Recommendations for Sustainable Landscaping and Features at the Cussewago Square Project

Presented to RAN LLC

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January 2025

Aerial view of Cussewago Square Project. Photo by Chris Shaffer.

Allegheny College Department of Environmental Science and Sustainability Publication 2025-1.

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Recommended Citation: Hunter, R. M. (editor); Biro, B. C.; Csonka, S. J.; Cousineau, K. M.; Dowden, G.; Johnson; W.T.; Klim, A.A.; McCrea, Q.L.; Pegher, R.K.; Simons, M.O.; Styers, I.A.; Tovanche, L. K.; Bowden, R.D. 2025. Recommendations for Sustainable Landscaping and Features at the Cussewago Square Project. Allegheny College Department of Environmental Science and Sustainability Publication 2025-1.

Executive Summary

There is much that can be done in landscaping Cussewago Square. For this to be an attractive and successful destination, Cussewago Square must be aesthetically pleasing and environmentally sustainable. To help achieve these goals, we have developed plans for five efforts at Cussewago Square: An interpretive walking trail, native landscaping and pollinator gardens, a fruit and vegetable garden, a bicycle pavilion, and flood mitigation.

We recommend constructing an interpretive walking trail that travels from Cussewago Square to Cussewago Creek. This walking trail will expand the space of the square to include some of the surrounding land, allow patrons to connect with nature, and enhance the overall customer appeal. It will include interpretive signs, fun and helpful amenities, a creekside rest area, and extra points of relaxation that allow for an enjoyable experience that transcends a simple walk to the creek.

The implementation of landscaping and pollinator gardens will attract people to the square, support local flora and fauna, and create natural barriers. Landscaping components will involve native seed mixes, shrubs, trees, infrastructure, parking lots, and the interpretive trail. Pollinator gardens throughout the square are recommended to provide attractive native flowers that support native pollinators.

The fruit and vegetable garden will supplement the ingredients utilized by Cup n' Spoon Coffee & Frozen Yogurt Bar and Dominic's Restaurant. We selected produce appropriate for this region's climate, derived sources for plants and trees, and developed budgets for all inputs. We identified locations on the property that could support this project while considering suitable growing conditions, including recommended square footage, fencing costs, irrigation needs, sunlight availability, and accessibility for maintenance.

A bicycle pavilion is proposed because there is a lot of potential for Cussewago Square to be a bicycle friendly area, as it is a semi-public space that will have easy access to Ernst Trail, which passes through

the property. We suggest connecting the square to the bike trail, building a bike pavilion, providing bike racks near the shops, and inviting the CATA bike share program to contribute to the project.

Flood management is important to the development of Cussewago Square because the property is located within the 100 year flood zone, so there is a strong likelihood that the area will flood following high intensity storm events. Although the buildings themselves are above the flood zone, the frequency and intensity of these heavy precipitation events are projected to increase in upcoming years; thus implementation of flood mitigation will lessen the long-term impact of flooding in the square. We designed rain gardens and planted areas to retain and filter stormwater and assist with local flood water management. Four locations were deemed suitable for rain gardens in Cussewago Square. These locations are designed to collect stormwater runoff from the roof of each building. Recommendations provide further information as to cost, type of plants and construction considerations.

Acknowledgements

We thank Mr. Rob Smith for his encouragement, suggestions, and gracious tours of the site, Mr. Steve Davies for an informative site planning exercise, Mr. Peter Oven for valuable guidance on trail construction, Ms. Melissa Dierdricks for graciously hosting us at Cup n' Spoon and for providing ideas for garden plantings, Mr. Greg Kedzierski of Ernst Seeds for sage advice on native plants and seeds, and Professor Chris Shaffer for extremely useful aerial drone images.

Introduction

Cussewago Square, located by Cussewago Creek, is a new redevelopment project by RAN Investments LLC in Meadville, PA that is renovating multiple buildings in Meadville's Fifth Ward that most recently housed the former Race Street Lumber Company, and in previous years, had been a distillery. Cussewago Square is planned to be a community destination with a restaurant, an event hall, a cafe, a theatre, an artist center, and pre-school. The inside and outside of existing buildings are currently being renovated and polished into a destination spot for locals, but plans for the outside land-use have not yet been fully developed. Developing sustainable landscaping and amenities will enhance the environmental sustainability of this development, increase the aesthetic appeal of the square, and link the participating businesses to surrounding natural amenities and assets.

Cussewago Square is located only a few hundred feet from Cussewago Creek, which is a tributary to French Creek, and is therefore one of the many connecting contributors to the French Creek watershed. Once fully developed, the square will also intersect with a newly constructed segment of Ernst Trail, which is a popular biking and walking trail crossing through Crawford County, Pennsylvania.

In the spring of 2024, Professor Richard Bowden from the Allegheny College Department of Environmental Science and Sustainability (ESS) discussed with Mr. Rob Smith, Co-owner of RAN Investments LLC, the possibility of students from Allegheny College developing recommendations for environmentally sustainable landscaping and features on the square. Mr. Smith enthusiastically embraced the idea, thus in the fall of 2024, students in the *course Junior Seminar in Environmental Sustainability* (ES585) worked on plans for environmental features for the project. The class visited the site several times, including visits with Mr. Smith, who gave tours of the site. The students brain-stormed ideas that seemed important, viable, and achievable in enhancing environmental sustainability at the project. After discussion and deliberation, the class decided to develop plans for five potential efforts:

- An interpretive walking trail
- Native landscaping and pollinator gardens
- A fruit and vegetable garden
- A bicycle pavilion
- Flood mitigation measures

To gain information to inform the plans, the class met at Cussewago Square with Mr. Steve Davies, Assistant Visiting Professor at Pratt Institute in the Urban Placemaking and Management Graduate Program, and co-founder of the Project for Public Spaces (https://www.pps.org/). Mr. Davies is a noted authority on designing spaces that invite community engagement. Professor Chris Shaffer of the ESS Department met the class at the Cussewago Square location to launch a camera-equipped drone used to obtain aerial images. To learn what fresh produce that could be used in products to be sold in the new Cup n' Spoon location, the class visited with Melissa Dierdricks, co-owner of Cup n' Spoon, at her downtown Meadville store. Finally, Mr. Peter Oven, from Wilson Engineering Services and a board member of French Creek Recreational Trail, Inc. visited the class to provide information on trail construction.

Working in teams of two or three, students explored each topic, and then developed site-specific plans for each potential effort. At the end of the semester, the class hosted a presentation on its findings for RAN Investments LLC as well as for others interested in the project.

Interpretive Walking Trail

Tommy Johnson, Riley Hunter, Grant Dowden

Statement of Issue

Interpretive trails help people enjoy natural spaces by engaging in environment education through interpretive signage. It also encourages physical activity and enhances the overall customer experience for people visiting Cussewago Square. It would allow people to go for a walk while waiting for a table at Dominic's Restaurant or after they have purchased a drink at Cup n' Spoon. This trail is a significant addition that will expand the physical space and enhance the "Hallmark" persona of Cussewago Square.

Plans and Recommendations

Our plans for this project include adding a porous-pavement trail, creekside rest area, interpretative signage, and amenities. Amenities include benches, lighting, trash cans, hammock stands, and dog bag dispensers, all of which will contribute to a positive experience on the trail. Interpretive signs, benches, and other amenities enhance visitor experience by providing information, comfort, and opportunities to rest in nature, making the trail more enjoyable and educational (Trapp, 2024).

We identified two locations for this trail. Both have access to Cussewago Creek. The first location (Fig. 1) starts outside near Dominic's restaurant, goes around the house and straight for the creek. This location goes through PennDOT property and also crosses the bike trail. The second location (Fig. 2) also starts outside of Dominic's Restaurant but goes around the backyard of the house on RAN property and heads straight to the creekside. This trail location is approximately the same length as the first option. The trail would be ¼ mile in total length (out and back). We also recommend that the trail is six feet wide which allows room for two-way traffic and space for wheelchair users.

There are two possible material options that suit the requirements for this trail; the first and most strongly recommended material is flexi-pavement. The material of this porous pavement comes from finely shredded recycled tires, crushed stone, and a binding agent. Flexi-pavement is environmentally friendly, easy on joints, smooth, and ADA-compliant. It is also anti-slip, porous, and resistant to freeze-thaw cycles from Pennsylvania weather (Prasad, 2023). A porous surface material is crucial since this trail is in a 100 year flood zone (Mazurowski, 2021). This trail surface material costs $6-12 per square foot (*American Trails,* n.d.). In total, the cost would be $23,000-46,000 to install (Table 1). The terrain is already relatively flat and clear where we would want to construct the trail.

The second surface material option is asphalt. This is a popular multi-use trail material, however, because our trail is dedicated to walking, being multi-use is not critical. Asphalt is an anti-slip material, relatively durable, low maintenance, ADA-compliant, and smooth (Mazurowski, 2021). Disadvantages include vulnerability to freeze-thaw patterns, reduced aesthetic appeal due to cracking, unforgiving on joints, and it is non-porous (Team, 2018). Asphalt is slightly less expensive, at $6-11 per square foot (*Rubcorp,* 2024). In total, this would cost $23,000-42,000 to install.

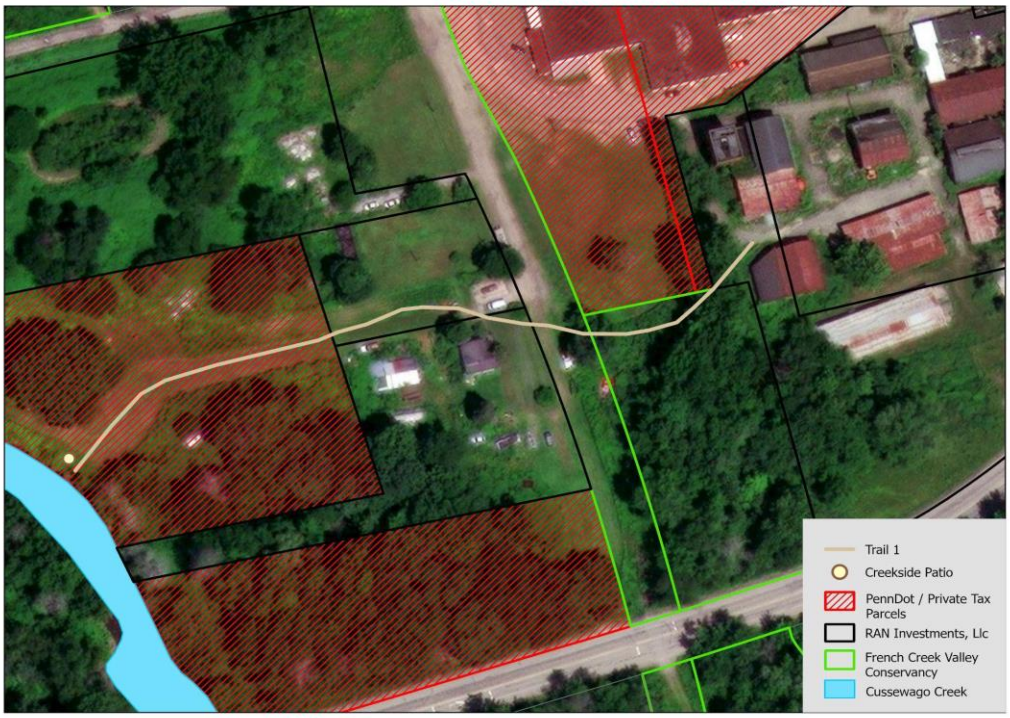

Figure 1. Preferred option (Trail 1) for interpretive walking trail.

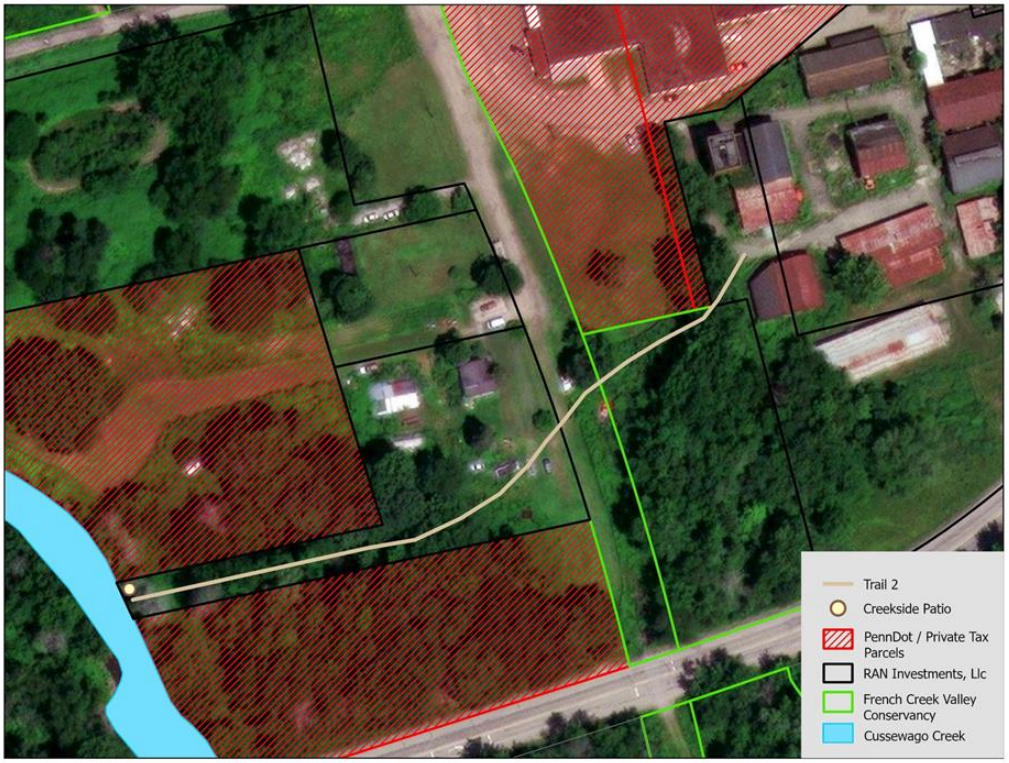

Figure 2. Optional location (Trail 2) for interpretive walking trail.

The destination of this trail is to the bank of Cussewago Creek, so we propose the construction of a creekside rest area. This will allocate space for patrons to relax and enjoy nature at the end of their walk to the creek. Due to erosion risks to the creek, the area is recommended to be located a minimum of ten feet away from the creek's edge (Fetter et al., 2021). We recommend implementing a sandstone patio. Sandstone is durable and aesthetically appealing. To allow for ample relaxation space, the proposed patio is 20x20 ft. Based on these measurements, cut sandstone for the patio would cost approximately $12,000, the combination of sand paver and a gravel base would cost approximately $3,000, and estimated labor costs would be $8,000. Therefore, the total estimated price for this patio comes to $23,000.

Recommendations for interpretive signage topics include biodiversity, native species, invasive species, pollinator gardens, history of Cussewago Creek, and renewable energy. These signs would be placed in areas that are relevant to their respective topic. The pollinator garden sign would be placed near a pollinator garden along the trail, the renewable energy sign would be placed near a bike rack or bike shelter, and the history of Cussewago Creek sign would be near the patio by Cussewago Creek. Signs should be eye-catching, using appealing imagery to attract visitors towards the signs (Hughes & Morrison-Saunders, 2002). They should also be written at an accessible reading level. We recommend that the signs are written at no higher than an eighth grade reading level, but may be targeted towards a younger audience with an opportunity to implement environmental education for the nearby preschool and daycare. It would also be useful to include a trail head sign, including a map and points of interest in and around Cussewago Square. A 2x3 ft sign from Vacker signs cost approximately $300 per sign, or $250 if the sign posts are bought separately, based on quotes for similar projects. A quality trailhead sign would likely cost upwards of $3,400.

Table 1. Minimum and maximum costs of the interpretive trail.

Trail Component	**Minimum**	**Maximum**
Pavement	$23,000	$46,000
Rest Area	$20,000	$25,000
Signage	$6,000	$20,000
Amenities	$25,000	$25,000
Total	$74,000	$116,000

Sustainable trail lighting practices are recommended to be used in Cussewago Square to avoid disturbing wildlife, minimize light pollution, and conserve energy (Longcore & Rich, 2017). Because this trail will be constructed away from the main Cussewago Square and towards the forested area by the creek, it (a) will require lights after dark to be considered safe and (b) should follow sustainable lighting practices to avoid disturbing nearby wildlife with light pollution. Sustainable lighting practices, according to sources from the National Park Service, include only lighting the area at the necessary times, only lighting

appropriate and necessary areas, using downward-facing, shielded light fixtures, using the minimum lighting level necessary, and using warm, white LED lights at 2700 Kelvin or less (National Park Service, 2024). The type of light fixture that most closely follows these requirements is bollard lighting, and there are a variety of models available. Bollard lights are ideal for pathway lighting because they face downward, pointed directly at the path without causing upward light pollution. Ideally, we would choose a model that is solar-powered and made from durable, sustainable materials to withstand weather conditions. One specific model that would work well is the Waterproof Solar Side Standing LED Outdoor Post Pathway Lights. These lights are solar-powered, available in a warm, white LED color, and are made from durable and waterproof materials. Eight lights are priced at $1,400, and if they are placed every ten feet on both sides of the 600 foot trail, the total price will come to approximately $21,000.

One trail amenity that would enhance visitor experience is benches. Trex benches are an inexpensive, yet durable option, and could be bolted to the path or concrete pads to prevent them from moving via vandalism or after flooding. We propose a total of five benches along the trail– two on the trail and three at the creekside patio, totaling $2,300. Another amenity is trash cans– we recommend two trash cans along the trail, one at the trailhead and one at the creekside patio, which would cost $860. Along with the trash cans, a dog bag dispenser is important in order to keep the trail clean. The trail is in close proximity to Ernst Trail, which is frequently used for dog walking. A dog bag dispenser would cost about $190. The last amenity on the trail is hammock stands. These are good places for people to bring their own hammocks and relax near Cussewago Square. These stands could be built out of wooden posts and hooks from Home Depot. The construction of three hammock stands would cost approximately $500.

In total, you could expect to pay around $93,000 to implement the trail, rest area, signage, and amenities (5 benches, 2 trash cans, 3 hammock stands, 1 dog-bag dispenser, and lighting) (Table 2). Additional costs or variables that could increase costs include permits, drainage system for porous pavement, a planted riparian buffer by the creek, landscaping around the trail, and trail maintenance.

Table 2. Preferred trail option costs.

Trail Component	**Cost**
Flexi - Pavement	$35,000
Rest Area	$23,000
Signage	$10,000
Amenities	$25,000
TOTAL	$93,000

Recommended Reading

- This article discusses the importance of flexible pavement being used where climate affects the deterioration rate of pavement, maintenance, and life cycle costs. (PDF) Flexible Pavements and Climate Change: A Comprehensive Review and Implications
- This article provides pros and cons regarding flexible pavement if you want to learn more about this surface material. Advantages and Disadvantages of Flexible Pavement – VideRime Online Learning
- Here is a reading that provides insight on how asphalt functions as a surface material. It is crucial to review what material to use for a trail surface since this will affect future maintenance cost and lifespan. FAQ: Is asphalt a good choice for a trail surface? - American Trails
- This paper discusses the ethics of valuing wilderness and why it is important that we conserve pristine night skies. http://www.georgewright.org/184duriscoe.pdf

Landscaping and Pollinator Gardens

Sarah Csonka and Alyssa Klim

Statement of Issue

While the businesses themselves will draw people to Cussewago Square, proper landscaping will make people want to remain within and return to the space. Strategic placing of flowers and shrubs will help hide unsightly machinery or pipes that will disrupt the beauty of the square. Flowers around the buildings will fill empty space and add appealing greenery that may boost the mental health of customers. Bushes along the perimeter of the square will give a natural and appealing barrier, keeping people within the confines of the square. Using alternative lawn plants will also reduce maintenance costs, while minimizing noise disruption from lawn mowers. Using native plants will also help support the local ecosystem and native pollinators. These touches of nature will help people feel connected to their surroundings and to the square itself, making them want to return to experience the beauty of Cussewago Square.

Plans and Recommendations

Recommendations start with pollinator and butterfly gardens. Pollinator gardens are important not just for the aesthetic beauty of the square, but also for native wildlife. We recommend having multiple plant boxes or gardens dispersed throughout the square with one at the trail entrance. These plants will support the local ecosystem and provide a pleasing aesthetic to the square. Interpretive signs can be put near some of these gardens to display information about the plants and the pollinators they attract. Seeds can be procured from https://www.ernstseed.com/. Seed mixes contain native plants and pollinator-supporting plants that include both annuals and perennials. Annuals live for only one year, and some mixes, such as Ernst Seed's Wildflower Mix, may need occasional seed additions until the plants become well established and begin producing seed regularly. Perennials regrow each spring and can live for multiple years (e.g. Ernst Seed's Honey Bee Forage mix, Deer Resistant Meadow mix, Northeast Solar Pollinator Wildflower mix, and their Showy Northeast Native Wildflower and Grass mix). There are also mixes with both annual and perennial seeds, including the Butterfly and Hummingbird Specific mix and the Northeast Wildflower mix, which are both highly recommended. These mixes all include plants that are suitable for the climate of western Pennsylvania, and they come from a company that Allegheny College has successfully collaborated with in the past.

There are multiple areas within and around the square that we recommend for pollinator and butterfly gardens (Fig. 3-10). The first area is adjacent to the porch of Cup n' Spoon. This is a nice, open area that guests will likely be attracted to once they have purchased their frozen yogurt. It's suggested that a few plant boxes or pots be set around the edge of the porch, filling in some space as well as giving guests something nice to look at. The next area is the porch for Dominic's Restaurant. This is a slightly smaller area where plants could line the perimeter of the porch. This creates a natural barrier between the porch and the rest of the square. Larger swatches where gardens can be implemented, rather than smaller boxes, are suggested on the outside edges of parking lots. These would still serve their purpose of upholding aesthetics and providing resources for the native ecosystem, while being out of the way of the rest of the square.

Non-pollinator garden plants can also be added, using mixes like the Northeast Wildflower mix. These are suggested to go on the outside corners of buildings. Some specific areas include covering the

grease trap at the restaurant, or the fences by electrical boxes. The electrical boxes will be fenced in to stop the public from accessing them, but ideally the boxes should be out of sight. To achieve this, plants can line the fences to transform the appearance from a maintenance area to a green space. Other places for plants could simply be corners of buildings, creating something visually interesting against the plain brick. An example of this could be at the front of the theatre, where topiaries could fit. These, of course, would require more maintenance and trimming compared to flower beds.

These would all possibly require planter materials. Some options for these include wood, brick, and terracotta. Suggestions for wood include oak or cedar. Cedar is commonly used and is decay-resistant. Alternatively, it would be possible to reuse oak already available on site, which could reduce costs. However, we need to make sure this wood is not previously treated. Treated wood can leak chemicals into the soil which can impact the growth of plants. Brick that is already on site is also an option, which could potentially reduce costs. Brick would be a more stable option, while wood would be faster to assemble. The last option is terracotta planters, which can be bought at a reasonable price but have a higher chance of breaking and are limited in variety of sizes.

Other forms of landscaping that would be beneficial to the square are trees and shrubs. Trees provide shade and a variance in greenery for aesthetic purposes. Small trees could be planted near parking lots or at the edge of the square. Recommended species of small tree are flowering dogwood or eastern redbud. Both are attractive trees that remain relatively small in stature at full maturity. Natural barriers are desired near the edge of Cup n' Spoon and the playground to assist with directing foot traffic. A plant that could serve this purpose include Highbush Blueberry, which could also be harvested to be sold at Cup n' Spoon or Dominic's Restaurant. The projected total cost for the landscaping and pollinator gardens, exclusive of labor, is approximately $3,000 (Table 3).

Table 3. Estimated budget for the landscaping and pollinator gardens - excludes cost of labor.

Materials	**Cost**
Planters	$400
Plants and Seeds	$2,000
Gardening Tools	$160
Wood	$100
Total	$2,660

Another landscaping recommendation is reducing the size of lawns and instead using alternative plantings. Non-native grasses that are commonly used for lawns can hinder and disrupt local ecosystems. Alternatively, native grasses enhance local biodiversity and require less maintenance than a conventional

lawn. We recommend *Carex Pensylvanica*, a plant native to western PA, as a lawn alternative for Cussewago Square. This plant only requires mowing once or twice a year, and usually reaches a maximum height of only four to six inches.

Finally, we must consider landscaping maintenance. Mowing and potential irrigation costs can be reduced by using alternative lawn options. Plantings may need occasional watering, fertilization, and weeding. This applies to all plants in the square, whether they are in boxes, pots, or the ground. This ensures the plants are healthy and thriving. However, it is likely that some plants will need to be removed or replaced in case of mortality. It may also be necessary to replace broken planters or pots. If trees are planted, then tubing should be put around the trees to prevent deer from browsing them and slowing their growth. The cost of maintenance is included in our budget, although the cost of labor is not.

Figure 3. Designated areas for pollinator gardens and shrubs.

Figure 4. Recommended area for pollinator garden outside Cup ‘n Spoon patio.

Figure 5. Recommended area for pollinator garden on western border of Cussewago Square, facing the house.

Figure 6. Recommended area for pollinator garden on western Border of Cussewago Square.

Figure 7. Recommended area for pollinator garden on corner of the Meadville Community Theatre.

Figure 8. Recommended area for pollinator garden to cover pipes and infrastructure outside building for art studio.

Figure 9. Recommended area for pollinator garden outside the event hall where air conditioning units will be installed.

Figure 10. Recommended area for pollinator garden to cover grease trap located by the restaurant.

Recommended Reading

- This peer-reviewed article analyzes how using native plants for landscaping can promote animal biodiversity within urban environments. The role of 'nativeness' in urban greening to support animal biodiversity - ScienceDirect
- This article explores the issue of root damage by urban trees and how it is caused. The article also discusses how to prevent and maintain damage caused by tree roots. Root damage of street trees in urban environments: An overview of its hazards, causes, and prevention and control measures - ScienceDirect
- This article looks at how landscaping can positively impact a person's mental health, just by being around plants and interacting with them. Gardening for health: a regular dose of gardening - PMC

Fruit and Vegetable Gardens

Quinn McCrea, Iris Styers, Lorenzo Tovanche

Statement of Issue:

In this section, we develop a plan and budget for installing a produce garden and fruit trees on the property of Cussewago Square. The owner of Cup n' Spoon expressed a desire for high quality, sustainable local produce to alleviate business costs, diversify their menu, and appeal to a wide range of customers. We provide plans for an efficient, low-maintenance, and cost-effective garden that is conveniently located for Cup n' Spoon's use, as well Dominic's Restaurant. At the same time, our garden is designed as a visible representation of Cussewago Square's charm and commitment to its community, businesses, and visitors.

Plans & Recommendations:

Location

To make a suitable recommendation for the garden design, we first identified the necessary conditions for the garden to help us conceptualize the amount of space needed for this project. We assessed the spatial parameters of various locations on the property that we anticipated would fit the project's criteria. First, we considered the amount of food that needs to be grown in order to reasonably supplement the needs of both restaurants. Our research, which we will expand upon later in the report, revealed that garden beds 4 feet in width and 8 feet in length were the optimal size for growing crops, and about 15 garden beds would reasonably accommodate the restaurants' produce needs. In addition to the beds, the garden would need to accommodate space for 12 fruit trees, all of which would have to be protected from wildlife by electric fencing. Next, the group considered how far away the house would be from the garden to be used as a water source. The house, located in the south portion of the property, provides a groundwater source, so the garden should be located close to the house to be reliably irrigated. These considerations led the group to a plot of land on the western side of the house that we expect will accommodate the garden (Fig. 11).

This area was the largest of the locations that we assessed, with about 5,200 square feet of land and dimensions of 73 feet by 71.5 feet. This area could reasonably support the 15 raised beds and 12 fruit trees, while also allowing enough space for the people tending the garden to comfortably move around. This area is 80 feet away from the house, so it is close enough to the water source for the garden's irrigation demands. However, compared to another plot closer to the house, this location may still experience irrigation complications, as experts recommend that drip irrigation systems be located as close to the water source as possible to mitigate possible pressure drops with shorter tubing (Wrightson 2016). Additionally, this area may face sunlight challenges because of its proximity to the riparian canopy. Nevertheless, these considerations indicate that out of all the possible locations that the group surveyed, this area is the most suitable for a garden.

Figure 11. The suggested location for the garden has approximately 5,200 square feet of land available and is located on the western side of the house. The perimeter of the plot is 280.89 ft.

Raised Beds

Raised garden beds provide an effective solution to many of the challenges that restaurant gardens face. Raised beds are compact and give plants vertical space to extend their roots, allowing gardeners to plant more crops in a smaller area (Burke, 2023). Additionally, raised beds provide improved drainage, reduce irrigation needs, and ensure soil quality by allowing the gardener to fill the beds with their choice of soil medium (Tacker et al., 2003; Yigezu et al., 2021; Miernicki et al., 2018). This is especially important for our project due to Cussewago Square's previous land-use as a distillery; using raised beds could diminish any contaminant uptake from the plants (Goli & Sahu, 2014).

Various materials can be used to construct raised beds, but our group suggests using bricks or wood. When planning raised beds, it is important to consider the unit cost of materials and how much material is required. Gardeners recommend growing in beds that are 4 feet wide by 8 feet long by 1 foot tall, as these dimensions provide the most area to grow while remaining physically manageable for gardeners (Burke, 2023). These beds should be constructed out of uncontaminated materials, since those contaminants can leach into the soil and negatively affect the crops (University of Saskatchewan). Untreated cedar is a durable timber option that is naturally resistant to rot and could last for about 10 years, but it is rather costly. Cedar boards, 2x4" x 8', from Lowe's cost $21.78 each; with 15 beds, this project would require 90 planks, totaling $1,960.20. At the same quantity, fir planks would cost $1,004.40. However, fir planks are not as naturally resistant as cedar planks, and would likely require replacement sooner than cedar planks. A cheaper option could incorporate reclaiming bricks that are already on the Cussewago Square property. The purchases for this option would likely consist of mortar mix, which would cost about $330 in total. However, this would be a more labor intensive process, as the bricks would have to be carried manually to the site and laid by hand.

Drip Irrigation

Adequate irrigation is vital to the health and productive capabilities of all plants. While many methods of irrigation are available, drip irrigation is considered one of the most efficient ways to provide food plants with water (Wrightston, 2016). The slow and evenly distributed water application of drip irrigation delivers moisture directly to the root area of the plants (Fig. 12), greatly reducing water loss from runoff, evaporation, or drainage. It can also prevent diseases that may develop from water contact with leaves, stems, and fruit (Shock, 2013). Drip irrigation is also adaptable, benefiting plants with both low and high water demands, and can be used for fertilizer and insecticide applications if needed (Shock, 2013). To take full advantage of what a drip irrigation system has to offer, it is critical to determine the watering schedule needed for your plants (Tacker et al., 2003). Once this timing is determined, a drip irrigation system can be set on an automatic timer, ensuring precise watering for crops and reducing manual labor needs to almost zero.

There are some issues associated with drip irrigation, mostly involving leaking, clogged drip tape, or clogged tubing. However, these issues can be easily mitigated with a high-quality system that includes all necessary components. The most reliable drip irrigation system in terms of performance and longevity uses 1/2-inch or 1/4 inch drip tubing, with pressure-compensating water emitters spaced every 9-12 or 6-12 inches respectively (Wrightson, 2016). We recommend placing tubing on top of the soil rather than subsurface in order to make observation and repairs more manageable. Tubing can still be covered by mulch to lessen damage from sun-exposure using this method (Wrightson, 2016). Furthermore, a filter is recommended to prevent clogging throughout the drip tape and tubing— one option is sand media filters, which are designed to be self-cleaning (Shock, 2013). There are many potential designs for this type of system; the one shown here (Fig 12), introduced by Shock (2013), shows a 4’ x 8’ vegetable bed with three individual drip lines. The + markers show the evenly spaced in-line emitters, while the blue markers show individual shut-off valves along the supply line.

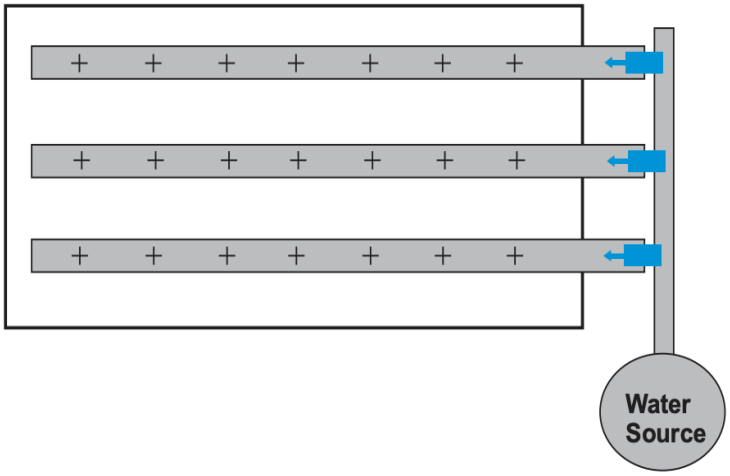

Figure 12. A potential drip irrigation design for a single 4’ x 8’ garden bed. (*Wrightson, 2016)*

While drip irrigation systems can be a higher initial investment than hand-watering or a standard sprinkler system, long-term costs are offset by more efficient water use, reduced labor costs, and higher crop yield from ideal soil moisture levels. To further offset these initial costs, there are a multitude of drip irrigation kits readily available through home supply stores and sites like Amazon that can be assembled

independently. The average cost of one of these kits is $50, and to fully irrigate our 15 raised beds, we have determined a need for approximately 3 kits— totaling around $150 for an independently assembled drip irrigation system. For a professional installation, drip irrigation systems typically run between $1.70 and $4.80 per square foot (Geiger, 2024). Our garden beds total 480 square feet, amounting to a professional installation cost between $816 and $2,304.

Fencing

When considering fencing, our main concern is protecting seedlings and plants from deer and other animals who may consume them. We recommend using the electric fence design of Dr. James C Kroll, Professor Emeritus of Forest Wildlife Management and Director for the Institute of White-tailed Deer Research and Management (Dr. James C. Kroll, 2024). This design is well researched, and will provide our plants with the most adequate protection. It is also moveable and allows for gate access as necessary (Higginbotham, 2017). As shown in the image below (Fig. 13), the fencing has a 3 dimensional configuration that will prevent deer from jumping the fence. It has an inner and outer line, made up of four electric wires and 6’ posts every 20 feet (Higginbotham, 2017).

Figure 13. An example of the 3D electric fence model. (*Texas All Outdoors)*

For electric fencing, there are several necessary components: a power source, electric wiring, posts, and insulator clips. At Tractor Supply Co., this Solar Powered Fence Energizer is highly recommended and can power four miles of electric fencing for $150. Electric wiring for 1252 feet costs approximately $50. We will need one 6’ post every 20 feet along the fence, totaling 63 posts. At $5.99 a

post, this will add up to $377.37. Finally, 80 insulator clips will be needed to attach wiring, with a pack of 10 at $6.99, the total cost for clips is $55.92. Combined, this type of fence will cost approximately $660. 3D electric fencing will allow our garden to be highly visible to any guests using the trail or exploring, while simultaneously preventing both humans and animals from disrupting the area.

Crops

Crop recommendations for the beds are mainly based on requests by Cup n' Spoon owner, Melissa Diedricks, including seasonal fruits and vegetables that are feasible for a smoothie menu. However, with the intent of also serving Dominic's Restaurant, these products could also be utilized on a seasonal basis to fulfill the chef's requests for seasonal menu items. With the addition of fresh produce as local as the backyard of the complex, this could add immense marketing value to both featured restaurants and Cussewago Square as a whole. Customers will be able to see where their meal is coming from, which is a rare and exciting experience in northwestern Pennsylvania. Prices were calculated for seeds and starter plants needed to fill the 4x8 foot beds, as well as fruit trees and herbs that would be outside of beds but within the fenced area (Table 4). Starter plants provide ease in planting compared to growing plants from seed. Total cost for garden materials (Table 5) is between $2480 and $9254. Many of these plants can also be companion-planted, which reduces pests, enhances growing space, provides balance to soil nutrition, and provides natural trellises for plants that need support (Philbrick & Gregg, 2012).

Vermicomposting

Composting (Fig. 14) can close the loop between the garden and kitchen. The produce grown from the garden can make its way back to fuel the next harvest after being composted, and it is a cheaper and more sustainable alternative to store bought fertilizers. With the introduction of worms in the composting system, waste products and possible pathogens are broken down through the worms' digestive systems; the end result is a more homogenous mixture than what is found through composting methods. Additionally, this process quickens decomposition and reduces labor needs– the worms break down organic matter quicker than average aeration processes in other composting methods–human labor, such as mixing, is not needed (Dominguez et al 1997).

Table 4. Potential pricing for starter plants and seeds. **Bolded** plants, including fruit trees and herbs, reflect plants that would fit in the allotted area outside of beds

Plant	**Cost**
Cucumbers	$24
Kale	$72
Spinach	$57
Mint	$10
Basil	$10
Thyme	$10
Apple Trees	$360
Pear Trees	$360
Strawberries	$62
Blueberries	$76
Raspberries	$136
Tomatoes	$36
Watermelon	$15
Cantaloupe	$27
Pumpkin	$18
Total	$1,273

Table 5. Budget estimate for all garden components.

Type	Low End Estimate	High End Estimate
Crops	$1300	$3000
Raised Beds	$330	$2150
Irrigation	$120	$2304
Fencing	$660	$1300
Compost	$70	$500
Total	$2480	$9254

Figure 14. Potential composting location.

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Bikes and Bicycle Pavilion

Katherine Cousineau and Riley Pegher

Statement of Issue

Sustainable travel is a goal for most countries, as common modern modes of transport (cars, planes, trains) are harmful to the environment due to their greenhouse gas emission. Bicycles do not emit greenhouse gasses, they emit little noise or light pollution, they provide inexpensive travel, are easily repairable, safer than cars, and promote an individuals' health and independence (Azevedo et. al, 2023). Bike shares have a relatively low reach among minority/low income communities. What this means is, though bike shares are usually targeted towards low income individuals in terms of pricing, placement of share racks, and advertisement, low income individuals rarely use bike shares. Most community members simply are not aware of bike shares or using bikes is not the norm for them (Leister et. al, 2018). Overall, there was a lack of studies conducted in the U.S. regarding bike shares or bike use. Thus, we looked at other niches of research that could help decide the best course of action to begin planning for bike infrastructure.

We looked into essential considerations for planning a public bike path, bike racks, and additionally, a pavilion. Biking trails can act as a safety measure for bikers– when presented with a trail, most cyclists stay on the trail, keeping them safe by limiting conflict with other outdoor groups. As a defined entity, trails confine biking activity, thus allowing for conservation or construction to be done near the trail with limited fear for the cyclists' safety (Hrůza et al. 2021). Specific to Meadville, Pennsylvania, the area of construction is on a flood plain, which can cause damage to the path, and it is threatened by freeze-thaw patterns that cause potholes (*Pennsylvania Department of Transportation*, 2017). To accommodate parking for bikers, we determined that parking should be accessible, able to accommodate different bike types, and suitable for short-term transportation. Bike racks will be important, and according to these guidelines, bike racks should be less than 50 feet from a trail entrance and parking lot so that users can easily see it. Ideally, it should be weather protected, secure in its grounding, and of appropriate quality. Racks should support a bike on at least two contact points, ensuring security and longevity. From these guidelines, we determined that a U-Rack shape coated with galvanized steel would be the best option (Benninghoff, 2024). In accordance with the rest of the Square, the racks should be ADA-accessible, in a place and position where it can be accessed by wheelchair users and different bike types, including ADA bikes (MacArthur et. al, 2020). We looked into trail maintenance as well, and found that trails should be effectively maintained at least yearly with an organized schedule, list of priorities, budget, and a system for users to report requests. The exact cost of that maintenance varies depending on frequency of use, amenities, types of recreation used, and trail mileage (*Rails to Trails Conservancy*).

Plans and Recommendations

Bike Racks:

There are many things to consider when planning a public bike rack: we began with where to acquire one. We found many commercially available racks like these loop racks, a collection of grid racks, and we found guides to determine which would be best option. The local public bus and bike share company CATA has offered to install bike share racks. As mentioned previously, bike shares are difficult to implement in low-income communities, but Meadville may be the exception. There is an established biking community here with well-known trails such as Ernst trail–the trail to which Cussewago Square's

trail will connect. Additionally, CATA's bike share racks are already well-known in the community, and can be easily recognized in Cussewago Square. CATA racks will be installed at the entrance to the bike path (Fig. 15). Other bike racks are recommended to be placed near the patio of the new Cup N' Spoon building. Both locations will be well-lit, visible, and within 50 feet of parking and the trail entrance. Overall, for the area of Cussewago Square, there should be room to store at least ten bicycles. Finally, we believe that it may attract more bikers if the areas around the rack are decorated and even interactive. Luckily, the potential gardens are planned to be implemented near Cup n' Spoon and the trail itself; they will be abundant with flowers and fruits, and signage will be added for information and ambiance.

Figure 15. *Labeled map of Cussewago Square. Note: The red line is a bike path, "Entrance" location is on Spring Street.*

Bike Trail

The main portion of the bike trail will belong to the Ernst Trail and will be constructed by French Creek Recreational Trails, according to their standards. A small portion that belongs to RAN Investments will run from the Square, across the Ernst Trail, to the pavilion. A bench should be added to this area, which may need to be firmly attached to the ground. We suggest this bench, but a similar metal one could replace this one to be more flood resistant. Near the square, there should be a bulletin board that will have informational signage. Some informational signage (Fig. 16-17) has already been designed, but some image rights may need to be acquired, and they will have to be produced.

Pavilion

The pavilion will be built on the opposite side of the Ernst Trail from the shops. It will be a transitional point between the trail and the shops, provide shelter from the elements, and serve as a spot to stop and rest. The pavilion will be purchased from either the backyard showcase or Fifthroom. For this pavilion, we suggest it be 16 by 24 feet, made of cedar, have 8 by 8 inch wooden posts, a 10 inch roof overhang, and have 7 foot 5 inch posts. Ideally, it will have a roof made of the leftover shingles used in the rest of the square. If those are unavailable, cedar shakes would be the next best alternative. The pavilion will be built on a concrete pad that will provide stability to the structure and reduce the amount of mud that will get into the pavilion as this whole area is in a floodplain. This pad will also include a wheelchair ramp. We have chosen Lawnstarter as the company to build the pad.

Other details have also been planned for the pavilion. We have two options for picnic tables - a 6ft option and an 8ft option. Both are made out of recycled plastic and are ADA-accessible. We would put in concrete hammock posts and have either a fabric or a canvas hammock. We need trash cans with both garbage and recycling sections, a place to clean up pet waste, and a way to dispose of pet waste. We also suggest having two squirrel-proof bird feeders.

Additionally, in considering what may attract more bikers specifically to a pavilion, we asked frequent bikers what they find important in a good bike path. One overwhelming answer was a bike repair stand with tools available to the public to perform tune-ups or basic repair (e.g. Fig. 18). We determined that an affordable and effective option would be this bike repair stand. The stand has a wide range of tools such as screwdrivers, Torx tools, chain tools, tire levers, and more. The only tool most stands rarely have is a bike pump, which can be purchased separately and attached to the stand with a cable. The repair stand should be installed under the pavilion to protect it from the elements, but it should be as close to the trail as possible.

Budget

Several options have been presented for each component of this project, all at different price points. As such, we wanted to create one budget plan composed of what we believe are the best options for this project. Our total cost is approximately $29,000 (Table 6).

Table 6. Budget for the bike pavilion and supporting elements.

Pavilion	**Quantity**	**Unit Cost ($)**	**Cost ($)**
Cedar pavilion	1	22,500	22,500
A-frame picnic table	1	1,620	1,620
Canvas hammock	1	25	25
Three-unit waste bin	1	305	305
Dog waste solar light	1	200	200
Hanging bird feeder	1	15	15
16'x24' concrete pad (cubic yards)	5	178	890
Wheelchair path (cubic yards)	0.5	178	89
		Total	**25,644**
Trail			
Bulletin board	1	620	620
Recycled plastic bench	2	600	1,200
Posters	3	12	36
Bike Racks		**Total**	**1,856**
CATA bike rack	1	0	0
Commercial bike rack	1	225	225
Repair stand with tools	1	775	775
Bike pumpt	1	15	15
Cable	1	38	38
		Total	**1,053**
		Grand Total	**28,553**

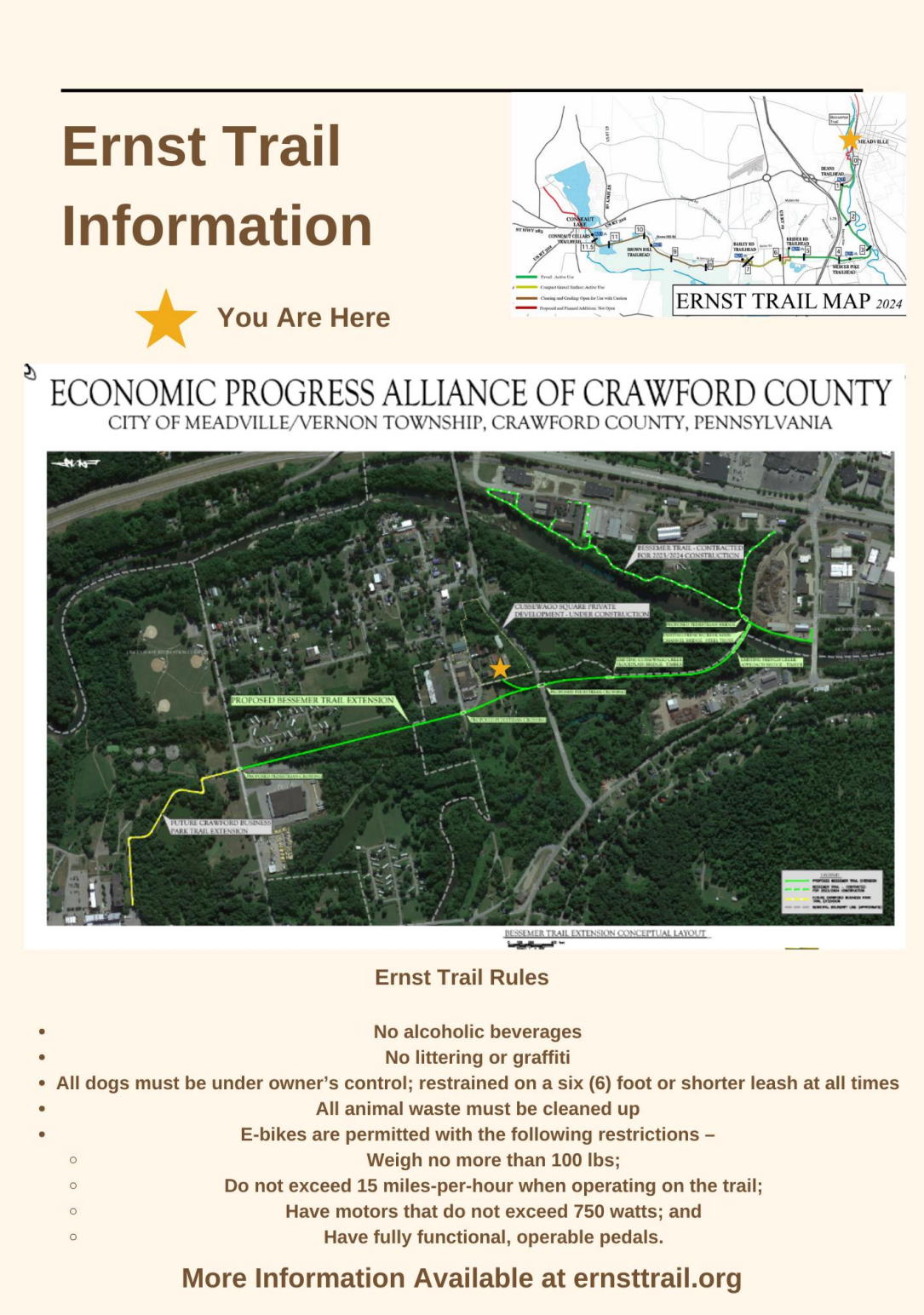

Figure 16. Draft informational sign about Ernst Trail (designed by Katherine Cousineau using Canva).

Figure 17. Draft informational sign on bicycle safety (designed by Katherine Cousineau using Canva).

Figure 18. Trailside bicycle repair station located on Ernst Trail. Photo credit: Rich Bowden.

Flood Mitigation Techniques

Brooke Biro & Macy Simons

Statement of Issue

Flooding is a critical concern for Cussewago Square. A significant portion of the Cussewago Square property lies within the 100-year floodplain of the nearby Cussewago Creek, which borders a portion of the property, and French Creek, which intersects with Spring Street. Because these areas are low-lying and located near streams, when heavy rainfall events occur, water levels rise and inundate the surrounding land. In recent history, the area has been impacted by flooding due to ice jams and the nearby 5th Ward community has experienced bottom-up flooding due to the area's location in the floodplain (FEMA, n.d). In the event of a 100-year storm– a storm of a magnitude in which there is a 1% chance of it occurring in a year– many parts of the Cussewago property, including parking lots and the walking trail, will be under standing water. While the type of flooding that would occur in Cussewago Square would not pose a danger to people, severe floods would have the potential to cause property damage to buildings and temporarily shut down usage of the area until the standing water subsides.

The concern of flooding is exacerbated by the effects of climate change. Annual precipitation is projected to increase in the upcoming century, and the occurrence of heavy rainfall events are expected to increase in frequency, magnitude, and intensity (IFC, n.d.). The number of days with "very heavy" and "extremely heavy" rainfall are expected to increase by 33% and 74% respectively by the end of the century (IFC, n.d.).

While there is no way to prevent heavy rainfall events and flooding from happening, stormwater best management practices can aid in mitigating property damage and allowing for controlled recharge of stormwater runoff. One strategy for rainwater management is the use of rain gardens. A rain garden is a depressed, planted area whose purpose is to catch water from a runoff source when it rains (Obropta et al., 2023), and allow that water to percolate into soil. These gardens divert polluted runoff from storm drains that dump water into the local watershed (Obropta et al., 2023). When these pollutants enter the watershed, they can have harmful effects on the aquatic ecosystem. Instead, when runoff enters rain gardens, the plants and root systems are able to filter and break down pollutants and allow water to percolate into the groundwater system (Obropta et al., 2023). The gardens also provide aesthetic value to the Square, as they can feature colorful native plants and flowers. There are many examples of rain gardens being successfully utilized in Crawford County, which can provide a framework for how to install rain gardens suitable for Meadville's climate in Cussewago Square (Crawford Conservation, 2010).

Plans and Recommendations

Four location choices are recommended for Cussewago Square (Fig. 19). The two rain garden locations nearest to buildings (1 & 2) were recommended by Rob Smith, as that corner of the parcel he had no prior plans for stormwater and flood mitigation. The sides of the buildings that the rain gardens are placed on were directly determined either by the angle of the flow from the rooftops gutters, or to prevent obstruction in main walking areas. The locations of the two parking lot rain gardens (3 & 4) were determined based on the topography of the lot (Fig. 20). The gardens were placed in low-lying areas that water would freely flow into. These locations are suggestions based on our site evaluations and Rob Smith's insight. We recommend that other stormwater best management practices such as infiltration

berms or trenches be constructed on the east edge of the small parking lot behind the theater and set buildings.

The construction of the rain gardens is also according to Silling's methods (Fig. 21). A four foot deep depression is to be excavated, the area of the hole being dependent on the runoff surface, as stated previously. These depressions are to be filled with a rain garden specific soil mixture and an overflow pipe with inner plumbing to divert any excess water into the stormwater system. The perimeter of the filled hole will be lined by a berm with a slope of 3:1 to hold any standing water as shown in Appendix B, Figure 1. The base should then be mulched and planted with Ernst's Seeds Native Rain Garden seed mix. The seed cost is based on prices listed on Ernst Seed's website. The garden will not require excess maintenance, only weed remediation every so often. The plants should be mature and established within one year.

Figure 19. A map of the proposed rain garden locations. 1= Cup n' Spoon rain garden; 2 = the Arts Building; 3 = west side of the parking lot rain garden; 4 = east side of the parking lot rain garden.

For each rain garden, we used a size calculation method from a senior comprehensive project by Allegheny student Andrew Silling. This paper led to the construction of the Allegheny College admissions building rain garden, which has been successful up to this point. For this reason we believe the calculation methods from Silling are sound. The ability of a rain garden to hold water depends on the soil's permeability (Silling, 2009). The soil on the Cussewago site is considered industrial soil and therefore

variable. We recommend a permeability test before proceeding. We calculated the proposed sizes of the rain gardens to accommodate 50% of runoff water during a 100 year storm event, which is 0.44 feet of water over 24 hours (Bonnie, et al., 2024).

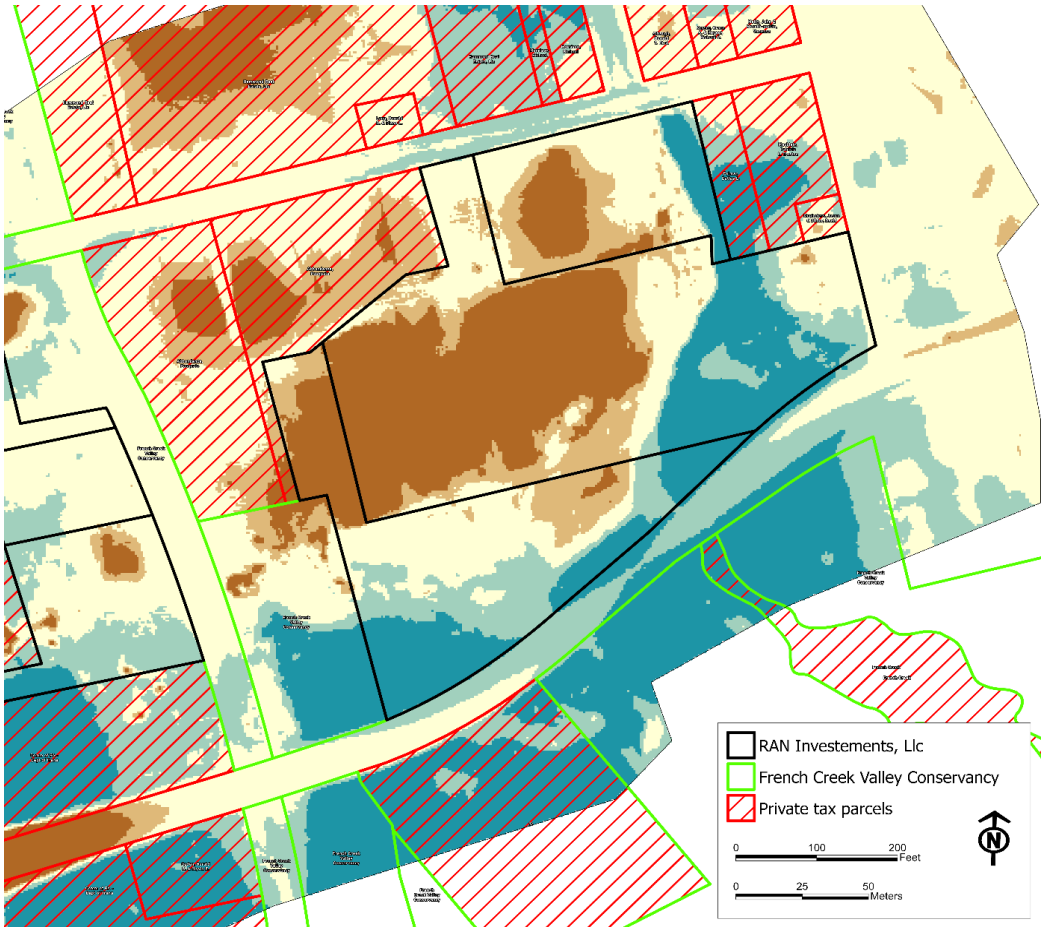

Figure 20. Topographic map of Cussewago Square property. Orange colors represent higher elevations while blue colors represent lower elevations.

We calculated the amount of water each rain garden must hold (Table 6). The approximate surface area of each runoff surface was measured with GIS tools and drone pictures. For the Cup n' Spoon rain garden (1), the approximate roof area was 3500 square feet. The rain garden size was approximately 200 square feet. The garden will need to be filled with 800 cubic feet or 30 cubic yards of rain garden mix soil. The example soil mix we found from the brand Soil Dynamics was 40 dollars per cubic yard. The cost of soil would be $1200. The seed cost is far less, at $5 to seed the whole garden.

For the arts building rain gardens (2), the roof area was 4000 square feet. The size of the rain garden needed is approximately 220 square feet. The cost of soil would be $1,320. Seed cost is approximately $4.

The two parking lot rain gardens (3 & 4) are slightly more difficult to determine because they are larger than the rooftop rain gardens, and it is less clear how much runoff will actually end up in the rain

gardens. For simplicity, we considered the entire parking lot the runoff surface, similar to the roofs. The same calculation of the rain gardens being able to hold 50% was utilized. The western lot has a surface area of 7272 square feet, thus needing a rain garden of 400 square feet, with a cost of $2400 for soil and $10 for seed. The east parking lot has an area of 7030 square feet and needs a rain garden of 380 square feet, with a cost of $2,200 for soil and $8 for seed. It should be noted that the price of soil mixtures can be brought down significantly if soil is mixed on site. These rain gardens are our best recommendation as a practical and beautiful landscaping solution to helping to deal with stormwater.

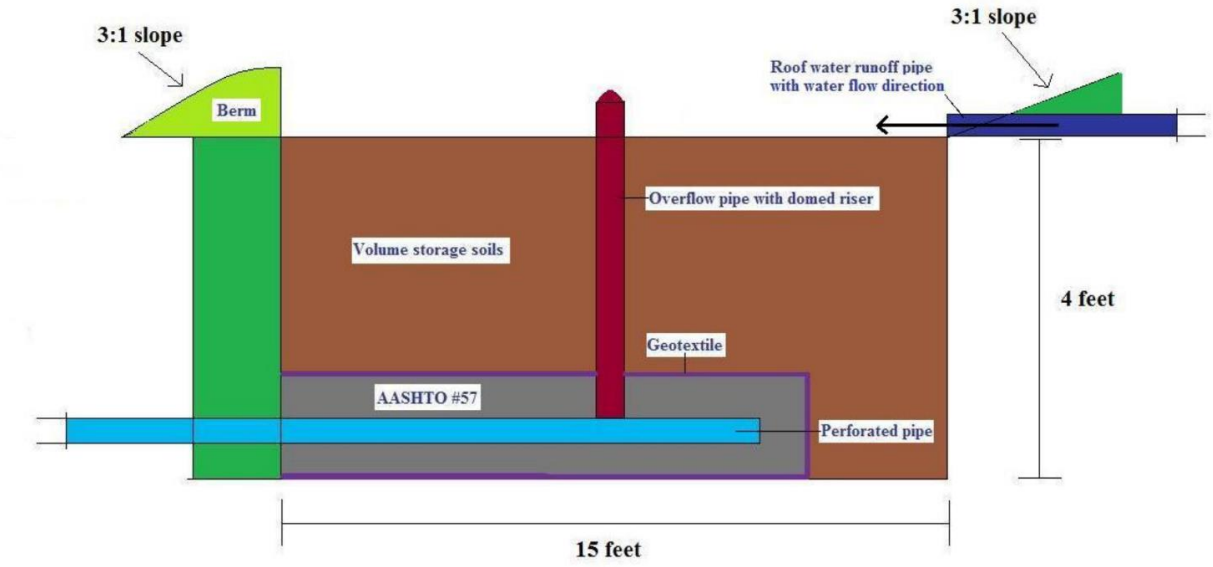

Fig. 21. Rain garden construction schematic (from Silling).

Table 7. Rain Garden Size Calculation as Referenced from Silling, 2009.

Size %	Size (ft^2)	24-hour 100 Year Storm Event (ft^3)	Final Rain Garden Area (ft^2)
50	2000	880	220

Table 1 Calculations

1. Size (Square Feet) = Roof Area (Square Feet) x .5 (Size %)
2. 24-hour 100 Year Storm Event (Cubic Feet) = Size (Square Feet) X .44 Feet (100 Year Flood Variable for Crawford County)
3. Final Rain Garden Area = 24-Hour 100 Year Storm Event (Cubic Feet) / 4 Feet (Depth of Rain Gardens)

Recommended Reading

- Rain Garden Manual of New Jersey
  This resource provides a comprehensive guide of different rain garden designs.
- Allegheny College's Admissions Building Rooftop Runoff Rain Garden Proposal
  This senior thesis outlines the proposal for a rain garden on Allegheny's campus. Equations to determine size and capacity, as well as the seed mix used in this garden influenced recommendations for Cussewago Square.
- Pennsylvania Stormwater Best Management Practices Manual
  This manual goes into detail about the key design elements and materials needed to construct a rain garden.

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