

Art & Ecology
Designs for Paradise Woods,
on the Smith College Campus
 Landscape Studies Studio (LSS 255)
 Smith College
 Spring 2025





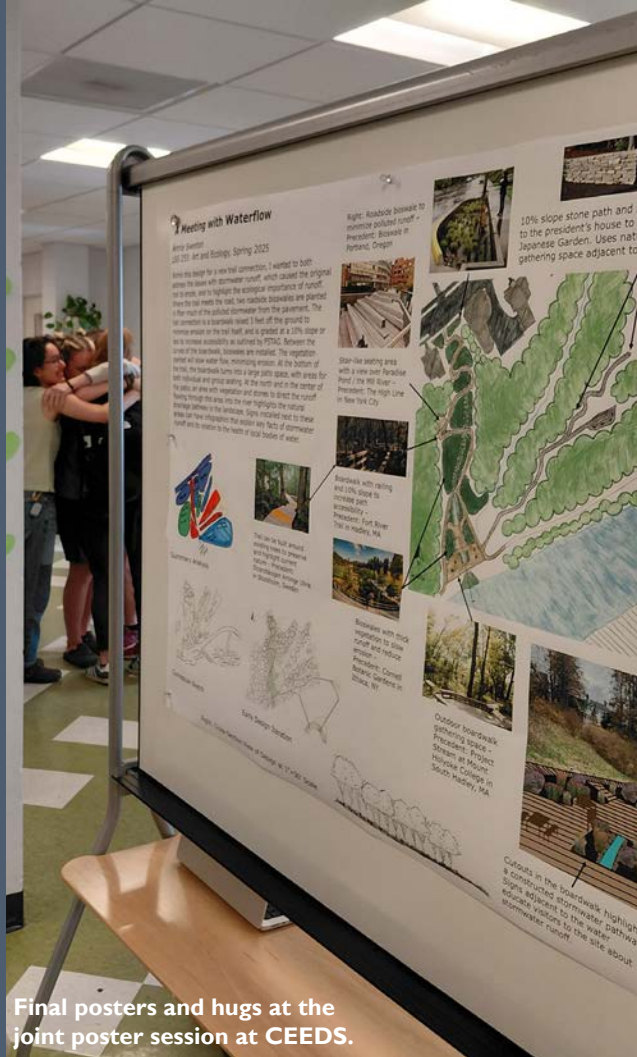
Students visiting the site in early February.



The students' final project involved rethinking this eroding path.



Municipal stormwater outfall on the site. Students from both LSS 255 and EGR 316 examined stormwater runoff and water quality implications.



Final posters and hugs at the joint poster session at CEEDS.



Students sharing their final posters with engineering class EGR 316 and other guests at CEEDS.

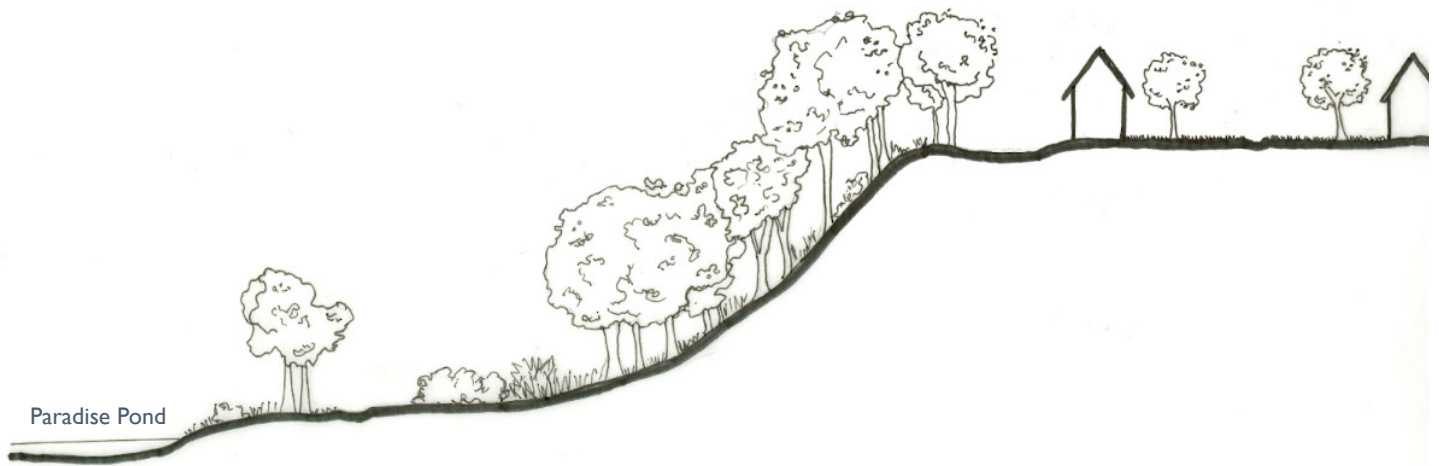


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LSS 255 Students

- Jamie Biagiarelli AC (Studio Art Major)
- Isabella Chen '27 (Architecture & Urbanism Major, Landscape Studies Minor)
- Rebecca Farrar '25 (Engineering Science Major)
- Grace Irizarry '27 (Environmental Science & Policy Major)
- Haley LaFortune AC (Environmental Science & Policy Major, Landscape Studies Minor)
- Molly Neu '25 (Architecture & Urbanism and Computer Science Major, Environmental Concentration)
- Robin Reed '27 (Environmental Science & Policy Major, Art & Ecology Minor)
- Yemilly Soto '25 (Computer Science Major, Landscape Studies Minor)
- Maria Tejada Gonzalez '26 (Architecture & Urbanism Major, Landscape Studies Minor)
- Iris Ventimiglia '27 (Biology Major, Biodiversity, Ecology, & Conservation Track)
- Riley Brandford '27 (Environmental Science & Policy Major, Landscape Studies Minor)
- Annie Sweeton '26 (Mount Holyoke College; Environmental Studies Major, Architecture Minor)



Section by Molly Neu '25

Introduction

Environmental designers are in the unique and challenging position of bridging the science of ecology and the art of crafting three-dimensional, outdoor experiences for people. This studio (*LSS 255: Art & Ecology*) emphasized the dual necessity for solutions to ecological problems that are artfully designed and artistic expressions that reveal ecological processes.

We began the semester by creating **site-specific, ephemeral artworks** in the landscape using found materials in order to draw attention to an element or process identified on campus. We then visited the site, Paradise Woods at Smith College, to gather our first impressions and reflected upon these impressions via collage. This launched us into site analysis, through which we **conducted spatial analysis and research to identify and understand ecological processes** on the site, such as sedimentation, wildlife habitat, geology, etc. Students crafted **ecological stories** informed by theory and research on **science communication and environmental psychology**. This work culminated in **design proposals for the site that address accessibility and stormwater issues**.

The students were inspired by **in-class presentations by two local artists** (Carolina Aragón and Todd Lynch) on how their artwork raises awareness of climate change and focuses attention on ecology. Students also **collaborated with a Smith College engineering class** (EGR 316: Green Infrastructure for Water Resources) that ran stormwater calculations for the site. Both classes presented their work via a **joint poster session at CEEDS** on April 30, 2025 open to the community.

Many thanks to the Smith College and Northampton-area community members who helped us throughout this process:

- Beth Hooker, Director of Sustainability, Smith College
- Reid Bertone-Johnson, Lecturer in Landscape Studies, Smith College
- Niveen Ismail, Associate Professor of Engineering, Smith College
- Jeff Squire, RLA, Principal, Berkshire Design Group
- Carolina Aragón, Associate Professor of Landscape Architecture, UMass Amherst
- Todd Lynch, Principal, Counsel of Trees
- Laura Krok-Horton (Smith College '17), Landscape Design Associate, Regenerative Design Group

Course: LSS 255: Landscape & Narrative (Spring 2025)

Professor: Kate Cholakis-Kolyosko



Students sharing in-process work with guests Todd Lynch and Laura Krok-Horton '17.



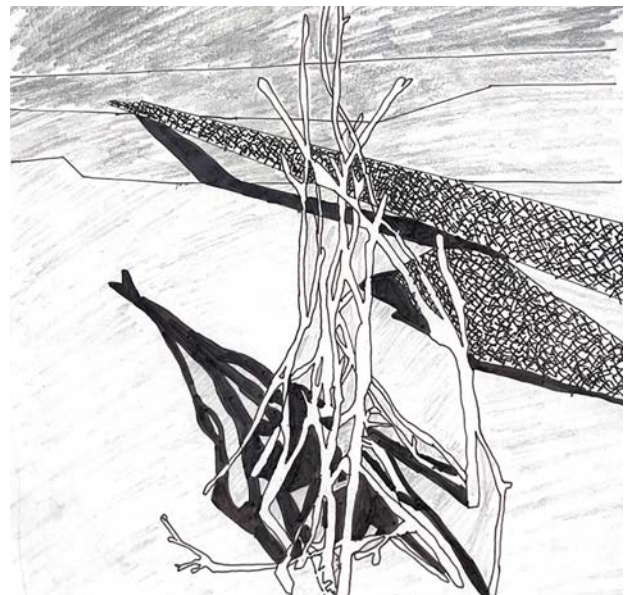
Students visiting the site in early February.



Joint poster session at CEEDS in April 2025 with engineering class EGR 316.

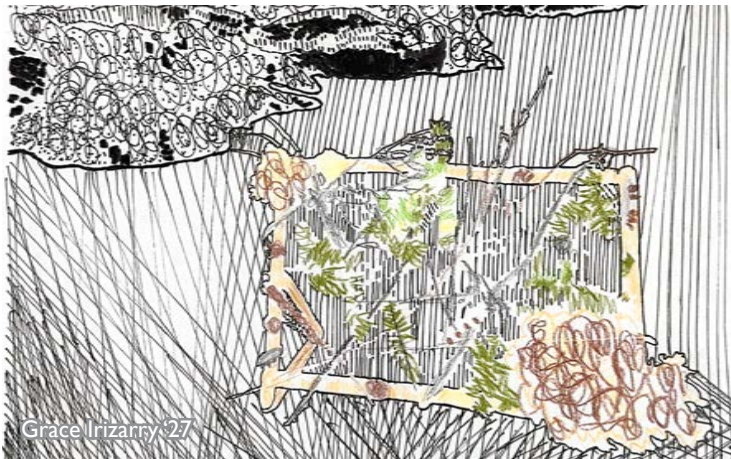
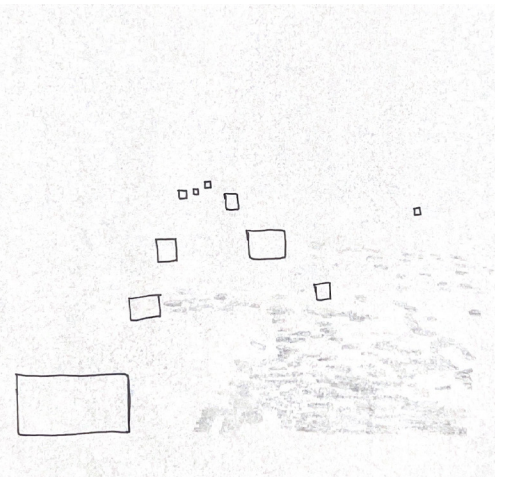
Project One A Moment in Time

For the students' first project this semester, they created ephemeral artworks on campus that captured a moment in time using natural and found objects. After photographing the artwork, they engaged in a series of diagramming and illustration exercises to highlight aspects of the work and experiment with drawing and craft.





Rebecca Farrar '25



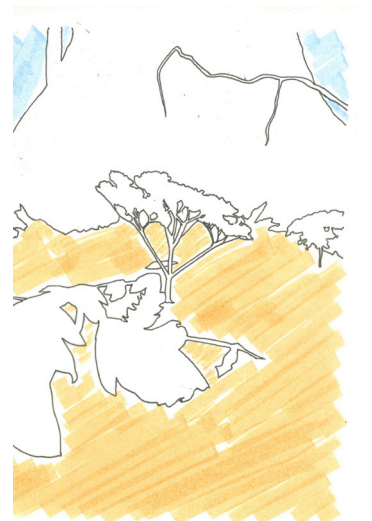
Grace Izarray '27



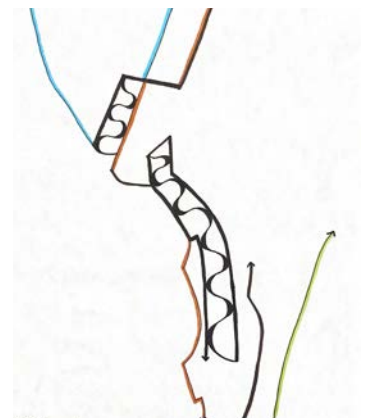
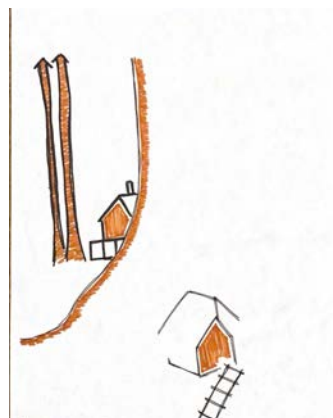
Haley LaFortune AC



Molly Neu '25

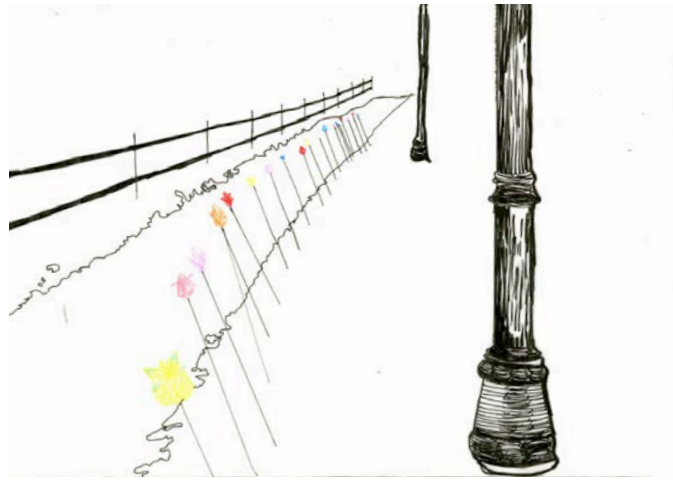


Robin Reed '27

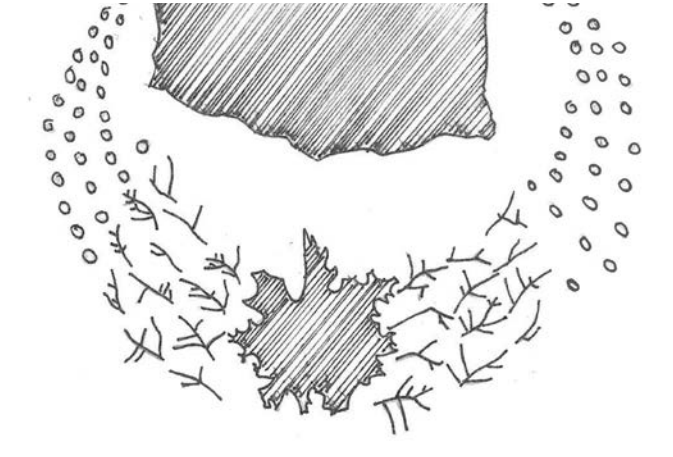




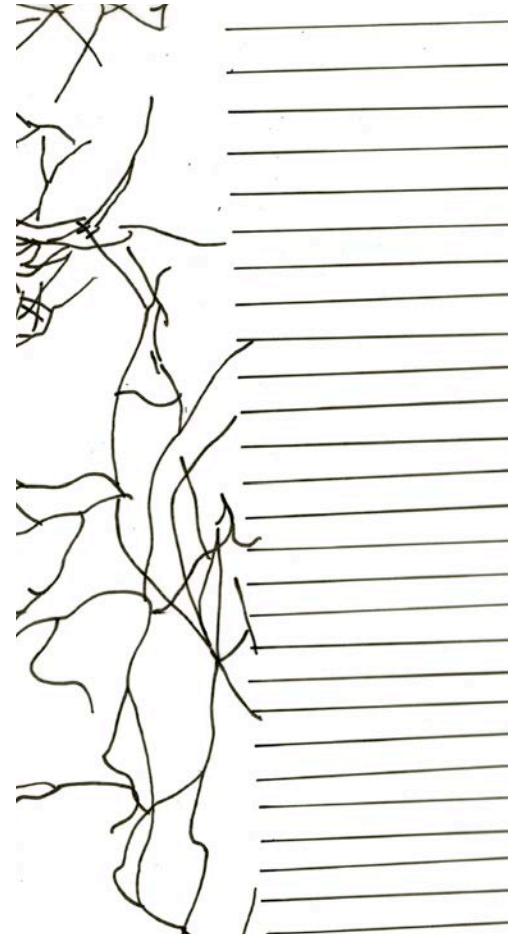
Yemilly Soto '25



Annie Sweeton (Mount Holyoke College '26)



María Tejada Gonzalez '26





Excerpts from students' artist statements:

Inspired by other ephemeral art, I was thinking about the idea of imposing human concepts into natural environments as a way to shorten the distance that we often feel from other living creatures in nature.

I want to inspire viewers to take in their surroundings, for a moment, the same way that a child might—viewing the seemingly mundane with curiosity and not taking details for granted.

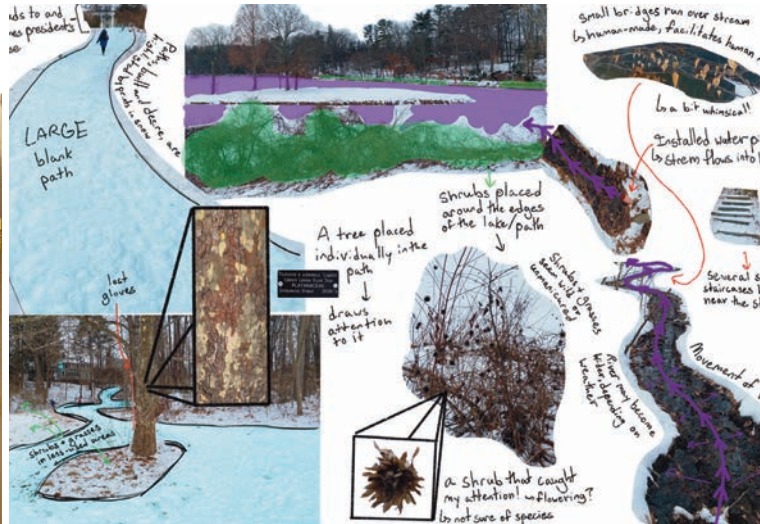
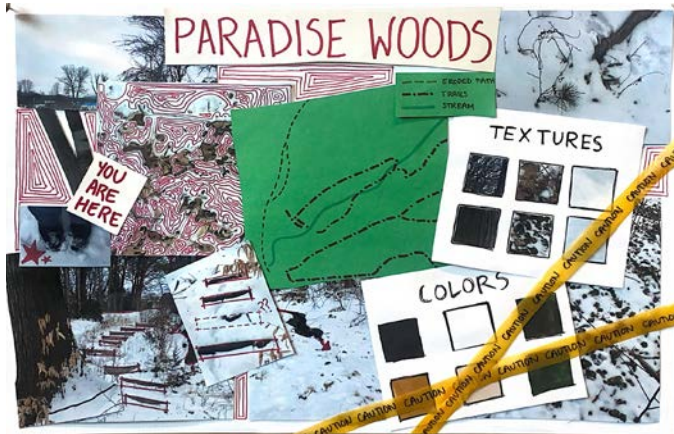
Inspired by Todd Lynch's presentation about the seeds growing toward the sun, I wanted to bring that sense of quiet resilience into the landscape. ... Seeing [the tulips] line the path fills me with hope, just as flowers push through the frozen earth, change and growth are always unfolding, even when we can't see them yet. This moment captures a quiet promise of transformation.

This piece was originally inspired while thinking about fences, specifically the boundaries and binaries that can be placed between "natural" and "artificial" landscapes in our society.

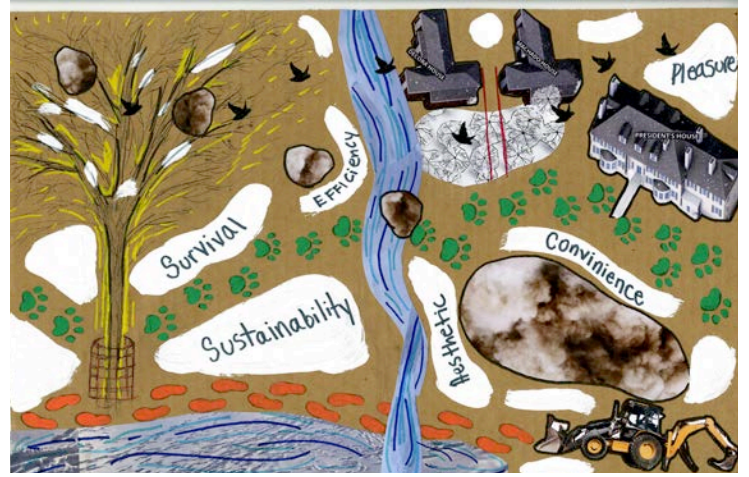
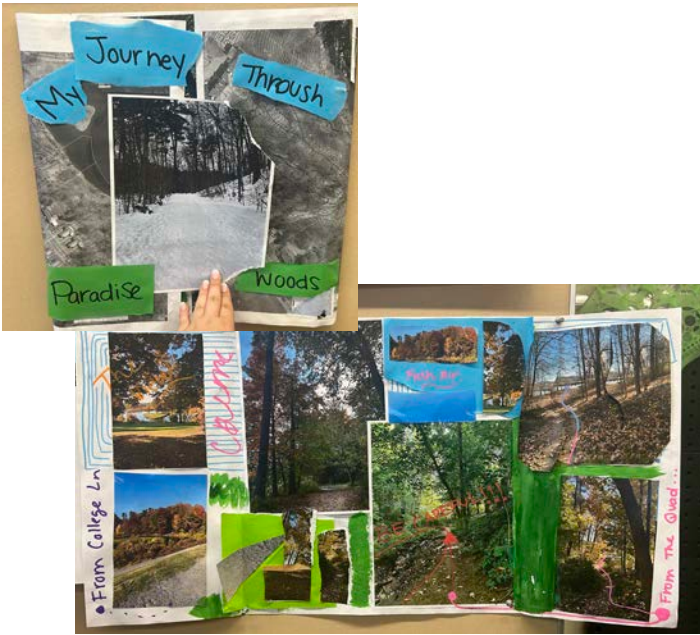
The process of healing isn't always beautiful and I think this aspect of trees can be a mirror for how most humans heal from trauma.

Project Two, Part I: First Impressions

After visiting the site in early February, the students were challenged to represent their first impressions via collage.



Clockwise from top left:
 Jamie Biagiarelli AC, Isabella Chen '27, Rebecca Farrar '25, Annie Sweeton Mount Holyoke College '26, Robin Reed '27, Riley Brandford '27



Clockwise from top left:
 Yemilly Soto '25, Maria Tejada Gonzalez '26, Iris Ventimiglia '27, Haley LaFortune AC, Molly Neu '25, Grace Irizarry '27

Project Two, Part II: Ecological Story

The students conducted analysis utilizing ArcGIS Pro, MassMapper, and other mapping programs and resources to explore their ecological topics. They incorporated these maps into a presentation that used infographics and text to interpret the topic for a general audience.

Excerpts from students' ecological story presentations:

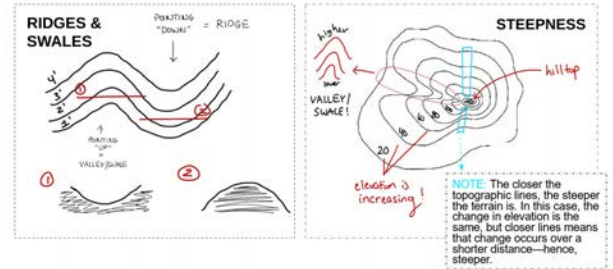


RIDGES AND SWALES

OBSERVATIONS/IMPLICATIONS:

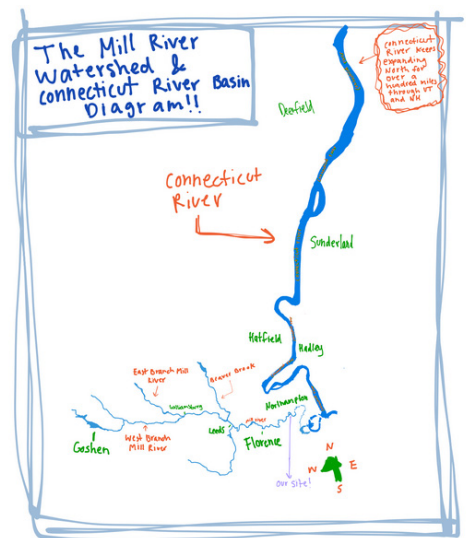
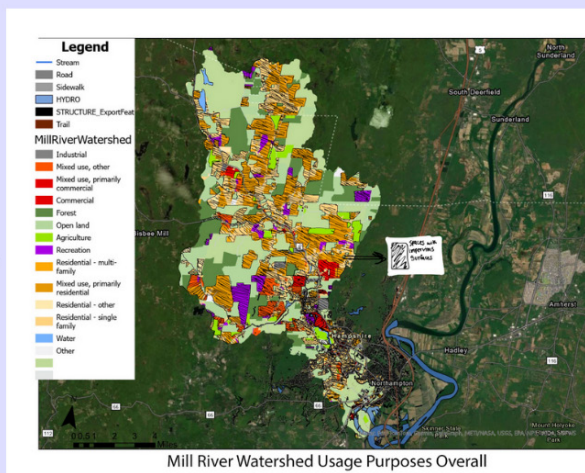
1. There are two swales and two ridges in the focus area.
2. The surroundings of the swales and ridges are much steeper.
3. Swales are where water accumulates and flows downwards → this is where more erosion might occur.

READING TOPOGRAPHIC MAPS

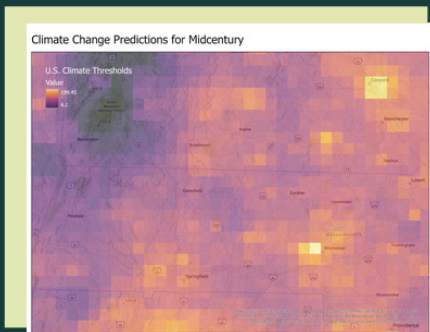


Observation & Implication statement:

In this map you can see a significant portion of the Mill River Watershed is made up of open land and forest; but there is also a lot of other water usage in the basin that includes residential, mixed use/commercial use, recreation etc. These developed spaces represent a lot of impervious surfaces which is important to keep in mind when thinking about watersheds and the health of these basins. With impervious surfaces, when it rains the water has trouble seeping naturally into the ground—creating puddles and even more extreme flooding (runoff) Which is why urban planners have created storm drains to capture this water and outlet it back to watersheds/basins eventually. However, impervious surfaces also hold harmful pollutants that can be accumulated by the rainfall and seep into the groundwater/watershed affecting the water quality of the basin.



Climate Change predictions for 2050



U.S. Climate Thresholds

- Uses greenhouse gas emissions data to predict climate changes
- Higher forcing (higher number) means greater warming
- Greater warming might change how we interact with the land and how we might change how we want to design within that landscape

CLIMATE CHANGE & ECOSYSTEM RESILIENCE

CLIMATE CHANGE

What is it?

Climate change is a long-term change in the average weather conditions that occur over the Earth's surface. It is caused by the increase in greenhouse gases in the atmosphere and the resulting warming of the planet.

ECOSYSTEMS

The world we live in

A geographic area that forms an interconnected relationship with its biotic and abiotic systems.

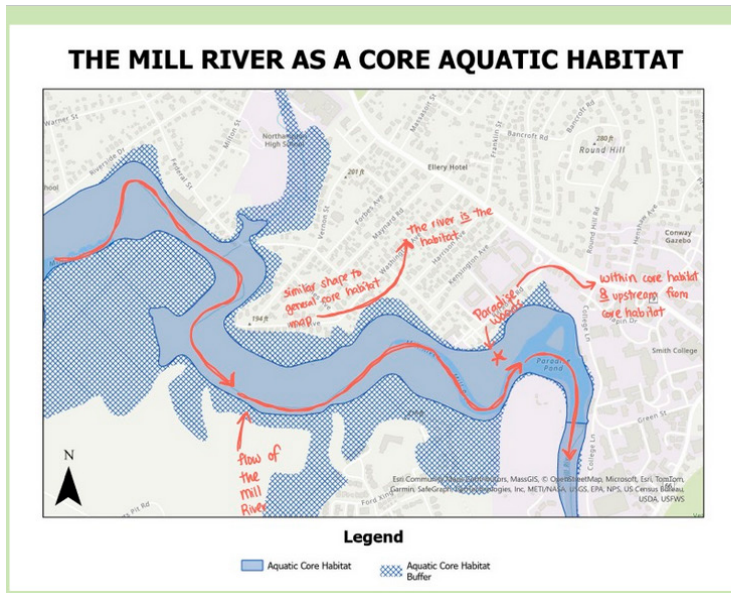
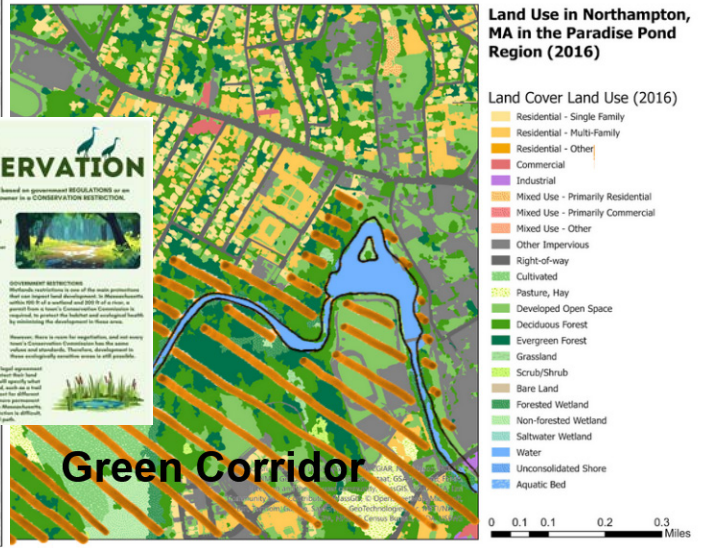
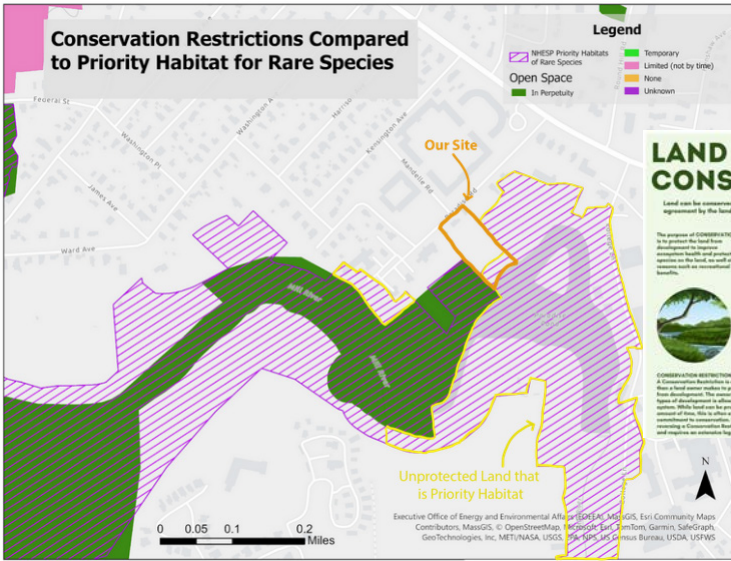
HOW THIS IMPACTS THE FUTURE

AND HOW WE CAN DESIGN AROUND IT

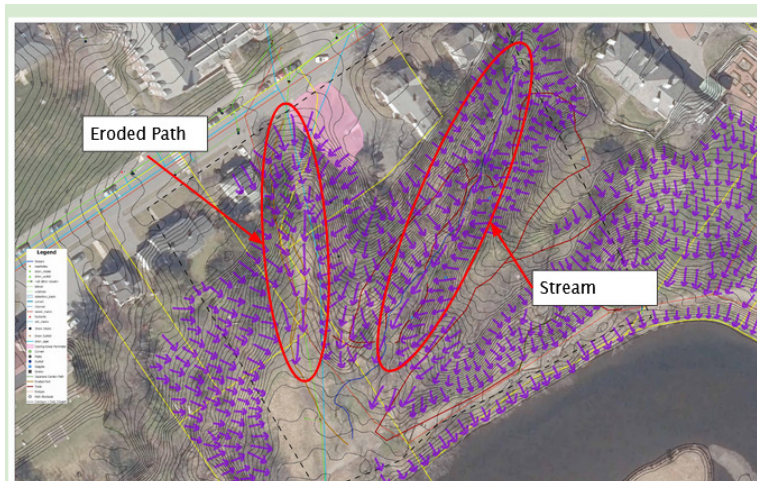
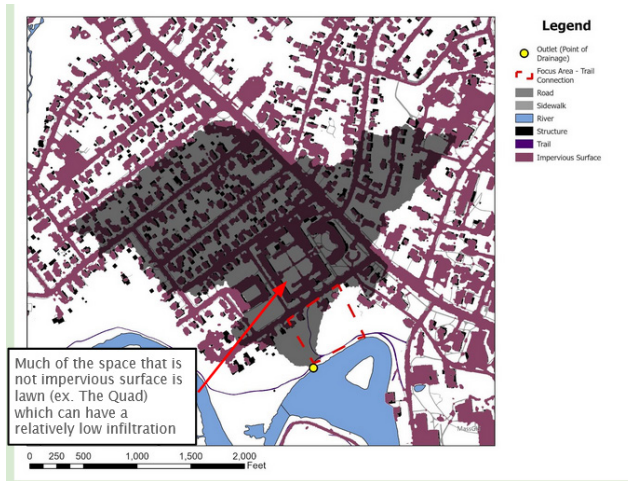
Resilient ecosystems are important to social and economic development and well-being by providing a stable base for many industries. They also provide food and resources to the world. The health of the planet and the environment is challenged and we will experience these ecosystem services. The resiliency of an ecosystem is important to understand when planning changes in that area.

WHY DOES IT MATTER?

If you want to contribute to a resilient environment through your work, you can use climate data and local ecosystem and species data, and by these data you can design your work to have both more and shape the climate of that area.



As I suspected based on core habitat patterns, the primary core habitat surrounding Paradise Woods is aquatic. This means that while we should still consider the patterns and needs of land species, it's especially important to focus on the impact our project may have on aquatic ecosystems. This is especially true because core aquatic habitat exists both upstream and downstream of our focus area.



Forest Habitat Type

- Observations**
- Boundary/border between developed and forest isn't rigid
 - Areas developed by humans are still habitats for some animals (squirrels)
- Implications**
- How do we design for this boundary?
 - What boundaries (if any) should be preserved to maintain these habitats?
- From Northeast Habitat Map



CANOPY

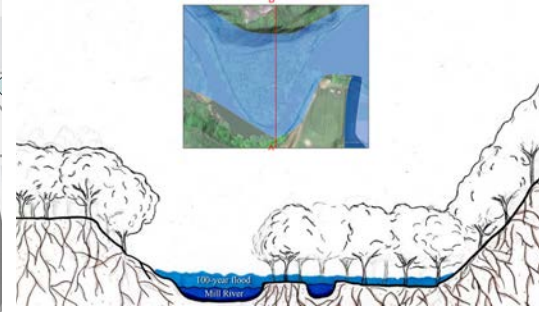
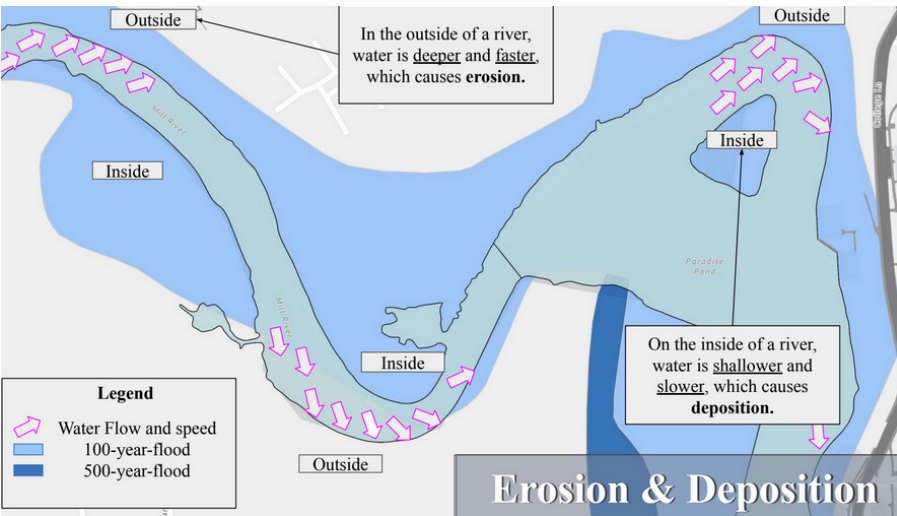
- Mature trees
- Vines that have taken over host tree
- High Air Flow - Sun light

UNDER-STORY

- Immature trees
- Vines
- High bushes
- Some access to light → high competition between species

FOREST FLOOR

- Ground covers
- Moss
- Low bushes
- Moist + low light



Category 4c waters listed alphabetically by major watershed "Impairment not caused by a pollutant – TMDL not required"

Waterbody	AU_ID	Description	Size	Units	Impairment
Cranberry Pond	MA34018	Sunderland.	28.00	Acres	(Eurasian Water Milfoil, Myriophyllum Spicatum*)
Danks Pond	MA34019	Northampton/Easthampton.			
Ingraham Brook Pond	MA34037	Granby.			
Lake Bray	MA34013	Holyoke.			
Lake Holland	MA34035	Belchertown.			
Lower Mill Pond	MA34048	Easthampton.			
Lower Van Horn Park Pond	MA34129	Storfield.			
Mill River Diversion	MA34-32	Headwaters, outlet Paradise Pond, Northampton at confluence with Oxbow (east of Old Road), Northampton (through former 2008 segment; Russell Milne MA32096 and excluding approximately 0.4 mile through existing segment; Meadow Pond MA32129) (formerly part of 2014 segment; Unnamed Tributary MA32A-21).			
Oxbow Cutoff	MA34067	The waterbody north of Island Road and south of Cold River, Charlemont (through former segment: Lower Reservoir MA33029).			
Whiting Street Reservoir	MA34101	Holyoke.			
Deerfield					
Deerfield River	MA33-01	Outlet Sherman Reservoir Monroe/Rowe, to with Cold River, Charlemont (through former segment: Lower Reservoir MA33029).			



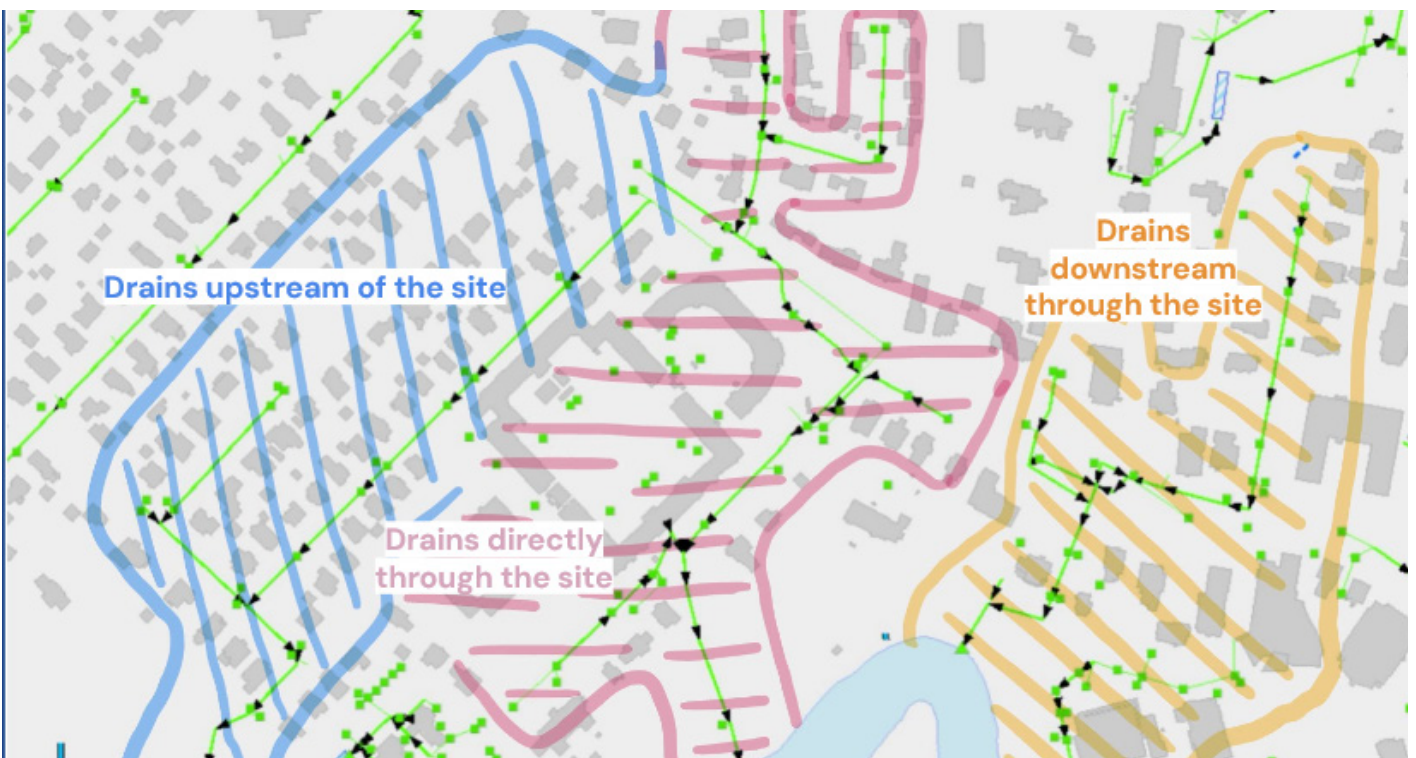
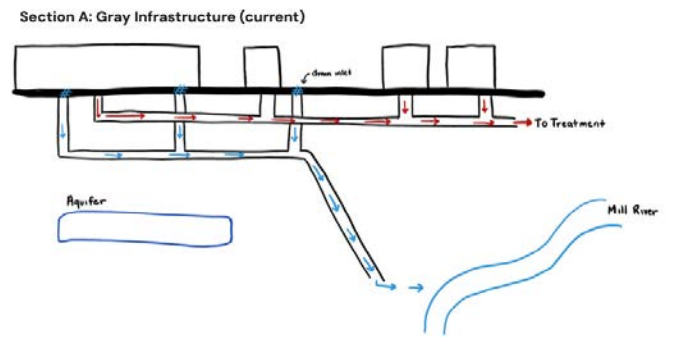
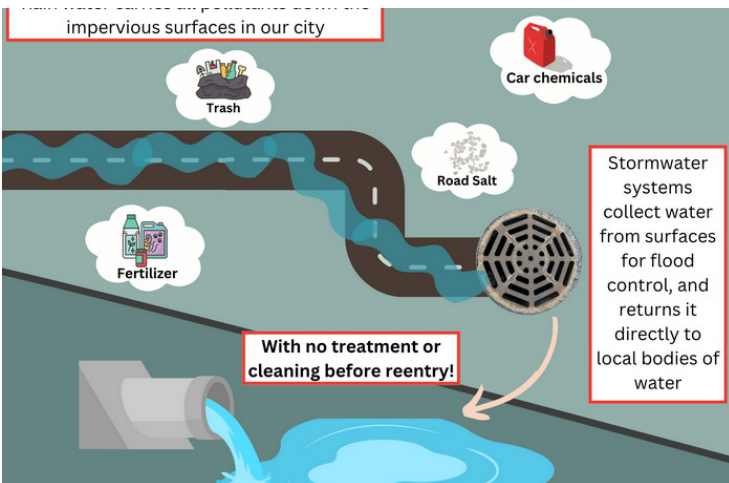
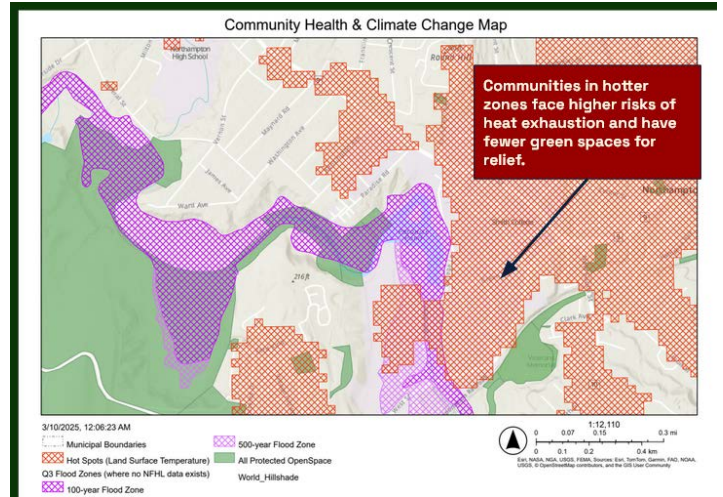
- DEP 2022 Integrated List Rivers**
- 2 - Attaining some uses; other uses not assessed
 - 3 - No uses assessed
 - 4A - TMDL is completed
 - 4C - Impairment not caused by a pollutant
 - 5 - Waters requiring a TMDL





Legend
Brown: Amostown-Windsor silty substratum-Urban land
Pink: Udorthents,
Blue: Belgrade silt loam
Green: Winooski silt loam
Orange: Boxford silt loam
Red: Raynham silt loam

- Observations**
1. Majority of the soil is silt and sand soils
 2. Our sight is Amostown and Windsor soils
 3. Red and Orange will produce the most runoff

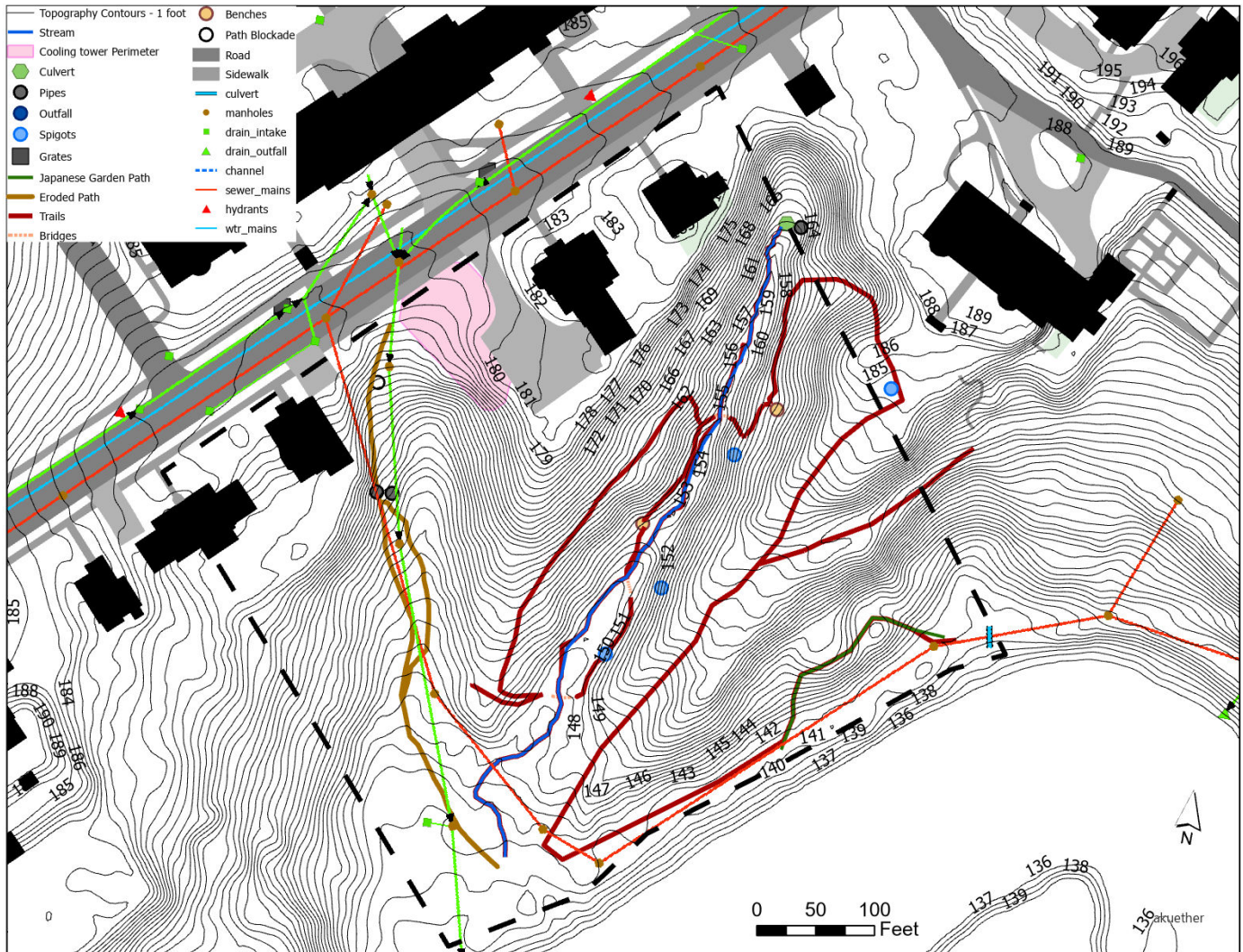


Project Three: Designs for Paradise Woods

The students crafted designs for a path connection from Paradise Road to the Pond. They utilized Forest Service Trail Accessibility Guidelines and learned how to align a path with a particular maximum slope percentage. Students also considered how to address the severe erosion occurring on site. Each design additionally needed to reveal or highlight an ecological process for the visitor, via a permanent or temporary landscape intervention.

Existing Conditions

The students worked with a basemap combining data from MassGIS, the City of Northampton, and field work conducted by Smith student Shira Goldman '25.



Steep, eroded path where it meets Paradise Road.



Culvert carrying runoff from the valleys on the site to the pond.



Open meadow area at the base of the slope near Paradise Pond.

Bridges and Streams

Isabella Chen

LSS 255: Art & Ecology, Spring 2025

Design Overview

The ecological element highlighted in this design is the flow of water—from runoff to streams. Running beneath this motif are guiding principles of accessibility and community. The design incorporates an accessible trail connection from the Quad to Paradise Pond. There is a longer, river-like trail that utilizes bridges to maintain a 5% slope and a slightly steeper connection for students who want a faster path to class. Multiple rest spaces at the bends of this "river" path include seating—encouraging observation of nature, providing study spaces, and serving as rest points. There are multiple vantage points over water, including two bridges over the stream and an outlook deck where the stream enters the pond. This way, people can be close to the water without disturbing ecological processes. Issues of water runoff are addressed through multiple rain gardens and a bioswale with rock check dams. The set of bridges right above the bioswale provides an opportunity for green infrastructure education. The current pipe system for the stream is removed so that the stream runs directly through the nature play space. Visitors can cross over small bridges reminiscent of already-existing bridges further upstream, or hop on rocks to cross the stream. Rocks, logs, a swing set and an open lawn in the play space provide ample opportunities for people to play, rest and gather. Its proximity to rain gardens is an opportunity for education about water runoff, perhaps through incorporation of artwork. However, the safety of children is considered in the placement of seating around the park and rock barriers between the rain gardens and seating. The currently neglected area can not only serve as a bridge for students to their classes, but also become a space for rest, education, and play.



Fengxiangzhou Park, Hainan, China
Natural elements, like this trail of wooden logs, are incorporated into play spaces



Broadmoor Wildlife Sanctuary, Natick, MA
Observation decks over the water allow for visitors to get close without disrupting existing nature.



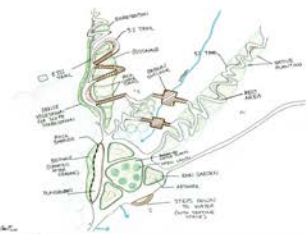
Central Park, Manhattan, NY
Big slabs of rock provide a space for both rest and play.



Design Detail
A view from around the middle of the play space, looking at the stream, picnic tables, and a rain garden.



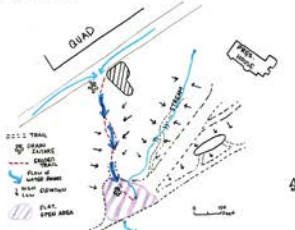
Concept Sketch
Early conceptual sketch showing a river-like path and an emphasis on rest spaces and accessibility.



Concept Sketch
Rough draft with more extensive intervention in the landscape and a smaller playground compared to final plan.



Site Impressions
Despite the frozen conditions, the flow of water and people at this site immediately stood out.



Summary Analysis
Main issues at this site are water runoff and steep slopes. Also, potential is seen in the flat open area at the bottom.



Proposed Design



Section A-A'
A section taken of the play space, looking north. Seating on both sides of the play space provides parents a place to watch their children. Rock barriers between seating and rain gardens allow for closeness but maintains safety.

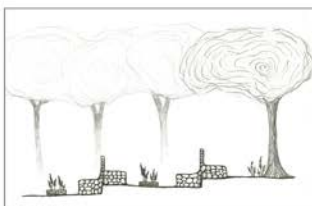
Following the Flow

Robin Reed

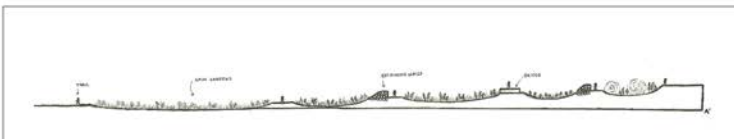
LSS 255: Art & Ecology, Spring 2025

Design Overview

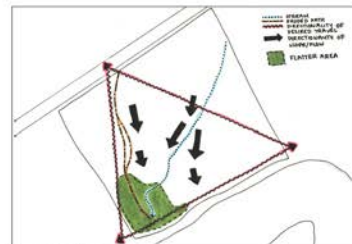
My design transforms the eroded path into a trail which winds between tiered rain gardens, directing and controlling the flow of water down the slope. In some places, bridges stretch over water channels; in others, retaining walls provide a place to sit and protection against erosion. Rain gardens closer to the top of the hill are drier and feature upland plants, while the lowest, largest rain garden is essentially a constructed wetland. My design also imagines a performance space in the lower area near the pond. A raised stage doubles as a place to sit when not in use, seating is built into the contours of the land, and is oriented in a way that it could accommodate either an audience or smaller groups sitting and socializing. This design highlights the natural slope and flow of Paradise Woods, making the form of the land more obvious to its visitors, while simultaneously reinforcing that form and protecting it against erosion.



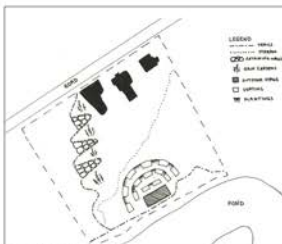
Design Detail
Flexible seating designed to flow with the land's contours and reinforce slope to prevent erosion.



Section A-A'
Rain gardens sit in constructed depressions in the slope, allowing water to gather and ultimately directing its flow towards the pond.



Summary Analysis
Focusing on directionality of the space itself and desired travel through it.



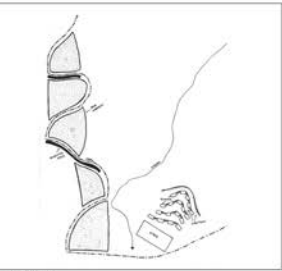
Concept Sketch
Early sketch of the stage and a meandering trail.



Precedent
Tiered bioswales at Crotty Hall in Amherst, MA.



Precedent
Trail on a slope at Muir Woods in Mill Valley, CA.



Concept Sketch
Initial plan of rain garden design: seating fitting the land's contours.



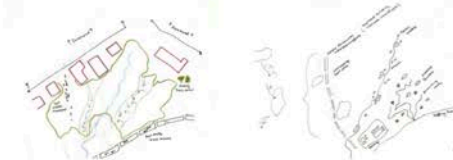
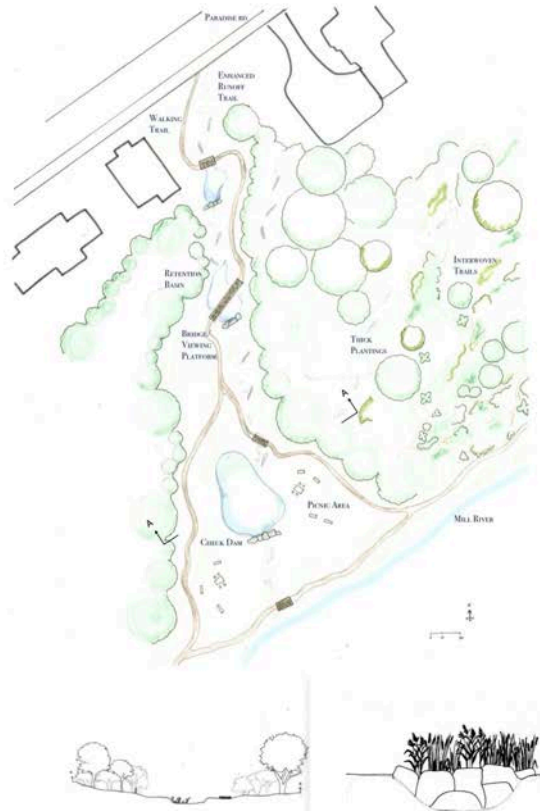
Proposed Design

Stormwater Stroll: integrated runoff and footpaths for Paradise Woods

Rebecca Farrar, LSS 25: Art & Ecology, Spring 2025

Overview

Paradise woods, situated between the Smith College Quadrangle (Paradise rd) and the Mill River, provides a secluded natural space for students and community members alike to hike, walk dogs, or sit and reflect. This design aims to preserve a sense of wild space, while also providing safer trail connection and cleaner stormwater infrastructure. Excess stormwater and runoff follows an enhanced path down where it filters through tiered retention basins fitted with check dams, allowing filtration through the ecosystem prior to reentering the river. The foot path intersects these basins, bringing the realities of flooding and runoff pollution to life for students passing down. Thick trees line the general path area and opens for seating and community space towards the river shoreline. Thick garden plantings towards the right side of the site allow for a forest like ecosystem, fitted with tightly woven trails, guided by these plantings, allowing students to "get lost" and wander slowly through the space.



Summary analysis
Initial impressions of the site note areas of high traffic, flow of water, and current hazards

Early concept 1
Tight overlapping foot path and runoff, slightly enhanced stream path

Early concept 2
Tiered basins and constructed wetlands, broader area at shore



Enhanced runoff trail
Impervious material directs flow of runoff

Anacostia constructed stream
Stormwater becomes stream in park



Trail drainage features
Large rock directs water to intersect trail

Community space
Picnic area at the shore of river



Photo trace
Parallel foot path and runoff, leading to Emerson house. Retention basin with bridge over it in the foreground

Section A:A
Cut shows trail, basin, and bridge within tree line

Check dams
Large boulders for natural dam look, wetland plantings in retention basin

Following the Land & Living Things: Learning Comes Alive Outdoors

Grace Irizarry
LSS 255: Art & Ecology, Spring 2025

Design Overview

This design illustrates the importance of working together with the natural environment to create a space where people can connect, reflect, and grow. The design is placed intentionally around the site to provide a moment of reflection and wonder when thinking about these insects, and their habitats, and contributions to the garden ecosystem and our health. The garden is made with native perennial plants, used to help mitigate runoff and the rocks provide a natural barrier and help with drainage and combating erosion. Similarly, the Pollinator Field is filled with native wildflowers to help bring more pollinators to our space. Softer biodiversity, and make the area more visually engaging than the present space. Also, the decomposed granite pathway (which is 18" wide and has a 10% slope max) is defined with heavy shrubs to ensure anyone able to get on the path, and also that they're meandering and reflecting through the landscape, as the topography has intended to be. Over the time these plants, this plan addresses stakeholders needs by providing the community with an Outdoor Classroom/learning space, an Edible Berry Garden to engage in community gardening without invasive maintenance, and a water path from the Quad to the Mill River Trail. There is also a retention zone intended to establish a strong natural buffer and maintain access from the land to the pond.



Design Detail #1
Sketch of one of the native plants in the Pollinator Field, Blackberry Milkweed



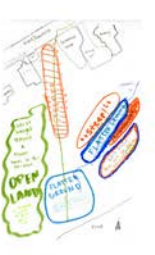
Design Detail #2
Sketch of one of the native plants in the Restoration Zone, Black-eyed Susan



Design Detail #3
Sketch of one of the native plants in the Restoration Zone, Penstemon Bourgeoisii



Design Detail #4
Sketch of one of the native plants in the Pollinator Field, Anemone Deep Pink / Pink Cut-leaved Whiteflowers



Precedent of Decomposed Granite Pathway



Precedent of Decomposed Granite Pathway
A decomposed granite pathway is better for drainage as decomposed granite is a permeable material. It easy to maintain, helps prevent erosion, minimizes flooding, and is overall a more ecologically sustainable option than asphalt for this site.



Precedent of Rain Garden: Rain Garden at 1530 St in Raleigh Park, Memphis



Proposed Design
Proposed Design including the Rain Garden, Decomposed Granite Path, Pollinator Field, Bug Sculpture, Outdoor Classroom, Restoration Zone, Edge of Forest, Edible Garden, and Pond



Concept Sketch
These Paper Sketch of My Current Design of the 40 acres (more formally said)



Proposed Design
Proposed Design including the Rain Garden, Decomposed Granite Path, Pollinator Field, Bug Sculpture, Outdoor Classroom, Restoration Zone, Edge of Forest, Edible Garden, and Pond



Section A:A
Section A:A Cut, of Scale, cut included in Plan View above.

Commentary On My Design Plan, Following the Land & Living Things: Learning Comes Alive Outdoors

This Design Plan includes plants that flow (partly) with the contour lines and natural topography. The surface is windy, and so in sun we are going to follow nature's lead with a meandering path downwards, leading up to existing paths alongside the Mill River and also towards the President's Garden.

This design also includes a Rain Garden with Native perennial plants such as the Yarrow, English Aster, Little Blue Star, Great Blue Lobelia, Red Oxeye, and Culver's Root. The Rain Garden also has rocks surrounding the decomposed granite pathway to help facilitate better drainage for runoff water and help mitigate erosion.

This design also includes a Pollinator Field filled with native wildflowers to help bring more pollinators and foster biodiversity. The native wildflowers intended to be in this space include: Anemone Deep Pink / Pink Cut-leaved whiteflowers, Orange Butterfly Milkweed, Honeysuckle, and also some Spring ephemeral wildflowers so that students in the spring can enjoy some flowers in bloom before the summer ends, which include: Trout Lilies, and Virginia Bluebells.

Another crucial aspect of this design is the Outdoor Classroom, which can also be used simply as an outdoor seating area, with a couple of picnic tables and movable stump-seats! Many members of the Smith community have expressed their interest in creating an outdoor classroom, and overall, making this site more usable, which is why I thought this flat open space, overlooking the scenic pond, could transform into a nice gathering place for community use. In my plan view, you will notice a change in color of grass-this is mostly because I designed the outdoor classroom space to have a low-maintenance clover landscaping cover, which would hopefully be better than the current mostly ground present in this area. The other different colored grass spaces are mostly meant to either remain as their current natural ground cover or be transformed into a Thermophilus Sedge type of grass/ground cover.

In the area closest to the pond, I decided to allow that space to be a Restoration Zone, allowing for more of a buffer between the outdoor classroom and the tree line in this restoration zone. I intend for it to include native plants such as Penstemon Bourgeoisii, Black-eyed Susan, Wild Columbine, and Tulip. The restoration zone also has boulder rocks surrounding the perimeter to ensure people don't encroach on this spot.

An additional aspect of this landscape is the non-decomposed Perennial Edible Berry Garden! With this, the berry bushes would be planted according to where the contour lines fall-allowing the garden to follow nature's lead rather than flat the natural topography. The berries I would like to include with this would be native to this area, including Blackberries, blueberries, and strawberries.

There are also the Bug Sculpture placed around the site intended to provide a moment of gratitude and wonder when thinking about insects, their habitats and their contributions to the ecosystem. One of the bugs were chosen through Paradise as a citizen science data collection service where you can observe where others have noticed certain species (grasshopper, cicada, etc).

The Bumblebee sculpture is placed by the pollinator zone of course because of their importance in pollinating flowers and various vegetation.

The Laying sculpture is present in the (adjacent) natural habitat that being grassy areas established by vegetation. Laying often being up and sitting in their spaces, and want that to be reflected in the landscape as well.

The False Potato Beetle sculpture is located in the outdoor classroom in a similar manner to the Laying. This insect is said to reside in many different ecological locations, but most likely by forest edges, gardens, or fields, where they can take up to 1 year to mature to include the beetle because it has never been of before I found it on Instagram, and thought this would be an interesting learning experience for many people meandering through the landscape.

The Praying Mantis Sculpture is located in the outdoor classroom area, because they also tend to have a broad range for their ecological habitat, specifically across the area, however because it is very able to the fairly able area that follows the Decomposed Granite Pathway. Later these always found praying mantises to be very captivating, and though I would cover by a nice, visually stimulating piece to the outdoor classroom/learning area.

Boardwalk Campus Connections

Riley Branford

LSS 255: Art & Ecology, Fall 2025

Design Overview

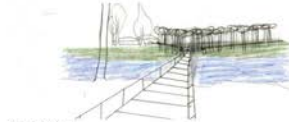
The main constructed part of my design is the boardwalk. The goal of this boardwalk is to provide more natural community spaces and connect different aspects of Smith campus. It connects the bathhouse, athletic fields, and the class site, meeting in the middle with a circular platform. This platform could act as a community gathering space or outdoor classroom. My design also works towards ecological restoration by allowing Paradise Pond to become a wetland. In this wetland, trees would be planted around the boardwalk to provide shade for the community. The boardwalk is connected to the class site by an existing path that connects to a newly designed path leading to the quad and creating a more inclusive natural space by adding connections between the quad and the rest of campus. The newly designed path between the class site and the quad is now separate from the swale carrying runoff water from the road. This will preserve both the new trail and swale, preventing erosion and degradation of the swale and path. Finally, I added a second new trail following the river upstream. It is placed close to the shore to give the community a second trail option and prevents desired paths from being made from the existing trail to Mill River's shore.



Smith College Proposed Plan Focusing On Wetland Restoration Area



Section A-A' Features Wetlands from a side view, too see the interactions with Mill River



Design Detail From Point 1

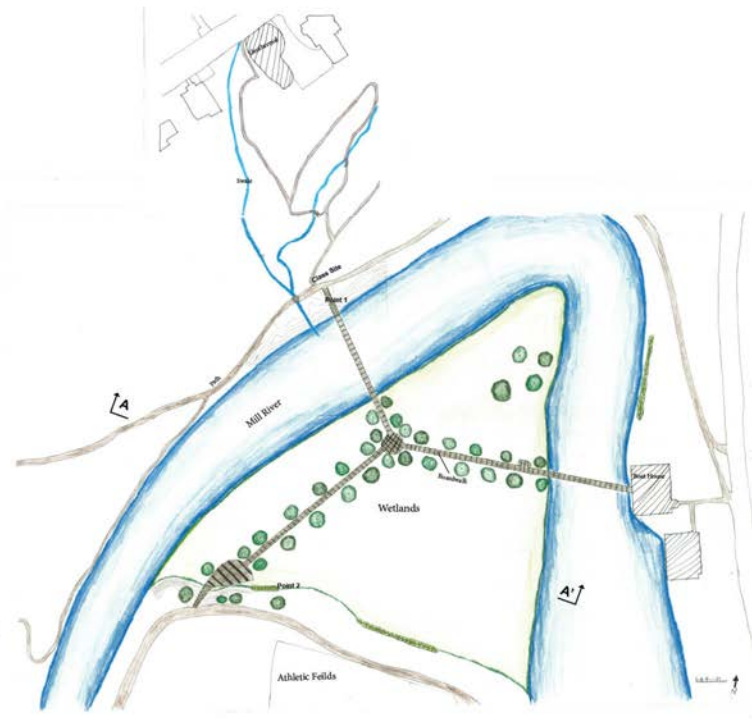
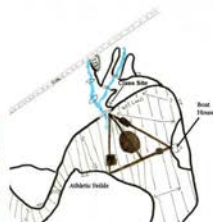


Summary Analysis Current Site Conditions, focusing on waterways and paths

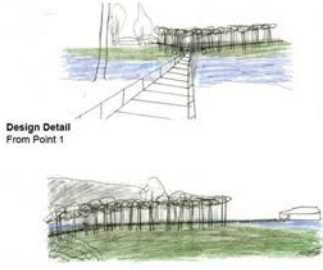


Design Detail From Point 2

Concept Sketch
My Original Idea, that contained too much boardwalk, and indirect paths



Proposed Design



Carver Lake Distinctive Restoration, contains a boardwalk leading to a circular platform



Tennessee River Overlook Laboratory Park, features a wide boardwalk with a ramp



Coventry Middle School, Akon OH Shows a boardwalk outdoor classroom



Plants Dominate Trees in MA Wetlands

Re-imagining Paradise

Yemilly Soto

LSS 255: Art & Ecology, Spring 2025

Design Overview

My objective for this project was to focus on the future of Paradise Pond. Specifically, what the site might look like if the pond were allowed to complete its natural transformation into a wetland. While the project prompt emphasized creating a trail connection from the Quad, I wanted to explore how a design could center this ecological transition. Drawing inspiration from the Smith Landscape Master Plan, I began to imagine what could be possible if we embraced change rather than resisted it. My design highlights the pond's shift by guiding visitors along a boardwalk path that traces the edge of the emerging wetland. Along the way, I included quiet seating areas, viewing platforms, an outdoor classroom, and a swing to encourage reflection and learning. By embracing seasonal water changes, sediment buildup, and native plant growth, the design invites people to witness ecological succession in action. Rather than trying to "fix" or preserve the pond as it was, this project celebrates its evolution into a dynamic wetland landscape, one that supports biodiversity, filters water, and encourages a deeper connection with place.

Proposed Design



Section A-A' The Section Captures the Experience of Going Through the Trail to the Island. Starting From the Deck to the Outdoor Classroom.



Summary Analysis A Description of the Sites Current Conditions



Design Detail Highlights the Bridge Connection from the Quad to the Athletic Fields



Concept Sketch The First Iteration of the Design



Landscape Master Plan (Smith College) The Future of Smith's Campus



Wild Mile (Chicago, IL) A Floating Eco-Park



Wild Mile (Chicago, IL) Urban Rivers



Concept Sketch The Initial Brainstorming

Paths for a Meadow—Smith College

Iris Ventimiglia
LSS 255: Art & Ecology, Spring 2025

Design Overview

My goal for this project was to draw attention to water features and create a more exciting, visually appealing, meadow area. I created paths that would lead students from the quad to central campus or down the pond path that would be realistically efficient but also offer a pleasant view and time to slow down. The new trail from the quad is on the east side of the existing ravine and connects with the current paths at a platform overlooking the meadow. This connecting point can provide a place for classes to gather and study ecology or for students to take a break and relax in the woods. The paths surrounding the meadow are a combination of gravelly paths and boardwalks that will go over the stream crossings. Boardwalks will allow for streams to be brought above ground and for trail goers to feel closer to the water features. The new stream I am proposing, created by runoff from the road and surrounding slopes, likely won't exist year round, so rock gardens and plantings will add visual interest in drought and help slow down water in high rain conditions.



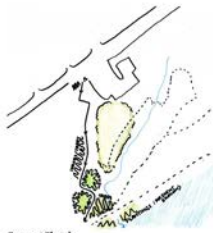
Design Detail
Overlook out to the meadow and Paradise Pond



Section A-A'
A section that shows transition from forest to meadow and view from the overlook



Summary
Current conditions and use



Concept Sketch
Focusing on vegetation, meadow, trees, and erosion



Concept Sketch
Trail connection from quad to existing paths



Broadmoor Wildlife Sanctuary
Wooded boardwalk



Broadmoor Wildlife Sanctuary
Meadow overlook



Alewife Stormwater Wetland
Wetland path and boardwalk

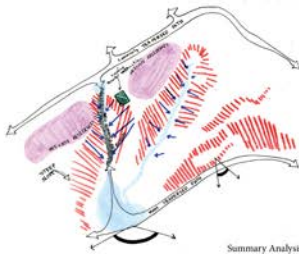


Proposed Design
Meadow close up

Native Wetlands Paradise

Molly Neu
LSS 255: Art & Ecology, Fall 2025

My design motivation for the Paradise Woods Walk redesign was to enhance the subtle designs that were already preexisting in the space and improve the accessibility and ecological function of the site. Knowing that runoff and erosion were key issues for the site, I designed a constructed wetland using native plants, with several check dams to slow surface runoff. The wetland is designed to have three zones, with the height of the plants increasing as people walk towards the water's edge. A range of plants that can be enjoyed from spring to fall were chosen due to the academic calendar, and the design was inspired by Getrude Jekyll and Beatrix Farrand's Art's and Craft style gardens. The newly designed path will be accessible with sections of decomposed granite path, a wooden bridge, and boardwalk that meanders through this wetland, with resting locations to enjoy the beauty of the wetland and the ecology that it supports.



Summary Analysis



Initial PlanView Design



Conceptual Sketch of Wetland Zones



Section A - A' of Bridge



Boardwalk at Elzse Butler Wildflower Garden



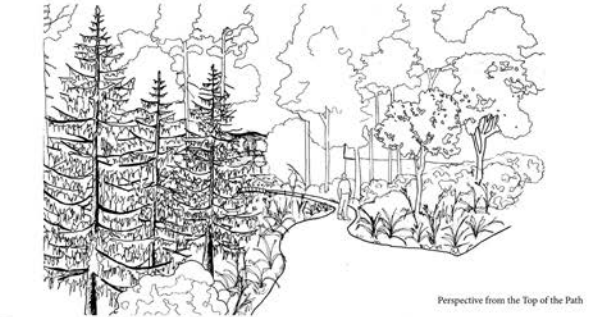
Wightwick Manor & Gardens



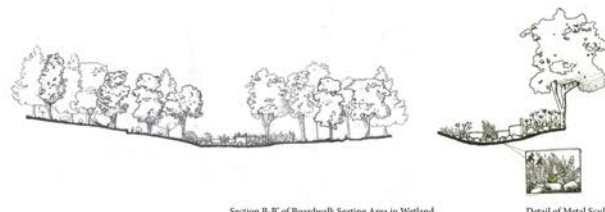
Dumbarton Oaks Gardens



Watercolor of Planting Plan

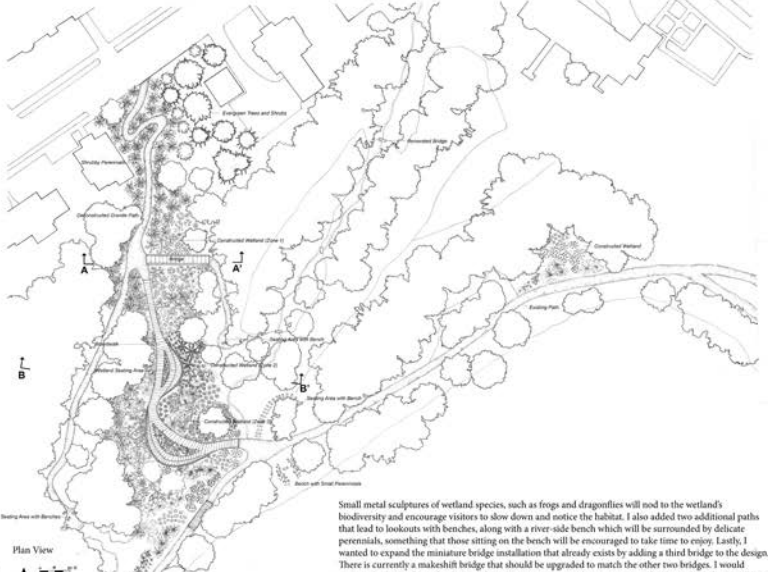


Perspective from the Top of the Path



Section B-B' of Boardwalk Seating Area in Wetland

Detail of Metal Sculptures



Plan View

Small metal sculptures of wetland species, such as frogs and dragonflies will nod to the wetland's biodiversity and encourage visitors to slow down and notice the habitat. I also added two additional paths that lead to lookouts with benches, along with a river-side bench which will be surrounded by delicate perennials, something that those sitting on the bench will be encouraged to take time to enjoy. Lastly, I wanted to expand the miniature bridge installation that already exists by adding a third bridge to the design. There is currently a makeshift bridge that should be upgraded to match the other two bridges. I would encourage this bridge to be dedicated to someone in the Smith community, as has been done for the others

ACCESSIBILITY & ECOLOGY

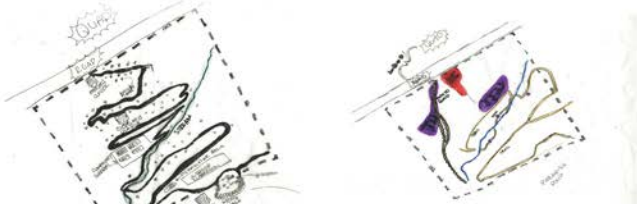
Haley LaFortune
LSS 255: Art & Ecology, Fall 2025

Design Overview

This design focuses on accessibility, intimacy with nature and mitigating erosion. Rain gardens capture water in various spots to slow erosion and purify stormwater from the road before it can reach Paradise Pond. Native plants make up the majority of the flora while still maintaining a focus on attractiveness. Reforestation reaches across most of the area in an effort to create a vibrant, thriving space that sustains the plant and animal life already established and to invite more. Biodiversity is promoted alongside accessibility, as most trails meet ADA specifications. There are several choices when traveling to or from campus and the quad: a more scenic route that meanders through lush landscapes or a quicker, more straightforward trail that allows for faster travel to classes. Rain gardens are simultaneously an interactive attraction and an integral asset to the ecological processes that already exist within the landscape. This design intends to balance aesthetics with the natural. It also boasts an outdoor classroom that is located close to Paradise Pond, which includes an observation deck and rock bridge. These are multi-purposeful and beneficial to STEM students conducting research and giving access to warmth, beauty and fresh air to everyone else.



Photo Trace
This is meant to capture the essence of entering the trail from quad. A balance of forest and wild but maintained native plantings



Summary Analysis
Erosion, steep hills and close proximity to the road were all glaring issues that I wanted to address.



Precedents
I was inspired by these precedents because they showcase an interactive exchange between human and plant. Native plants that grow flush against trails and a rock bridge that stretches out into the water allow close and interesting access to nature in an ecologically safe & fun way.

Early Concepts
Rain gardens and native plantings were aspects I wanted to introduce to this place. I also began to focus on accessibility and making trails that could support different needs.

Section A-A'
This section slices through a heavily forested area, a seating/patio area, the stream and back into forests. While visually interesting, it also intends to express the interaction between human and nature and how immersive the experience of taking one of these trails would be.



Proposed Design
The overall design focuses on maintaining a working relationship between human and nature. It creates a welcoming atmosphere for all bodies while investing energy into necessary biological processes that promote a healthy environment.

Meadow Solace

Maria Tejada
LSS 255: Art & Ecology, Spring 2025

Design Overview

This design proposal responds to the goals expressed by Smith College for a more accessible and direct path, as well as their desire to reduce liability in the area. I also considered that the site currently receives minimal maintenance, so I avoided proposing features that would require high upkeep. Key elements of the design include a raised boardwalk approximately two feet off the ground, boulders marking an erosion path where I've planted blue wildflowers to evoke the presence of water, and an iron bridge/balcony. The boardwalk surrounds a wildflower meadow, while additional erosion-control meadow mixes are placed on surrounding green surfaces. A stone path leads to the Japanese Garden, and a rain garden replaces a current parking lot that contributes significantly to erosion. Study spaces are integrated along the raised boardwalk, though I have not proposed specific seating to keep the space flexible.

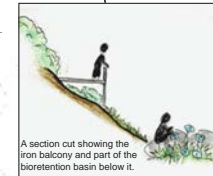
A central focus of my design is addressing and highlighting the impact of water runoff and resulting erosion. Blue wildflowers and strategically placed boulders trace the eroded pathway—serving both aesthetic and functional purposes. The boulders also help control erosion, provide informal seating, and introduce a playful element to the landscape. Additionally, I draw attention to a critical ecological process involving the presence of beavers. My design reflects the tension between the college's goal to protect trees and the beavers' need to use them for constructing their homes. It also emphasizes how the draining of the pond disrupts this natural process.



Section Cut B-B'
This section shows the raised boardwalk in relation to the boulders.



Section A-A'
A section cutting through the center of my design, with a view of the wildflower meadow that show some taller patches of flowers. This section shows the iron balcony bridge and captures the steep surfaces in the landscape.



A section cut showing the iron balcony and part of the bioretention basin below it.



Summary Analysis
A description of site conditions concerning topography, runoff, and flat surfaces.

Concept Sketch: Brainstorming
A sketch of the early stages of the design process

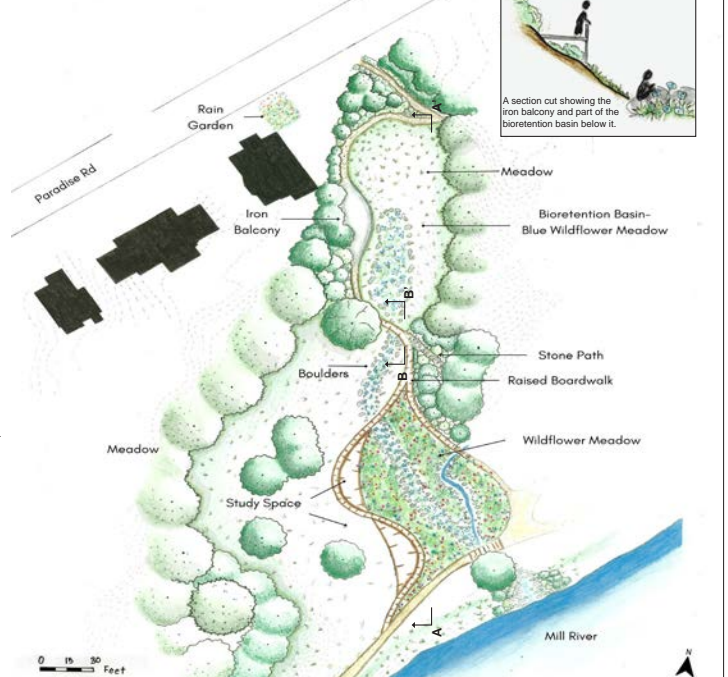
Concept Sketch
A conceptual draft showing earth design proposals like the small pond and stone balcony.

Merriments Gardens, East Sussex
Pig sculptures made of pliable wooden materials.

BUGA Playground, Munich, Germany
Boardwalk in a wildflower meadow.

Proposed bridge/balcony
View of proposed iron bridge/balcony and path looking up the Quad.

Ephemeral Art Installation
A beaver sculpture and tree grad to bring awareness to how the draining of the pond disrupts this ecological process.



Proposed Design

A Meeting with Waterflow

Annie Sweeton
LSS 255: Art and Ecology, Spring 2025

Within this design for a new trail connection, I wanted to both address the issues with stormwater runoff, which caused the original trail to erode, and to highlight the ecological importance of runoff. Where the trail meets the road, two roadside bioswales are planted to filter much of the polluted stormwater from the pavement. The trail connection is a boardwalk raised 3 feet off the ground to minimize erosion on the trail itself, and is graded at a 10% slope or less to increase accessibility as outlined by FSTAG. Between the curves of the boardwalk, bioswales are installed. The vegetation planted will slow water flow, minimizing erosion. At the bottom of the trail, the boardwalk turns into a large patio space, with areas for both individual and group seating. At the north and in the center of the patio, an area with vegetation and stones to direct the runoff through this area into the river highlights the natural drainage pathway in the landscape. Signs installed next to these areas can have infographics that explain key facts of stormwater runoff and its relation to the health of local bodies of water.

Right: Roadside bioswale to minimize polluted runoff – Precedent: Bioswale in Portland, Oregon



10% slope stone path and stone patio on the trail leading to the president's house to match the stones used in the Japanese Garden. Uses naturally flat landform to create a gathering space adjacent to the path



Stair-like seating area with a view over Paradise Pond / the Mill River – Precedent: The High Line in New York City



Boardwalk with railing and 10% slope to increase path accessibility – Precedent: Fort River Trail in Hadley, MA



Bioswales with thick vegetation to slow runoff and reduce erosion – Precedent: Cornell Botanic Gardens in Ithaca, NY



Outdoor boardwalk gathering space – Precedent: Project Stream at Mount Holyoke College in South Hadley, MA



Cutouts in the boardwalk highlight a constructed stormwater pathway. Signs adjacent to the water educate visitors to the site about stormwater runoff.

Legend

- Bioswale
- Trees
- Water
- Boardwalk
- Stone Pavers
- Building
- Pavement

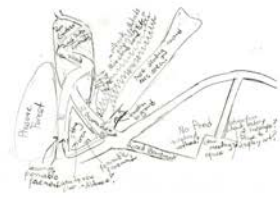
Left: Plan View of Design at 1"=30' Scale
Below: Digital Drawing and Collage of Boardwalk Over Site Photo



Summary Analysis



Trail can be built around existing trees to preserve and highlight current nature – Precedent: Strandskogen Arninge Ullna in Stockholm, Sweden



Conceptual Sketch



Early Design Iteration



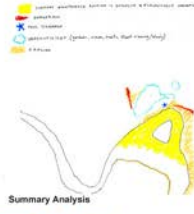
Right: Cross-Section View of Design at 1"=30' Scale

Appreciating and Increasing Biodiversity on Campus

Jamie Marigold Biagiarelli
LSS 255: Art & Ecology, Spring 2025

Design Overview

This design addresses problem areas on the site where erosion, storm water runoff and drainage are ongoing issues. Along with addressing what is not working, I want also to highlight what is lovely about this site: mountain views, spring ephemerals, a charming woodland walk, formal gardens, and a meadow. Currently two of the most heavily used main access points to the site are trails that are so steep and eroded that one cannot safely enjoy the views as they enter because they need to watch their every step. My proposed trail connection coming from Paradise Road begins on the existing path, then switches back and follows the ridge to a bridge across the ravine, then connects to an existing lesser known trail which leads (with very little elevation change) to College Lane. People crossing the bridge among the towering white pines will also get a view of the under-utilized woodland trails along the stream below, and if they have a little extra time, maybe they'll take the trail connection down to look closer at what is growing or an art installation that communicates something about rainwater in forests.



Summary Analysis



Concept Sketch
Thinking about potential trail connections, and dreaming of more outdoor seating areas on campus



Design Detail
Looking across proposed bridge towards Paradise Road and Emerson House



Precedent
Kyoto Gyoen National Garden bridge



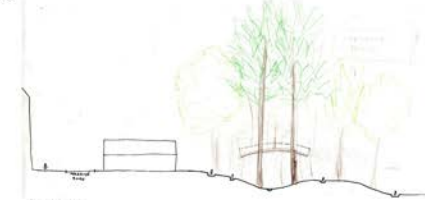
Precedent
Textural Evergreen Trees and Shrubs – Smith College Botanic Garden



Precedent
Increased use of woodland trails could lead to tender plants getting trampled. This style of edging clearly defines paths without being too much of a visual barrier between people and plants. This style ties in visually with the aesthetics of the existing Japanese garden path on campus.



Precedent
Deck, Boardwalk, Outlook, Seating Area – Broadmoor Wildlife Sanctuary path on campus.



Section A-A'



Proposed Design

EGR 316 Final Posters



Nitrogen Removal Efficiency in Bioretention Basins

Lilliana Frantz '25, Lilies Tencic '26, and Professor Niveen S. Ismail
Department of Engineering Science, Smith College

Background and Motivation

- This project focuses on improving the water quality of stormwater in Paradise Woods by increasing the removal efficiency of nitrogen through adsorption and plant uptake in a bioretention basin
- Nitrogen is an important chemical often used in agricultural practices and other fertilizers
- Nitrogen enters water bodies through stormwater runoff and soil erosion
- High levels of nitrogen can cause harmful effects on aquatic ecosystems such as depletion of aquatic diversity and an excess of algae blooms
- Bioretention basins are an important stormwater management tool that involves bioengineered filter media and vegetation to treat on-site stormwater runoff



Fig. 1: Bioretention Basin 1 Fig. 2: Bioretention Basin 2 Fig. 3: Bioretention Basin 3 Fig. 4: Bioretention Basin 4

Adsorption

- Adsorption is a physicochemical pollutant removal process that needs contaminants to stick to chosen filter media on the surface
- Essentially, substances in a liquid are attached to a solid the liquid is running through/surrounding. Thus, the substance is removed from the liquid
- There are two broad types of adsorption mechanisms:
 - Physical adsorption, where substances are bound to solids without electrons exchanging
 - Chemisorption, where a specific exchange of electrons occur
- Outer-sphere adsorption, which is where particles are attracted to each other due to electrostatic attraction of opposite charges, is a type of physical adsorption and is the main mode of nitrate adsorption to soils
- Adsorption highly depends on how much water an adsorbent is able to absorb and hold

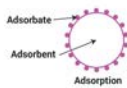


Fig. 5: Adsorption diagram

Plant Uptake for Nitrate

- Nitrogen is an important element for plant growth and development
- One of the main ways plants receive nitrogen is by absorbing nitrate
- Plants use transporter proteins in the root cell membrane to uptake nitrate from the soil
- Nitrate is either used immediately or stored in vacuoles to be used later
- Plants do not fully break down nitrogen when using it for growth, so to fully remove nitrogen from your system plants should be cut down/fruit should be harvested at the end of the growing season so that when the plant's mass decomposes over the winter nitrogen is not reintroduced to the system

Life Expectancy of Filter Media

- The type of filter media used in a bioretention basin is important to consider as that affects how much water can infiltrate and absorb various pollutants
- Filter media generally consists of sand and other soils such as loam and clay
- Sand accounts for the majority of its composition due to low water content and high porosity as opposed to clay



Fig. 6: Drawing of a bioretention basin with filter media and vegetation

- The life expectancy of the chosen filter media can be determined through isotherm testing
- The isotherms used were based on a mixture of 50% sand, 20% limestone, 15% sawdust, and 15% tire crumb
- New volumes calculated based on BDG surface areas and infiltration depths for 1 and 2 hours
- Life expectancy of the filter media was based on amount of media, concentration of nitrate, and flow rate of stormwater

Table 1: Life expectancy of bioretention basins designed for 1-hour and 2-hour storms

Design Storm	Depth (ft)	B-1	B-2	B-3	B-4
1-hour	0.58	85.5	151.8	832.1	148.4
2-hour	0.97	142.6	253.4	1388.7	247.7

- An increase in infiltration depth means more filter media is used which is proportional to its life expectancy

Removal Rates of Filter Media

- The removal efficiency of nitrate can be calculated based on initial aqueous concentrations and time
- A higher removal rate means more nitrate is being removed from the initial concentration which leads to cleaner waters

Table 2: Removal rates of nitrate in filter media

	Initial Concentration (mg/L)	
Storm	0.5	2.5
1-hour	82.6%	42.3%
2-hour	90.5%	59.8%

- A higher concentration of nitrate leads to a lower removal rate
- More time increases the removal rate because this allows for the pollutant to settle out improving its water quality

Plant Selection

Plant Selection for Erosion Control:

- Bidens Cernua* or *Scabrida Bar Marigold* was chosen due to the performance of its closest cousin, *Bidens Frondosa*, which has been found to remove more than 80% of total nitrogen



Fig. 7: B. Cernua

Plant Selection for Wetlands:

- Juncus Effusus* or *Soft Rush* was chosen due to its total nitrogen removal rate of 69%
- Plan to interplant with *Saguna Milkweed (A. Incarnata)* and *Eyes Sedge (C. Vulpinoidea)* in a 2:1:2 ratio respectively as this has been found to increase nitrogen removal to 93-99% in 7 days



Fig. 8: J. Effusus



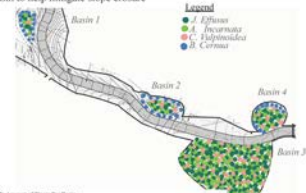
Fig. 9: A. Incarnata



Fig. 10: C. Vulpinoidea

Plant Placement

- Plants placed in basins according to seed type recommendations from Berkshire Design Group
- When Erosion Control plants are included, they are planted along edges of the basin to help mitigate slope erosion



Legend
● J. Effusus
● A. Incarnata
● C. Vulpinoidea
● B. Cernua

Fig. 11: Map of plant placement in bioretention basins

Table 3: Amount of Plants Per Basin

Basin #	J. Effusus	A. Incarnata	C. Vulpinoidea	B. Cernua
1	750	375	750	375
2	1500	750	1500	750
3	1500	750	1500	750
4	1500	750	1500	750

Limitations and Analysis

- Design of soil choice was limited to one mix since it was the only one with data on isotherms for nitrate adsorption found
- Assumptions were made from limited data on plant types for plant selection
- Data for local nitrate concentration in stormwater runoff was available, so concentrations used in paper were analyzed
- If we attained more specific data for nitrate in our location, nitrate isotherms with different soil, native plant nitrogen removal rates, and a more precise design would have been possible; without that, assumptions must be made



E.Coli Begone: Using Green Infrastructure to Address Issues of Water Quality in Paradise Woods Area 3

Taylor Ang, Brooke Testa, Professor Niveen Ismail

Smith College Picker Engineering Program



Introduction

Our project aims to solve issues of water quality, namely high e.coli levels, through the implementation of a combined vegetated swale and bioretention basin.

The site currently exists of a wooded hillside with poor stormwater infrastructure and a pedestrian path. The watershed drains into the Mill River (Paradise Pond).

The GI practices we are implementing are designed to slow down the flow of stormwater, both to increase infiltration and to allow for adequate ponding time to reduce e.coli levels through UV inactivation.



Fig. 1 Proposed Infrastructure



Fig. 2 Site Map

Design and Treatment Capacity

One way to remove E.coli is through sunlight disinfection. When E.coli is exposed to sunlight, the sun's light can directly penetrate and damage vital bacterial cell organelles. Sunlight can also interact with photosensitive materials and indirectly damage E.coli (Maraccini et al. 2016)

Using the inactivation rates of E.Coli by UV found by Silverman and Nelson's (2016) we conclude that in full sunlight, detaining our stormwater for 10 hours in full sunlight should be sufficient to achieve 2 log (99%) removal.

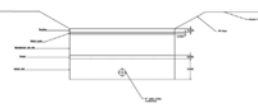


Fig. 7. Proposed Basin Layers

Background

What is Green Infrastructure?

GI is an integration of natural and engineered systems designed to improve water quality and quantity, with a variety of other environmental benefits. We will implement:

1. **Vegetated Swale:** a vegetation-lined channel designed to slow runoff and increase infiltration (below image #1)
2. **Bioretention Basin:** depression meant to collect stormwater runoff from impervious surfaces, remove pollutants, and increase infiltration rates (below image #2)



Fig. 3 Swale



Fig. 4 Basin

E.coli in the Mill River

E. coli is a coliform bacteria with certain strands that can cause severe disease in humans. The EPA regulates safe levels for E.coli in certain contexts, such as recreational waters (235 CFU/100 mL) and drinking water (0 CFU/100 mL). However, sampling in the Mill River, which runs through Area 3, has found E.coli levels as high as 648.8 CFU/100 mL



Fig. 5 E.coli Posting

Analysis

The biggest limitation of our design is the inconsistency of UV intensity due to variation in day length, local weather conditions, and site specific impediments. Since Northampton limits ponding time to 24 hours due to mosquitoes this will also limit the efficacy of our design.

References

- Maraccini, P. A., Mattioli, M. C. M., Sassoubre, L. M., Cao, Y., Griffith, J. F., Ervin, J. S., Van De Werhorst, L. C., & Boehm, A. B. (2016). *Solar inactivation of enterococci and escherichia coli in natural waters: Effects of water absorbance and depth*. Environmental science & technology. <https://pubmed.ncbi.nlm.nih.gov/27119980/>
- Silverman, A. I., & Nelson, K. L. (2016). Modeling the endogenous sunlight inactivation rates of laboratory strain and wastewater E. coli and enterococci using biological weighting functions. *Environmental Science & Technology*, 50(22), 12292-12301. <https://doi.org/10.1021/acs.est.6b03721>



Permeable Path to Paradise: Redesigning the Paradise Woods Path for Accessibility and Infiltration

Aina Endo^{2,1}, Arisha Faiyas¹, Associate Prof. Niveen Ismail¹

¹Picker Engineering Program, Smith College, MA 01093
²Department of Art, Architecture & Urbanism, Smith College, MA 01093



Introduction

While the path from the Paradise Road to the pond was envisioned to have a slope of 5% in the Landscape Master Plan [1], the path design suggested by Berkshire Design Group has a slope of 10%, limiting accessibility. Our project suggests an ADA-compliant path with an average slope of 5% [2],[3]. Furthermore, we suggest using Permeable Pavers (PP) instead of gravel for the path. Its design would provide substantial temporary storage, allowing runoff to dissipate gradually rather than accelerating down the slope to the pond. The goal of the project is to design the path with adequate storage volume capacity, infiltration rate and material choices.

Site Overview



Fig. 1 Topographical map of Area 3 in Landscape Master Plan near Paradise Pond (by Chrobak-Kolysko)

Soil Profile:

- Windsor Silty Substratum
 - Soil types: loamy sand, sand, silt loam
 - Hydrologic Soil Group: A
- Bottom of the path - Ammowson
 - Soil types: fine sandy loam, stratified very fine sand silt loam
 - Hydrologic Soil Group: B [4]

Site prerequisites for PP without underdrain:

- Sandy or silty clay
- Low sedimentation loading
- Minimum 2 feet separation from water table
- Low traffic
- No plans for ploughing snow [5]

Design Iterations

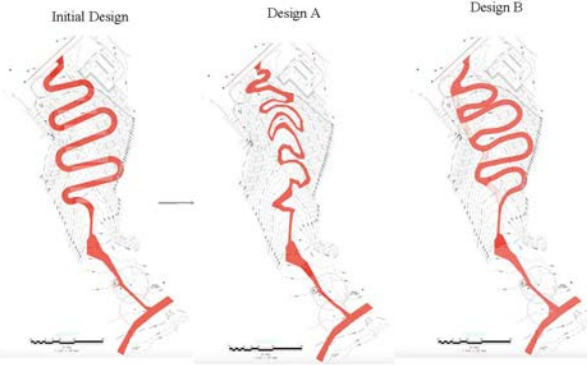
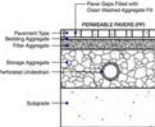


Fig. 2 (Left) Initial design without considering terrain, (Center) Design considering terrain from Inary 27, (Right) Design with bridges from Chen 27

Path Cover Considerations



- ### Permeable Pavers (PP)
- Easier to construct
 - Easier to replace/repair
 - Higher up-front cost but lower maintenance cost
 - Aesthetically pleasing
 - Longer project lifetime [5]

Design Calculations

- Pavement dimensions (initial design) = 8' x 800'
- Pavement surface area = 0.15 acres
- Drainage area = 1.5x Pavement surface area = 0.22 acres
- Minimum volume to be stored to maintain water quality (water quality volume) = 280 cubic feet
- Number of baffles required = 4-5
- Standard parameters:
 - 12 in thick filter course made of sand & gravel
 - 4 in of crushed stone layer for frost protection [6]

Design Descriptions

Initial Design	Design A	Design B
Path follows ADA compliant switchbacks, works around existing trees, and sufficiently meets path requirements provided by the National Parks Service	Path follows terrain lines as a strategy to minimize erosion, optimize drainage, provide efficient routes, and enhance the visual aesthetic provided by the National Parks Service	Path includes bridges to allow quicker path option and create opportunities to incorporate bioswales beneath them

Discussion

- Assumptions
 - Path's slope would not exceed 5% at any point
 - Runoff would primarily flow from the sides of the path
 - Clogging will not be an issue
 - Underdrain not required due to soil type
- Limitations
 - Not suitable for high speed traffic (<40 mph)
 - Drainage area should not exceed three times the surface area of the permeable pavement

Future Direction

- Calculate impact on bioswale design presented by BDG
- Evaluate sedimentation and erosion propensity
- Soil infiltration and percolation rate testing
- Consider cost efficiency by comparing permeable pavement manufacturers
- Designing for a larger storm or greater slope

Bibliography



Acknowledgements

- Heartfelt gratitude to:
- Prof. Niveen Ismail for her guidance
 - Peers from EGR 316 for their valuable feedback
 - Prof. Katherine Chobakis-Kolysko for providing with terrain maps
 - Grace Inary '27 and Isabella Chen '27 from LSS 255 for design A and B respectively
 - Beth Hooker (Center for the Environment, Ecological Design and Sustainability) and Charlie Conant (Smith College Facilities Management)

Design A Constructed Wetland for Paradise Woods

Almanzo Gao '25

EGR 316 — Green Infrastructure for Water Resources (Instructor: Professor Niveen Ismail)
Picker Engineering Program, Smith College

Introduction

Constructed wetlands (CWs) are engineered systems designed to replicate the functions of natural wetlands. They are commonly used to treat wastewater, stormwater runoff, and agricultural or industrial effluents by removing pollutants through sedimentation, filtration, plant uptake, and microbial activity. This project focuses on designing a CW for Smith College's Paradise Woods to evaluate its potential for improving hydrological performance and water quality.

Background and Motivation

The Berkshire Design Group (BDG) originally designed four bioretention basins in Paradise Woods to reduce runoff and remove pollutants. For my EGR 316 term project, I designed a large-scale horizontal flow constructed wetland (HSSFCW) to replace and enhance these basins. The design addresses flow configurations, sizing, media selection, and vegetation choices, with a primary focus on removing total suspended solids (TSS).

Frequent post-snowstorm runoff events in Northampton during the spring can increase suspended solids in stormwater, particularly after the first post-snowstorm event due to the use of sand for traction during snowy conditions. A larger CW would provide greater retention capacity, promoting sedimentation and reducing suspended solids before they reach Paradise Pond.

Site Description



1. Large, relatively flat terrain with a 1:87 slope toward the pond.

2. Open area with grass as the primary vegetation.

3. Square manhole nearby, as an existing stormwater infrastructure.

Location Benefits

- Location:
- Right before stormwater exits to the pond, helping enhance pollutant removal and reduce contamination entering the pond.
 - In a large, flat area, providing greater retention capacity and extended sedimentation time.
 - Near the LMP-V3 outdoor classroom, supporting educational activities and easier O&M.

Design & Treatment Capacity

In this section, the design volume capacity, schematic constructed wetland (CW) design, and sedimentation with suspended solids (SS) removal calculations are presented.

Treatment Capacity Calculation

Methodology approaching Storage Volume/Treatment Capacity:

Basin Properties: Flow Length/Slope/Subsaturated Area

$$t_c = 0.0288 \cdot \frac{L^2}{S \cdot V} = 78.116 \text{ s}$$

Precipitation Information: Rainfall intensity and depth

$$V = C \cdot I \cdot A = 9.467 \text{ m}^3$$

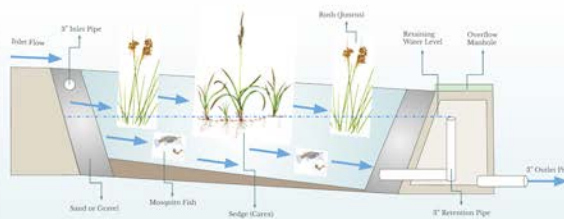
$$Q_i = (q_i)(A)(WQV) = 3.22 \text{ cfs}$$

3" PVC outlet pipe

$$Q = C_d A_o \sqrt{2gh} = 0.034 \text{ m}^3/\text{s}$$

Volume Storage Calculated from: AASHTO #: 5.53 m³; Abt and Grigg: 5.87 m³.

Constructed Wetland Design (Cross-Section)

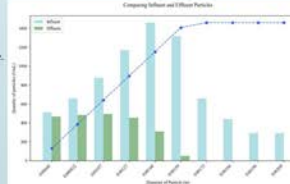


Sedimentation and Suspended Solids Removal Calculations

What are suspended solids (SSs)?
Fine particles of sediment in water in suspension status, with contaminants often attached to them.

- Why are SSs important to remove from runoff?
- Reduces turbidity and improves water quality;
 - Clog fish gills;
 - Limits light penetration, which restricts aquatic vegetation growth due to reducing photosynthesis activities and oxygen production. This could contribute to the formation of Dead Zone (hypoxic/low-oxygen conditions).

- What are the mechanisms of SSs removal in CW?
- Two main mechanisms are sedimentation and filtration.
 - Sedimentation, or settling by gravity, includes discrete settling (settle individually) and flocculent settling (particles interact and settle together).
 - Filtration occurs when dense plant roots physically trap SSs.



Research data: Settling Velocity and Number (#) of Influent Particles (A)

$$v_s = \frac{g \cdot d_p^2 \cdot (\rho_p - \rho_f)}{18 \mu}$$



$$\text{Fraction of Removal (a): } \frac{\text{From Settling Velocity}}{\text{divided by Critical Velocity}}$$

$$\# \text{ of Removed Particles (B): } \# \text{ of Effluent Particles (C): } B = A \times \eta, C = A - B$$

$$\text{Removal Efficiency: } \frac{\text{Sum of Removed Particles}}{\text{Sum of Influent Particles}} = 70.64\%$$

Further Implementations

- Substrate: Sand and Gravel.
- Aquatic Plants: 1. Rush (Juncus), 2. Sedge (Cares), 3. Fish Selection: 3. Cricker frogs, 4. Mosquito fish (Gambusia affinis), 5. Grass shrimp (Palaeomonetes kadakarensis)

Limitation & Future Steps

- Develop a full system, integrating:
 - Primary treatment (settling tank) → before HSSFCW.
 - Vertical flow CW and collection chamber → after HSSFCW.
- Revise basin shape based on geological conditions, using contour maps.
- Research specific vegetation types to target specific contaminants in this Paradise Wood area.
- Lack of real stormwater pollutant data, further research is needed to evaluate and calculate pollutant removals.

Acknowledgements

I would like to thank Professor Niveen Ismail for her patient guidance and support in furthering my research. I am also grateful to my classmates in EGR 316 for their thoughtful feedback and insights. Special thanks to CEEDS for providing a platform to present this project and to share ideas for building a sustainable future for Paradise Pond.

Rethinking Runoff: Optimizing Bioretention Basins in Paradise Woods

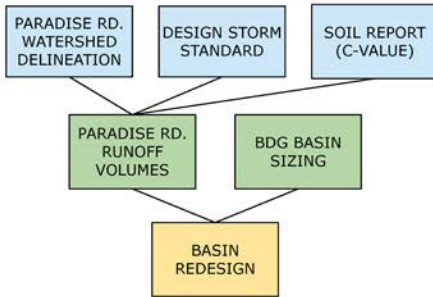
K. Padilla¹, A. Manning¹
¹ Smith College Department Of Engineering



Motivation

In this project we examine the sizing of four bioretention basins on Area 3 of Paradise Woods. While the current design estimates flow from Area 3 watersheds, it does not take into account the possible upslope overflow added to the site from Paradise Road if curb repair does not take place. Our project seeks to evaluate how these basins might be redesigned and resized to accommodate the extra flows. We propose having each basin overflow into the next one rather than into the main drain pipe as a possible solution.

Process



Future Work

- Looking forward for the project, we hope to:
- Conduct infiltration calculations to ensure the soil of each basin can handle additional runoff.
 - Use these infiltration calculations to optimize the outlet height or basin size.
 - Compare potential pipe materials and soil types for the project through cost analysis.

Proposed Design



Figure 1: Delineation of Paradise Road Watershed Using 1 ft Contour Lines (19,000 m²).

Our proposed **cascading basin design** handles the extra runoff from Paradise Road through resized bioretention basins that filter the water. Overflow would still follow a delayed path to the pond, allowing further water to infiltrate.

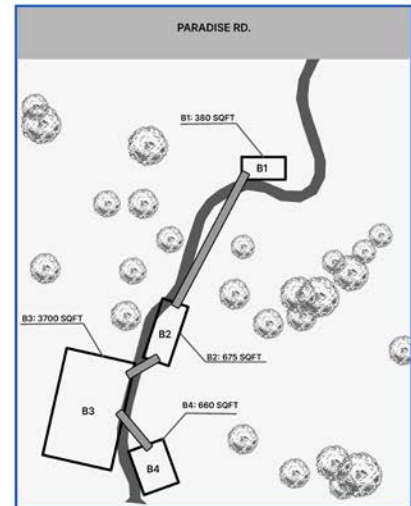


Figure 2: Aerial View of Cascading Basin Design.

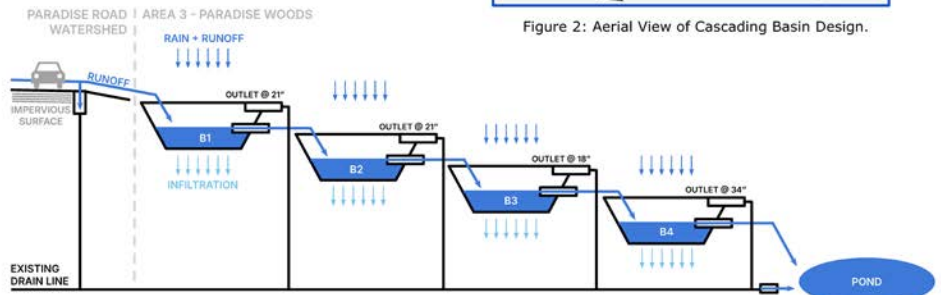


Figure 3: Conceptual Model of Cascading Basin Design.