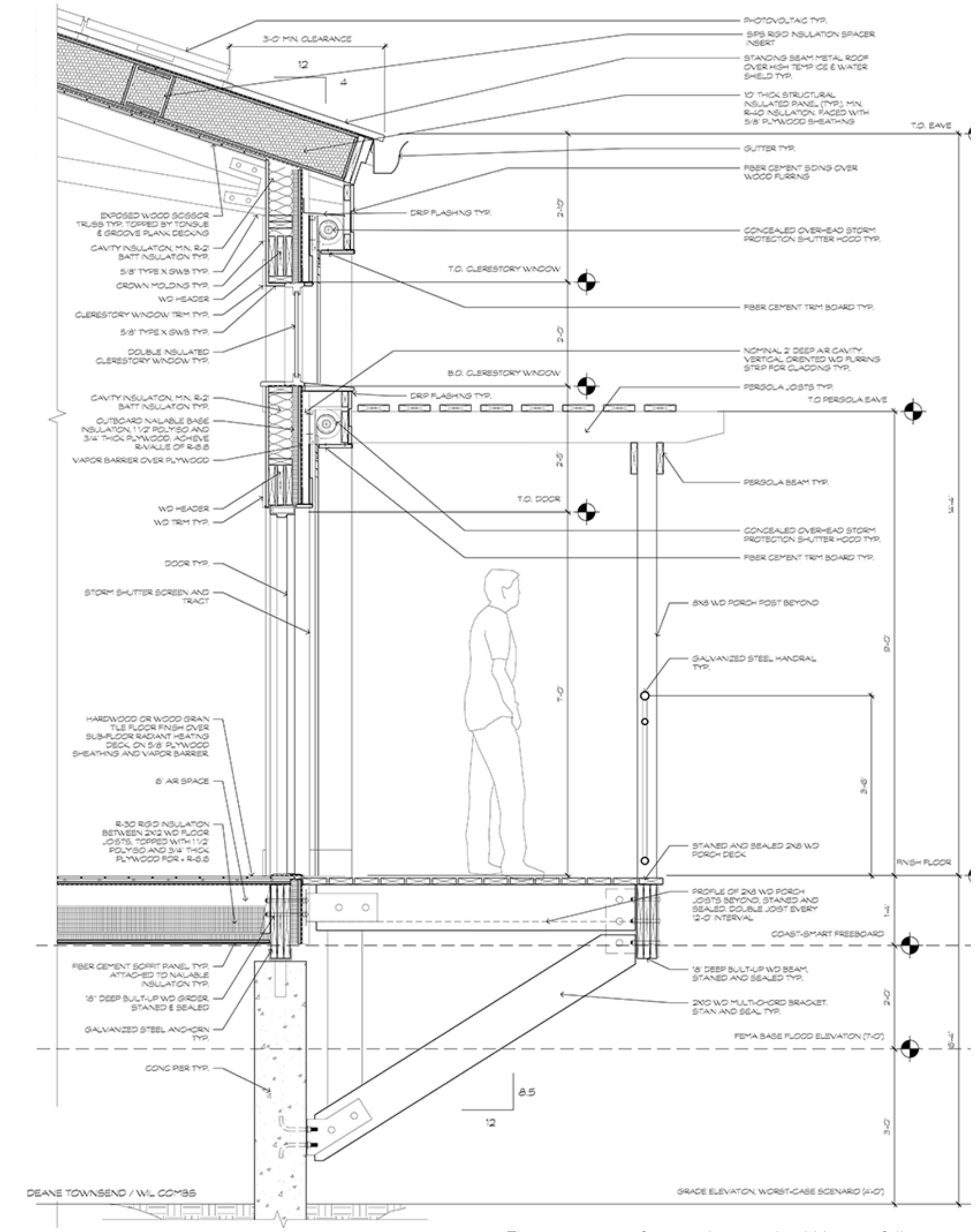
Sustainability
Our sustainability goals for the building found expression in the choices of materials. For instance, recycled and reclaimed materials from buildings on the site figured prominently among the proposed schemes.

Durability
Our studies note that materials need to be durable in this environment of brackish water and salt-laden air.

Context / Vernacular
As has been cited previously, materials were selected for their fit with the architecture of the region. For instance, siding materials included wood siding, fiber cement siding, corrugated metal. Roofing materials included predominantly standing seam metal.

Cost
Material selections were made with an eye towards cost -- cost in acquisition, proximity/delivery/shipping, installation, and durability (life cycle cost).

Salvaged lumber from deconstruction may be reconfigured for use in finish trim



The integration of storm shutters should be carefully considered so that their presence can be a seamless part of the architectural intent (Combs and Townsend)

STORM PREPAREDNESS

The need for storm preparedness drove the designs in the following ways:

- Building height and complexity: the taller the building, the more time and equipment it may take to prepare the building for a major storm.
- Material selection: materials and finishes need to be durable and weather and corrosion resistant.
- Type and location of insulation, especially underneath the raised first floor, should take into account periods of inundation by brackish water.
- Size and protection of glazing: the need to protect windows and glazed doors from projectile objects may limit the size of the glazing and location on the building.
- Design and integration of storm shutters: for every window or glazed door there needs to be a hurricane shutter or other solution to allow the building to be closed in the event of a storm.
- Energy self-sufficiency: in this remote location, a significant power outage could threaten ongoing research projects.

Aspects about working on the project with this client that I enjoyed included working through the process of designing the building, understanding the systems, and exploring unique aspects of the site. I particularly appreciated working with aspects of the site such as the different views: the forest on one side, open area on another, and a river on the other side. Working through solar orientation to place the building, and addressing the clients requests provided us with unique opportunities for designing a sustainable minded project.

- Kelsey Winters, Student

6

ACKNOWLEDGMENTS

Integrated design is a collaborative process. This investigation tapped the expertise of many professional consultants, old friends of the studio and new colleagues. DNR and CBNERR-MD staff and other agency representatives gave generously of their time and experience. With the enthusiastic participation of everyone involved, the students tested creative ideas, made discoveries, and produced an abundance of good work to inform the future design of the Monie Bay Field Station.

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Getting the opportunity to work with a client during the ARCH 600 studio was a very beneficial, real world experience. It gave us students the chance to design with someone in mind, we got the opportunity to talk to and ask our client how they would experience the space and what they were looking for in their building. Working on such a natural site for clients with high goals of sustainability was a great challenge and learning opportunity when designing for the structure and site.

- Amber Robbs, Student

7

APPENDIX

PRIMARY

Coast Smart Construction Program
http://dnr.maryland.gov/climateresilience/Pages/cs_Council.aspx

House Bill 615 - Section 3-1001-3-1004 of the Natural Resource Article. *Coast Smart Council - Coast Smart Construction Program.*

State of Maryland Department of General Services. *Procedure Manual for Professional Services.* Design Construction and Energy Project Management and Design Division. November 2015. Chapter II, Section 6; Appendix C.

Federal Emergency Management Agency. *Protect Your Home from Flooding: Low-Cost Projects You Can Do For Yourself.* Risk management assessment brochure in tandem with National Flood Insurance Program and what it means for new structures in Maryland.

Maryland Historical Trust Inventory of Historic Properties. *James Phillips House.* Inventory Number S-357. Accessed 1-8-2019. https://mht.maryland.gov/secure/medusa/PDF/Somerset/S-357.pdf

SECONDARY

**Resources not directly covered in class (or considered) but were drawn upon in NFIP presentation.

- FEMA, Protect Your Property
  - www.fema.gov/protect-your-property
- FEMA Region III, Mitigation Division
  - www.fema.gov/region-iii-mitigation
- FloodSmart
  - www.foodsmart.gov

More detailed publications available from FEMA:

- FEMA. 2010. Home Builder's Guide to Coastal Construction. Technical Fact Sheet Series, FEMA P-499. (www.fema.gov/media-library-data/20130726-1538-20490-2983/fema499web_2.pdf)
- FEMA. 2014. Homeowner's Guide to Retrofitting. 3rd Edition. (www.fema.gov/media-library/assets/documents/480)
- FEMA. 2010. Protecting Your Home and Property from Flood Damage. (www.fema.gov/media-library/assets/documents/21471)
- FEMA. 2017. Protecting Building Utility Systems from Flood Damage, FEMA P-348. (www.fema.gov/media-library/assets/documents/3729)
- FEMA. 2009. Recommended Residential Construction for Coastal Areas, FEMA P-550. (www.fema.gov/media-library-data/20130726-1517-20490-9361/fema_p550_rev3.pdf)
- FEMA. 2015. Reducing Flood Risk to Residential Buildings That Cannot Be Elevated, FEMA P-1037. (www.fema.gov/media-library/assets/documents/109669)

LIST OF COMMON ABBREVIATIONS

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BFE	Base Flood Elevation
CBNERR-MD	Chesapeake Bay National Estuarine Research Reserve-Maryland
DNR	Department of Natural Resources
EUI	Energy Use Intensity
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
IECC	International Energy Conservation Code
LEED	Leadership in Energy and Environmental Design
MHW	Mean High Water
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
PTAC	Package Thermal Air conditioning systems
PV	Photovoltaic
SETs	Surf Elevation Tables
SIP	Structural Insulated Panel
SWMP	System-Wide Monitoring Program
UMD	University of Maryland
VRF	Variable Refrigerant Flow
XPS	Extruded Polystyrene