Landscape Design for Nutwood Farm

Growth and Regenerative Opportunities in a Young Agroforestry System

Nutwood Farm Landscape Design
For: Seva Tower and Kalyan Uprichard
76 Porter Hill Road
Cummington, MA 01060

Designer: Lisa Krause
The Conway School
Fall 2018

Index

Introduction and Project Goals

NUTWOOD FARM is a young 7-acre, diverse ecological agricultural operation in Cummington, Massachusetts, with the goal of cultivating a wide variety of edible perennial nuts, fruits and grains for the region. The farm is designed to be as productive as possible while also attending to continuous soil building, nutrient cycling, and wise resource management through crop diversity, effecient processing, zero-waste, and local distribution.

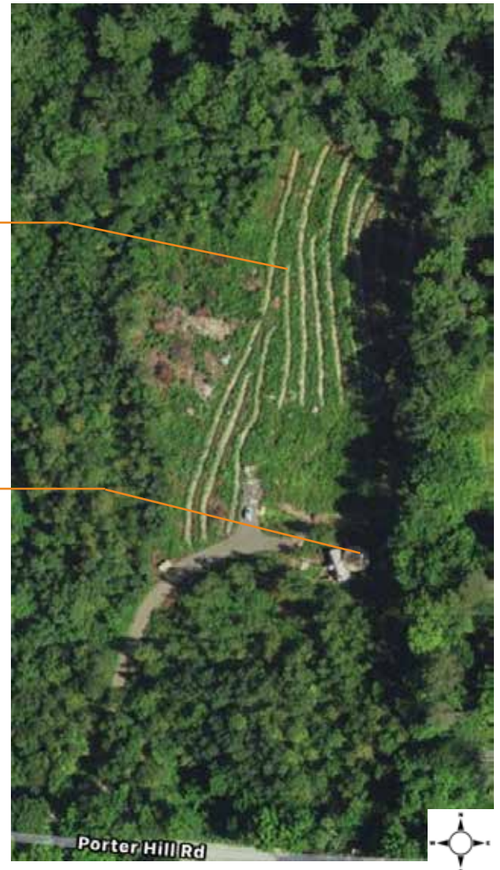
Nutwood Farm intends to become Massachusetts' first small-scale nut farm, offering English walnut, Chinese and American hybrid chestnut, Korean stone pine, Michigan pecan, Siberian pea shrub, hazelnut, butternut and heartnut. These trees are integrated into a series of diverse hedgerows. As the canopy matures it will be interspersed with small-scale annual grains, vegetables, mushrooms, and livestock. Owners Seva Tower and Kalyan Uprichard hope the farm will become part of the forefront of young innovative farms shaping the future of small-scaled, community based, ecologically sound, regenerative food systems.

Seva Tower and Kalyan Uprichard, www.nutwoodfarm.com

THE NUTWOOD FARMERS

Seva Tower and Kalyan Uprichard met at the 2014 Permaculture Conference in Unity, Maine. In 2015, they purchased property at 76 Porter Hill Road and began to transition the site from a spontaneous forest that had regrown from a clear-cut Christmas tree farm into a perennial nut farm. With strong backgrounds in farming, they selectively hand-cleared the land and contoured the west-facing slope with a series of swales and hugelkultur berms, planting them with young nut trees with the help of friends and their community. They currently live in a yurt on the property while they build their straw-bale home. They plan to continue living off-grid and operate as a vehicle-less farm, managing everything by hand or with the help of small livestock. They have ducks and plan on having geese and sheep or goats. In addition to their farming knowledge and experiences, they have obtained consultation through Keyline Vermont and have had a Conservation Plan prepared by the USDA Hampshire County Field office for the property.

Young nut orchard, October 2018.



Aerial property photo of 76 Porter Hill Road, Apple Maps.

PROJECT GOALS

Seva and Kalyan expressed interest in several project goals. These include adding to their existing water catchment systems of swales and small ponds in order to increase water storage for the farm, while addressing water runoff and sediment entering the southwest of the property. Because their farm is young and growing, they were also looking for input on siting buildings and infrastructure for their expanding operation (farmstore, parking, propagation greenhouses, rustic intern housing) while considering efficient circulation routes throughout the property.

SLOW & STORE WATER

- Mitigate runoff, stabilize existing berms, explore opportunities for bioremediation
- Increase water storage on site for crops

SITE BUILDINGS & PARKING *(clients' ideal specifications)*

- Farmstore *(approximately 20' x 40')*
- Parking pad *(for 3 small cars)*
- Intern camp area *(rustic, no utilities required)*
- Greenhouses *(two structures: 100' x 30' each)*

REINFORCE EFFICIENT CIRCULATION

- Create efficient walking routes for maintenance, harvesting, and linking zones of use.
- Create distinct zones with different uses and characteristics

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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause

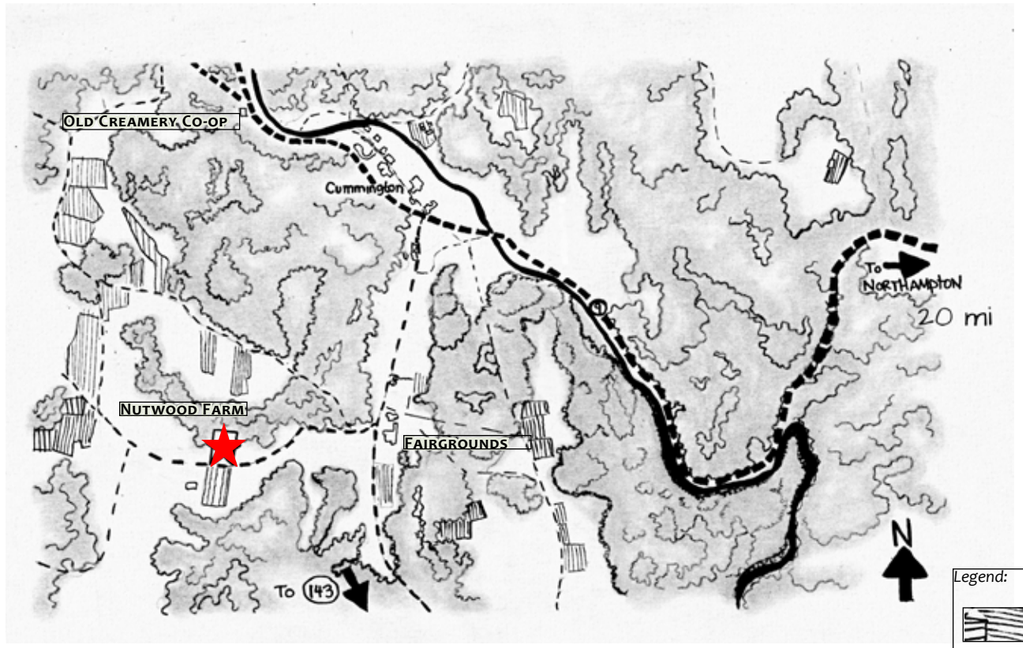
Fall 2018

Introduction & Goals
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington MA 01026

A Strong Farming community in a Rural and Forested Hilltown

Cummington is a small hilltown of the Berkshire Mountains in western Massachusetts at an elevation of approximately 1,300 feet. The town has a population of 876, which is a decline from the last census in 2010. The town is rural, and largly forested with significant agricultural land. As young farmers, Kalyan and Seva are very involved with the strong farming community in the area, an involvement which is integral to a rural lifestyle through sharing knowledge and community support.

The Westfield River flows through town, bringing visitors to enjoy recreational activities such as kayaking, hiking, and fishing. There are many areas along the waterways designated as priority habitats by the Natural Heritage & Endangered Species Program (NHESP), which has helped establish the Westfield River as an official *National Wild and Scenic River*. In addition to the river, area attractions also include the Old Creamery Co-op and the Cummington Fairgrounds. With these sites in the area already drawing visitors, it is possible that Nutwood Farm's future farmstore could draw these and additional visitors. The farm could benefit from the growing popularity of agri-tourism and hands-on activities, or workshops Nutwood Farm may offer could be promoted through these local resources.



Aerial property photo, 2005.

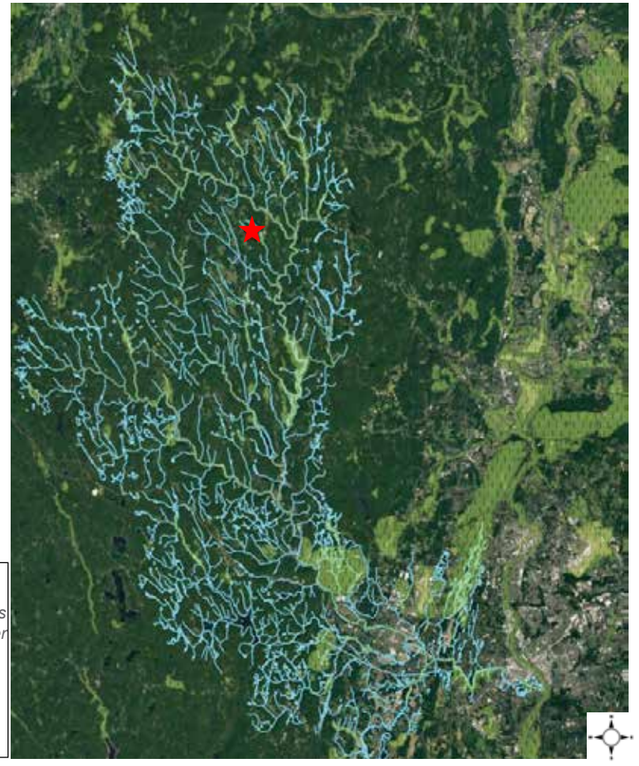
Legend:
- Farmland
- Major Roads
- Secondary Roads
- Westfield River

Old Creamery Co-op

Westfield River

Cummington Fairgrounds, David Fessenden 2015

Tower Brook



Nutwood Farm, located high in the Westfield River watershed

Legend:
- Rivers & Streams of Westfield River Watershed
- NHESP Priority Habitat
- Nutwood Farm

Nutwood Farm is 2 miles from the center of town and 1/2 mile from the fairgrounds, situated higher up in the mountains along a rural, forested road lined with several private homes and farms. Therefore it is likely that visitors would arrive to the farm by car. The property is located high in the watershed, with Tower Brook starting just northwest of the property and skirting along the stone wall at the corner of the property, eventually winding its way to the Westfield River.

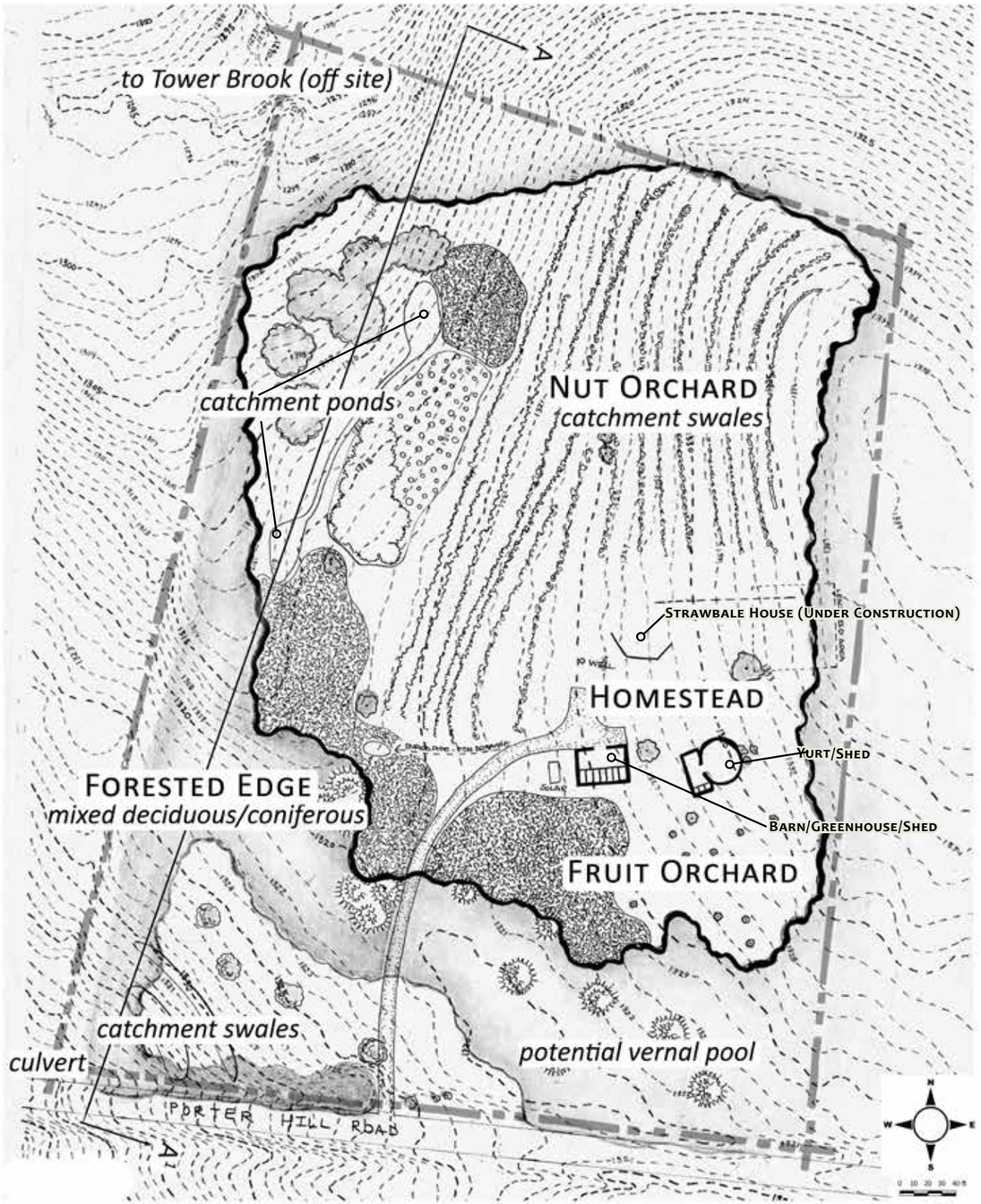
The stone walls that surround the property are recognized as the property boundaries and indicitive of past history as a New England sheep pasture. Some years later it became a Christmas tree farm which then was clear-cut 25 years before Seva and Kalyan purchased the property. The clearcutting of the Christmas tree farm is evident in the decomposing stumps throughout the property, which is characterized by heavily acidic soil. Such a large scale previous disturbance as clearcutting from heavy machinery may have also compacted soils and influenced the topography of the land.

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

CONTEXT
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

A Young Farm on a Great Mission

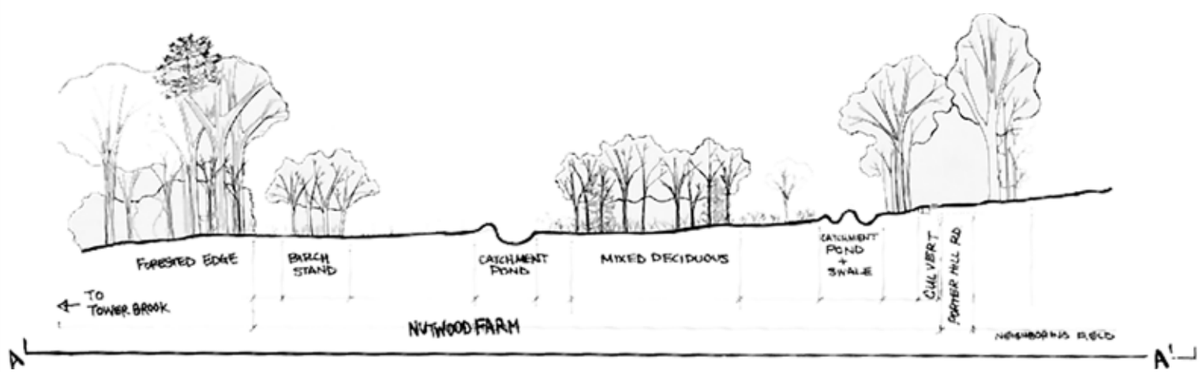


Nutwood Farm is an off-grid homestead, relying on a hand-pumped well and newly-wired 1 KW solar panel. The yurt is heated by a central wood stove and wood is also used for cooking. Seva and Kalyan use a composting toilet. Near the yurt is a small greenhouse, which doubles as a goat barn and tool shed. It was recently constructed and will be used for curing and processing nuts.

Across the gravel driveway is a recently poured foundation indicating the site of their permanent home, currently under construction with Kalyan and Seva doing much of the work themselves. It will be earth-banked with strawbale construction and an attached, south-facing geodesic dome greenhouse. They plan to install a geothermal-type heating system, composting toilet, and fiberoptic passive solar lighting. Due to a high water table, greywater will be pumped to an uphill leachfield.

The property is cradled by an 80' tall border of mixed-deciduous and coniferous trees with an understory of brambles and wildflowers which extend into newly-cleared areas to the south and east. The homestead is surrounded by lush annual garden beds with flowering herbs under a young oak and several birch trees, which provide shade for an outdoor dining table. To the south beyond the kitchen gardens, there is the largest of several rock-lined firepits situated in secluded places across the property, with this one at the edge of a young fruit orchard underplanted with polycultures. To the north are 15 swales dug on countour descending a west-facing slope, which were laid out using an A-frame level and a bunyip. Each swale is adjacent to mounded-earth hugelkultur berms planted with young nut tree polycultures, with the lowest swales planted as part of a Sustainable Agriculture Research and Education grant project, through which Kalyan and Seva are exploring the effectiveness of polyculture design in soil building and pollination.

The southeast corner of the property is the site of a potential vernal pool, with wetland species and soils present. The southwest corner has a culvert which carries stormwater runoff and sediment into the property from Porter Hill Road. A catchment pond and swales have been created to intercept this sediment and runoff. Drainage from the housing construction is diverted westward below ground to a small pond to the west with two catchment ponds connected by a channel located along the western side of the property downslope from the swales.



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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause

Fall 2018

Existing Conditions

Landscape Design for Nutwood Farm

76 Porter Hill Rd, Cummington, MA 01026

Circulation & Site Views

Efficient circulation zone planning is already in place for agricultural operations. Adjustments to the system may be needed to improve circulation for volunteers and visitors. Adding programming for farmstore visitors may create a need for defining public and private space.

Zone 1

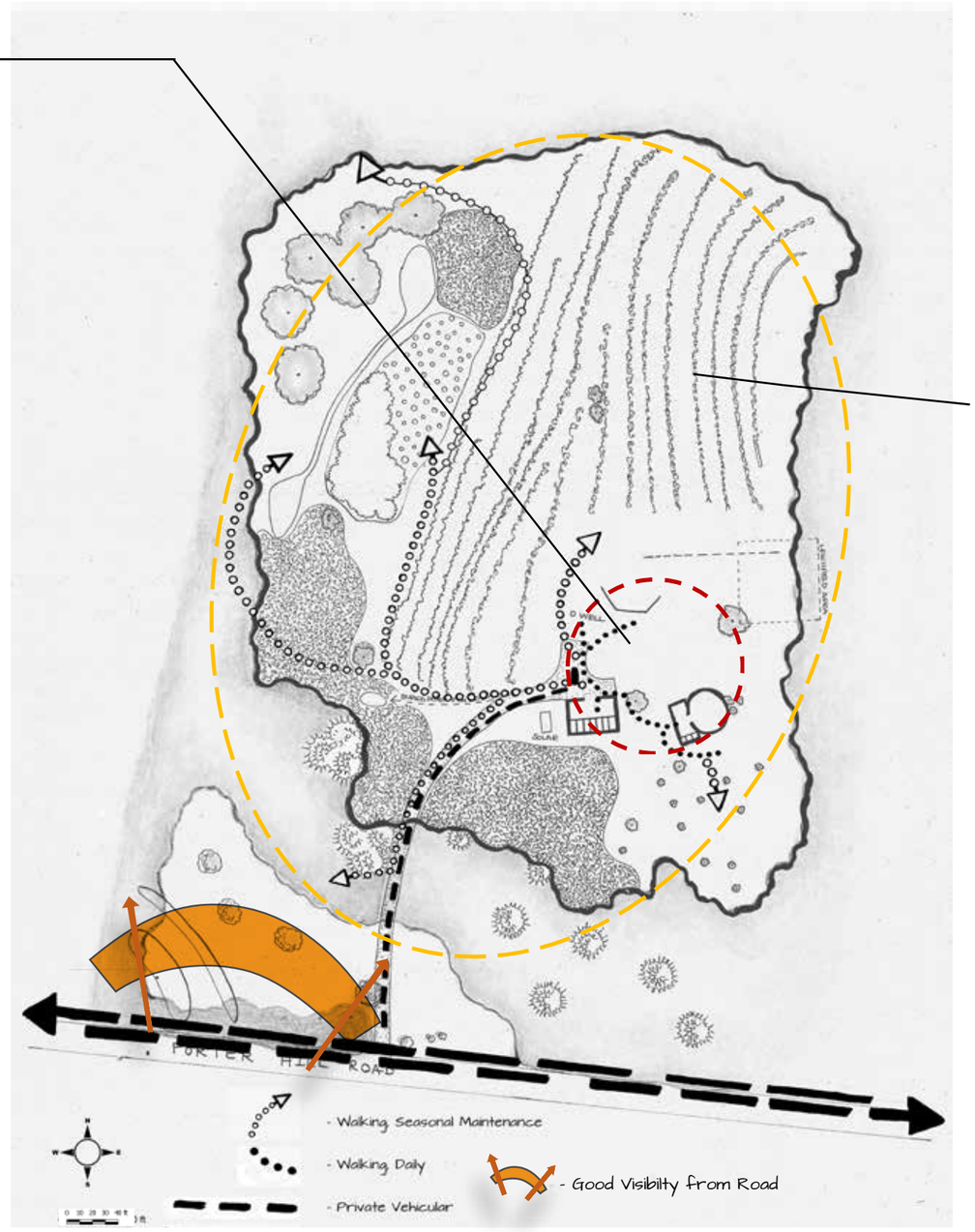
Permaculture design principles encourage efficient circulation planning with daily activities being centralized near the home. Daily activities at Nutwood Farm include pumping water at the well, tending to vegetable and herb gardens, animal care and access to the vehicle and construction site of the new straw-bale home. While at this time there are no interns, Kalyan and Seva would like to provide a private camp location for them out of view of the homestead.

Paths through flower and vegetable gardens lead to the home.

Barn and greenhouse with solar panel.

Strawbale home under construction.

Porter Hill Road, looking south..



Access

Nutwood Farm is located on Porter Hill Road, a rural, semi-paved route occasionally used as a cut-through for vehicles going to Route 149. There are filtered views of the farm from the road, with a sweeping view of the property potentially more visible with selective tree removal. If signs, a farmstore, and parking were sited near the road, they would be visible to passing cars. Kalyan and Seva have an agreement with their neighbor to the east to maintain a 20' wooded privacy border between their properties.

Seva taking the goats to forage.

Zones 2 & 3

Seasonal responsibilities are located farther away from the home, which at Nutwood Farm include maintaining the fruit and nut orchards, clearing brush and stump sprouts from recently cleared land, and taking goats to brambly areas for foraging. There is rough terrain in the orchard areas with large stones, long open swales, and pathways dense with brambles and tree stumps in between rows. Stepstones are in place to make it easier to cross berms and reduce compaction, but are not always visible to occasional work-day volunteers. Clearer, more frequent berm crossings may support efficient maintenance and circulation.

Twin hawthorn trees in the center of the orchard mark stepstone swale crossings.

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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause

Fall 2018

Circulation/Views

Landscape Design for Nutwood Farm

76 Porter Hill Rd, Cummington, MA 01026

Vegetation, Sun & Shade

This site has a history of disturbance and is going though yet another transition. It supported a monoculture Christmas tree farm, which was subsequently clear-cut approximately 25 years ago. Since this dramatic event, spontaneous forest and understory vegetation has grown in. Now, Kalyan and Seva intend to work with the land and mimic forest ecology dynamics through a regenerative approach that harmoniously supports human, livestock, and wildlife needs.

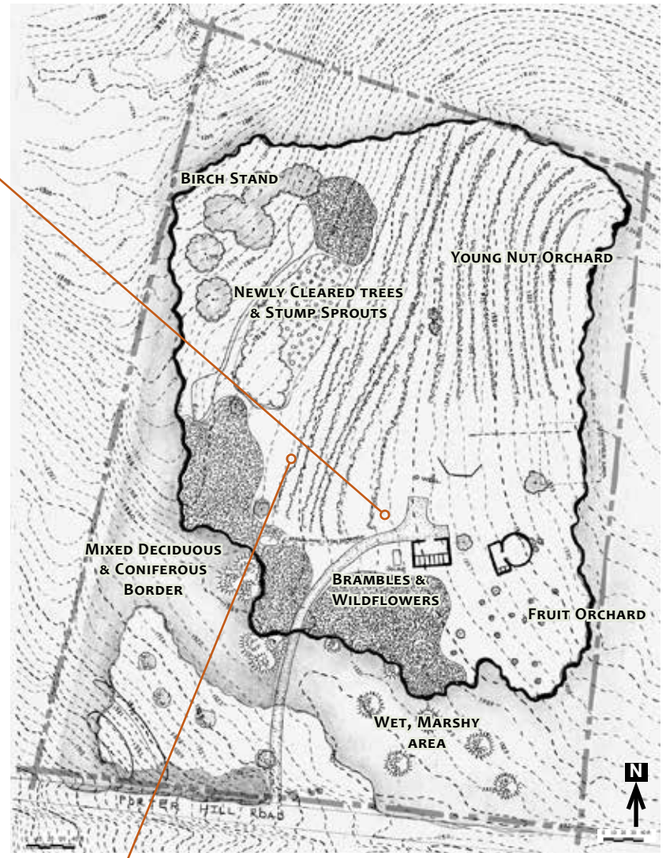
Young nut orchard, October 2018.

Vegetation

An 80' tall mixed-deciduous and coniferous border cradles all sides of Nutwood Farm. It is dominated by maple, birch, white pine, and hemlock with an understory of hawthorn, serviceberry, crabapple, and elderberry. Since assuming stewardship of the property, Kalyan and Seva have been working to open the canopy selectively by hand, shaping 15 berms planted as young nut orchard (hazelnut, heartnut, walnut, chestnut, butternut), and establishing a small fruit orchard to the south of their yurt, which is surrounded by beautiful, lush herb and vegetable gardens.

Their vision is to establish a silvopasture system that will harmoniously support small livestock beneath the shady canopy of rows of food-bearing trees that may be used for coppicing and future woodworking projects. Tree crops and pasture below will provide animals forage and grazing opportunities, and animals in turn will provide fertilizer.

Currently, the young trees are shrubby and small, receiving full sun, resembling the Oldfield Mosaic stage of succession. A brushy, wild mix of both native and invasive species is found throughout the understory, happily filling open space in the orchards and forest edges where recently cleared cherry trees attempt to return through sending up stump-sprouts through the mats of woodchips from their ground-up predecessors. Orchard trees are supported by a living mulch of polyculture plants providing supportive functions (nectary, mineral accumulation) and edible or medicinal yields. An often wet and marshy area is found in the wild understory in the southeast corner of the property, and a large canopy of conifer and birch shades the slope to the stream in the northwest corner.

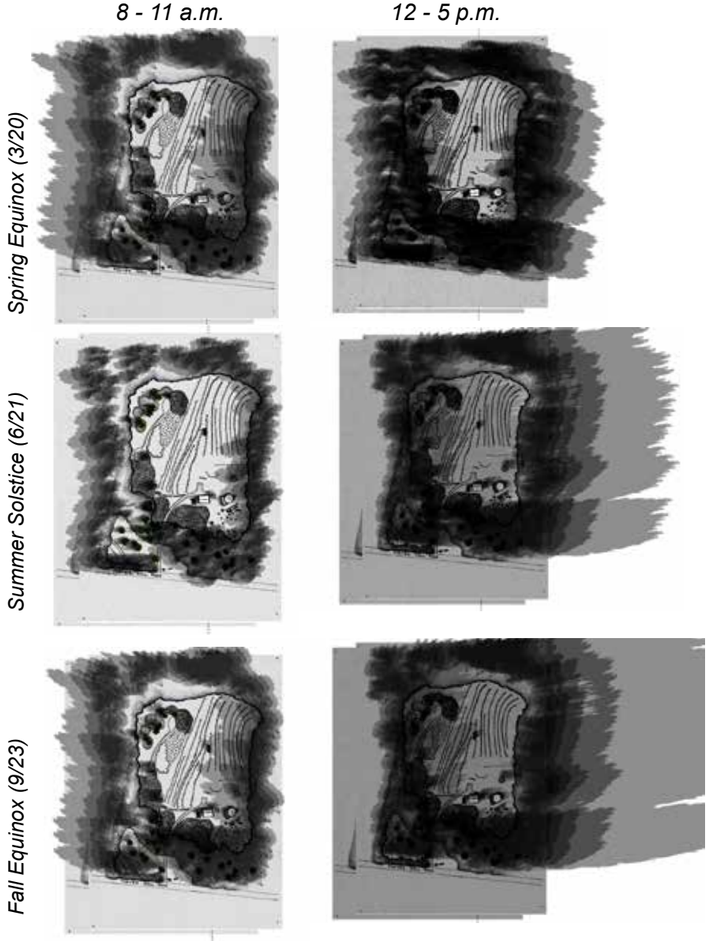


Insectary polyculture test plot

Nutwood Farm is already contributing valuable research to what is known about strategies in regenerative agriculture through a ***Sustainable Agriculture Research and Education (SARE)*** grant. Currently several polyculture test plots are part of a research study with University of Massachusetts in Amherst observing the viability of permaculture claims that certain plant communities can be designed to support the health and harvest volumes of trees. These plots are to be preserved and unaltered during the study.

Sun & Shade

Projecting light across a 3-dimensional model of Nutwood Farm allows the sun's movement and the shadows cast by the 80' tall treeline to be tracked throughout the growing season. Three dates were chosen (March 20, June 21, and September 23), but it must be noted that deciduous trees may not be in full canopy on March 20 or September 23, which is not reflected in the model. This analysis is helpful for making general observations and identifying potential areas where the canopy can be opened to create more solar exposure for the new farmstore, solar PV panels and greenhouses.



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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed by: Lisa Krause
Fall 2018

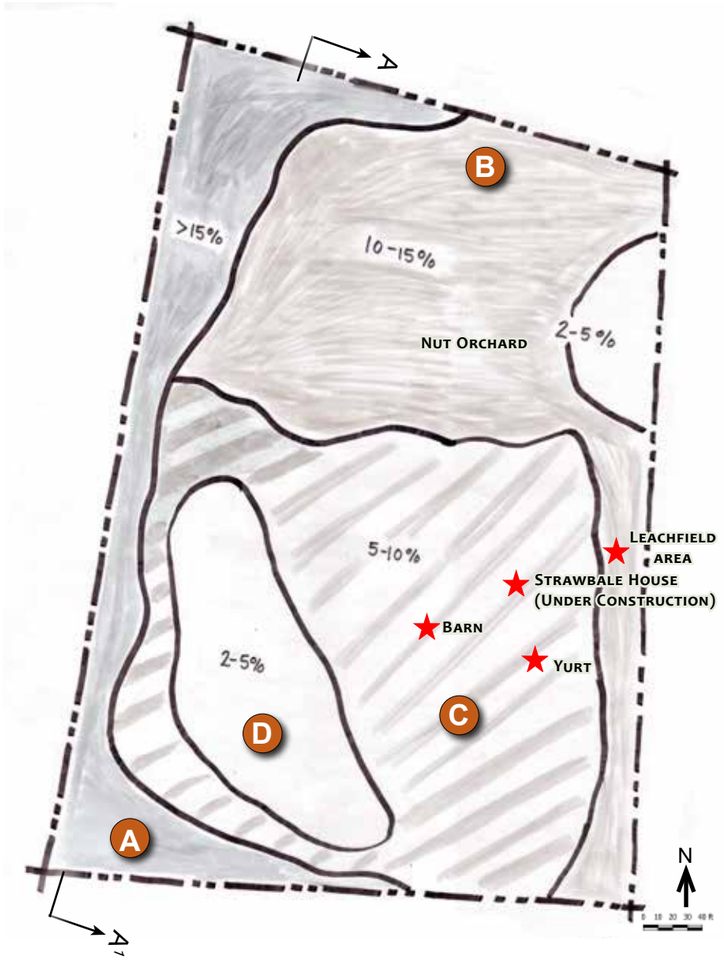
Vegetation/Sun
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

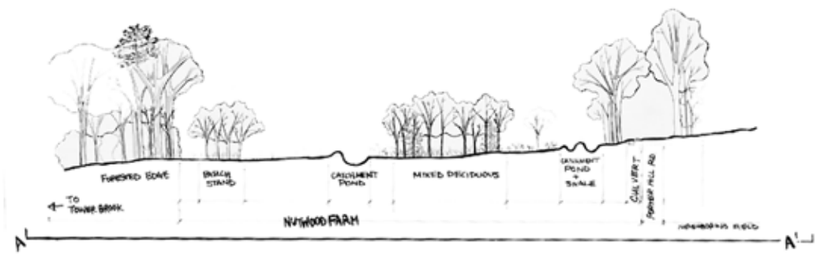
5/19

Soil & Slopes

Stony soils, a high water table, and steep slopes may constrain the development of new buildings and infrastructure. But they do support the agricultural operation, and there are opportunities for expanding production, increasing water catchment, and siting a farmstore, parking and a greenhouse in a location visible from the road.

The Web Soil Survey indicates that Nutwood Farm has a mix of well-drained stony soils, typical of woodlands, with a high water table (1.5 to 2' below the surface) in most areas. The greywater leachfield for the new house is located high in the property because of the high water table. Although these soils are not known for supporting conventional agriculture, they may support agroforestry. Boulders and rocks on site may be useful for erosion control, although they may make planting and excavating difficult. The prominance of extremely stony soils throughout the site and areas of wet soils in the southeast can severely restrict development and may constrain building plans. The depth to bedrock for these types of soils is typically very deep. Deep bedrock is conducive to digging a deeper pond, because areas of shallow bedrock would restrict pond depth or require blasting. Any ponds in fast-draining areas may need an ecological liner such as bentonite clay, depending on perc test and further, more detailed soil studies. While loamy soil is ideal for farmland, the only loamy area is along the road and exceeds 15% in slope, making traditional agriculture difficult.





Section A-A', Indicating gradual slope of the property toward Tower Brook flowing past the northwest corner of the property boundary.

Slopes analysis indicates a range of changes in topography across the site ranging from 2 to 5% grade up to >15% grade.

A 

Areas of the property with >15% slope near the culvert in the southwest corner are showing signs of erosion, observed as washed out areas, exposed tree roots, and dry channels. Slope stabilization may be necessary.

B Any construction of structures or parking area development in areas of 10 to 15% slope would require extensive grading; however, these slopes are appropriate for nut orchards, as they are currently planted.

C The yurt, barn, and construction site of the new home are in a 5 to 10% slope area, requiring a moderate amount of grading for easy circulation on foot and building construction. Any further development in this area would likely need the same level of grading.

D Areas of 2 to 5% slope are ideal for siting buildings because minimal grading is required to accommodate these structures and associated paths and parking. Many of these areas are visible from the road and would be visible to visitors driving by if developed for the farmstore and parking.

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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Soil & Slopes
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

6/19

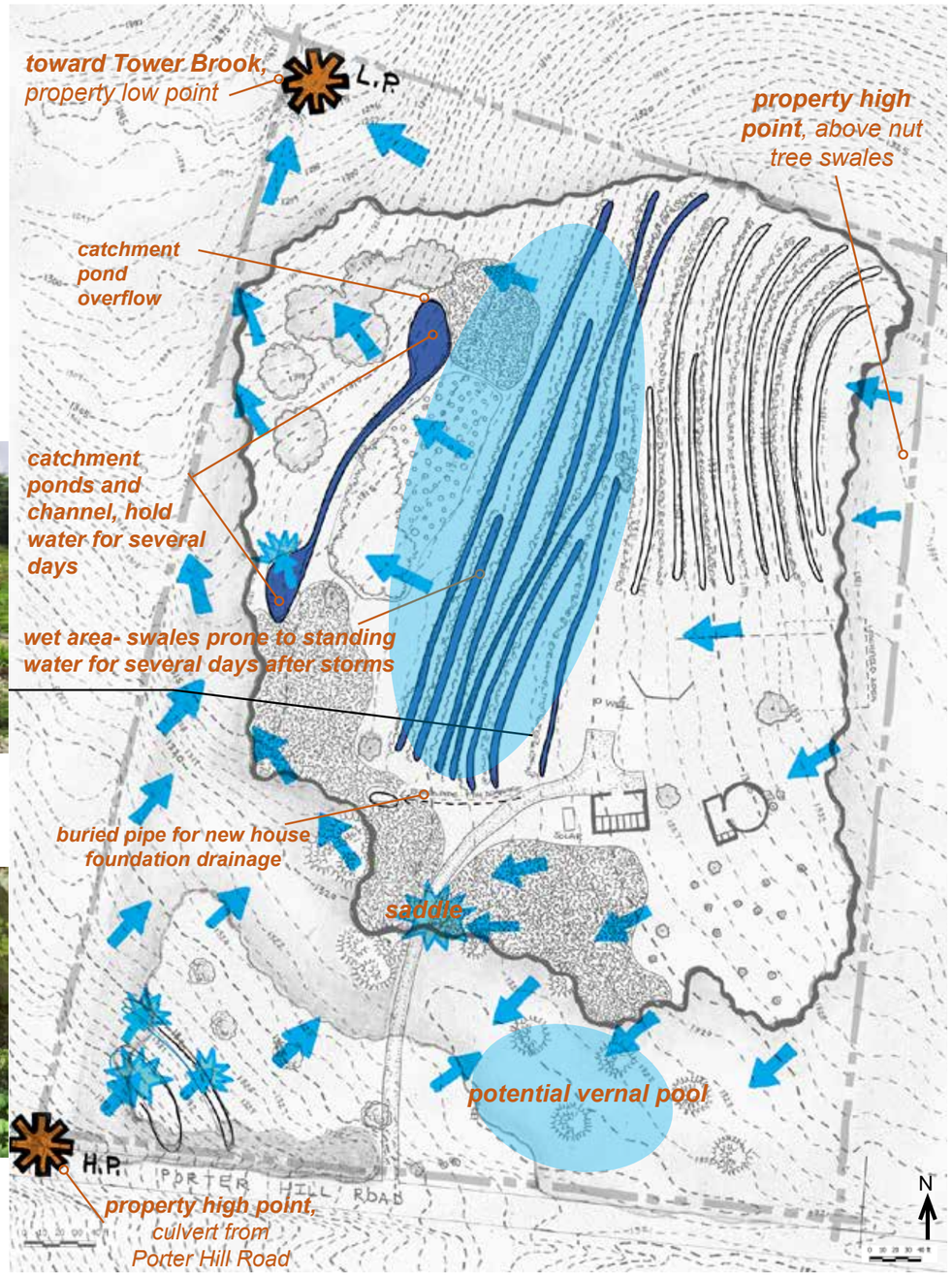
Slopes & Drainage

Given increasing severity of storms, slopes provide opportunities to intercept, store, and move water using gravity, but options for more permanent water catchment or diversion measures may be necessary due to climate change. Road runoff may need to be remediated and wet conditions create habitat for mosquitos.

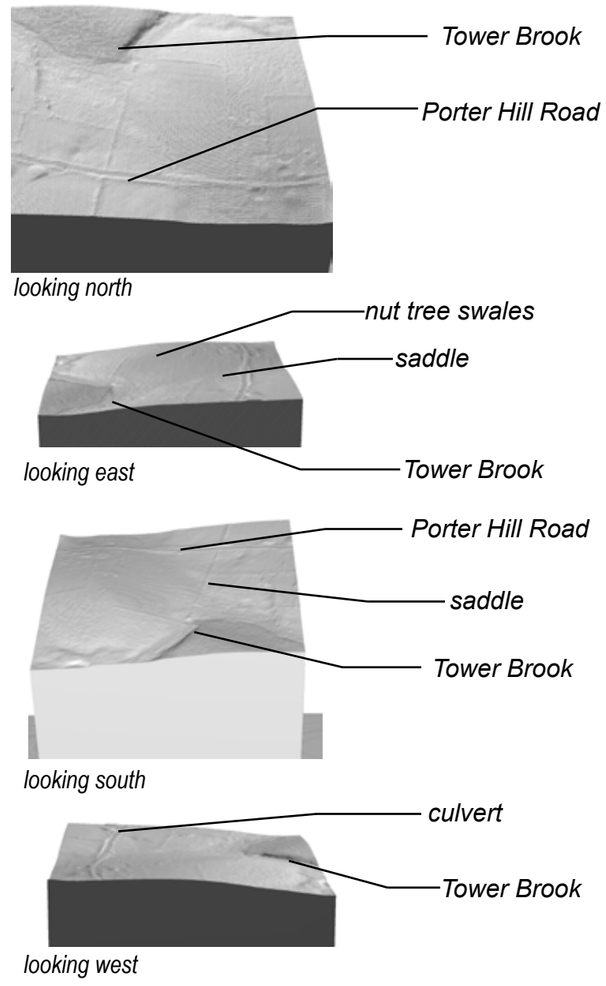
The property is characterized by two high points located along the northeast property line and in the southwest corner. The slopes descend from these two points down to a saddle where stormwater trickles across the driveway from the southeast toward the northwest. A saturated area in the southeast may be a vernal pool. All runoff on the property heads northwest toward Tower Brook. There is a 50' change in elevation across the 7-acre property ranging from 1340' at its high points dropping to 1290' where the property meets the brook.

After storms, standing water often appears in swales and the ground remains saturated for several days. If storms become more severe or frequent, these wet areas may become flooded, impeding orchard maintenance and restricting new building development in the area. Temporary flooding and standing water provides breeding ground for mosquitos, but establishing natural pond ecosystems as more permanent wildlife habitats for frogs, fish, dragonflies, bats, purple martins, and swallows will help to control mosquito populations.

The culvert from Porter Hill Road in the south-west corner discharges road runoff onto the property after storms. It has overwhelmed the current catchment system and brings sediment that may also contain road toxins, posing a maintenance issue. A sediment cleanout chamber may be necessary closer to the road. There are also breeches in pond dams and swale berms that will likely continue to erode and topsoil loss is possible unless these areas are stabilized.



With the stone wall property line visible as a raised straight surface below, LIDAR laser detection surveying shows the topography of the parcel.



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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Slope & Drainage
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

7/19

Legal Restrictions: siting buildings and parking areas

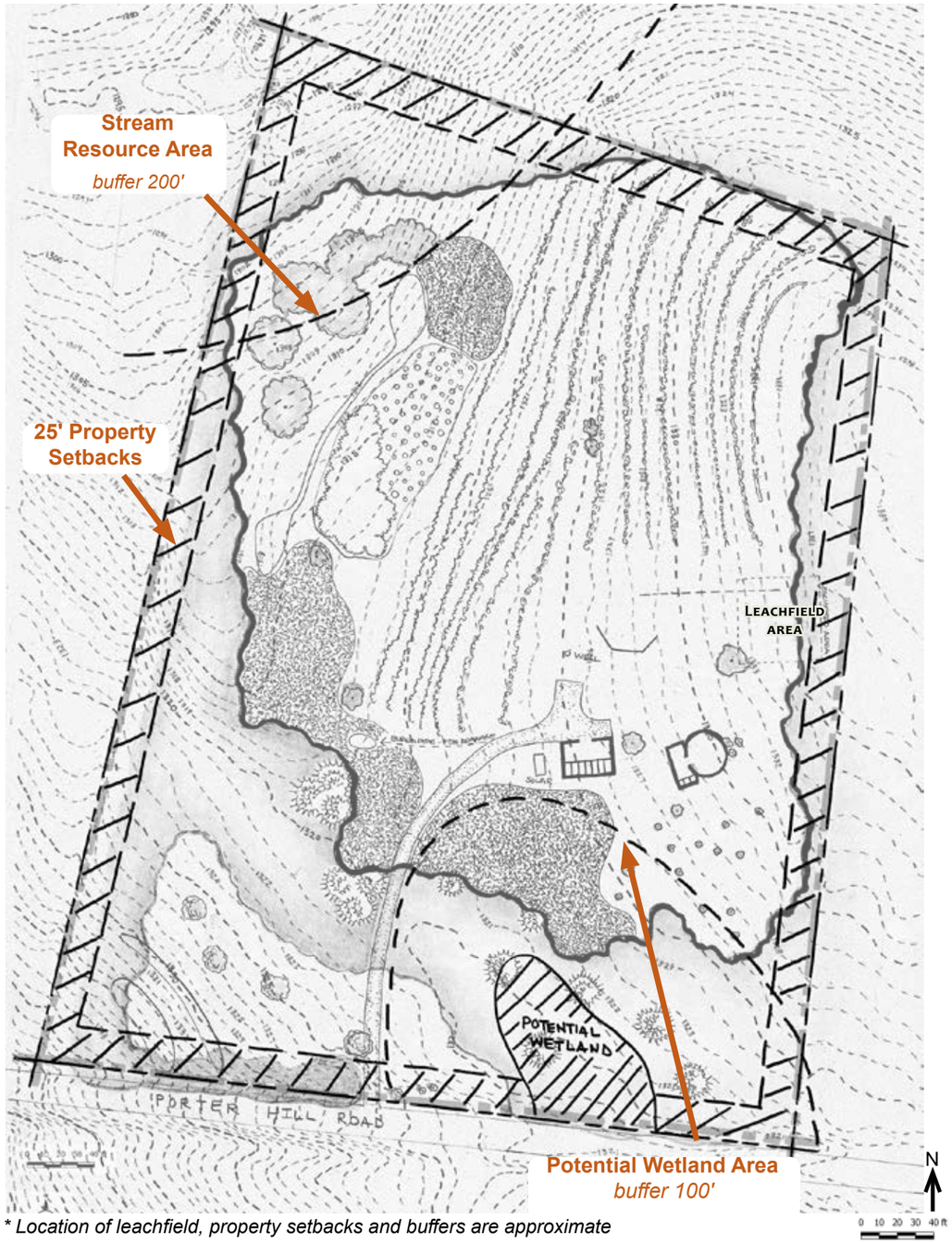
Zoning setbacks and wetland buffers may limit the construction of new buildings, infrastructure, and additional agricultural development. Professional delineation and a permitting process may be necessary.

Wetlands Regulations

The Massachusetts Wetlands Protection Act (WPA) regulates activities within and near areas that have water all or part of the year, as defined by an abundance of wetland plants, hydrology, or soil type. Wetlands are important because of their ecological role in filtering and purifying water by breaking down heavy metals and pollutants from road and agricultural runoff, replenishing the water table, mitigating storm flooding damage, and providing critical habitats for both plants and wildlife like fish, amphibians and insects.

Potential Vernal Pool area in the southeast property corner

Wetland Buffers and Stream Resource Areas are present on the property due to the proximity to Tower Brook and a potential vernal pool or possible wetland requiring delineation in the southeast corner of the property along Porter Hill Road. These areas are subject to WPA regulations. The buffer for a vernal pool or wetland is 100' and the buffer for a stream resource area is 200'. Buffers prohibit any alteration of the land or agricultural production within those zones without a permit from the Conservation Commission. There are risks of heavy fines being assessed for not following through with the permitting process. It is recommended that buffers be professionally delineated before making any alterations in these areas and the permit process be followed through the requirements of the Cummington Conservation Commission.



** Location of leachfield, property setbacks and buffers are approximate*

Just a wet year? While the 2018 growing season had been exceptionally wet and standing water was common, it takes many years for the establishment of hydrology, wetland plant communities and hydric soils required to verify a wetland for the WPA. One year of heavy rain wouldn't necessarily create a wetland.

Opportunities for regenerative agroforestry in wetland buffer zones may exist. While destructive conventional agricultural and development practices are restricted in buffer zones, restorative improvement of land and maintenance can be allowed. This opens up possibilities for creating a regenerative understory of productive plants adapted to wetter conditions. These areas could support native plants with high market value such as American ginseng and goldenseal. See the plant palette section for list of edible and medicinal native plants that may be potentially planted and managed within saturated areas.

American ginseng

Goldenseal

Additional Development Restrictions:

- Buildings cannot be located within 25’ zoning setbacks on all sides of the property.
- The width of a single loaded parking area is 40' which would include a place onsite for cars to turn around, so they do not back into the road.
- Nothing should be built over the leachfield area.

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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Legal Restrictions
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

Summary Analysis

Possible design solutions emerge through the interactions of several key analyses. Combining interactions of soils, vegetation, slopes, drainage, views, legal restrictions, and circulation help give a clearer picture of several of the elements impacting Nutwood Farm's goals of siting a farmstore with parking, greenhouses and intern camping locations, addressing current water catchment systems, and maintaining efficient circulation.

Siting a Roadside Farmstore with a Small Parking Pad

There appears to be a large section of developable space with slopes of 2 to 5% and 5-10% grade near the road. Water entering the property from the culvert and sheeting across this area would need to be redirected to prevent any flooding. Trees may need to be removed for construction and the canopy may need to be opened for additional exposure if the farmstore will have a solar PV panel. The most appropriate site may be more apparent after professional delineation of the potential wetland area across the driveway in the southeast corner along Porter Hill Road. Wet or extremely rocky soils may restrict building development.

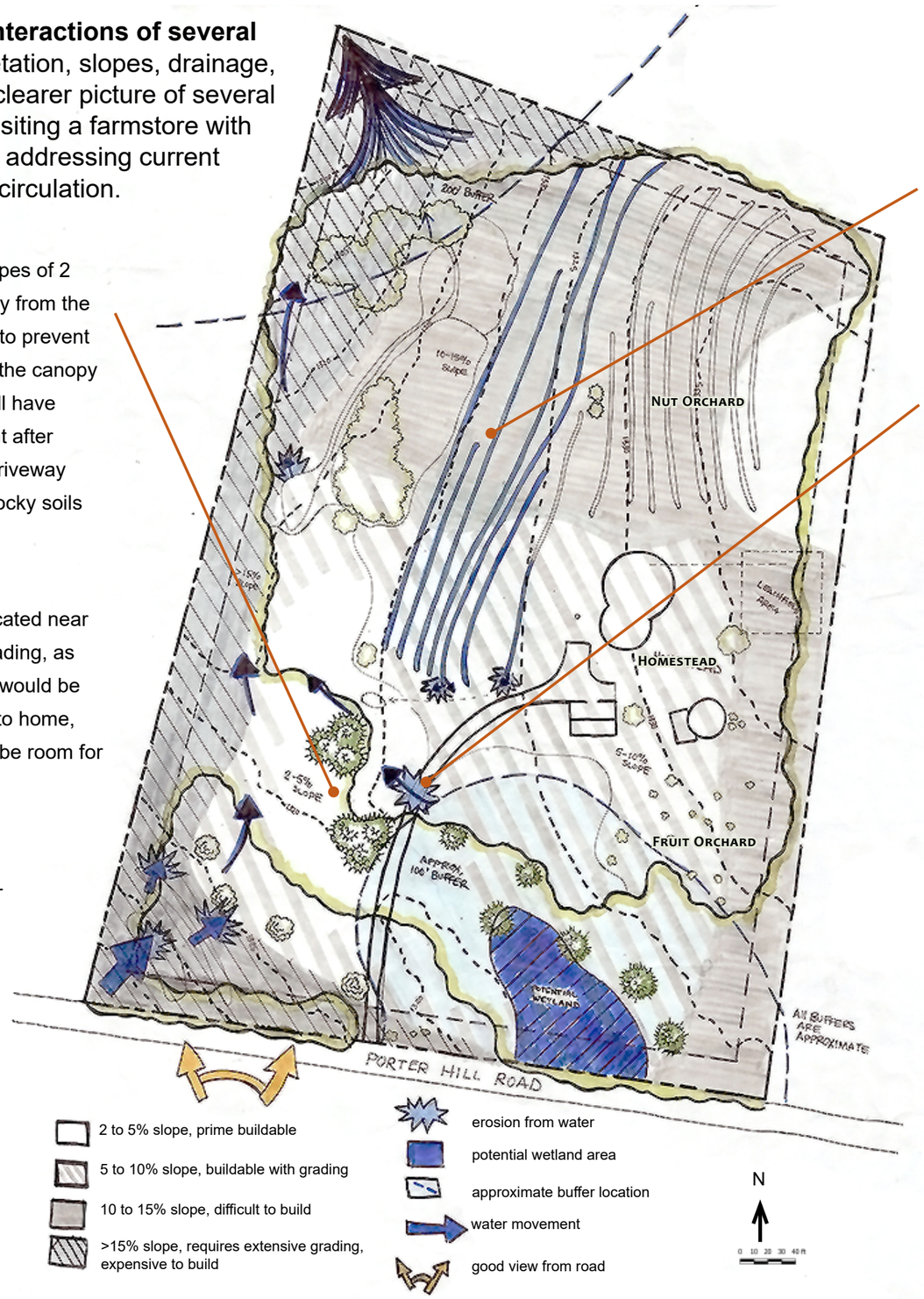
Siting Greenhouses

Two 80' to 100' long production greenhouses could possibly be located near the central home area near the barn and well. This will require grading, as well as moving the yurt and several young fruit trees. The benefit would be having the greenhouses close to existing infrastructure and close to home, making regular and frequent maintenance easier. There may also be room for a greenhouse close to the farmstore.

Siting Intern Camping Area

Rustic camping locations are available throughout the site with some brush clearing and slight grading, but some areas are wetter than others. For longer-term camping, interns may be happiest in drier, more level areas such as above the nut orchard swales or in the fruit orchard.

Efficient Circulation can be maintained through concentrating daily activities and activities requiring infrastructure support near the existing homestead area. Concentrating a public retail area near the road with visible parking will help eliminate confusion of public and private space by farmstore visitors. For maintenance support, any potential trip hazards like the large rocks throughout the orchards may be relocated and reused in slope stabilization and erosion control.



Adding to Current Water Catchment Systems

Topography and soils affect water movement. Water can be slowed and stored using a variety of techniques.

With the possibility of storms becoming more severe, the lower swales (#9-15) which already hold water for several days, may breach their banks and cause flooding. An overflow plan may include channeling the water to a larger, more permanent catchment area that will provide habitat for mosquito predators.

The water trickling across the driveway after heavy storms appears to be coming from a potential wetland area. In addition to providing wildlife habitat, wetlands function as natural nutrient-rich sediment traps and treat runoff. The wetland buffer would need to be professionally delineated and siting a pond within the wetland buffer would require a permit process with the Conservation Commission, but there may be other locations where a large fishing and swimming pond could be located.

Runoff and sediment from the culvert in the southwestern corner of the property are causing erosion. Treatment of pollutants in the runoff might be achieved through phytoremediation techniques. This water might then be used on site. Addressing runoff presents an opportunity to showcase sustainable stormwater management and erosion mitigation.

Production can be increased sustainably through reforesting buffer zones and heavily erosion prone, >15% sloped areas with polycultures of native plants with harvestable yields. There are also areas for further silvopasture expansion and expanded vegetable gardens. Adding a pond may also be an opportunity for experimenting with aquatic production systems.

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

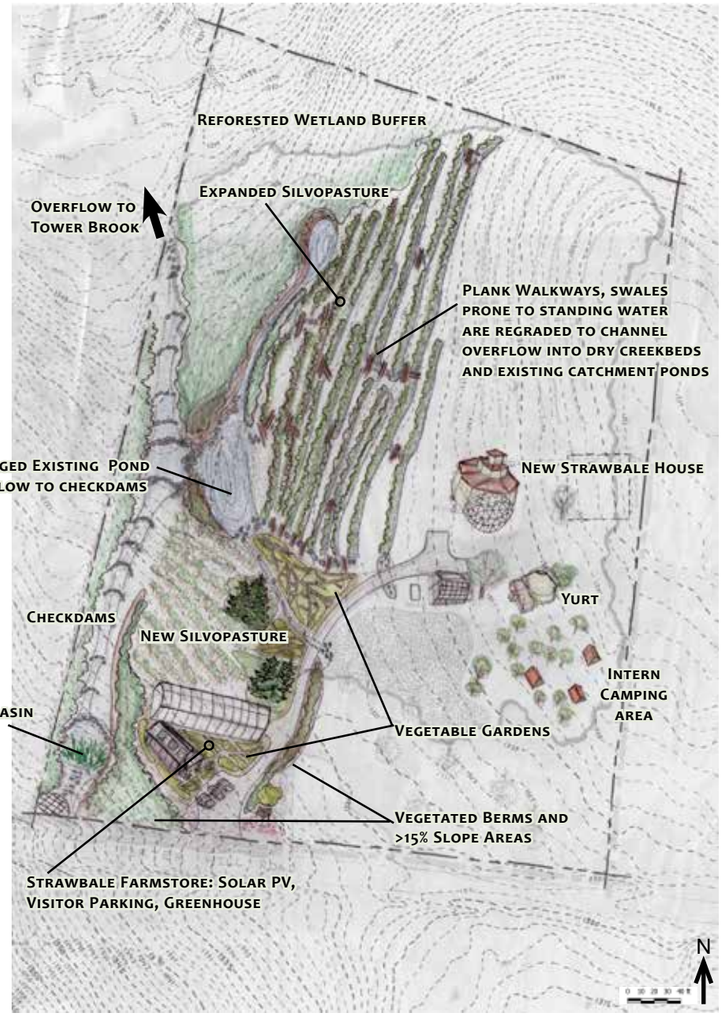
Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

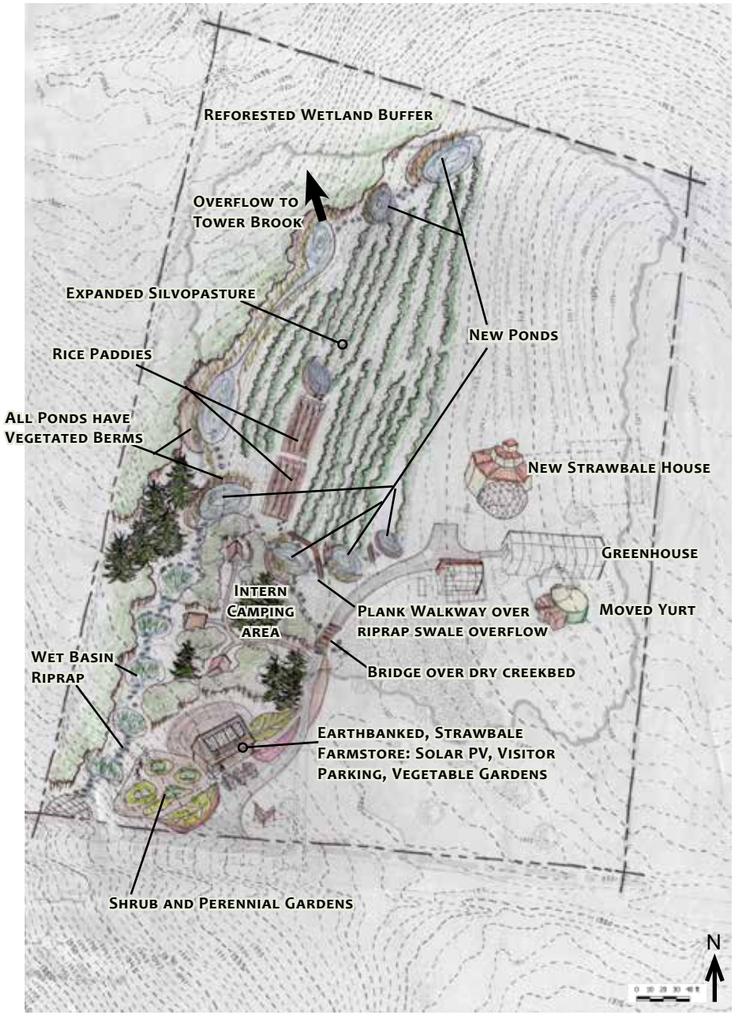
Summary Analysis
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

Preliminary Design Alternatives

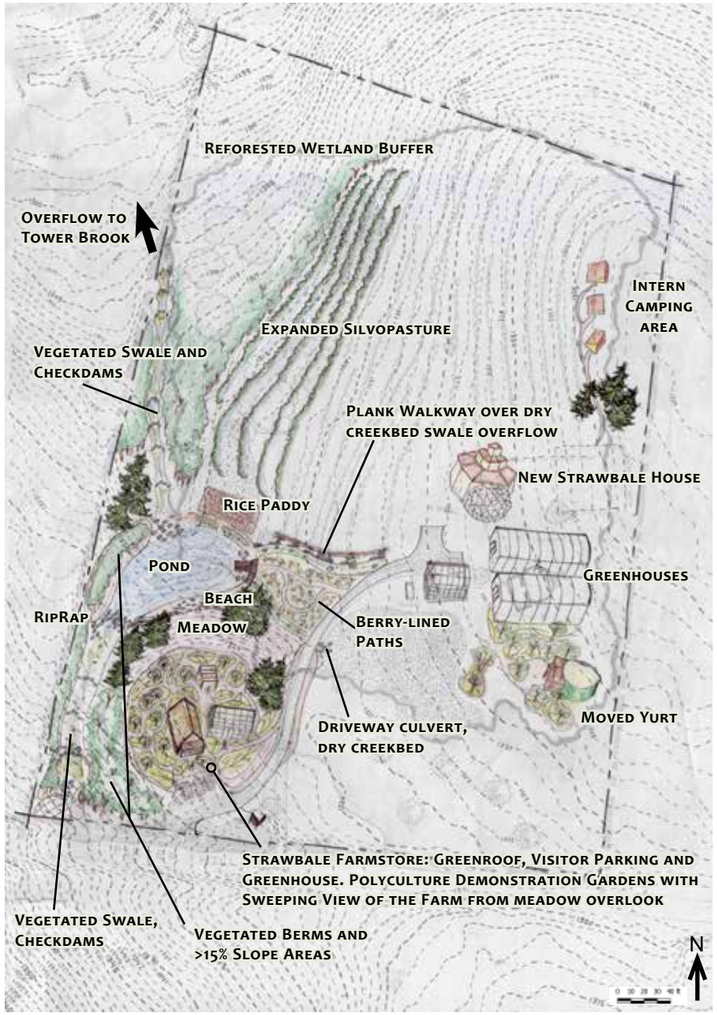
Three conceptual designs explore ways to achieve client goals and respond to site opportunities and constraints. All include a sediment chamber and remediation strategies to address runoff in the southwest corner of the property, expand water catchment options throughout the site, locate the farmstore with parking area near the road, redesign the driveway, and site rustic intern housing. All designs also increase crop production and diversity through reforesting >15% slopes and wetland buffer areas with native, yield-producing edible and medicinal plants. They differ in how they direct and hold water and whether they place stronger emphasis on education or production.



Increased Production employs berms to guide water away from the potentially buildable area near the road, creating room for more silvopasture and protecting space for the farmstore with vegetable gardens, parking, and a 100' -long greenhouse. Road runoff is conveyed along the western property boundary by a series of check dams, treating and guiding water toward Tower Brook. Current agroforestry swales are regraded and overflow is channeled to the enlarged pond with riprap and simple plank boardwalks making maintenance and circulation less cumbersome. Intern camping is located in the sunny, drier orchard location. Interrupting swales requires transplanting trees.



Regeneration Education focuses on education through highlighting water treatment and habitat creation for farmstore visitors through the addition of paths in gardens containing short edible shrubs and perennials. Runoff from the culvert is treated through wetbasins diverted into ponds. A nearby enclosed intern camping area is protected by additional conifers and forest. The swales are regraded so overflow is directed to a chain of pools leading to rice paddies in existing wet areas and expanded silvopasture area. The yurt is moved farther into the orchard to provide space for a 85'-long greenhouse near the home. More catchment may be needed and reshaping swales requires transplanting trees.



Confluence Island features a large 100 x 75' pond fed by treated water conveyed from the road culvert and potential wetland via treatment swales. Pond overflow is directed to a rice paddy or a swale with checkdams discharging in the northwest corner of the property. The pond is accessed via berry-lined paths terminating at a pier and small beach to the south. Excavated soil from digging the pond is graded into a raised island upon which sits the farmstore, parking, small retail greenhouse, and tour gathering space with polyculture demonstration gardens and sweeping farm views. The yurt is moved deep into the orchard, making room for two 85' -long greenhouses. Intern housing is located in the high, flatter location above the swales and not far from infrastructure. Conifers increase privacy. This design requires extensive excavation and grading.

the **Conway**School
Graduate Program in Sustainable Landscape Planning + Design
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Design Alternatives
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

10/19

Final Design

The final design reponds to the vision and project goals of Nutwood Farm, increasing crop diversity throughout the site and adding several greenhouses. A roadside location was identified for the farmstore and associated parking. A road runoff treatment train of pools and ponds increases water catchment capacity and overflows into the northwest corner of the site. Daily circulation is concentrated in the existing Zone 1: Homestead and additional Zone 1: Retail Area. Zone 2-3: Seasonal Maintenance is expanded through the planting of additional crops and silvopasture, and strategic interventions in the buffer zones.

Confluence Pond Habitat

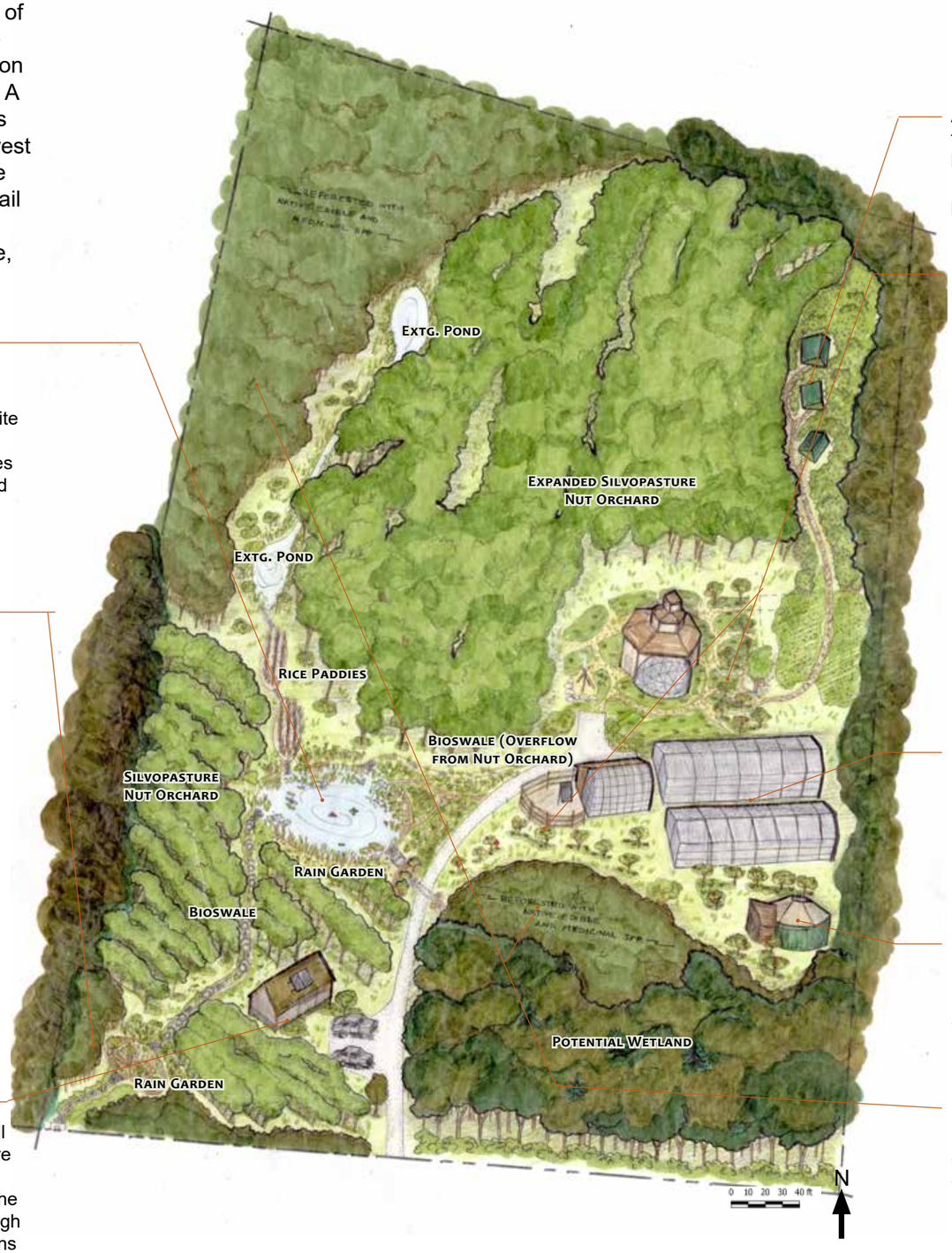
The 75 x 100' pond is fed by bioswales directing stormwater from orchard infiltration swale overflow, the potential wetland area, and treated culvert runoff. The pond is lined with bentonite clay and planted with habitat plants for fish, frogs, birds, dragonflies, and other mosquito larvae-eating predators. Edges are planted with wetland medicinals and food plants. The pond overflows to a series of rice paddies, which connect to the current catchment pond system that overflows toward Tower Brook. *See p. 14.*

Culvert Runoff Treatment Train

Road runoff is directed from the culvert through a series of steps that slow, spread, and sink stormwater. The potentially contaminated water is purified through phytoremediation as it passes through a rain garden, bioswales, check dams and Zuni bowls. *See p. 12 & 13.*

Strawbale Farmstore and Parking

A rustic, handmade sign by the road welcomes visitors to pull into the driveway. From the road, a small strawbale farmstore is visible through the trees, flanked by gardens and sheep grazing under rows of nut trees. Farmstore visitors pull into the small parking pad and hear culvert stormwater trickling through a rocky swale stream, as it is treated by flowering rain gardens and gently cascading though lush vegetated checkdams passing behind the strawbale farmstore on its way to the pond.



A Rustic Camp for Summer Interns

is located uphill from the nut orchard. The camp's location just north of the homestead is convenient in terms of potential utility connections. Highbush blueberry, elderberry and shrubby serviceberry provide a degree of summer privacy from the homestead.

Expanded Orchards

host new fruit trees and those transplanted from locations now occupied by the 100' long greenhouses. Trees are underplanted with polycultures close to homestead and south of the existing barn.

Two 30x100' Greenhouses

for propagation and season extension are oriented east-west to maximize sun exposure. A 10' alley between them allows for maintenance and snow removal. Gothic-style greenhouses are peaked in the center to better withstand heavy snowfall. Greenhouse installation costs may be reimburseable through a Natural Resources Conservation Service (NRCS) grant.

The Yurt's new location in the orchard, where it is surrounded by polycultures and vegetable gardens

offers privacy for an inlaw, longterm apprentice, or Airbnb guest. It is still a short walk from the central homestead.

Reforesting Buffer Zones

The stream resource area and wetland buffer zones are planted with yield-producing native trees, shrubs, and understory plants for forage, wildcrafting, coppice, and harvesting using low-impact and sustainable practices.

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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Final Design

Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

11/19

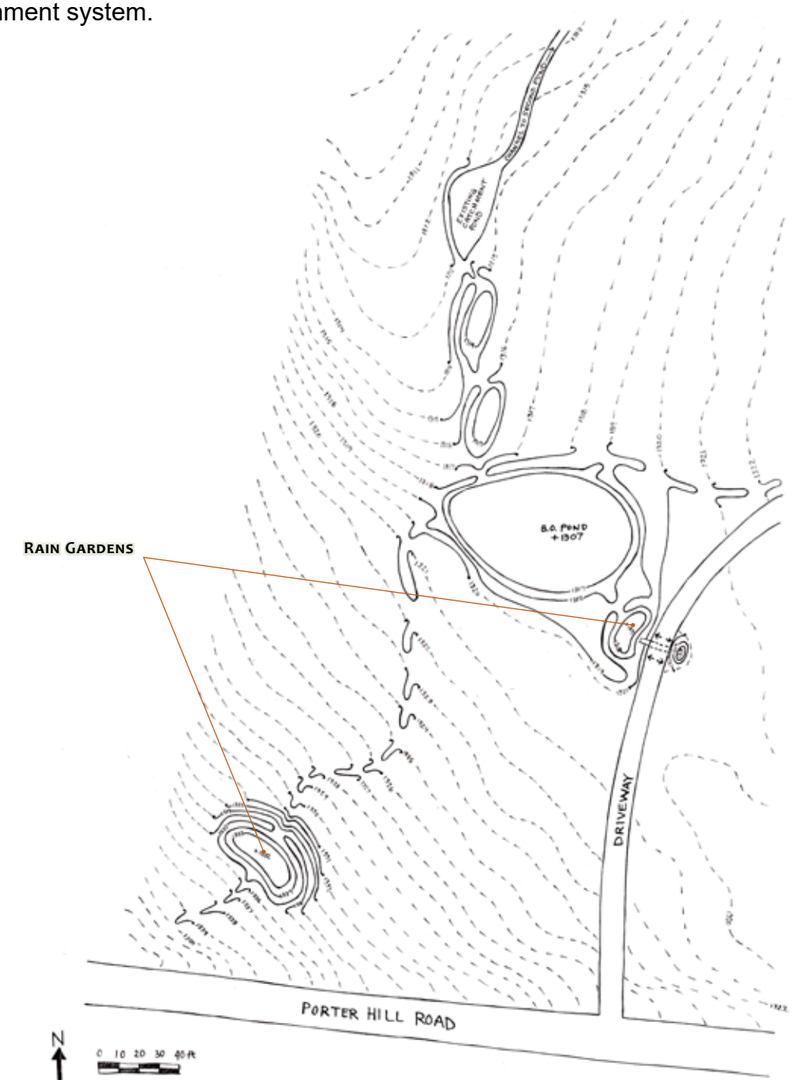
Confluence Pond Grading

This detailed design of the confluence pond area shows the ways in which the pond is fed. It recieves treated water that enters the site from the culvert and is first directed through a rain garden and a bioswale. While in the bioswale, water moves through a series of vegetated check dams and Zuni bowls, as rocks and plants filter contaminants, slow velocity, and settle out sediment.

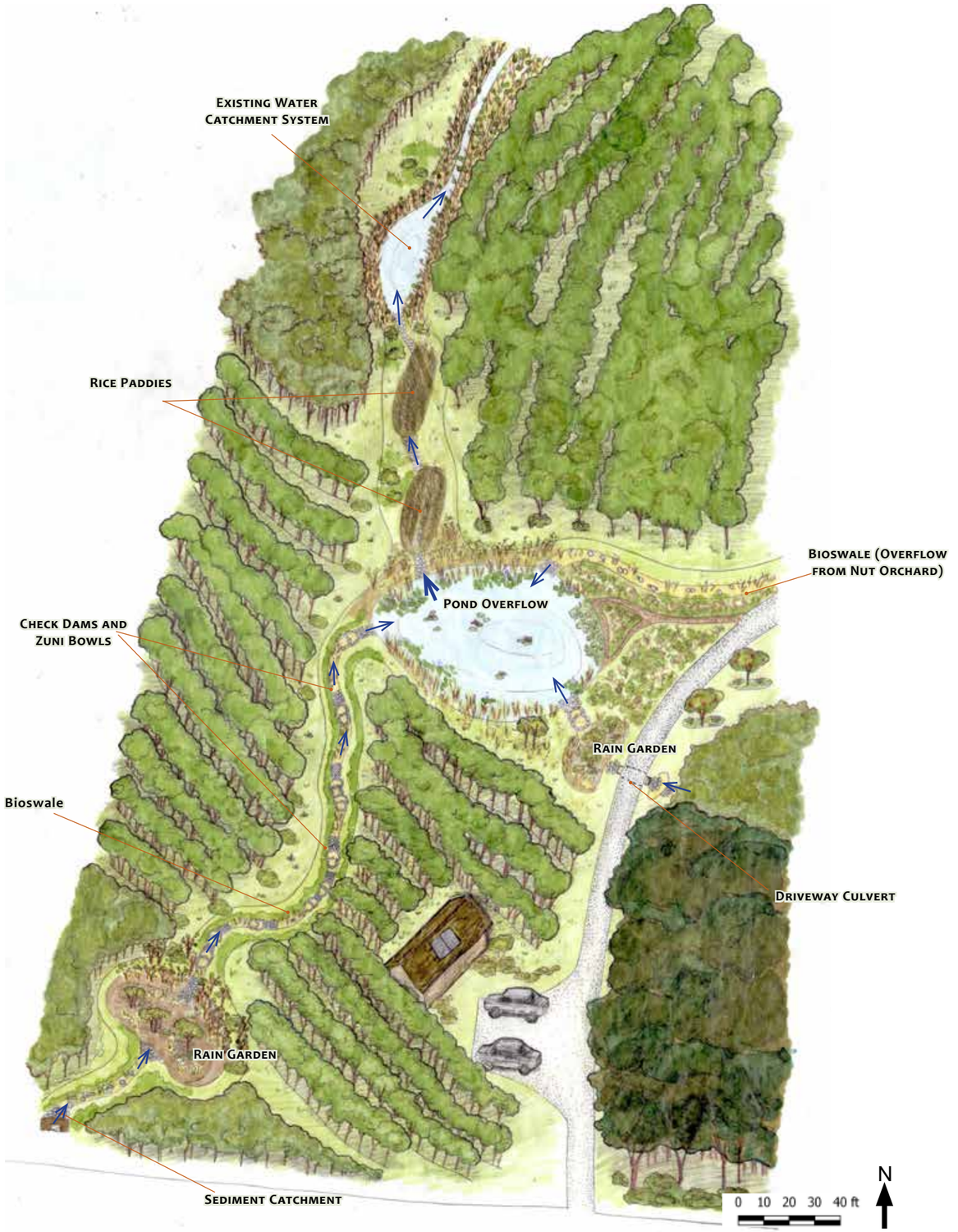
Stormwater overflow that had once flowed across the driveway from the potential wetland area is diverted into a driveway culvert which daylights into a rain garden. Overflow from the rain garden flows into a Zuni bowl and check dam before flowing over a rock apron into the pond.

When swales in the nut orchard overflow, the runoff is directed to the pond via a bioswale.

Pond overflow is directed into a series of cascading rice paddies before joining the existing catchment system.



Treatment Train - Grading Plan



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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause

Fall 2018

Confluence Pond Grading

Landscape Design for Nutwood Farm

76 Porter Hill Rd, Cummington, MA 01026

12/19

Treatment Train for Culvert Runoff

The approach for treating runoff entering the site via the culvert goes beyond *Slow, Spread, & Sink* by treating runoff and building habitats. This treatment train starts at the source high in the property watershed, and takes the form of gently cascading spillways built with on-site materials including stone, stump-sprouts, and saplings to create weirs that guide water flow. Bioswales and rain gardens are planted with vegetation for infiltration, erosion control, and slope stabilization.

Culvert sediment catchment basin

- **Purpose:** As the first stage of sediment catchment, a basin slows water and encourages it to drop rocks, sand, and silt.
- **Design Location:** The catchment trap at the base of the culvert, near the road allows for ease of maintenance for scooping out sediment and transporting buckets via farm cart.
- **Materials:** Typically poured concrete, creating a smooth base to allow for removal of sediment with shovel without causing further excavation. *Alternatives: urbanite (broken chunks of concrete), large man-made pavers or brick.*

https://www.braenstone.com

Culvert Sediment Catchment Basin with Riprap

Riprap

- **Purpose:** Buffers against erosion and topsoil loss through dissipating water energy with rocks, allowing water to slow and infiltrate.
- **Design Location**: Partially buried stones at the outflow of culvert sediment basin, outflow of raingardens, apron at base of checkdams and zuni bowls and outflow of pond and rice paddies.
- **Materials:** use stones and rocks onsite, must be large and heavy enough to handle water velocity. In his book, *Rainwater Harvesting for Drylands and Beyond*, Brad Lancaster recommends 12" - 24" rocks that weigh 20lbs.

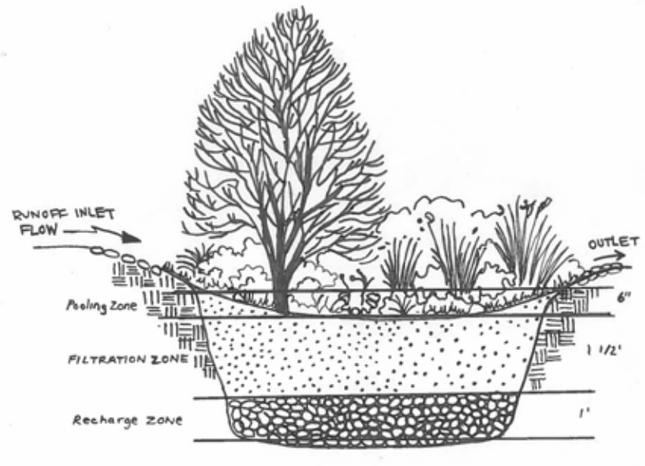
Why not gabion?

Gabion is a popular alternative to riprap, but there is a risk of it rusting quickly if used in highly saturated areas. In rural, unpolluted areas, gabion baskets can last up to 100 years. But gabion baskets degrade in as little as 5 years when used oceanside where they experience constant salt spray. More research would be required to determine how road salts may impact gabion basket lifespan.

Source: *https://www.gabion1.com/gabion-life-expectancy/*

Raingardens

- **Purpose:** Raingardens are basins planted with vegetation that help filter and infiltrate stormwater and settle silt sediment. They help purify water through phytoremediation and create habitat for beneficial microbes, thereby removing pollutants including sediment, fertilizers, pesticides,automotive fluids, and metals. Infiltration is encouraged through the use of vegetated berms, which hold water in place. Overflow outlets prevent flooding. They can also provide habitat for birds, amphibians and insects.
- **Design Location:** Downslope of culvert sediment catchment basin and downslope of the new driveway culvert.
- **Materials:** Gravel and soil amendments to increase infiltration, composted woodchips for mulch, and rain garden plants that can withstand periods of flood and drought. *See p. 17.*



Rain Garden Section Illustrating Runoff Infiltration with Soil Amendments and Plants

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause

Fall 2018

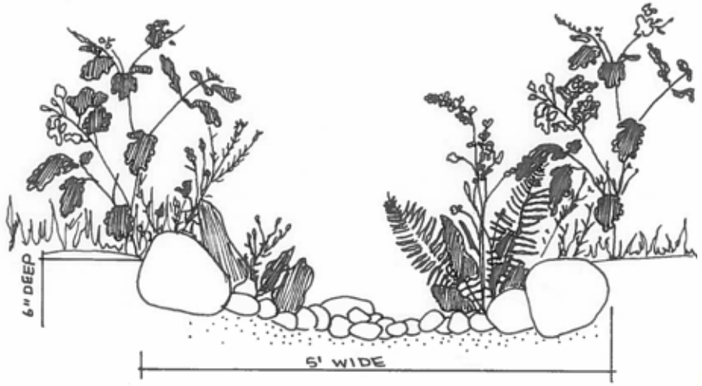
Culvert Treatment Train
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

Bioswale: A meandering dry creek bed with check dams & Zuni bowls

Creating meandering bioswales requires using water flow deflectors (*such as baffles and vanes made of stone or coppice waddling*), grade control structures (*dry creek beds, check dams, Zuni bowls, riprap, and rock aprons*), and vegetation for remediation, stream flow manipulation and slope stabilization.

Bioswales

- **Purpose:** Hold water on site longer by working with the natural land contours to meander runoff slowly through the landscape. A bioswale is a dry creek bed with plants that help to slow and filter runoff.
- **Design Location:** Mark out the location of the bioswale according to the plan. Excavate the swale by hand 6" deep below grade, gradually sloped downhill between each one-foot contour. Install cobble, stone and gravel to mimic natural watercourses at the base of the swale. Mixing gravel in with the natural soil in the creekbed will increase water absorption. Indicate where checkdams and zuni bowls are to be built. Install stones for riprap, one-rock dams, checkdams, zuni bowls and aprons. Install perennials, ferns and grasses that can handle both wet and dry conditions in the swale bed and along creek edges. See the list of perennials, ferns and grasses recommended for bioswale plants on p. 17.
- **Materials:** Stones, cobble and gravel. Bioswale plants.

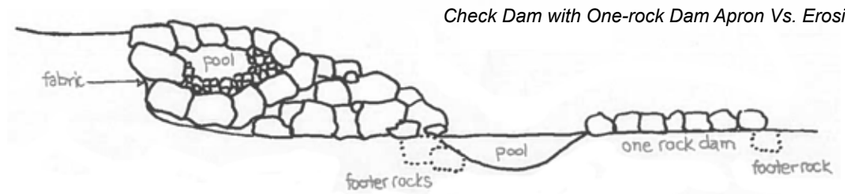


Bioswale Section Drawing with Dry Creek Bed

Fig. 10.6. Well-anchored check dams upslope of trees and boulders

fRainwater Harvesting, Lancaster.

Check Dam with One-rock Dam Apron Vs. Erosion Caused Without



Zuni Bowl Section Drawing

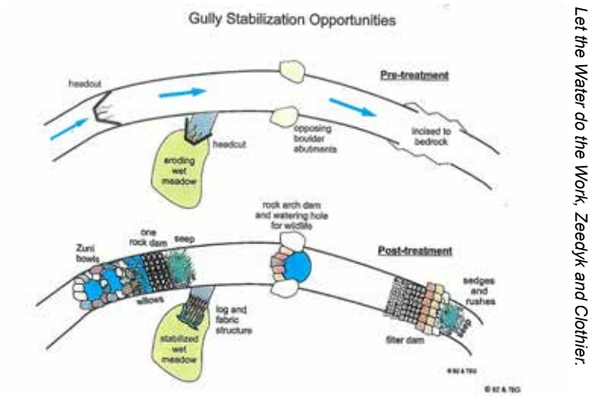


Figure 5-25. Various types of grade control structures might be used to stop headcutting, stabilize the bed and create pools or stimulate plant growth in an eroding system.

Let the Water do the Work, Zeedyk and Clothier.

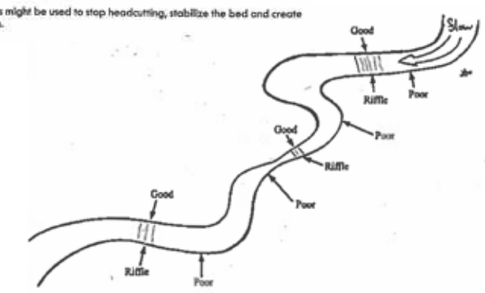


Fig. 10.4. Hypothetical check dam locations, good and poor (plan view)

Rainwater Harvesting, Lancaster.

Check dams, Zuni bowls and one-rock dam aprons

- **Purpose:** These elements provide opportunities to slow water so it can release sediment, infiltrate, and prevent further erosion or topsoil loss. In his book, *Rainwater Harvesting for Drylands and Beyond,* Brad Lancaster states that creating many small checkdams is a better design approach because they are easier to build and rebuild than a large dam.
- **Design Location:** Throughout the new meandering bioswale. When siting checkdams along the dry creekbed, they can be anchored upslope of trees and boulders already existing in the landscape. The best place for checkdams are in long, straight courses called riffles- perpendicular to the flow of water in order to prevent bank erosion. Curves are better places for Zuni bowls. Both check dams and Zuni bowls need to be "heel-to-toe" in a step-down formation where the base of one is the height of the next. Key in stones half buried in soil to stabilize, layered against the dam like shingles. Always use a one-rock-high dam course as an apron for the overflow in order to prevent erosion.
- **Materials:** 12-24" angular rocks weighing approximately 20 lbs. Water can be treated using phytoremediation plants like willows and sedges on p. 17.

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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

DESIGNED BY: LISA KRAUSE
FALL 2018

BIOSWALE DRY CREEK BED
LANDSCAPE DESIGN FOR NUTWOOD FARM
76 PORTER HILL RD, CUMMINGTON, MA 01026

Pond Habitat

Creating a pond habitat

Ponds have several different plant zones with specialized communities of plants including the Upland Zone, Wet Meadow Zone, Emergent Zone, and Deep Water Zone. Edible or medicinal plants found in pond habitats include jewelweed, sweetfern, cattails, taro, dock, water chestnut, cranberry, pickerel weed, watercress, and some water-lilies. See p. 18 for more information about pond plant communities.

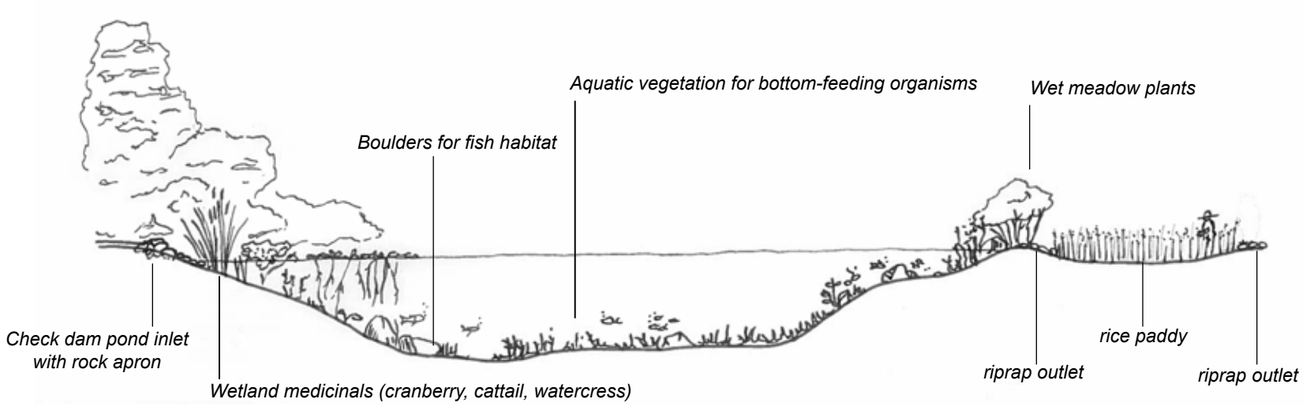
Bloody Dock

Cranberry

Water Chestnut

Benefits of a pond habitat include:

- Mosquito control though creating a permanent habitat for fish, frogs, dragonflies and birds.
- Adding permanent water holding in the landscape in case of drought or fire
- Adding varied crops and medicinals as well as opportunities for fishing
- Swimming
- Opportunities for duck habitat, especially if floating islands are added to protect ducks from predators like foxes.



South **Check Dam Inlet for Pond Habitat with Rice Paddy Overflow** **North**

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

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Pond Habitat
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

Plants for Buffer Zones

Plants in this list are suggestions for reforesting and sustainably managing wetland buffer zones with native edible, medicinal, or other yield-producing plants and/or for pollutant removal through phytoremediation. As a rule, never harvest more than a third of a crop (unless keeping the patch in check) and leave the rest for wildlife.

TREES

American basswood (*Tilia americana*)

American beech (*Fagus grandifolia*)

American persimmon (*Diospyros virginiana*)

Birches (*Betula spp.*)

Black gum (*Nyssa sylvatica*)

Black walnut (*Juglans nigra*) *beware juglone affects neighboring plants

Cherry (*Prunus spp.*)

Hackberry (*Celtis occidentalis*)

Hickory (*Carya spp.*)

Maple (*Acer spp.*)

Oak (*Quercus spp.*)

Red mulberry (*Morus rubra*)

PawPaw (*Asimina triloba*)

Spruce (*Picea spp.*)

Red speckled alder (*Alnus incana subsp. rugosa*)

Slippery elm (*Ulmus rubra*)

SHRUBS

Aronia/chokeberry: black aronia (*Aronia melanocarpa*), red aronia (*A. arbutifolia*), purple aronia (*A. prunifolia*)

Blackberry (*Rubus spp.*)

Blackcap raspberry (*Rubus occidentalis*)

Black huckleberry (*Gaylussacia baccata*)

Blueberry: low-bush (*Vaccinium angustifolia*) and high-bush (*V. corymbosum*)

Brambles: blackberry, raspberry, thimbleberry, dewberry

Chinkapin (*Castanea pumila*)

Cranberry (*Vaccinium macrocarpon*)

Elderberry (*Sambuchus spp.*)

Hawthorns (*Crataegus spp.*)

Hazelnut: American hazelnut (*Corylus americana*), beaked hazelnut (*C. cornuta*)

Rose: pasture rose (*Rosa carolinia*), swamp rose (*R. palustris*), Virginia rose (*R. virginiana*), meadow rose (*R. blanda*)

Serviceberries (*Amelanchier spp.*)

Spicebush (*Lindera benzoin*)

Shrub oaks: bear oak (*Quercus ilicifolia*), dwarf chinkapin oak (*Q. prinoies*) Staghorn sumac (*Rhus typhina*)

Viburnums: nannyberry (*Viburnum lentago*) black haw (*V. prunifolium*) highbush cranberry (*V. trilobum*), wild raisin (*V. nudum*)

UNDERSTORY/PERENNIALS

American ginseng (*Panax quinquefolius*)

Ashwagandha (*Withania somnifera*)

Bearberry (*Arctostaphylos uva-ursi*)

Beebalm (*Monarda didyma*)

Coneflower, tall (*Rudbeckia laciniata*)

Columbine, wild (*Aquilegia canadensis*)

Fern, ostrich (*Matteuccia struthiopteris*)

Ginger, wild (*Asarum canadense*)

Goldenseal (*Hydrastis canadensis*)

Ground-nuts (*Apios americana*)

Honeysuckle (*Lonicera sempervirens*) vine

Licorice (*Glycyrrhiza lepidota*)

Milkweed (*Asclepias syriaca*)

Mountain mint, broadleaf (*Pycnanthemum muticum*)

Mullein (*Verbascum Thapsus*)

Nettle, wood (*Laportea canadensis*)

Red clover (*Trifolium pratense*)

Skullcap (*Scutellaria lateriflora*)

Solomon's seal (*Polygonatum biflorum var. commutatum*)

Virginia waterleaf (*Hydrophyllum virginianum*)

Wintergreen (*Gaultheria procumbens*)

Yarrow (*Acheilla millefolium*)

EDIBLE MUSHROOMS

Chantrelles (*Cantharellus spp.)*

Chicken-of-the-woods (*Polyporus sulphureus*)

Morel, common (*Morchella esculenta*)

Shaggy mane (*Coprinus comatus*)

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Plants for Buffer Zones
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

16/19

Native Plants for Runoff Treatment

Plants in this list can be used in bioswales and rain gardens. Some have harvestable yields, but it is recommended to only harvest fruits from treatment gardens because leaves and greens tend to hold toxins such as heavy metals. Bioswales are typically 40 to 60% sedges and grasses, with some perennial flowers.

Shrubs and Trees

Birch, river - *(Betula nigra)*
Black tupelo - *(Nyssa sylvatica)*
Blueberry - *(Vaccinium corymbosum)*
Buttonbush - *(Cephalanthus occidentalis)*
Carolina allspice - *(Calycanthus floridus)*
Chokeberry, red - *(Aronia arbutifolia)*
Elderberry - *(Sambuchus nigra)*
Fothergilla, dwarf - (*Fothergilla gardenia)*
Fringe tree - *(Chionanthus virginicus)*
Magnolia, sweetbay - *(Magnolia virginiana)*
Summersweet - *(Clethra alnifolia)*
Viburnum, arrowwood - *(Viburnum dentatum)*
Virginia sweetspire - *(Itea virginica)*
Wild raisin/witherod - *(Viburnum nudum)*
Willow, autumn - *(Salix serissima)*
Willow, meadow - *(Salix petiolaris)*
Willow, flame - *(Salix alba)*
Winterberry holly - *(Ilex verticillata)*

Perennials

Ageratum, hardy - *(Eupatorium coelestinum)*
Alum root - *(Heuchera villosa)*
Beebalm - *(Monarda didyma)*
Blue lobelia - *(Lobelia siphilitica)*
Cardinal flower - *(Lobelia cardinalis)*
Culver root - *(Veronicastrum virginicum)*
Goldstar - *(Chrysogonum virginianum)*
Iris, blue flag - *(Iris versicolor)*
Iris, Virginia - *(Iris virginiana)*
Joe Pye weed- *(Eupatorium dubium)*
Pitcher plant - *(Sarracenia purpurea)*
Ragwort - *(Senecio aurea)*
Swamp sunflower - *(Helianthus angustifolius)*
Orchid, ladies trusses - *(Spiranthes cerna)*
Turtlehead – *(Chelone lyonii)*
Yellowroot - *(Xanthorhiza simplicissima)*

Ferns

Cinnamon fern - *(Osmunda cinnamomea)*
Maidenhair fern - *(Adiantum pedatum)*
Ostrich fern - *(Matteuccia struthiopteris)*
Royal fern - *(Osmunda regalis)*

Grasses

Eastern narrowleaf sedge - *(Carex amphibola)*
Grays sedge - *(Carex grayii)*
Palm sedge - *(Carex muskingumensis)*
Pennsylvania sedge - *(Carex pennsylvanica)*
Switchgrass - *(Panicum virgatum)*
Tussock sedge - *(Carex stricta)*

PHYTOREMEDIATION PLANTS RECOMMENDED IN THE BOOK *PHYTO:*

Red maple	Cottonwood
Alder	Quaking Aspen
Serviceberry	Willow
Netleaf hackberry	White Oak
Silky dogwood	Elderberry
Sweetbay magnolia	Vetiveria
Poplar	Brassicacae

HIGH BIOMASS-PRODUCING PHYTOREMEDIATION PLANTS:

Poplar	Sunflower
Cottonwood	Flax
Quaking aspen	Switchgrass
Willow	Willow
Bamboo	Corn
Rapeseed	Chinese silvergrass
Hemp	

WATER BIOFILTER PLANTS:

Variegated celery	Chinese lizards tail
Canna	Manna grass
Iris	Pickerel rush
Taro	

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Native Plants - Treatment
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026

17/19

Pond Planting Zones

Plants below are separated based on the pond planting zone they occupy, and listed in native and non-native plant categories.
They have multiple purposes in providing various harvestable yields and/or wildlife habitats.

POND EDGE: WET MEADOW ZONE

Wet meadow edible/medicinal: native

Cinquefoil, shrubby *(Potentilla fruticose)* - summer harvest, leaves: tea

Dock, bloody *(Rumex sanguineus)* - full sun-part shade, edible, medicinal

Jewelweed *(Impatiens capensis)* - medicinal

Stinging nettle *(Urtica dioica)* – summer harvest, edible, medicinal

Sweetfern *(Comptonia peregrina)* - edible, medicinal uses: tea, topical

Sweetflag *(Acorus americana)* - 4', full sun, spring harvest, edible, medicinal, perfume

Peppermint *(Mentha piperita)* – summer harvest, edible, medicinal

Purple Avens *(Geum rivale)* - harvest all year, roots taste like chocolate

Angelica *(Angelica atropurpurea)* - spring/summer harvest, stems edible

Boneset *(Eupatorium Perfoliatum)* - full sun/part shade, medicinal

Water Celery *(Oenanthe javanica)* – 1-2' blooms: July-Sept harvest, biofilter, edible

POND EDGE: EMERGENT ZONE

Emergent edible/medicinal: native

Arrowhead *(Sagittaria latifolia)* - edible: rootstock

Bullrush, Hard-stem *(Scirpus tabernaemontani)* - to 9', Edible: tubers, pollen, seeds (flour/syrup/sugar), medicinal, craft uses, wildlife habitat

Cattail *(Typha latifolia)* - edible: spring shoots and pollen, uses: torches, mattress stuffing

Cranberry *(Vaccinium macrocarpon)* - edible, medicinal

Pickerelweed *(Pontederia cordata)* - 2-3', biofilter, purple flowers, edible: young leaves and seeds- salads

Swamp root *(Saururus cernuus)* – 1-2', biofilter, Sun to heavy shade, medicinal, ornamental

Water plantain *(Alisma plantago-aquatica)* – 3', sun, medicinal

Wild Rice *(Zizania aquatica)* - edible: seeds/grain, mid/late summer

Emergent edible/medicinal: non-native

Bramhi *(Bacopa monniera)* - important Ayurvedic medicinal herb – edible: salads, soups, pickled: lemonbalm-like flavor – hardiness zone 8-10

Watercress *(Nasturtium officinale, N. microphyllum)* - reseeding annual, edible: salads or stirfrys hardiness zones 3-11

Gotu kola *(Hydrocotyle asciatica)* - edible, medicinal – hardiness zone 10-11

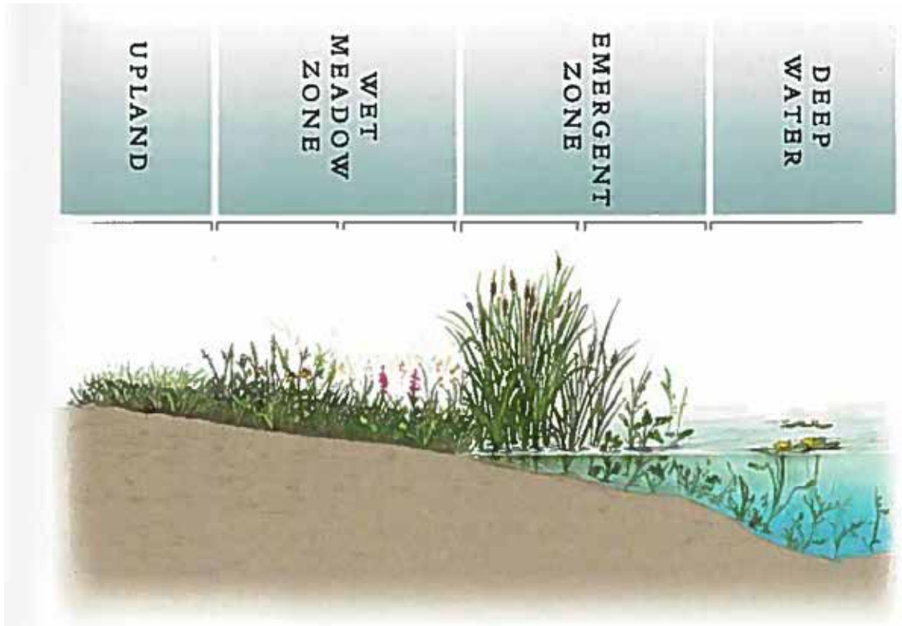
Kang-kung/water spinach *(Ipomoea aquatica)* - annual, edible: stirfry – hardiness zone 11

Society Garlic *(Tulbaghia violacea)* – edible: salads or cooking – hardiness zone 7-10

Taro, Edible *(Colocasia esculenta)* - biofilter, edible: root – hardiness zone 8-11

Waterchestnut, Chinese *(Eleocharis dulcis)* - edible: salads or stirfry – hardiness zone 9-12

Water Parsley *(Oenanthe javanica)* – edible: salads - hardiness zone 9-11



Pond zones illustration from The Natural Water Garden: Pools, Ponds, and Marshes for Backyards Everywhere by C. Burrell

DEEP WATER ZONE:

Deep water habitat plants: native

Waterweed *(Elodea canadensis)* - habitat

Tapegrass *(Vallisneria americana)* - habitat

Deep water edible/medicinal: native

Yellow pond-lily *(Nuphar variegatum)* - full-sun, medicinal, edible: leaves, seed, root - like potato

Coon's Tail *(Ceratophyllum demersum)* - pond oxygenator with medicinal uses

Deep water edible/medicinal: non-native

Sacred Lotus *(Nelumbo nucifera)* - edible, decorative seed pods, pink flowers – hardy to zone 4

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause

Fall 2018

Pond Planting Zones

Landscape Design for Nutwood Farm

76 Porter Hill Rd, Cummington, MA 01026

Resources

American Indian Health and Diet Project http://www.aihd.ku.edu/foods

Deep Green Permaculture https://deepgreenpermaculture.com/permaculture/permaculture-design-principles/4-zones-and-sectors-efficient-energy-planning/

Edible Water Plants: Aquatic Vegetables http://natures-water.com/education_information/edible_plants/

Edible Wild Mushrooms http://ediblewildmushrooms.com/

Gabion basket design life chart https://www.gabion1.com/gabion-life-expectancy/

Massachusetts Association of Conservation Commissions (MACC) https://www.maccweb.org/page/ResWPAFAQS

Natural Resources Conservation Service Greenhouse Grant https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/?cid=stelprdb1046250

Our One Acre Farm https://ouroneacrefarm.com/wild-edible-post-index/

Plants for a Future database https://pfaf.org

Sediment & Erosion Control on Construction Sites Field Guide, University of Virgin Islands Cooperative Extension Service (2002). https://www.coralreef.gov/transportation/sederosuvi.pdf

Virginia Water Resources Research Center- Virginia Stormwater Best Management Practice Clearinghouse (2011). Appendix D - Sediment Forebay https://www.swbmp.vwrrc.vt.edu/

Wild Plant Culture https://wildplantculture.com/home/2015/11/native-permaculture-plants.html

Burrell, C. (1997). *The Natural Water Garden: Pools, Ponds, Marshes & Bogs for Backyards Everywhere.* NY: Brooklyn Botanic Garden.

Darwish, Leila. (2013). *Earth Repair: A Grassroots Guide to Healing Toxic and Damaged Landscapes.* Gabriola Island, British Columbia-Canada: New Society Publishers

Falk, Ben. (2013). *The Resilient Farm and Homestead: An Innovative Permaculture and Whole Systems Design Approach.* White River Junction, VT: Chelsea Green

Kennen, Kate and Kirkwood, Niall. (2015). *Phyto: Principles and Resources for Site Remediation and Landscape Design.* New York: Routledge.

Lancaster, Brad. (2013). *Rainwater Harvesting for Drylands and Beyond, Vol. 2 Water Harvesting Earthworks*. Tuscon, AZ: Rainsource Press.

Peterson, Lee Allen. (1977). *Peterson Field Guides: Edible Wild Plants of Eastern and Central North America.* New York: Houghton Mifflin Company.

Shepard, Mark. (2013). *Restoration Agriculture: Real-World Permaculture for Farmers.* Greeley, CO: Acres USA

Zeedyk, Bill and Clothier, Van. (2009). *Let the Water do the Work: Induced Meandering an Evolving Method for Restoring Incised Channels.* White River Junction, VT: Chelsea Green

Graduate Program in Sustainable Landscape Planning + Design
the ConwaySchool
88 Village Hill Rd.Northampton, MA 01060
413-369-4044
www.csld.edu

Designed By: Lisa Krause
Fall 2018

Resources
Landscape Design for Nutwood Farm
76 Porter Hill Rd, Cummington, MA 01026