SCOVIL MILL CENTER
Fostering the Local Economy
Higganum, CT

Prepared for Connecticut Resource Conservation and Development Area
Designers: Dan DeLago & Renee Ruhl | The Conway School | Spring 2018
PROJECT OVERVIEW

The Connecticut Resource Conservation and Development (CTRC&D), a non-profit organization, cultivates innovative partnerships and programs to promote agriculture, conservation, rural economic growth, and healthy food systems. CTRC&D identified the Scovil Hoe Mill site, located in Higganum, Connecticut, a village within the Town of Haddam, as a possible home for its offices and an opportunity to support and host rural, land-based enterprises.

It is seeking to reuse existing mill buildings on site for:
- A regional market and cafe
- Maker space
- Office space
- Education center
- Event space

The Town of Haddam is working toward innovative solutions for rural economic development in Higganum Center and throughout the town. While a final site location has not been determined by CTRC&D for its offices and other mission-aligned enterprises, it hopes to evaluate the potential of the historic Scovil Hoe Factory site (currently owned by Connecticut Department of Transportation CTDOT) to serve as a multi-use hub for rural commerce.

PROJECT GOALS

In order to meet CTRC&D's programming needs, the project goals are to:
- Develop a site design connecting interior space and proposed programming with the exterior landscape.
- Design the exterior landscape to as a destination that draws local entrepreneurs and visitors.
- Recommend climate preparedness solutions and phases of site development.
- Connect the site to the surrounding natural resources and village amenities.
- Site a greenhouse (up to 5,000 sf) and storage barn (300 sf).

SITE HISTORY

The D & H Scovil Hoe Company was founded in 1844 by brothers Daniel and Hezekiah Scovil Jr. who designed a self-sharpening planter's hoe and produced it in the mills at 11 Candlewood Hill Road for over 60 years. The State of Connecticut purchased the site in 1941, converted the buildings for use as a CTDOT repair garage and storage facility, and actively used the buildings until 2014. Currently, the two mill buildings are vacant.

The site soils contain pollutants and currently the Town of Haddam has contracted a team of engineers on an environmental site assessment. It is assumed for the scope of this design that the site has been remediated; however, some design recommendations incorporate educational components demonstrating phytotechnology’s potential utility in remediating polluted landscapes.
SITE CONTEXT

The Scovil Hoe Mill is located in Higganum, Connecticut, a small village within the town of Haddam. Residential development abuts the site to the north and south, and the site is within approximately 800’ of Higganum Village. The Village Green is located directly north of the site across busy Candlewood Hill Road. Candlewood Hill Brook, a tributary of the Connecticut River, flows along the southern edge of the property. Arterial roads create easy access to this site from interstate highways I-91 to the west and I-95 to the south.

The site is located in a rural portion of the Connecticut River Valley and is approximately twenty to thirty miles from the urban centers of Hartford and New Haven and six miles from Middletown, home of Wesleyan University. Natural resources surrounding the site include several state parks, and the Higganum Reservoir could support land-based businesses such as fishing, kayaking, and eco-tourism.

CTRC&D envisions the site as a commercial site that could draw residents of southern New England. It seems that the Scovil site has potential to draw tourists to the area, provide a memorable experience for visitors, and support rural business development.

With farmland to the west and urban centers to the north, the Scovil Hoe Mill site has the potential to promote economic exchange between rural businesses and urban populations of Middlesex County.

The village green sits across Candlewood Hill Road from the eastern portion of the site. The mill could explore the possibility of collaborating with the town on hosting events in this space, providing stronger connections of town amenities.

The site is within walking distance of the commercial center to the east. Unfortunately, pedestrian flow is restricted with no sidewalks connecting the mill site with the village center.
EXISTING CONDITIONS

The Scovil Mill’s legacy as an industrial manufacturing site is evident upon first inspection. Most of the 4-acre site is paved in asphalt and the buildings were sited for maximizing production and energy generation via hydro power.

Remains of the industrial legacy include a historic dam wall in the western portion of the property and buried hydroelectric pipes and storage tanks in the eastern portion of the property. Large areas of polluted fill are present in the western portion of the property, and storage tanks and hydrocarbon leaks in the central and eastern portions of the property will require removal and remediation (Church et al., 2018).

The landscape comprises three zones: a gradually sloping, mostly paved western area, a flat central corridor between the two mill buildings, and a flat eastern area adjacent to a community center. All of these zones are bordered by Candlewood Hill Brook to the south and the accompanying riparian ecosystem. Much of the opportunistic vegetation occupying the space between the asphalt and the riparian community is listed as invasive and will require eradication and/or management.

The site is well connected to major roads, natural resources and trail systems. Two entrances, one on the east and another on the west, with parking on both sides creates easy vehicle access to and within the site. Pedestrian access is limited by lack of sidewalks and the steepness of slopes north of the site. Within one quarter mile are state parks, including Higganum Reservoir State Park trail system to the south along Hull Avenue.

The southern canopy along the Candlewood Hill Brook provides shade.

The site contains two historic buildings with a wide, open space in between.

Candlewood Hill Brook and the accompanying riparian ecology are an excellent resource for conservation education.

The southern building sits within the floodplain and is at risk of inundation.
NATURAL DIVERSITY

The Scovil Mill site is located one half mile from the Connecticut River. The riparian communities associated with the river and its numerous tributaries, one of which runs along the site’s southern boundary, can potentially support CTRC&D’s goals of conservation education, and recreation/tourism business development.

The site is within a significant natural diversity area, as defined by the Connecticut Department of Energy and Environmental Protection, which is home to state listed animal species (either endangered, threatened, or of special concern) and significant natural plant communities. From an education standpoint the site has the potential to serve as a living classroom educating visitors about the diversity of organisms found in riparian areas and their associated local ecologies. The Seven Falls State Park, Higganum Reservoir State Forest, and Cockaponset State Forest to the north, south, and southeast of the site, respectively, expand the living classroom by providing examples of healthy forest ecosystems for observation.

The Connecticut River and Higganum Reservoir offer excellent recreational opportunities and a rural business incubator could potentially support recreation-based businesses.

Candlewood Hill Brook along the southern boundary of the site.

Higganum Reservoir is only a short walk from the site. CTRC&D could help to raise visitors’ awareness of this natural resource.

Cockaponset State Forest to the southeast offers an excellent example of a healthy forest ecosystem and can provide a living classroom for conservation education.

Candlewood Hill Brook is lined with diverse vegetation, but many plants are invasive which could negatively impact the sensitive ecosystem in this area.

Natural Diversity Area
- Scovil Mill Site
- State Forest
- Water bodies
- Municipal
- Residential, Commercial, Other
- School
- Cemetery

Seven Falls State Park
Higganum Reservoir
Cockaponset State Forest
Higganum Reservoir State Park
Scovil Mill Site
Candlewood Hill Brook
Connecticut River
Higganum Reservoir
Not for construction. Part of a student project and not based on a legal survey.
SUN & SHADE

Sun exposure influences the type and density of vegetation on the landscape, and is also critical to the atmosphere of the site. CTRC&D is seeking a landscape aesthetic which is both inviting and comfortable for visitors in all seasons.

The riparian canopy which has developed on the slope adjacent to the brook shades the southern portion of the site from spring through autumn. The lack of vegetation on the remainder of the site results in full sun conditions year round, with the exception of shade cast to the north of buildings. The gradient of sun exposure will allow for a diversity of vegetation adapted to varied light conditions.

The site is exposed to the sun in the cooler shoulder seasons and shaded at least partially during hot summer months, particularly in the central open area between the two mill buildings.

Aside from the obvious considerations of visual appeal and comfort, CTRC&D also seeks to incorporate a greenhouse for the exhibition of sustainable indoor production strategies. This will require full sun exposure throughout the growing season. A sun/shade model (right) indicates that the northern half of the site receives the most sun exposure.

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The open space between the buildings may be too hot in the summer.

The canopy trees along the southern boundary of the site provide ample shade across the southern half of the site throughout the growing season while allowing the central core of the site to receive full sun.

The canopy to the north and south of the site provides an inviting feeling of enclosure but does not shade the site's center.

The center of the site remains in full sun year round with the exception of an area directly along the southern building's northern edge.

The sun/shade model illustrates:
- Full sun exposure
- Part sun exposure
- Limited sun exposure

The map above illustrates sun exposure in spring and autumn.

The map above illustrates sun exposure in summer.

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SLOPES & DRAINAGE

Steep slopes directly north of the northern building and across the brook to the south create a feeling of enclosure on the site.

Most of the site slopes gradually toward the village center to the east. This eastern aspect and close proximity to the village makes the site feel as though it is connected to the community’s activity.

Because most of the site is polluted from industrial use and paved in impervious asphalt, polluted runoff enters the brook after significant rain events (Church et al., 2018).

Fortunately most of the site has a gradual west to east drainage pattern which slows the momentum of runoff toward the brook. However, the eastern and southwestern portions of the property do slope toward the brook. Preventing stream bank erosion in these areas would help protect the brook.

Areas of steep slopes north and west of the northern building present complications for grading as trucks would be required to traverse this area when approaching the buildings from the west.

Beyond the flat area between the buildings, land slopes up to the western property boundary.

With slopes exceeding 10%, the northwest portion of the site is exposed to polluted runoff from Candlewood Hill Road.

Land slopes down steeply between Candlewood Hill Road and the buildings.

Not for construction. Part of a student project and not based on a legal survey.
FLOODING

Like many industrial mills of New England, the Scovil Mill depended on a natural resource which provided cheap hydropower energy for manufacturing. Because this form of power generation depends on harnessing the high volume of water flowing through Candlewood Hill Brook, the mill buildings were located as close as possible to the brook. For this reason, the infrastructure was intentionally constructed in the brook’s floodplain.

This location in the floodplain leaves the site vulnerable to flooding events. As shown in the map and cross section, 100-year and 500-year storm events lead to floodwaters abutting and inundating the southern building respectively. Because this hazard has implications for the safety of the CTRC&D staff and the site’s infrastructure over the long term, it will be a major consideration throughout the design process.

DAM HISTORY

While these flood levels take into consideration the volume of water flowing through the site during the extreme events mentioned, flood levels associated with dam breaks are unpredictable and extremely variable. Several community members reported that two notable floods associated with the failing of upstream dams in 1934 and 1982 inundated both buildings. The flood of 1982 involved the failing of the Upper Pond dam due to several small dam breaches upstream. Ten dams along Candlewood Hill brook are upstream of the Scovil Mill site. While the majority are of low hazard, four dams have higher level of hazard including the Upper Pond Dam (moderate hazard), the Black Shop and Bell Shop Pond Dams (significant hazard), and the Scovil Reservoir Dam (high hazard) (Midstate Regional Planning Agency and the Lower Connecticut River Valley Council of Governments, 2013).

The map above shows the significant dams which drain into Candlewood Hill Brook upstream of the site.

The Scovil Reservoir Dam’s high hazard classification means that failure of the dam would result in “probable loss of life, major damage to habitable structures and highways, and major economic loss” downstream (Midstate Regional Planning Agency and the Lower Connecticut River Valley Council of Governments, 2013). Detailed information about the current condition of this dam is unknown, however a report published by the Army Corps of Engineers in 1984 listed this dam as being in ‘poor’ condition. Because this dam is upstream of the Scovil Mill site and is of high hazard classification, an assessment of this dam should be performed, prior to the acquisition of the mill site by CTRC&D.

THE SCOVIL MILL CENTER, HIGGANUM, CT

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CLIMATE CHANGE

The increase in global temperatures associated with climate change has correlated with an increase in the intensity of rain events. This has lead to more abundant and destructive flooding events (Kundzewicz and Schellnhuber, 2004). Being in the floodplain of Candlewood Hill Brook, the historic mill site could undergo damage future extreme flooding events.
SUMMARY ANALYSIS

Over the two centuries in which this site has served as an industrial mill and Department of Transportation facility, little has been done to improve of the landscape in terms of its natural resources. In proposed reuse of the historic industrial site, creates opportunities to improve the site for commercial use while mitigating harmful impacts on the stream. The site has been vacant for four years. Historic buildings remain intact and have the potential to house CTRC&D’s proposed programming, thereby expanding the commercial activity of the village and the Town of Haddam. Major design considerations include the following:

1. The historical architecture of the mill buildings and their position nestled between steep slopes to the north and south creates a unique atmosphere for the programming needs of the client.

2. The site’s proximity to the village center, town green, and nearby state parks may help draw visitors, but pedestrian access to the site from the village and state parks is limited.

3. Two entrances off of Candlebrook Hill Road connect to large flat areas suitable for parking. The landforms will help to delineate the parking and pedestrian zones.

4. A novel ecology has formed in the wake of the site’s abandonment. Although it is located in a larger region of significant natural plant communities, its prior land uses have encouraged the growth of invasive vegetation that may require management.

5. The site is within a floodplain where 100-year and 500-year flood would inundate at least one of the buildings requiring the landscape to work with the floodwater or fortify against it.

6. Impervious surfaces and pollutants in the site’s soils may inhibit the ecological function of the site and the brook. This may also have implications for the health of the Connecticut River less than half a mile downstream.

7. A large, flat, and sunny area between the mill buildings presents opportunities for indoor/outdoor programming but some seasonal protection from the sun may be needed.
DESIGN ALTERNATIVES 1

These 3 design concepts were based on client and community feedback. Each focuses on different ways to respond to the increase in future flood events.

- “Inner Forest” design restores the riparian ecology.
- “Above the Water” flood proofs the infrastructure.
- “Protect from the Flood” diverts the water from the infrastructure.

INNER FOREST
A natural riparian ecosystem is regenerated, filling the floodplain. The roof of the southern building is removed and the historic shell is filled with interior gardens that extend into the landscape. Vegetation is restored on the west and east for demonstration gardens that serve as a buffer to the brook. A center plaza supports market and cafe visitor use and a boardwalk brings visitors from this space to the brook. A bridge over the brook connects with a pathway to the Higganum Reservoir State Park. Shared offsite parking on adjacent properties further supports the site’s restoration and Candlewood Hill Road is closed at the village green access road for safe pedestrian flow. A bioswale along the southern portion of the property slows and treats runoff.

ADVANTAGES
- Existing sensitive riparian ecology is augmented.
- Restoration efforts provide an opportunity for education in support of the organization’s goals.
- Vehicle access is limited, encouraging pedestrian flow.
- Indoor garden in south building provides opportunity for a unique event space experience.
- Site allows flood water to rise without putting people at risk.

DISADVANTAGES
- Programming is reduced in southern buildings.
- Seasonally limited usage of southern building.

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DESIGN ALTERNATIVES 2

ABOVE THE WATER

In response to base flood elevations (BFE) the building floor is elevated to the design floor elevation (DFE). A platform at the same DFE between the buildings acts as a connector to the north and south buildings, and extends out over the lawn area at the west and Candlewood Brook to the south. This central core acts as one functional space interacting with the buildings and the brook. A catwalk extends from Candlewood Hill Road south of the village green above the two mill buildings, and across the brook to Maple Avenue East establishing connections to the site from the Village Green, Hull Avenue, and Higganum Reservoir State Park.

ADVANTAGES

Mitigates the effects of potential floodwaters by allowing water to flow below elevated floor and platform heights.
Unified connections of the buildings are realized through the outdoor platform, catwalk, and boardwalk.
Limits parking on site to 48 spots and shares with adjacent parking lots.

DISADVANTAGES

Significant grading will be required for truck off loading at the western end of the northern building.
Parking off site will require town planning approval.
Significant changes to building infrastructure will be required.
DESIGN ALTERNATIVES 3

PROTECT FROM THE FLOOD
A berm to the southwest of the buildings protects them from potential flood inundation. It hugs an outdoor patio extension off the southern building. A center plaza between the north and south buildings supports an indoor/outdoor market and cafe. Recreational and garden space located on the western portion of the property furthers the outdoor experience on site. A mobile market and event space located on the eastern side of the site connects to both the mill buildings and the village center.

Village Green

ADVANTAGES
Protection against flooding limits damage to infrastructure and potential soil erosion.
Building programming is supported with parking with 80 combined spots on the western and eastern portions of the property.
The center plaza is an interactive space for community gathering.

DISADVANTAGES
Commercial vehicle access to the buildings is limited.
A levee to armor the site doesn’t guarantee flood proofing of infrastructure and may require annual maintenance.

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Commercial vehicle access to the buildings is limited.
A levee to armor the site doesn’t guarantee flood proofing of infrastructure and may require annual maintenance.
The design assumes increased extreme weather events and inundation of the site. Raised interior floor heights and a deck platform extending out and around both buildings helps to connect the interior and outdoor spaces. The unique design elements draw people to this location, supporting a regional market, event and office space and an education center. The Scovil Mill Center is linked to the neighborhood and regional resources for eco-tourism.

**1 PLAZA AREA**
A deck connects to both buildings and aligns at the raised building floor height to protect it from flood inundation. It connects the indoor programming of both structures. Decks extend over the brook from the southern building and west towards the outdoor event area. The deck allows for various seating options in the central core of the site. Vegetation is planted in the deck openings to provide shade. Paths leading up to the platform entrances on the west and east are ADA accessible.

**2 SHARED PARKING**
The Village Green parking lot across Candlewood Hill Road could provide shared parking opportunities to minimize paving on site. A crosswalk from the green across the road and into the site provides easy pedestrian access to and from other village amenities and establishes stronger connections. Making Candlewood Hill Road a one-way road with on-street parking also increases parking capacity nearby. Parking is shared in the east lot with the Community Center. Three handicapped spots are provided as well as a bike rack.

**3 GREENHOUSE**
A 4,000 sf greenhouse is positioned in the north to maximize sun exposure and is built into the side of the hill to maintain optimal views of the mill buildings from the eastern arrival.

**4 MARKET AREA**
The front area serves as flexible space for mobile markets or pop-up markets.

**5 EDUCATION/PLAY AREA**
A play area is framed with 2’ tall granite blocks that are reminiscent of a demolished building’s foundation (see map on page 19). Water harvested from the southern building roof is funneled through and simulates an old dam system. The play area demonstrates how water once powered the building. The granite blocks function as seating for parents while kids are playing.

**6 BRIDGE AND TRAIL**
A footbridge across Candlewood Brook connects with a proposed trail along the brook’s southern edge. A second bridge brings people back over the property.

**7 ATRIUM**
Replacing a portion of the existing building’s roof with a glass roof creates a greenhouse and allows for vegetation indoors. The solar gain increases the thermal energy and allows natural light in. The plants create a unique indoor experience throughout all seasons. The southern building opens in the plaza via two garage doors on the north and a third on the western side.

**8 OUTDOOR EVENT AREA**
The existing dam foundation walls are rebuilt to 3’ in height and frame a lawn area for outdoor events such as wedding receptions, café overflow, and birthday rentals. Pollinator gardens border the stone walls.

**9 PARKING AREA**
Two entrance points along Candlewood Hill Brook bring visitors to a parking lot with 50 total parking spots including 3 universally accessible spots. The lot is covered in porous paving and contains vegetated islands and pollinator strips. An ADA-accessible path leads down from the parking area to the platform that connects the north and south buildings.

**10 TRUCK LOADING**
One entrance to the site allows truck access to the western portion of the north building. Truck parking during market and other events is provided at the far western portion of the parking lot.
Visitors can flow through the landscape to and from the buildings to experience the landscape on the deck and down into the lawn area framed by the foundations of the old dam. A footbridge over Candlewood Hill Brook connects to a trail that leads further south to a local stair park.

The deck connects the two buildings and extends out into the landscape where visitors can enjoy sitting outside and overlooking Candlewood Hill Brook on the southern end of the property.

Inside the buildings are a regional market in the northern building and an atrium in the southern building which serves as a unique venue for events and a café.
DESIGN SKETCHES

The site connects to the village green to the north via pathways flowing from the site's center. A 4,000 sf greenhouse provides opportunity for food production and education. A rainwater cistern feeds into a simulated dam system for education purposes in an interactive play area.

An interactive play area demonstrates how hydroelectric power is generated and highlights the implications of dammed river systems for infrastructure downstream. Educational signs describe how the trees species shading the area help to remediation pollution below ground.
DESIGN SECTIONS

Section A: North-Facing View

Section A: South-Facing View

Section B: East-Facing View

Not for construction. Part of a student project and not based on a legal survey.
DESIGN SECTIONS

Section C: East Facing View

Residential | Candlewood Hill Road | Vegetation to catch road runoff | Interior Market | Deck | Stairs & ADA Ramp | Deck off cafe | Glass atrium south building | Deck over Candlewood Brook | Candlewood Brook | Trail | Residential

Section D: West Facing View

Residential | Trail | Bridge over Candlewood Hill Road | Lawn area for events. 3' stone wall with pollinator garden | ADA accessible path | Truck loading | Candlewood Hill Road | Residential

Vegetation to catch road runoff

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## PLANT LIST

### Pollinator habitat

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
<th>FLOWER COLOR</th>
<th>HT</th>
<th>SEASON</th>
<th>SUN</th>
<th>SOIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquilegia canadensis</td>
<td>wild columbine</td>
<td>red &amp; yellow</td>
<td>12-15”</td>
<td>May-Jun</td>
<td>part shade, shade</td>
<td>sandy, well drained</td>
</tr>
<tr>
<td>Asclepias spp.</td>
<td>milkweed, butterfly weed</td>
<td>yellow to orange</td>
<td>1-3’</td>
<td>May-Aug</td>
<td>sun to part shade</td>
<td>dry to moist</td>
</tr>
<tr>
<td>Baptisia australis</td>
<td>false blue indigo</td>
<td>blue-purple</td>
<td>3-6’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>dry to moist</td>
</tr>
<tr>
<td>Coreopsis tripteris</td>
<td>purple coneflower</td>
<td>pink</td>
<td>2-4’</td>
<td>Jun-Aug</td>
<td>full sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Leptosyne spp.</td>
<td>globe thistle</td>
<td>blue-purple</td>
<td>2-4’</td>
<td>Jun-Aug</td>
<td>full sun</td>
<td>dry to moist</td>
</tr>
<tr>
<td>Eupatorium spp.</td>
<td>Joe-Pye weed, boneset</td>
<td>pink, purple</td>
<td>1-10’</td>
<td>Jul-Oct</td>
<td>sun to part shade</td>
<td>medium wet to wet</td>
</tr>
<tr>
<td>Geranium spp.</td>
<td>cranesbill</td>
<td>purple or pink</td>
<td>1-2’</td>
<td>Apr-Jul</td>
<td>full sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Hakonechloa spp.</td>
<td>susuki</td>
<td>yellow</td>
<td>1-6’</td>
<td>Jul-Oct</td>
<td>full sun to part shade</td>
<td>dry, well drained</td>
</tr>
<tr>
<td>Liatris spp.</td>
<td>blazing star</td>
<td>rose-purple</td>
<td>3-6’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>dry to moist</td>
</tr>
<tr>
<td>Solidago spp.</td>
<td>goldenrod</td>
<td>yellow</td>
<td>1-6’</td>
<td>Jun-Oct</td>
<td>sun to part shade</td>
<td>dry to wet, well drained</td>
</tr>
<tr>
<td>Viola pedata</td>
<td>bird’s foot violet</td>
<td>purple</td>
<td>3-8”</td>
<td>Apr-Jun</td>
<td>full sun or filtered shade</td>
<td>dry to med wet</td>
</tr>
</tbody>
</table>

### Riparian zone trees and shrubs

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
<th>FLOWER COLOR</th>
<th>HT</th>
<th>SEASON</th>
<th>SUN</th>
<th>SOIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer rubrum</td>
<td>red maple</td>
<td>red</td>
<td>40-70’</td>
<td>Mar-Apr</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Amelanchier spp.</td>
<td>serviceberry</td>
<td>white</td>
<td>6-25’</td>
<td>Mar-Apr</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Cornus sericea</td>
<td>redosier dogwood</td>
<td>white</td>
<td>6-12’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>med wet to wet</td>
</tr>
<tr>
<td>Hamamelis virginiana</td>
<td>witchhazel</td>
<td>yellow</td>
<td>15-20’</td>
<td>Oct-Nov</td>
<td>sun to part shade</td>
<td>moist</td>
</tr>
<tr>
<td>Kalmia latifolia</td>
<td>mountain laurel</td>
<td>pink-lavender</td>
<td>12-20’</td>
<td>May-Jun</td>
<td>part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Liriodendron tulipifera</td>
<td>tuliptree</td>
<td>orange</td>
<td>60-90’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Cercis canadensis</td>
<td>Eastern redbud</td>
<td>pink-lavender</td>
<td>20-30’</td>
<td>Apr-May</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Gleditsia triacanthos</td>
<td>honey locust</td>
<td>white</td>
<td>30-50’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>moist, drought tolerant</td>
</tr>
<tr>
<td>Juniperus virginiana</td>
<td>Eastern red cedar</td>
<td>non-flowering</td>
<td>30-60’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>dry to moist</td>
</tr>
<tr>
<td>Physocarpus opulifolius</td>
<td>common ninebark</td>
<td>pink</td>
<td>3-5’</td>
<td>May-July</td>
<td>part shade</td>
<td>moist to wet</td>
</tr>
<tr>
<td>Quercus bicolor</td>
<td>swamp white oak</td>
<td>yellow</td>
<td>50-80’</td>
<td>Apr-May</td>
<td>sun to part shade</td>
<td>dry to wet, average</td>
</tr>
<tr>
<td>Acer rubrum</td>
<td>red maple</td>
<td>red</td>
<td>40-70’</td>
<td>Mar-Apr</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Amelanchier spp.</td>
<td>serviceberry</td>
<td>white</td>
<td>6-25’</td>
<td>Mar-Apr</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Cornus sericea</td>
<td>redosier dogwood</td>
<td>white</td>
<td>6-12’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>med wet to wet</td>
</tr>
<tr>
<td>Hamamelis virginiana</td>
<td>witchhazel</td>
<td>yellow</td>
<td>15-20’</td>
<td>Oct-Nov</td>
<td>sun to part shade</td>
<td>moist</td>
</tr>
<tr>
<td>Kalmia latifolia</td>
<td>mountain laurel</td>
<td>pink-lavender</td>
<td>12-20’</td>
<td>May-Jun</td>
<td>part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Liriodendron tulipifera</td>
<td>tuliptree</td>
<td>orange</td>
<td>60-90’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Cercis canadensis</td>
<td>Eastern redbud</td>
<td>pink-lavender</td>
<td>20-30’</td>
<td>Apr-May</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Gleditsia triacanthos</td>
<td>honey locust</td>
<td>white</td>
<td>30-50’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>moist, drought tolerant</td>
</tr>
<tr>
<td>Juniperus virginiana</td>
<td>Eastern red cedar</td>
<td>non-flowering</td>
<td>30-60’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>dry to moist</td>
</tr>
<tr>
<td>Physocarpus opulifolius</td>
<td>common ninebark</td>
<td>pink</td>
<td>3-5’</td>
<td>May-July</td>
<td>part shade</td>
<td>moist to wet</td>
</tr>
<tr>
<td>Quercus bicolor</td>
<td>swamp white oak</td>
<td>yellow</td>
<td>50-80’</td>
<td>Apr-May</td>
<td>sun to part shade</td>
<td>dry to wet, average</td>
</tr>
<tr>
<td>Acer rubrum</td>
<td>red maple</td>
<td>red</td>
<td>40-70’</td>
<td>Mar-Apr</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Amelanchier spp.</td>
<td>serviceberry</td>
<td>white</td>
<td>6-25’</td>
<td>Mar-Apr</td>
<td>sun to part shade</td>
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<tr>
<td>Cornus sericea</td>
<td>redosier dogwood</td>
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</tr>
<tr>
<td>Hamamelis virginiana</td>
<td>witchhazel</td>
<td>yellow</td>
<td>15-20’</td>
<td>Oct-Nov</td>
<td>sun to part shade</td>
<td>moist</td>
</tr>
<tr>
<td>Kalmia latifolia</td>
<td>mountain laurel</td>
<td>pink-lavender</td>
<td>12-20’</td>
<td>May-Jun</td>
<td>part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Liriodendron tulipifera</td>
<td>tuliptree</td>
<td>orange</td>
<td>60-90’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Cercis canadensis</td>
<td>Eastern redbud</td>
<td>pink-lavender</td>
<td>20-30’</td>
<td>Apr-May</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Gleditsia triacanthos</td>
<td>honey locust</td>
<td>white</td>
<td>30-50’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>moist, drought tolerant</td>
</tr>
<tr>
<td>Juniperus virginiana</td>
<td>Eastern red cedar</td>
<td>non-flowering</td>
<td>30-60’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>dry to moist</td>
</tr>
<tr>
<td>Physocarpus opulifolius</td>
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<td>3-5’</td>
<td>May-July</td>
<td>part shade</td>
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</tr>
<tr>
<td>Quercus bicolor</td>
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<td>yellow</td>
<td>50-80’</td>
<td>Apr-May</td>
<td>sun to part shade</td>
<td>dry to wet, average</td>
</tr>
<tr>
<td>Acer rubrum</td>
<td>red maple</td>
<td>red</td>
<td>40-70’</td>
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<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Amelanchier spp.</td>
<td>serviceberry</td>
<td>white</td>
<td>6-25’</td>
<td>Mar-Apr</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
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<tr>
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<td>redosier dogwood</td>
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<td>Oct-Nov</td>
<td>sun to part shade</td>
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</tr>
<tr>
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<td>mountain laurel</td>
<td>pink-lavender</td>
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<td>tuliptree</td>
<td>orange</td>
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<tr>
<td>Cercis canadensis</td>
<td>Eastern redbud</td>
<td>pink-lavender</td>
<td>20-30’</td>
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<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
<tr>
<td>Gleditsia triacanthos</td>
<td>honey locust</td>
<td>white</td>
<td>30-50’</td>
<td>May-Jun</td>
<td>sun to part shade</td>
<td>moist, drought tolerant</td>
</tr>
<tr>
<td>Juniperus virginiana</td>
<td>Eastern red cedar</td>
<td>non-flowering</td>
<td>30-60’</td>
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<td>sun to part shade</td>
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</tr>
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<td>moist, well drained</td>
</tr>
<tr>
<td>Amelanchier spp.</td>
<td>serviceberry</td>
<td>white</td>
<td>6-25’</td>
<td>Mar-Apr</td>
<td>sun to part shade</td>
<td>moist, well drained</td>
</tr>
</tbody>
</table>
HYDROCARBON REMEDIATION AGENTS

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
<th>HEIGHT</th>
<th>SUN</th>
<th>SOIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cercis canadensis</td>
<td>Eastern red bud</td>
<td>20-30'</td>
<td>Sun to part shade</td>
<td>Moist, well drained</td>
</tr>
<tr>
<td>Prunus pensylvanica</td>
<td>Green ash</td>
<td>50-70'</td>
<td>Sun to part shade</td>
<td>Moist, well drained</td>
</tr>
<tr>
<td>Ulmus americana</td>
<td>Honey locust</td>
<td>60-50'</td>
<td>Full sun</td>
<td>Moist, drought tolerant</td>
</tr>
<tr>
<td>Juniperus virginiana</td>
<td>Eastern red cedar</td>
<td>60-50'</td>
<td>Full sun</td>
<td>Dry</td>
</tr>
<tr>
<td>Menispermum canadense</td>
<td>Red mulberry</td>
<td>50-55'</td>
<td>Sun to part shade</td>
<td>Moist, well drained</td>
</tr>
<tr>
<td>Populus spp.</td>
<td>Willow, poplar, aspen</td>
<td>60-80'</td>
<td>Sun to part shade</td>
<td>Moist, flood tolerant</td>
</tr>
<tr>
<td>Quercus macrocarpa</td>
<td>Willow oak</td>
<td>50-70'</td>
<td>Sun to part shade</td>
<td>Moist</td>
</tr>
<tr>
<td>Quercus phellos</td>
<td>Willow</td>
<td>60-50'</td>
<td>Sun to part shade</td>
<td>Moist, flood tolerant</td>
</tr>
</tbody>
</table>

**Herbaceous plants**

- Andropogon gerardii | Big bluestem | 4-6' | Full sun | Dry to moist
- Festuca pratensis | Blue grama grass | 2' | Full sun | Dry, drought tolerant
- Carex echinata | Meadow sedge | 2-3' | Full sun | Moist, flood tolerant
- Elodea canadensis | Canada wild rye | 2-5' | Full sun | Dry, drought tolerant
- Helianthus annuus | Sunflower | 6-10' | Full sun | Dry, drought tolerant
- Paspalium vaginatum | Switchgrass | 3-6' | Sun to part shade | Moist, drought tolerant
- Sagittaria latifolia | Arrowhead | 1-4' | Sun to part shade | Wet, flood tolerant
- Typha latifolia | Narrow leaf cattail | 2-4' | Full sun | Dry, drought tolerant
- Utricularia foliosa | punching cattail | 3-5' | Full sun | Dry, drought tolerant

The table above includes vegetation native to the Northeastern U.S. which have proven effective at hydrocarbon pollution remediation.

**HYDROCARBON REMEDIATION AGENTS**

While organic contaminants like hydrocarbons can be degraded into less toxic parts, heavy metals are problematic because they cannot be degraded or destroyed through biological processes (Chaney et al., 2010). However, using phytoremediation, metal accumulating plants like Indian mustard can be grown and harvested in polluted areas to remediate sites (Anjum et al., 2012). Some metals like arsenic have high bioavailability and can readily assimilate into plant bodies (Van der Ent et al., 2001, Barac et al., 1999). Others, like lead, require chelating agents to become bioavailable for absorption by roots (Zia et al., 2011).

Research regarding biological agents beyond plants is being done to address persistent inorganic contaminants. The proteobacteria Geobacter metallireducens have been shown to oxidize hydrocarbons in anoxic environments (Holliger et al., 1996). Additionally, the mushroom genera Agaricus, Armillaria, Boletus, Polyporus, Pleurotus, Russula, and Termitomyces have been proven to uptake heavy metals within their mycelial networks between soil particles (Raj et al., 2011).

**PERSISTENT POLLUTION**

While organic contaminants like hydrocarbons can be degraded into less toxic parts, heavy metals are problematic because they cannot be degraded or destroyed through biological processes (Chaney et al., 2010). However, using phytoremediation, metal accumulating plants like Indian mustard can be grown and harvested in polluted areas to remediate sites (Anjum et al., 2012). Some metals like arsenic have high bioavailability and can readily assimilate into plant bodies (Van der Ent et al., 2001, Barac et al., 1999). Others, like lead, require chelating agents to become bioavailable for absorption by roots (Zia et al., 2011).

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**SCOVIL MILL’S LEGACY**

Evidence of the Scovil Mill’s industrial legacy is obvious in its landscape and architecture. Like many historic industrial sites, a large amount of waste material and degrading infrastructure lies unseen below the surface. This material has contaminated the site with heavy metals and hydrocarbons (Church et al., 2018). Some hydrocarbons such as benzene and pyrene are known carcinogens (Church et al., 2018). Some hydrocarbons such as benzene and pyrene are known carcinogens (Church et al., 2018). Some hydrocarbons such as benzene and pyrene are known carcinogens (Church et al., 2018). Some hydrocarbons such as benzene and pyrene are known carcinogens (Church et al., 2018). Some hydrocarbons such as benzene and pyrene are known carcinogens (Church et al., 2018).

**SCOVIL MILL POND**

The Spar mill pond was created in 1881 by damming Candlewood Hill Brook for hydroelectric power and was later filled in 1941 with polluted soil and construction materials. Asphalt and coal fragments used to fill the pond contain PAHs (Polycyclic Aromatic Hydrocarbons), ETPH (Extractable Total Petroleum Hydrocarbons), and heavy metals (arsenic, lead). These contaminants are also spread throughout the property as a result of petroleum and hydraulic fluid spills (Church et al., 2018). Petroleum hydrocarbons are the most common contaminant of sediments and soils globally (Stroud et al., 2007).

Full remediation of the site using chemical and mechanical solutions is planned. However, in considering the educational goals of CTRC&D, there is great potential to highlight the rapidly developing field of phytotechnology and its utility as an agent of remediation. Numerous biological agents for remediation of some of the aforementioned contaminants on site are known. April and Sims 1990, Balcom and Crowley 2009, Barac et al., 1999, Cook and Hesterberg 2010, Euliss et al., 2011). Petroleum hydrocarbons are the most common contaminant of sediments and soils globally (Stroud et al., 2007).

**HYDROCARBON REMEDIATION AGENTS**

- **Trees**
  - *Cercis canadensis*: Eastern red bud
  - *Prunus pensylvanica*: Green ash
  - *Ulmus americana*: Honey locust
  - *Juniperus virginiana*: Eastern red cedar
  - *Menispermum canadense*: Red mulberry
  - *Populus spp.*: Willow, poplar, aspen
  - *Quercus macrocarpa*: Willow oak
  - *Quercus phellos*: Willow

- **Herbaceous plants**
  - *Andropogon gerardii*: Big bluestem
  - *Festuca pratensis*: Blue grama grass
  - *Carex echinata*: Meadow sedge
  - *Elodea canadensis*: Canada wild rye
  - *Helianthus annuus*: Sunflower
  - *Paspalium vaginatum*: Switchgrass
  - *Sagittaria latifolia*: Arrowhead
  - *Typha latifolia*: Narrow leaf cattail
  - *Utricularia foliosa*: Punching cattail
  - *Utricularia foliosa*: Indian grass

The table above includes vegetation native to the Northeastern U.S. which have proven effective at hydrocarbon pollution remediation.
COST ESTIMATE

The following costs are approximate. Site analysis, planning, and design will be required to evaluate the full cost of developing the former Scovil Mill.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>COST</th>
<th>QUANTITY 1</th>
<th>QUANTITY 2</th>
<th>QUANTITY 3</th>
<th>COST PHASE 1</th>
<th>COST PHASE 2</th>
<th>COST PHASE 3</th>
<th>TOTAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEMOLITION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fill removal</td>
<td>cubic yard</td>
<td>TBD</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearing and grubbing</td>
<td>acre</td>
<td>$8,000</td>
<td>1.25</td>
<td>0.75</td>
<td>$10,000</td>
<td>$0</td>
<td>$6,000</td>
<td>$16,000</td>
<td>$0</td>
</tr>
<tr>
<td>Asphalt removal (assume part of remediation)</td>
<td>square yard</td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Subtotal</td>
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<td>$10,000</td>
<td>$0</td>
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<td>$16,000</td>
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<td>Landscaping</td>
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<tr>
<td>Erosion &amp; sediment control</td>
<td>lf</td>
<td>$5</td>
<td>500</td>
<td>300</td>
<td>$2,500</td>
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<tr>
<td>Grading</td>
<td>sf</td>
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<td>9000</td>
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<td>$7,000</td>
<td>$1,350</td>
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<tr>
<td>Imported topsoil</td>
<td>cy</td>
<td>$55</td>
<td>960</td>
<td>160</td>
<td>510</td>
<td></td>
<td>$52,800</td>
<td>$8,800</td>
<td>$28,050</td>
</tr>
<tr>
<td>Bark mulch</td>
<td>cy</td>
<td>$50</td>
<td>480</td>
<td>80</td>
<td>260</td>
<td></td>
<td>$24,000</td>
<td>$4,000</td>
<td>$13,000</td>
</tr>
<tr>
<td>Trees (2’ caliper)</td>
<td>each</td>
<td>$400</td>
<td>25</td>
<td>8</td>
<td>15</td>
<td></td>
<td>$10,000</td>
<td>$3,200</td>
<td>$6,000</td>
</tr>
<tr>
<td>Shrubs (average 3’ center)</td>
<td>1 gallon</td>
<td>$25</td>
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Not for construction. Part of a student project and not based on a legal survey.
## COST ESTIMATE

The map above shows the proposed phases of development on the site.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>UNIT COST</th>
<th>QUANTITY PHASE 1</th>
<th>QUANTITY PHASE 2</th>
<th>QUANTITY PHASE 3</th>
<th>COST PHASE 1</th>
<th>COST PHASE 2</th>
<th>COST PHASE 3</th>
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</tbody>
</table>
CONCEPTUAL CONSTRUCTION DETAILS

CONCEPTUAL DETAIL OF TREE IN DECK AREA

- 2" caliper tree
- Weather resistant wood decking
- Burlap and wire basket completely removed.
- 2" caliper tree
- Pressure treated post, set plumb
- Prepared subgrade

CONCEPTUAL DETAIL OF RAISED FLOOR PLAN

- Elevated floor level
- Existing floor level
- 6" of imported topsoil
- Prepared subgrade
- 2" wide vent closed at night
- UV resistant polyethylene film
- Concrete wall for structural support
- 2" Steel beam for structural support
- Prepared subgrade
- Cotton curtain rolled down at night

CONCEPTUAL DETAIL OF PASSIVE SOLAR GREENHOUSE

- 2" caliper tree
- Weather resistant wood decking
- Burlap and wire basket completely removed.
- 2" caliper tree
- Pressure treated post, set plumb
- 6" of imported topsoil

Disclaimer: Final construction details to be designed by others.

Not for construction. Part of a student project and not based on a legal survey.
MATERIAL + PRECEDENTS

Open air cafe with seating along a river at the Book Mill in Montague, MA. Image courtesy of Renee Ruhl.

Ithaca Farmer’s Market is in a floodplain with an open construction without walls to accommodate variable water levels. Image courtesy of Wikipedia.

Landscape character of sloping path and stairway leading from parking to elevated Pulaski Park. Image courtesy of Renee Ruhl.

Abandoned infrastructure at Duisburg-Nord frames gardens providing a unique outdoor experience. Image courtesy of WikiCommons.

Granite blocks repurposed in a public park. Image courtesy of Renee Ruhl.

A water feature at Smale Park in Cincinnati, OH, is an educational playscape for children. Image courtesy of Sasaki.

A wooden bridge provides pedestrian access over a brook. Image courtesy of WikiCommons.

Vegetation planted within an atrium. Ford Foundation Atrium. Image courtesy of WikiCommons.

Passive solar greenhouse in Ladakh, India. Image courtesy of Mother Earth News.

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REFERENCES


