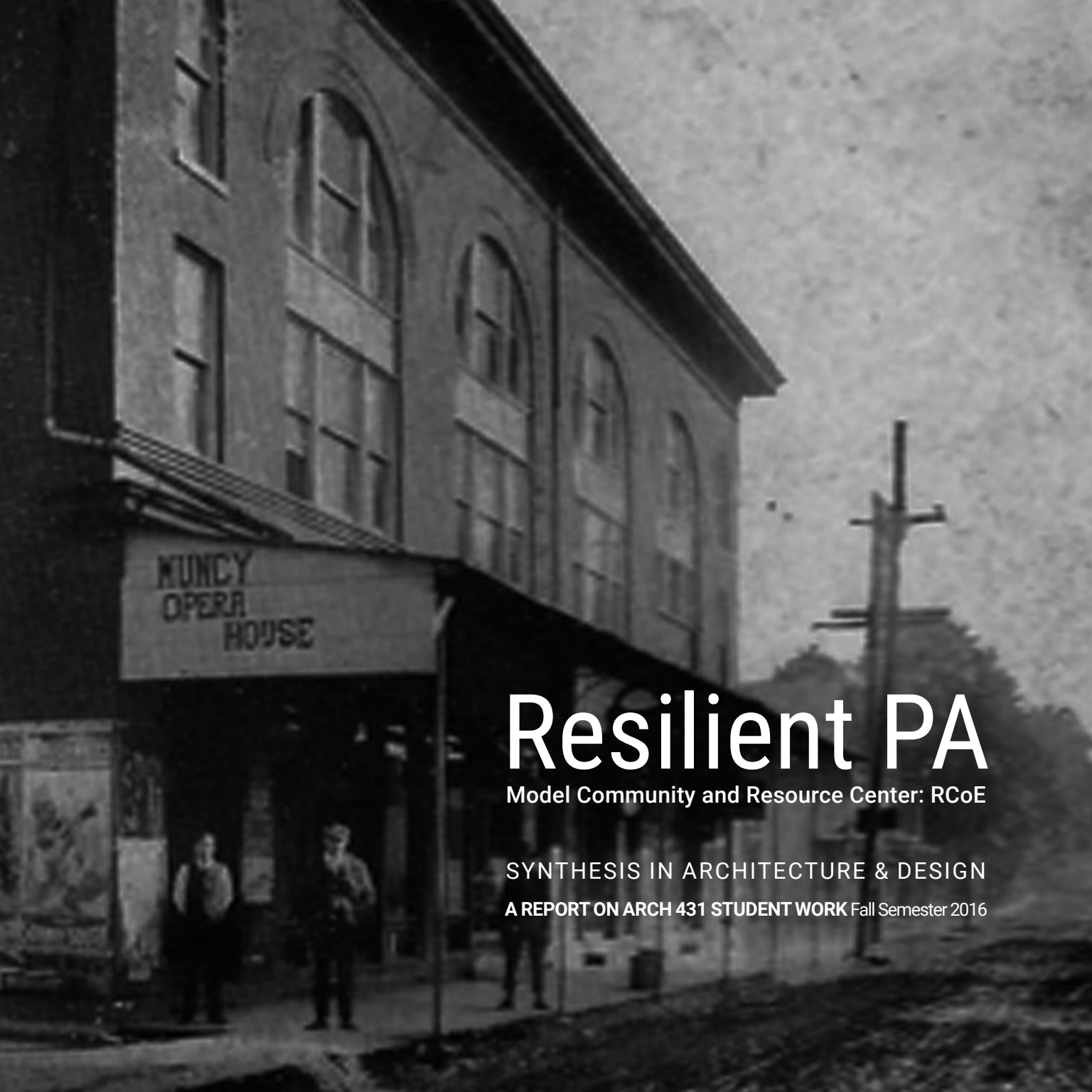

Resilient PA

Model Community and Resource Center: RCoE

SYNTHESIS IN ARCHITECTURE & DESIGN

A REPORT ON ARCH 431 STUDENT WORK Fall Semester 2016

Resilient PA

Model Community and Resource Center: Resilience Center of Excellence

Arch 431 SYNTHESIS in ARCHITECTURE & DESIGN
Stuckeman School of Architecture and Landscape Architecture
The Pennsylvania State University

University Park, Pennsylvania, U.S.
Fall 2016

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1 RESEARCH INITIATIVE BACKGROUND

Community resilience is a paramount issue. Most of the world's established communities are located along waterways and are vulnerable to storm-related flooding and water inundation due to rising sea level. A U.S. Geological Survey regarded only 186 of Pennsylvania's more than 2,500 communities safe from high water. This Commonwealth experienced five federally declared hurricane and "super storm" disasters from 2011 to 2013, resulting in approximately $1 billion in damages. Inherently sustainable communities are being marginalized due to people abandoning buildings in the face of recurring flooding and unaffordable flood insurance. Climate change disaster has been dubbed the "ultimate gentrification" with low-income residents disproportionally affected (Zachs 2016; Mock 2015).

This report is a result of a community-university initiative to address climate change impact and community degradation. A centrally located community threatened by recurring flooding was identified for a "Resilient Makeover." Partners include governmental organizations from state, county, and local levels and a Research and Land Grant university, Pennsylvania Department of Community and Economic Development (PA DCED), Lycoming County, Muncy Borough, The Hammer Center for Community Design, and Penn State. Design is at the center of this initiative, specifically Passive Low Energy Architecture retrofit and new construction combined with green and renewable energy infrastructure solutions.

The study is undertaken as an engaged scholarship project applying principles of Integrative Design. During the fall semester of 2016, teams of architecture students were challenged to research, program, and design a Resilience Center of Excellence (RCoE) through a process that included strong benefactor participation and workshops with sustainability specialists.

The resulting projects demonstrate innovative designs for flood protection and resilience that inform and are informed by the community. Moreover, through this initiative, future designers, builders, and policy-makers are embracing challenges posed by environmental realities and a process necessary for long-term thinking and problem solving.

2 INTRODUCTION

Flooding is the preeminent natural disaster threatening Pennsylvania's rural communities. The harmful effects of flooding include destruction of property, economic loss, public safety concerns, and the erosion of a community's sense of place.

PA DCED 2016

Over the past five decades, climate change has had a profound impact on the weather patterns of the Northeast Coast. The science on climate change and severe weather predicts increase in more intense and frequent rainstorms, putting many communities in Pennsylvania at risk for devastation from floods. Rising air temperatures allow the atmosphere to absorb more moisture and hold it for longer periods of time, which has resulted in a growing amount of severe weather events. For Pennsylvania, this means a rising trend in heavy precipitation, hurricanes, and storms of increasing intensity and duration, and a heightened risk of high-magnitude flooding. As the percentage of Pennsylvanians living in the 100-year floodplain continues to grow, riverfront communities become increasingly more vulnerable due to overworked stormwater systems, runoff pollution, rising flood insurance costs, and damaged infrastructure.

Pennsylvania has long been considered one of the most flood-prone states in the United States. Only 186 of Pennsylvania's 2,571 communities are regarded by the U.S. Geological Survey as safe from high water due to the nearly 83,000 miles of rivers and streams in three major watersheds encompassing most of the state. Pennsylvania's topography creates conditions that are susceptible to unpredictable, localized flash flooding as well as large scale sustained flooding. These flooding types are increasing in both magnitude and frequency, and often cause major property destruction and fatalities.

Effects of the increasing frequency of severe weather events due to climate change are augmented in river communities by the changes in land use patterns. Increases in impervious area disrupt the natural water balance and reduce infiltration. Increases in runoff lead to higher flood peaks and volumes, even for short-duration, low-intensity rainfall (Swan 2010; Villarini et al. 2010; Suriya & Mudgal 2012). The combination of the need for new development in these communities and the expanding reach of floodplains puts valuable resources (hospitals, schools, agriculture) as well as vulnerable populations (low-income, the elderly) in harm's ways. Climate change disaster has been dubbed the "ultimate gentrification" with low-income residents affected (Zachs 2016; Mock 2015).

With 67 counties and more than 2000 municipalities, Pennsylvania faces a unique challenge in terms of coordination, unnecessary competition, and lack of strategic use of resources. In order to pursue statewide resilience, Pennsylvania must "set and follow its own course in floodplain and stormwater management and flood hazard mitigation based on its own needs and unique political structure" (PAFPM 2016). Strategies for communication and sharing of innovative concepts need to be implemented in order to foster cooperation throughout government agencies and support wider adoption and employment of proven best practices.

3 RESILIENT PA

Pennsylvania's goal is to take a holistic approach to the stresses facing the Commonwealth through a targeted approach, sharing of best practices, scientific study, and other approaches in order to create more flood resilient communities.Toward this end a community-university initiative was established to address climate change impact and community degradation. Moreover, a centrally located community threatened by recurring flooding was identified for a "Resilient Makeover."

1936 Flood, Muncy Borough, Lycoming County, PA

Model Community

The greater Muncy area, like many of Pennsylvania's established communities, meets most of the criteria of a livable community, but, also like many of these established communities, it is at a crossroads and its future resilience and sustainability is uncertain.

PA DCED 2016

Fairly central and generally representative of communities and conditions in Pennsylvania, the greater Muncy area of Lycoming County was identified for a holistic study resulting in a plan of action that includes specific details for implementation of best practices for community resilience. The desired outcome is for Muncy to serve as the model for community resilience to showcase how small-scale, rural communities can successfully leverage a whole community approach and incorporate best practices of resiliency in developing their long-term recovery plans (PA DCED 2016).

Pennsylviana Resilience Center for Excellence (RCoE)

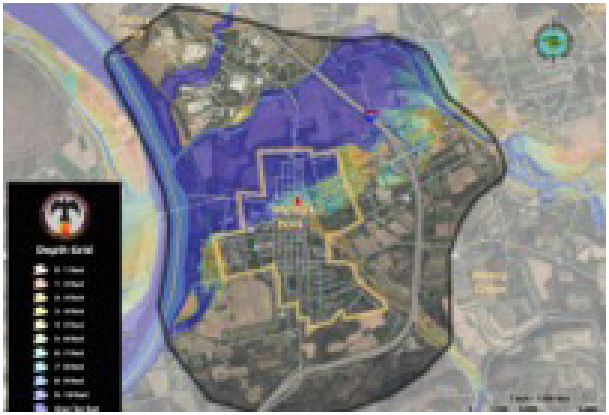
Central to this plan will be the Pennsylvania Resiliency Center of Excellence (RCoE).

*RCoE will serve as a non-partisan center for research and leadership training on resiliency and related disaster prevention, recovery, and mitigation issues in Pennsylvania (*PA DCEC 2016).

The site, identified for an 'extreme makeover,' is at the heart of Muncy Borough where Water Street and Main Street intersect. The cross street's name is indicative of its location within the floodplain (flooding depth grid: 0-5 ft.). The site comprises a historic opera house and a former theater of cultural value to the community, a brownfield lot, and an unpaved parking area adjacent to the theater.

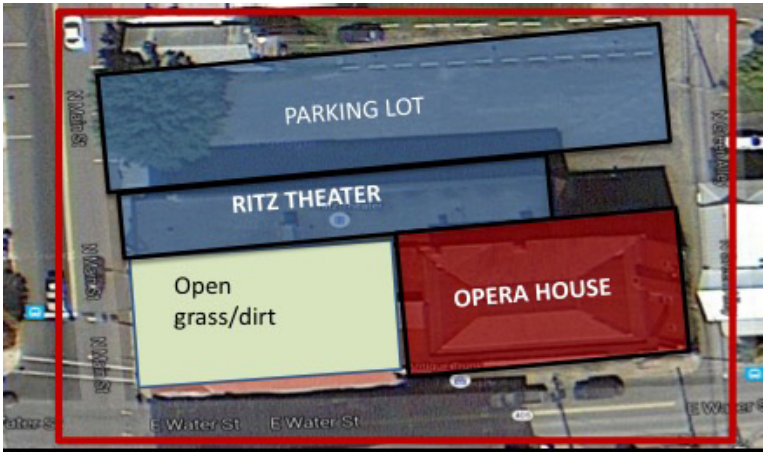
RCoE will serve as a regional destination, a repository for sharing of knowledge for community organizers, government officials, researchers and academics, and others with the intent of establishing "a network of national experts to bear on issues related to resilient planning, hazard mitigation, transportation and public health, housing and community development, and urban development" (Allen, 2016). The main

RCoE program includes interactive exhibition space, teaching and event spaces, research incubator, archive and library, and administration areas. Additionally, the project is envisioned as a model for historic structure preservation and green infrastructure. Equally important, but less defined, was RCoE's role as a local community resource. Although DCED had specific ideas about the program for the RCoE, ways to engage the community were less clear.



Flooding in Muncy Borough, Lycoming County, PA and surrounding area.

Red box in the aerial photo above indicates location of the RCoE site.



Project site located at the corner of E. Water Street and N. Main Street.

Program Space for the Community Program and Visitors' Center

Reception

Exhibition: a small space(s) for mostly rotating exhibitions. Related storage space of 1/4 the size of the exhibition area is required.

Library: library space with study areas; flexible archive with storage capable of handling many types of document storage, "official" record and "unofficial" documents; map room with storage and viewing areas.

Theater/Auditorium: space for approximately 50 spectators. Layout and support spaces will vary based on selected use.

Education/Event Area: Space use must be team-defined and may be multipurpose/flexible/ adaptable consistent with resilient design principles.

Administration/Research Space: offices or administrative suite.

Community Visitors' Center: defined based on community needs and concept.

Visitor support including restrooms.

Mechanical and Circulation Spaces will be needed as per code and in synthesis with the overall design intentions for the project.

Publically accessible open spaces may showcase resiliency strategies. Potential opportunities identified include the corner brownfield site, accessible green roof, and/or existing parking lot. In addition, community program may include downtown housing for elders/inter-generational/ special needs populations; entrepreneurial incubator spaces; resident researcher accommodations and support.

Considering building structure and design-specific program, the approximate size of the RCoE will be approximately 40,000 S.F.

Mozley Opera House South Elevation

Corner view of E. Water Street and N. Main Street: Ritz Theater and Mozley Opera House

4 INTEGRATIVE STUDIO ENGAGEMENT

During the fall 2016 semester, twenty-three (23) fourth-year architecture students responded to the challenge posed for the RCoE. Working in teams of two or three students, they explored resiliency design and community solutions for the site at the heart of Muncy Borough. Design was at the center of this initiative, specifically Passive Low-Energy Architecture retrofit and new construction combined with green and renewable energy infrastructure solutions. Moreover, the students had to respond to realistic regulatory and safety constraints.

Resilience, Sustainability, and Code Requirements

Projects had to integrate strategies/best practices for resilient and sustainable buildings (RSB) and provide for the necessary infrastructure to buffer the site from storms and power outages. In addition to strategies for "Passive Survivability," designs were to showcase Green Infrastructure, sustainable stormwater and flood management solutions. All public and work spaces were to be humanely designed, incorporating access to exterior views, controlled day-lighting, and natural ventilation. Public spaces were to be ADA accessible and Universal Design compliant, adhering to applicable International Energy Conservation Code (IECC) 2009 or higher, International Building Code (IBC), and local regulatory requirements.

Students were provided with a U.S. Army Corps of Engineers report, establishing BFE (base flood elevation) information and providing them with guidance for floodproofing of the opera house and adjacent properties (U.S. Army Corps of Engineers, 2016).

The National Flood Insurance Program defines minimum requirements for floodproofing of non-residential buildings (FEMA/FIA, 1993). Compliance includes:

• Assuring that buildings are watertight or substantially impermeable to the passage of water to the floodproof design elevation;

• The building's utilities and sanitary facilities, including heating, air conditioning, electrical, water supply, and sanitary sewage services, must be located above the BFE, completely enclosed within the building's watertight walls, or made watertight and capable of resisting damage during flood conditions;

• All of the building's structural components must be capable of resisting specific flood-related forces outlined in Technical Bulletin 3-93.

Mozley Opera House window detail

Opera House interior mezzanine

Mozley Opera House (circa 1901)

Hybrid studio / technical systems integration courses

In the profession, approaches to complex design challenges require the attention of a diverse design team. This integrative approach was central to the pedagogical goals of the curriculum for the fourth year at an accredited B.Arch program in the United States. Students worked in teams and were co-instructed in studio, encouraging collaboration. Concurrently, they took a technical systems integration course where they were introduced to passive and active sustainable design practices.

Expectations for the studio and seminar were for students to demonstrate understanding of integration of technical systems integration in their design. Although enrollment was limited to architecture students', multidisciplinary collaboration was simulated in regularly scheduled "integration workshops" where students interacted with professionals from law, ecology/sustainability specialists, and engineers. Half-way through the semester, environmental designer, educator, and author (Design for Flooding, 2010) Don Watson gave a public lecture on "Designing for Climate Change" and provided students with feedback on their projects. Designs also benefited from student interaction with community members and project partners throughout the 15-week project duration.

On September 15, the class visited Muncy Borough for a design workshop, tour, and building site visit. Students presented their initial analysis and design proposals to representives from the community, DCED, Lycoming County, and Muncy Borough on the top floor of the existing opera house. The community design workshop in the unoccupied and power-less opera house proved the viability for passive solar design, specifically natural light and ventilation.

Guided visit of Muncy Borough with community members and government representatives.

Lycoming County Planner and Muncy resident Fran McJunkin with students in front of the Muncy Historical Society.

5 INTEGRATION WORKSHOPS

The studio dynamics involved several workshops with professionals and community members. The workshops with professionals were very diverse, ranging from design and construction to policy issues. The community engaged with students at their town and at the university as well.

Early in the semester, the students engaged with the community during a workshop that took place in the opera house (together with an initial site and town visit). Community members and representatives of the PA RCoE Program participated in the workshop with a round-robin discussion of student work. After that, there was a tour of Muncy Mozley Opera House and a walking tour of Muncy guided by community members. Some of the community representatives also participated in design reviews throughout the semester. They also attended the final review that took place after a final design exhibition.

Lara B. Fowler, a senior lecturer at Penn State Law and assistant director for Outreach and Engagement, Institutes of Energy and the Environment, lectured about "Flood Mitigation for Pennsylvania's Rural Communities: Community-Scale Impact of Federal Policies," with the goal of enhancing understanding of cost impacts of recent federal changes on communities across the Commonwealth and the design implications related to flood insurance.

Three other workshops provided students the opportunity to interact with the Integrative Project Delivery team for the Chemical and Biomedical Engineering Building at Penn State Univeristy Park, as part of the academic enhancement contract between HOK and Penn State. They were:

Penn State Institutes of Energy and the Environment (IEE) and Penn State Law faculty member Lara Fowler interacting with a team of Arch 431 students.

1. Building Analytics and Sustainability (Mike Walsh and Julia Rogers, R. G. Vanderweil Engineers and HOK): energy model, building performance of system analysis, life cycle cost analysis, assessment of building constraints to support a lab environment.

2. Laboratories, Vibration Control, and Structures (Brad Kirkham, Baker Ingram and Associates; Jonathon Lui, Colin Gordon; Danile DeBoo, HOK): laboratory program requirements for stability, structural design vibration analysis, optimum structural framing to support program clearances for a critical mass of contiguous space, the vibration control, and overall head room clearance.

3. Envelope Performance and Regional Wind Studies (John Neary, HOK; Dr. Roy Denoon, CPP Wind Engineering Consultants): microclimate and wind tunnel simulation, system performance, barrier design for climate control.

DCED Commonwealth Disaster Recovery Coordinator Jeff Allen and Lycoming County Planner Josh Schnitzlein introducing the students to the project.

6 OVERVIEW OF STUDENT WORK

The eight resulting projects explore design for new construction, historic building renovation and retrofit, and flood protection that inform and are informed by the community. The projects demonstrate strategies for sustainability and resilience through diversity of use, simultaneously serving as a premiere State-wide destination and a community asset for the Borough of Muncy. Emphasis is placed on the following issues:

- Incorporation of resiliency measures;
- Whole community approach;
- Green Infrastructure (including site design and sustainable development best practices and renewable energy production);
- Showcase government/non-governmental cooperation and partner agency efforts;
- Address impacts on vulnerable populations, economic impacts, and environmental impacts;
- Examine ways to encourage action by individuals and communities.

The projects present diverse approaches to design in flooding: Infrastructure and urban approaches, sectional solutions with vertical zoning, and material solutions to inundation. Recognizing that many properties, suffering recurring floods of 12' or more, were valued far below the cost of flood-proofing, one team posed reclaiming property as a public park. Green infrastructure implementation on this buffer land was shown to reduce flooding in Muncy by 40 percent. With flooding at the site eliminated, another project celebrated water for supporting life and power generation.

Some projects chose to flood-proof the existing structures and proposed renovations built at different levels through the manipulation of 'ground', engaging and educating the public about building in flood-prone areas.

Other projects are defined with uses for community programs that address an identified need in the community while simultaneously responding to flooding by paralleling uses with wet- and dry-proof material strategies. Market space (a former use for the open lot on the site); entrepreneurial incubator spaces with resident researcher accommodations and support; and a mixed-use destination building housing a regionally appropriate specialized tourist center with Muncy-specific commercial space are some of the innovative program spaces suggested in projects.

Community exhibition and final design review at Penn State

7 CONCLUSIONS

During the spring 2017 semester, cross-disciplinary teams of students representing architecture, landscape architecture, and four architectural engineering disciplines (structural, mechanical, electrical, and construction management) developed and refined RCoE designs in a Collaborative studio (Co-lab) offered to fifth-year students in each of the disciplines. The student work is informing governmental partners and fueling fund-raising efforts. Through this initiative, future designers, builders, and policy-makers are embracing challenges posed by environmental realities and a process necessary for long-term thinking and problem solving. Central to the initiative are academic connections, engaging researchers and students in ongoing collaboration. A need moving forward will be to foster implementation, while supporting research and dissemination of results for broader impact. At the moment, most funding sources fund implementation or research, a limitation to engagement.

Students with Jeffrey Allen, Joshua Schnitzlein, and Lisa Iulo after design exhibition.

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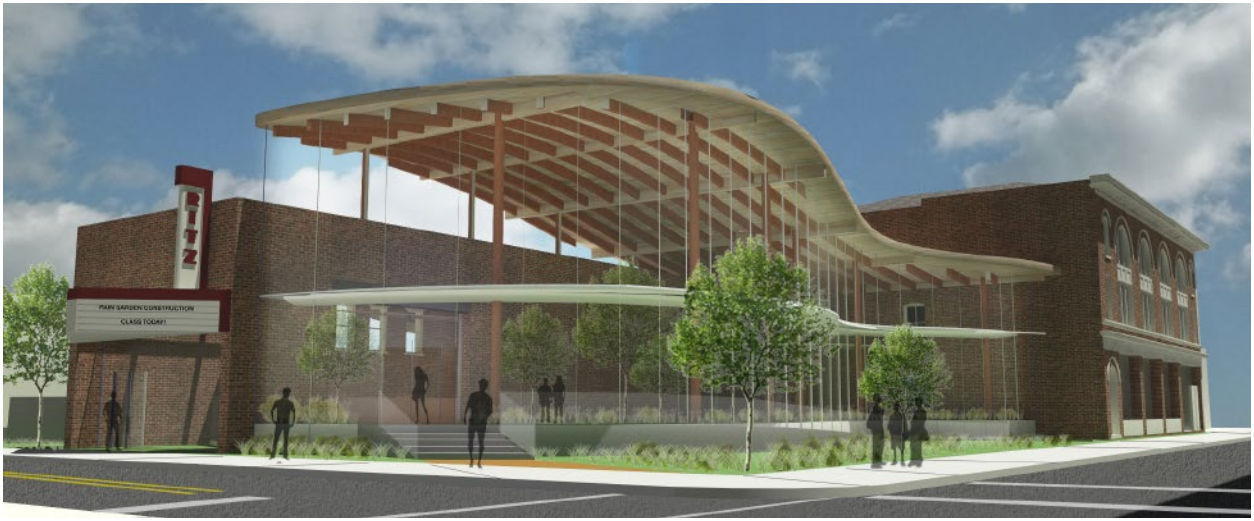
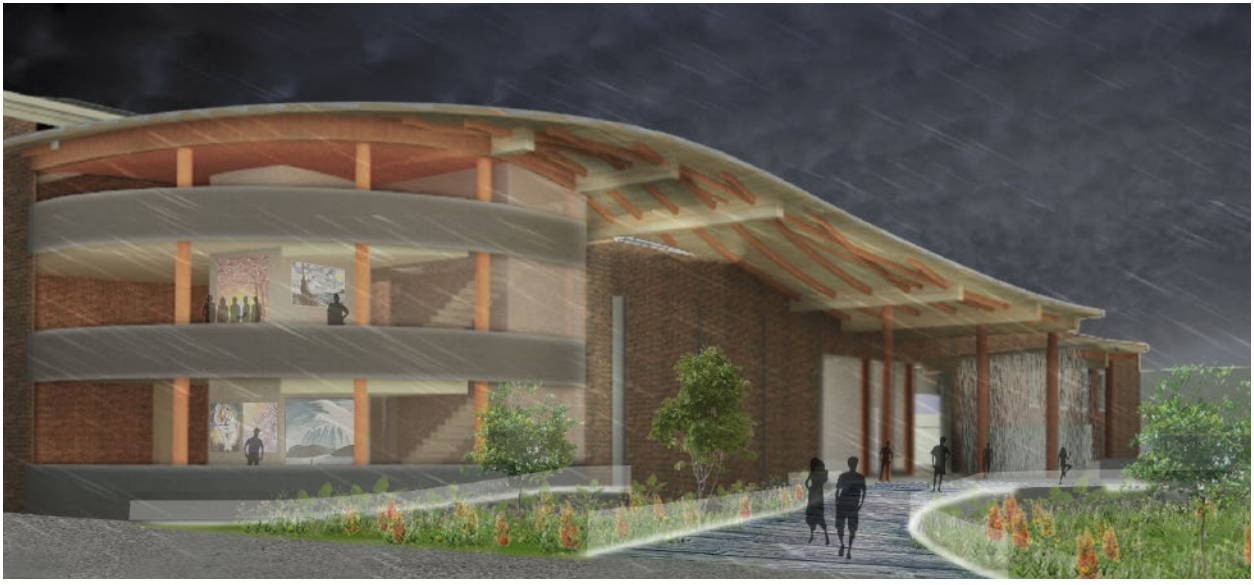
9 STUDENT PROJECTS

TRANSITIONS

Chin Hsu, Samuel Oztan, Lindsay Krause

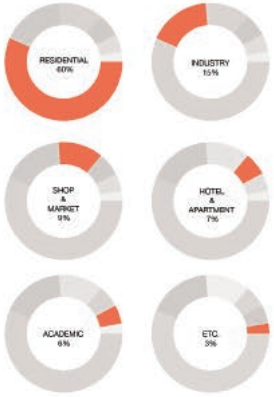





RITZ
WELCOME TO THE NEW TOWN CENTER

SITE INFORMATION

MUNCY STATE MAP



AREA USAGE

VIEW LOCATION

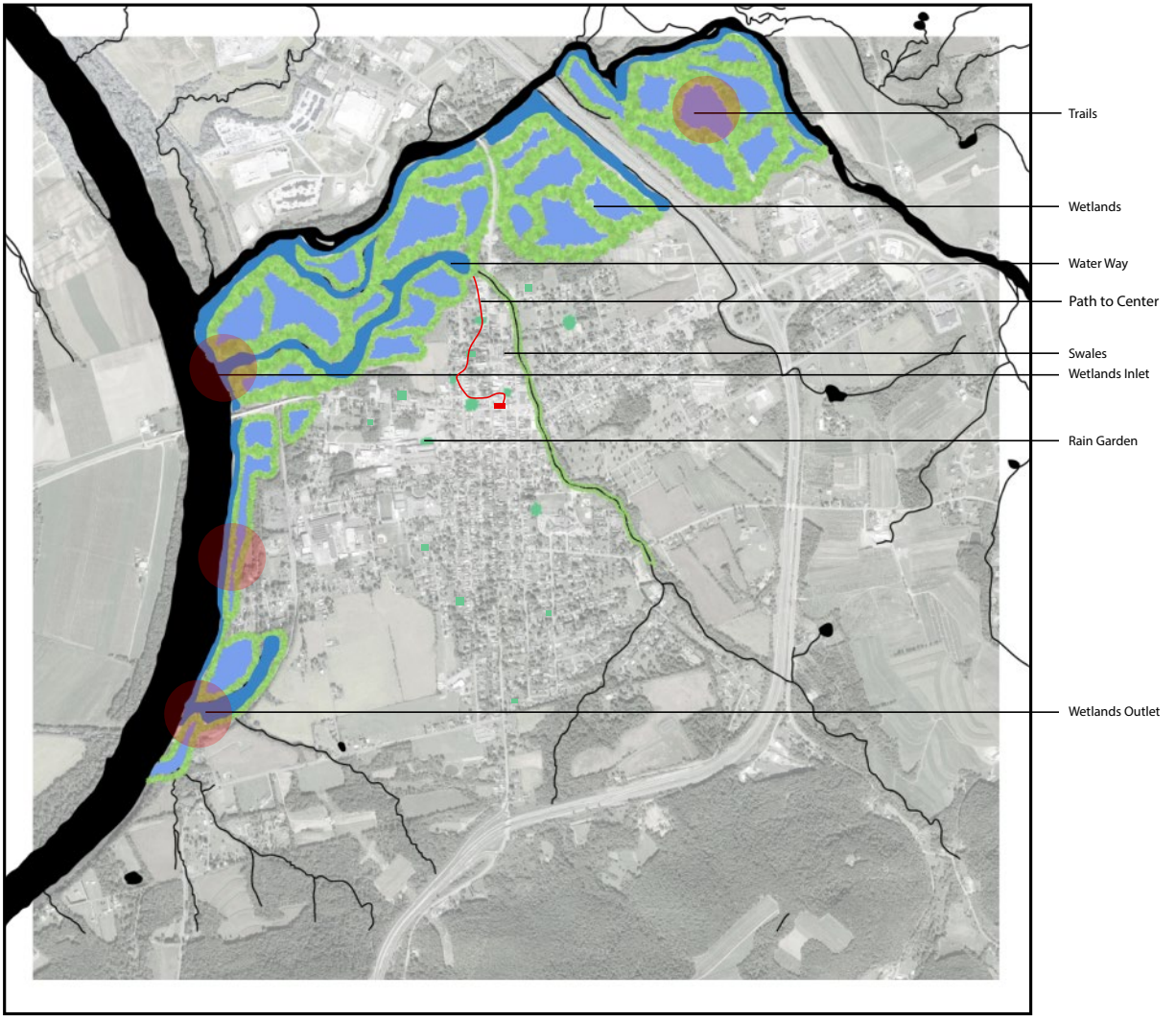
SITE MAP

TOWN PHOTOS

COLLAGE OF MUNCY

MATERIALS + OBJECTS FOUND

MASTER WETLAND PLAN

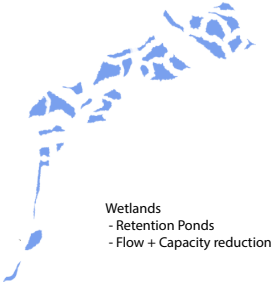


WETLAND BREAKDOWN + DETAILS

Trails

Trails
- Bikes
- Pedestrians
- Parks

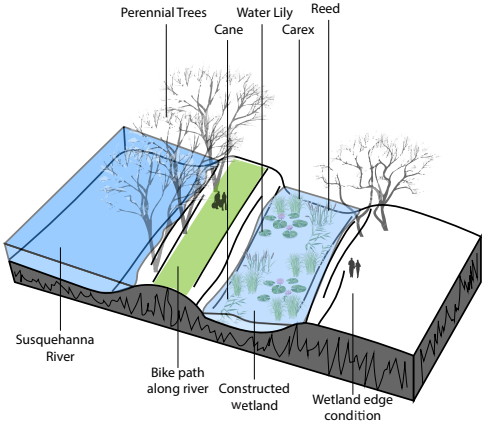
Water Retention

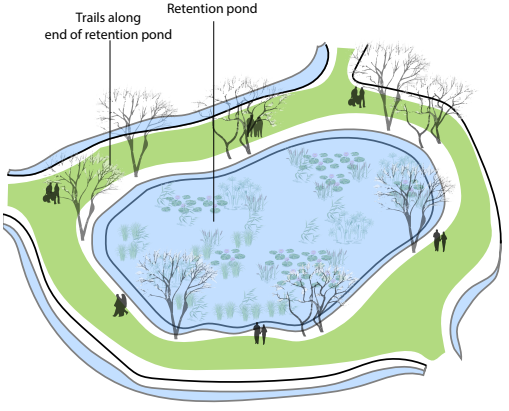


Wetlands
- Retention Ponds
- Flow + Capacity reduction

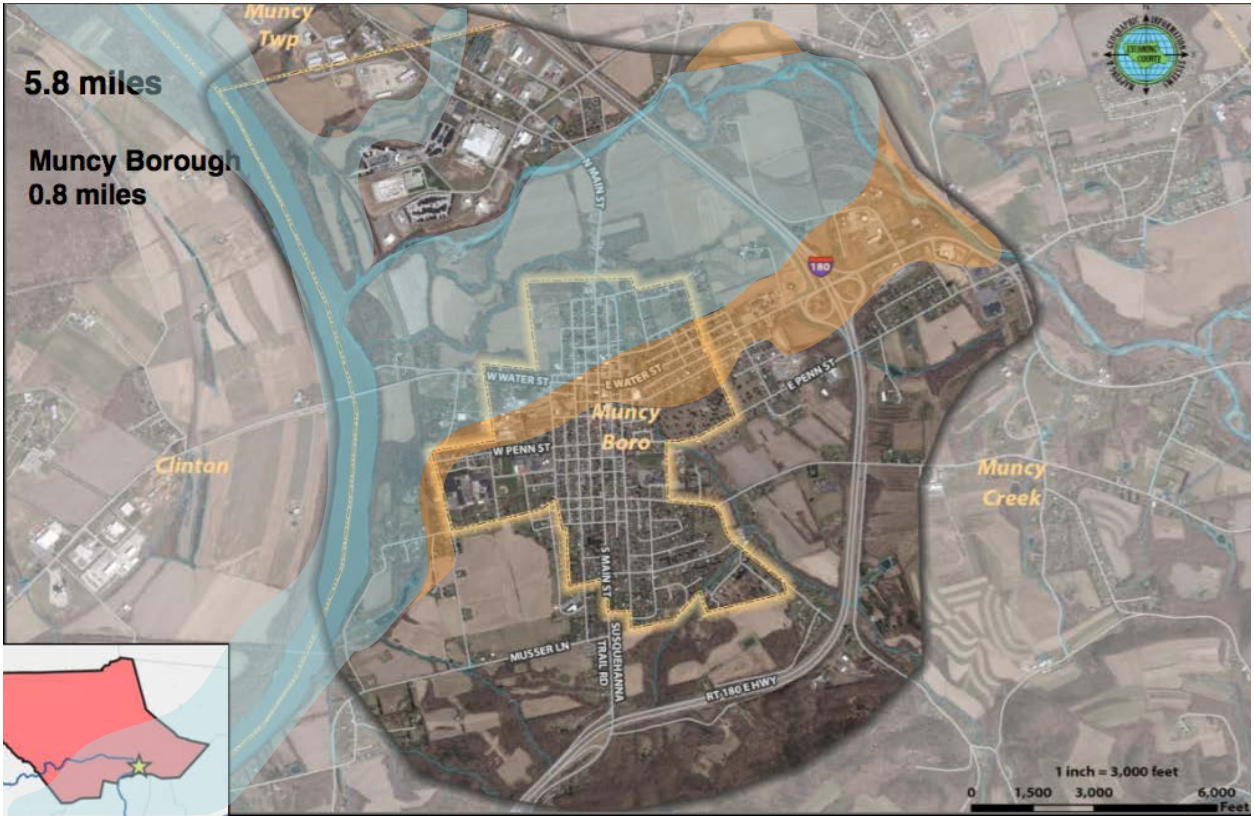
Water Passage

Water Way
- Path for flood to follow
- Leads downstream river





FLOOD ZONE REDUCTION DIAGRAM



CURRENT FLOOD ZONE

FLOOD ZONE REDUCED - 15%

Current condition = 41% of Borough in Flood Zone

Proposed solution = 29% of Borough in Flood Zone