Final PDC Design by Brent Verrill

Client - Georgia Institute of Technology Community Garden

The Georgia Tech Community Garden is a project of the student group, Students Organizing for Sustainability. I have undertaken the design of this garden site with the help and consent of the leadership of S.O.S. This project also serves as a final project in my pursuit of a Permaculture Design Certification through PermacultureEducation.com under the instruction of Dr. Alan and Jessica Enzo. I have taken this certification course as professional development through my employer, the Brook Byers Institute for Sustainable Systems. I propose that this design serve as a call to action for students, faculty, administration and staff to become involved in growing some of their own food, make a positive impact on their community and environment, and learn how designing like nature in a garden can be an elegant metaphor to inform all design endeavors in any field. This proposed plan is designed in such a way that it can be implemented on campus incrementally with student participation and limited funds.

The current garden coordinator duties are divided between two members of the S.O.S. leadership; Ishaan Patel, and Galen Gambino. They are responsible for the day to day running of the garden. The Georgia Tech Community Garden is a relatively young project. The garden was initiated by S.O.S.'s former president, Stephanie Kehl in 2012. She secured the space from the administration and won a grant from the Student Government Association to build the current garden beds. Many faculty and staff have pitched in their time, support and resources to help this project move forward.

Georgia Tech, like many university campuses, is equivalent to a small city. About 42% of the students live on campus and will have limited opportunities to explore permaculture in their day to day lives. Providing this opportunity on campus, I regard as vital, not only as a means of exposing students to the permaculture design methodology, but also as a platform to initiate a dialogue on food issues and gardening. Students may then go on towards implementing and adapting what they experience in the garden into their personal and professional lives. The Georgia Tech culture, being a technological research university, is one of practicality and conservatism. Faculty, administrators, and students will be more strongly persuaded of the validity of regenerative design if they can be immersed in tangible examples. This has been referred to as the “pedagogy of place.” It is my hope that this design effort will catalyze such a place for participants to explore regenerative design within the Georgia Tech community.

It has been said in the design world that the best thing that can happen to a designer is to be given lots of restrictions. Some of the best designs come about through the thorough investigation of all of the degrees of freedom in which a design is allowed to manifest and function. While my degrees of freedom as a permaculture designer at Georgia Tech are severely restricted in some ways, those that are open to me are the scale of a mid-sized public research university with a mission of fostering into adulthood a group of smart young adults. This is yet another example of the permaculture maxim, “the problem is the solution.”

It has also been said that one of the greatest leverage points to affect change is at the level of higher education. College graduates newly formulating their personal lifestyles and working lives not only begin to influence the older generation in their chosen career and workplaces, but also their peers, and, of course, their children. Giving college students the opportunity to learn about permaculture and regenerative design might just be one of the best leverage points available to affect a positive change.

**Project Goals**

**Awareness** - The burgeoning trend in urban agriculture should be no mystery. People are looking for solutions to the declining quality of our food supply that corresponds to the declining health of people,
disproportionately, young people. People at Georgia Tech, being a technological university, have a bias towards technological solutions to problems. Furthermore, since farming and agriculture are culturally regarded as commodity production, and therefore an area where the environment for innovation is either not fruitful, or is filled by the land grant universities, the potential for design, innovation, and the fulfillment of niche demands go largely ignored. A permaculture garden in the heart of such a campus will serve to bring such issues to light both with direct regard to food issues, but also as a counter-metaphor for the larger societal issues of automation, standardization, and globalization.

**Graduates** - Georgia Tech turns out lots of specialists in a wide variety of specialties, mostly in technical fields. By spreading permaculture into the minds of some of the students, this will serve to identify and cultivate a category of students who will be generalists with a holistic set of ethics combined with a practical toolkit of principles and techniques that will serve them, and the rest of society, very well in the "interesting" times to come.

**Knowledge** - There is no doubt that Georgia Tech students are smart. Permaculture is a design movement with the potential, if properly couched, for broad appeal. If practiced in a place with lots of smart, energetic, young, and idealistic people, permaculture can not help but be advanced. I anticipate many innovations coming from future Georgia Tech permaculturists.

**Site Technical Parameters**

**Overhead View of Garden Site:**

![Overhead View of Garden Site](image-url)
30 year average rainfall:  49.71 inches

Wind speed/direction:  Not much of a factor.  It very rarely gets above 5 miles per hour.  Dominant directions are due East or due West with very little pattern to when the wind is coming from one direction or another.  There is a slight flagging in the trees surrounding the garden site to the Southeast. The trees that display this feature are all relatively young, probably less than 10 years old or so. The trend in flagging is at the very top branches of the trees which are very recent vertical growth.

Altitude/latitude effects:  990 feet (~300 m) above sea level, which can have the effect of a 3 degree southern latitude shift. Georgia Tech is at 38 degrees North latitude, with altitude effects, effectively at 35 degrees North latitude.

Solar Geometry for Atlanta, GA:  Winter Solstice- sun angle = 90 - 33.7 - 23.5 = 32.8 degrees above horizon at Noon.  Summer Solstice- sun angle = 90 - 33.7 + 23.5 = 79.8 degrees above horizon at Noon.

Frost prone areas:  The two walls of the adjacent building are red brick, so that thermal mass may buffer the localized temperature a little. The raised beds are made from stacked precast retaining wall blocks, which also will provide a bit of thermal mass directly to the soil. However the garden is situated downhill from a gentle slope and is nestled into the corner of a large building. So, it is possible that cold air could flow downhill, pool in the corner and just sit there.  On the other hand, the garden has a south-easterly aspect, so it will get good sun from about 9:30 AM until about 4 PM, when the adjacent building will shade it out.

Soil type/pH:  The soil in the raised beds was trucked in when the garden was initially constructed.  It tested pH = 7.0, loose, not compacted, plenty of organic matter.  The soil under the turf tested pH = 6.5, and is very compacted.  I dug down about 7 - 8" and did not encounter a topsoil horizon.

The soil for the settling tests in the raised beds was collected from the same holes from which the pH test was performed. The jar settling test reveals that it has about 5% clay, about 15% silt, and 80% fine sand. It also has a layer of floating organic matter that is about the same thickness as the silt layer. I think overall, this soil would be classified as sandy.

The soil under the turf has about 1% clay, about 20% silt, and the rest is sand. The layer of organic material floating on top is about half of the previous test. I think this soil would also be classified in the sandy category.

Site History:  The history of this spot includes several radical re-developments. 150 years ago, it was probably mixed hardwood forest. 100 years ago, it probably was beginning to become a semi rural neighborhood. 50 years ago, there was probably a major road running adjacent to the site, along which there were likely lots of small businesses. Then Georgia Tech bought it. There was a solar concentrating research site there, a short railcar line to transport students from dormitories to the student center, now research and classroom buildings. During the 1996 Olympic games, the field in which the garden is now located had a recreational swimming pool for the athletes. It was immediately razed after the games to the boring turf field we have today with a few young trees and sidewalks.

Plant survey of surroundings:  
many large canopy deciduous trees, oak, hickory, some pecan hydrangea azalea holly pampas grass balsam fir variety as understory tree rosemary hosta
various wildflower species
serviceberry
beauty berry
low growing juniper bushes
various varieties of monkey grass, including variegated ferns
ginger lily
unidentified yucca variety
lantana
Cotoneaster bushes (I think)
crepe myrtle
Yellow buckeye - not common in the Atlanta area, according to Wikipedia.

**Flood locations and periodicity:** Flooding in the region of the garden is very unlikely. It is well above any flood zone and there aren't any waterways nearby. Intense and/or prolonged rain will result in some areas of garden site with a few inches of standing water for 1-3 days after rain event ends.

**Temperature patterns and extremes:** (images from Weatherspark.com)

The daily average low (blue) and high (red) temperature with percentile bands (inner band from 25th to 75th percentile, outer band from 10th to 90th percentile).
The average fraction of time spent in various temperature bands: frigid (below 15°F), freezing (15°F to 32°F), cold (32°F to 50°F), cool (50°F to 65°F), comfortable (65°F to 75°F), warm (75°F to 85°F), hot (85°F to 100°F) and sweltering (above 100°F).

Rainfall patterns, intensity/seasonality:

Rainy seasons in the Atlanta area are in the middle of July, with 50% of days with rain, and the beginning of January, with 45% rainy days. The winter rainy season is almost exclusively moderate to light rains, while the summer has predominantly heavy rains. The temperature extremes occur at the same peaks as the rainy times of year. Atlanta’s drought cycle seems to run about every 5 to 7 years, however, as the effects of climate change become more pronounced, predicting the periodicity or severity of droughts becomes problematic.

Total precipitation effects: The rule of thumb is that more moisture comes to the earth as condensation than as rain. There is no indication in the statistics how condensation contributes to total moisture on the ground. Atlanta is definitely in a humid climate, so based on this rule of thumb, at least 50 inches of moisture
comes to ground as condensation in addition to rainfall.

**Potential environmental disasters:** Among the most likely events are intense rain events, drought, ice storm, tornado and hurricane. Also, localized chemical release from surrounding research buildings are a possibility. Prolonged power outages, and contaminated municipal water supply are potential secondary effects from extreme weather events.

**Client Interview**

Since I initiated this project on my own, there wasn’t really a client to interview. I have consulted the student group which maintains the current garden site throughout the process and have been able to get a feel for the needs and wants of the group members in this institutional setting. As is the case with most designs, it will likely evolve over time as projects are implemented and constituencies change.

Below is a version of a client survey completed by me based on what I currently understand about the garden, the organizations, and the people involved.

**Resident garden users:** Institutional setting. Some student residents but not near this site.

**People who will do most of the gardening:** Garden coordinator for Students Organizing for Sustainability, and Brent Verrill.

**Numbers of persons who will eat foods/herbs from garden:** Possibly 100+, more likely 15 – 20.

**Period of tenure for garden and users:** Tenure of plot is a bit tenuous. It depends on student involvement over time. If it doesn’t get used, it will get taken out. Transient student population.

**Existing concerns:** Completely open to passersby. Long term, and continuing chemical use on surrounding lawn.

**Planting restrictions enforced by local council, community or neighbors:** The campus administration probably won’t be happy with spreading or “invasive” species or overstory tree species. They will also favor a more organized, tidy look.

**Positive elements to be retained or enhanced:** Raised beds. It is the only public garden space available on campus. The students worked hard to convince the administration to let them have it.

**Would you like to attract native species to your site?** Yes. Mostly perennials like serviceberry, beautyberry, paw paw. Any kind of wildlife.

**Favorite plants/vegetables/herbs/flowers/foliage color for public areas:** The selections for annual plants will likely be pretty conventional, due to the institutional setting. Perhaps theme gardens like sauerkraut bed, salsa bed, etc, would be possible. Some decorative but functional species around the perimeter may help gain public acceptance.

**Client requirements:**

- Fenced perimeter
- Tool access/storage
- Compost facilities
Bee hives (in conjunction with the Georgia Tech Honey Bee Project)
Outdoor work space/classroom
Car and/or heavy vehicle access (to deliver bulk materials) - max height 9'
Sitting/eating area with seasonal shade
Fruit trees, possibly espalier

**Budget:** Undetermined amount in a line item grant from the Student Government Association, possibility of funding from campus administration for fence.

**On site resources:** 6 large raised beds, small tool shed, some tools, wheelbarrow, garden hose, hose bib.

**Machinery:** Potential for Facilities Department for help with small approved projects.

**Living materials:** Whole campus worth of seed/cutting stock (mostly decorative species), occasional access to wood chips and leaves from facilities department.

**Building materials (freely available):** Cardboard from recycling department, possibly urbanite from campus construction projects or from surrounding urban environment, pallets from campus and surrounding areas.

**Annual maintenance funds:** Some student organization dues are devoted to garden.

**Time and level of enthusiasm expected from participants:** Work is ongoing to get students, faculty and staff interested in participating, as well as foster succession amongst student organization leadership. Currently, about 12-15 motivated people.

**Experience level of main participants:** Brent Verrill - Much home renovation/building experience, kept small flock of chickens, some gardening, some alternative energy experience, M.S. in Industrial Design. Current SOS Garden Coordinators, Ishaan Patel - some home gardening experience, interest in hydroponics aquaponics, and food businesses, Business Administration major. Galen Gambino - some gardening experience, experience in hydroponics, Electrical and Computer Engineering major.

**Specialist workforce available:** Students, faculty and staff in wide array of mostly technological specialties.

**Current behavior patterns:** Garden volunteers sign up for weekly weeding/watering shifts. Special events are scheduled separately for plantings, harvests, and infrastructure improvements.

**Ideals or philosophy that are to be reflected in the garden:** At a technical university, designs should be blatantly functional, if possible, or obvious with minimal explanation. “Pedagogy of place” should be the guiding design imperative.

**Interest in cooking:** Since the garden has been established, more of the produce has gone to rot as has been consumed. I’m hoping that coordinating with other organizations around campus will not only provide an outlet for the produce, but also teach the gardeners how to use it. Some preference should be given to species that are easily eaten out of hand.
Social Systems
I recommend that the management regime be transitioned to one of individuals caring for specific plots, rather than the current strategy which is that all space is communally cared for with planting decisions made by the garden manager. Plantings around the perimeter and other edge opportunities should be mostly perennial and can be cared for by the whole gardening community.

To maintain continuity with transient student population, I recommend the use of online resources and organizational strategies:
- Maintenance Schedule - Google Calendar
- Plot Tenure and Contact - Google Sheets
- Maintenance Instructions - Staked signs with QR codes linked to YouTube videos, dedicated static web pages, or wiki threads.
- Maintenance Tools - Dedicated, inventoried, color coded toolboxes and kits grouped based on task.

Zone and Sector Analysis
Typical permaculture zone analysis poses some problems that can't be solved by strictly sticking to the garden site. I have considered the garden site within the conventional permaculture zones I - V, but also expanded on what zones mean conceptually for a system in an institutional setting where land tenure is less than secure but other non-horticultural yields and resources are widely available. From this perspective the zone system could be thought of as analogous to spheres of influence within the social or economic ecosystems rather than within cultivated or natural biological ecosystems.

Zone I - The garden plot consisting largely of annual and biennial crops. This system also can serve as a recognizable introduction to permaculture for interested parties who are familiar with conventional gardening techniques. Zone I will be primarily defined by the 6 garden beds within the garden site. The proposed tool shed and outdoor furniture elements can also be considered part of the Zone I system as they are infrastructure elements with which the people in the system will most frequently interact. Portable outdoor cooking infrastructure might also be a valuable element to introduce into this zone as an attraction to help ensure higher participation by the members and greater recruitment of new members. The choice of the site for the first garden is just outside a classroom building in which much of the student body has at least one class during their academic career. This means that it will not only be visible to many students, but accessible to those who chose to become involved.

There is a possibility for a greenhouse to be built immediately adjacent to the garden site. The student group Engineers for a Sustainable World is collaborating with the Atlanta area nonprofit, SEEDS Global, to establish a greenhouse in which a hydroponic system will be installed. SEEDS Global will provide the equipment and expertise to EFSW, while EFSW will locate a site and possibly raise the funds to build a greenhouse. A percentage of the produce raised will be donated to surrounding communities which are “food deserts.”

This greenhouse proposal represents the fourth to come forward in the last three years. If the garden remains in its current site, it is highly likely that if this proposal does not come to fruition, then a future proposal will. Therefore, it is important to integrate a greenhouse into the site design now, even if implementation may not happen immediately.

In the future, perhaps more Zone I gardens can be established at other locations around campus which may be associated with particular buildings or organizations and overseen by people so affiliated. This model of development can mimic what one might think of in a small community setting where one permaculture system can serve as a demonstration to other households which will establish Zone I & II systems and might share in some of the outer zones as part of the commons. Placement of future Zone I & II systems should correspond with frequently traveled paths, entrances, or routes of those who will be responsible for maintaining the gardens. Goodwill and credibility can also be regarded as a possible yield of this zone.
Zone II - Garden border including vertical spaces. The clients want to build a fence to define and protect the garden plot from the destructive influence of the two-footed creature known as the “tailgater.” This fenced border as well as infrastructure elements that extend into the vertical dimension such as trellises, birdhouses, small aquatic systems, dwarf varieties of fruit trees and other perennials along the borders, should all be considered as being in zone II in this institutional context. Plantings in this zone should favor perennials. Trees should be dwarf varieties to foster ease of access for maintenance and harvesting tasks. Livestock will be very difficult in an institutional setting, however the integration of elements to encourage local biodiversity could help to bring in some of the benefits one expects from livestock. Strategically placed birdhouses and feeders can fertilize growing beds. Small water features can encourage amphibians and lizards, which serve as pest control and fertility generators. It might even be possible to integrate a small scale aquaculture system with fish into the rain harvesting and irrigation system. Worms are also an obvious “livestock” choice for this setting, but will require ongoing and regular attention.

Zone III - Extending out from the garden to the immediate surroundings are some guerrilla gardening/harvesting and “tending of the wild” opportunities in neighboring landscaped zones. Also available are opportunities to increase animal biodiversity. By encouraging or establishing plants or groups of plants that will attract beneficial animals or insects to the surroundings, the garden will benefit indirectly. Conventional notions of livestock are not possible, however beehives might be. Also, attracting birds or bats outside of the Zone I and II systems could add additional help with pest control and fertility. Future phases of development might include establishing spaces for food forestry. Success of the Zone I & II systems will help establish credibility to expand Zone III and higher systems into the campus landscape master plan, which includes the "daylighting" of historically occurring open water features, i.e. creeks and ponds which have been buried as stormwater system pipes. These plans are years from implementation, but, assuming credible successes with Zones I & II, integrating permaculture systems into this aspect of the campus master plan is a perfect dovetail.

Also, since this permaculture design is being established in a college campus setting, cultivating interest, enthusiasm, experience, hopefully training and certification should also be regarded as a Zone III yield. The reason for this being regarded as a Zone III activity roughly corresponds in frequency and intensity of effort to other Zone III activities. With a transient population of students, and to a lesser extent, faculty and staff, it is critical to consider trained and qualified people as an essential element in the perpetuation and expansion of such institutional permaculture systems.

Zone IV - Zone IV activities in an institutional setting like Georgia Tech are slightly different than they would be for a homestead. Possible candidates would include establishing a Google Map of edible and medicinal plants that are available in the public spaces on campus and in surrounding areas. This map could be extended to include under utilized harvestable food from surrounding residential neighborhoods from within the auspices of the campus gardening organization. There are many precedents from around the country for such urban gleaning/harvesting groups. Also, some materials "harvested" from campus landscaping operations could be considered as coming from zone IV and could be cycled into the zone I & II systems. Such materials include wood chips, leaves, composted food waste, construction waste, pallets as building material, cardboard and paper as sheet mulch materials, large diameter branch and trunk wood from trimmings and culling, rocks, urbanite, fill dirt, topsoil all from construction and renovation activities, etc.

There are many collaborative academic relationships between Georgia Tech and neighboring colleges and universities. Collaborations between campus gardening organizations amongst these institutions could also be considered a Zone IV yield.

Zone V - The definition of Zone V is tricky in any urban setting. Possibilities include: lobbying the campus administration to designate particularly suited areas of campus as candidates for small-scale rewilding, "adopting" a local wilderness area or state park for annual litter collection or invasive species mitigation, identifying small plots of abandoned or un-landscaped land that could be nudged into accelerated succession towards a more wild state. Many other possibilities exist for Zone V within the general theme of cultivating, protecting, or establishing areas that are wild and unmanaged. Part of the purpose of Zone V is
as a pedagogical model for how we should design our systems. By adopting this general strategy for Zone V in the urban setting we achieve this goal and serve to increase biodiversity at the same time. For an educational institution, a Zone V as pedagogical element is essential. As people become interested and begin to learn about permaculture, having a Zone V example close at hand or for which there is some sort of oversight in perpetuity through the gardening organization will become important both as a metaphor for lessons on diversity but also as a practical lesson on “The Model” (Earth’s functioning ecosystems) design that informs our permaculture designs.

**Sector Analysis**
See also Site Technical Parameters section above.

![Sector Analysis Diagram](image)

**Phase 1 Design**
Phase 1 will focus on elements that will do the most to enhance the productivity and fertility of the garden site while reducing the workload of the gardeners. These elements are often referred to as mainframe or infrastructure. The placement of the phase 1 elements is noted on the site diagram below. The elements to be included in phase 1 are:

- Perimeter fence and gate
- Mulched paths
- Redesigned raised beds
- On-site composting
- Tool shed
- Complement of tools (basic hand tools and site maintenance tools, like a wheel hoe)
- Outdoor furniture (picnic tables, benches)
- Outdoor classroom awning
- Bee hives
- Espalier and vine trellis structures
- Comfrey tractors
- Productive tree and bush guilds
- Social systems
Phase 1 Element Analysis

Perimeter Fence and Gate - The adage, “Good fences make good neighbors,” holds true even in an institutional setting. A physical and visual structure that defines what is garden and what is not garden will help to ensure that the diverse neighbors to the garden site will not disrupt the garden’s functions. Some of these neighbors include students with trash, landscaping personnel with chemical sprays, and tailgaters with frisbees and boisterous behavior.

Intrinsic factors: Visual and physical boundary, vertical height, simple and inexpensive to construct, repair or relocate, semi-permanent structure.

Inputs: Paint, periodic repair.

Outputs: Shade (very minor), structure to grow plants against, structure to hang other elements
onto, boundary protection, vernacular design aesthetic that evokes “farm” or “garden,” imparting a sense of permanence of the garden and buy-in from the institute administration.

**Mulched Paths** - Currently, about half of the paths in the garden are mulched with wood chips. Keeping the non-production intensive areas clear makes the garden a more efficient and pleasant place to be. It will also help keep the maintenance of the paths to a minimum, leaving more time and energy for the garden.

Intrinsic factors: High carbon, spongy, light barrier, earthy smell.

Inputs: Periodic replenishment, periodic weeding, raking.

Outputs: Weed suppression, water retention, growth medium for mycelium, habitat for decomposers, pleasant walking surface.

**Redesigned Raised Beds** - The current design of the garden beds is a bit wide for convenient reach from one side. Consequently, gardeners can frequently be found standing in the beds during maintenance and harvesting tasks. They are designed for simple uniform production rows. The redesign of the beds suggested in this report tailors the shape of these beds to allow for efficient use by multiple individually managed plots so that all of the productive area is within reach without the need for standing in the beds themselves.

Intrinsic factors: Height, length, width, shape, color, thermal mass, stability without mortar.

Inputs: Occasional repositioning due to settling or dislodging forces.

Outputs: Stored heat (thermal mass), modular nature of blocks facilitates reshaping design, soil retention, reduced soil compaction, increased drainage, increased oxygen to root zone, ergonomic elevation of garden surface, imposes a shady side, sitting surfaces, rim serves as wind-break for seedlings.

**On-site composting** - Keeping nutrient cycling as close to the point of use is critical to the success of an intensively managed Zone 1 garden.

Intrinsic factors: Length, width, depth, shape, construction materials.

Inputs: Waste biomass, turning/stirring, sifting, water.

Outputs: Compost, heat, nutrient rich runoff.

**Tool Shed** - There is already one small tool shed that the garden team recently installed. It houses most of the commonly used tools. This design calls for two more small sheds. One would be used to store large tools and bulk materials, and the other would be used to store portable outdoor furniture. Separating the types of tools that get stored in different sheds ensures that they remain protected while allowing access to particular individuals, for specific functions. There aren’t many tools that are necessary to maintain a garden like this, but without them, gardening becomes too laborious. Tools are expensive, so should be protected from the weather, pilfering, and neglect. Organization and easy access make gardening jobs easier and more efficiently accomplished.

Intrinsic factors: Physical shape, construction materials, roof area, height above ground, access (doors, ramps, latches, etc.), management of access/keys.

Inputs: Building materials, paint, locks and keys, organizational materials (shelving, hooks, racks, etc.).
Outputs: Tool and material storage and protection, organization, concentrated roof runoff, shade, covered space underneath, aesthetic qualities.

**Complement of Tools** - There are already a few basic tools in the garden. Most are now stored in the tool shed, but some remain outside due to space limitations. There are a few tools that should be added to that would make this site function at a higher level, such as a wheel hoe. However, more tools should not be purchased unless they can be securely stored.

Intrinsic factors: Shape, size, hazardous nature, portability, desirability (thievability), construction materials.

Inputs: Cleaning, sharpening, oiling, replacement, labor inputs (to make the tools work), mechanical advantage.

Outputs: Work, exercise, injuries (if improperly handled).

**Outdoor Furniture** - This garden should not only produce food, but be a social space, a learning space, and also a relaxation/contemplation space. These functions are tremendously facilitated by furniture. Since the furniture will be spending most or all of its time out of doors, it should be designed with this constraint in mind. It is also likely that some of the furniture might need to be moved around within the garden to maximize the utility of the garden space to a given function. By the same token, the moveable furniture pieces should either be able to be secured, packed away, or in some way not desirable, to guard against theft.

Intrinsic factors: Shape, size, weight, texture, ergonomic comfort, weight bearing, aesthetic qualities, foldability, transformability.

Inputs: Cleaning, sanding, painting, oiling, placement, set up, packing away, storage, repair, replacement.

Outputs: Comfort, utility, versatility.

**Outdoor Classroom Overhang** - If the garden space is to be functional as an outdoor classroom, it will be necessary to buffer people from the heat of the sun, or the falling of rain. The classroom overhang is designed to provide deployable shade cover when it is needed that can be stowed away when it is not. When the shade is stowed, it will not be vulnerable to the weather, wear and tear, or vandalism. It functions much like a roll out awning that is common on recreational vehicles.

Intrinsic factors: Surface area, color, opacity, UV durability, deployment mechanism, method of securing, aesthetic qualities, access to deployment mechanism.

Inputs: Labor to deploy, labor to stow, management of keys to deployment mechanism, periodic replacement of awning material due to weathering, wear and tear.

Outputs: Shade, water concentration/catchment when deployed.

**Bee Hives** - Bee hives are an excellent addition to a garden. Honey bees are experiencing major die-offs around the world. Keeping bees in the garden is a small way to help contribute to the resiliency of the domesticated bee, at the same time as it benefits the production of the garden. It would also serve to support the Urban Honey Bee Project, a project in the Georgia Tech College of Sciences.

Intrinsic factors: Size, weight, height above ground, flight path of bees, wind exposure, distance from places of travel or congregation.

Inputs: Observation/maintenance 4-6 times per year, water bowl for bees, supplemental feeding
(possibly), hive box maintenance, harvesting honey.

Outputs: Honey, wax, propolis, pollination, education, entertainment (I like watching bees).

Espalier and Vine Trellis Structures - The two walls of the building that are adjacent to the garden face northeast and southeast and are quite tall. They are perfect structures to use for vertical growing space utilizing trellises. However, the campus administration would likely frown upon the attachment of any structures to the building, and probably any plant material that would adhere itself to the brick. For these reasons, I propose to construct a set of tilt-able trellis structures that would be fastened to the ground and leaned against the building's walls that would tilt down to allow easy maintenance. Plant selections for these installations would not be of the adhesive pad or clinging root variety. This leaves open the possibility of many productive plants, such as passionflower, kiwi, grape, and annuals such as peas and beans.

The fence line provides ample opportunity for espalier fruit trees to be integrated with the open fence structure, thus increasing the productive space without encroaching on the annual garden beds.

**Intrinsic factors:** Size, weight, height above ground, ease of operation and maintenance.

**Inputs:** Pruning, harvesting and maintenance 2-3 times per year.

**Outputs:** High visibility aesthetic value, increased yields, faster ripening, shade, air flow moderation against building.

Comfrey Tractors - A comfrey tractor is a method that takes advantage of comfrey's inherent characteristics to propagate clumps of plants quickly and easily. Comfrey is a bioaccumulator with a deep taproot. One of the easiest ways to propagate comfrey is with root cuttings. A comfrey tractor takes advantage of both the taprooting habit and the root propagation by planting a starter clump in a container with holes drilled in the bottom to enable the taproots to grow through the container and into the soil below. Once the starter clump has established itself in a location, the container is given a quick twist against the ground, and then relocated to the next spot. The taproots that have grown through the bottom of the container will snap off at ground level and will grow into new comfrey plants. A layer of mulch and a good watering will help ensure that all the root fragments will survive.

I have heard a few criticisms of this technique. First, comfrey is so prolific, once established, that to propagate it in this way is foolish. I think this criticism comes from a tillage mindset. Because the plant reproduces so easily from root cuttings, digging the plant up and tilling the soil only makes it come back multiplied. When you are deliberate about how and where the plant is grown, I think its “invasive” nature can be kept in check. I have also heard that it is difficult to grow comfrey in container because it likes lots of moisture, it gets root bound, and it needs an established taproot to be healthy. The moisture issue might be mitigated by planting with composted biochar. The compost should help mitigate some of the nutrient issues associated with the periodic pruning of the taproot. The root binding can be mitigated by growing it in a situation where it can air prune its spreading roots. One of the easiest and cleverest techniques I have seen to deal with this is to grow in a synthetic reusable grocery bag. The fabric of these bags is very similar to weed blocking fabric or other geotextiles. If one of these bags were placed in a milk crate, filled with composted biochar and soil, I believe most of the issues would be mitigated.

**Intrinsic factors:** Growth habits, weight, color, blossom season.

**Inputs:** Water, compost, labor, milk crates, shopping bags, starter rootstock.

**Outputs:** Biomass, soil and water remediation, mineral and nutrient accumulation, nutritional uses, medicinal uses, mulch, compost, more comfrey, nursery stock to sell, bee forage.
**Productive Tree and Bush Guilds** - Currently, the garden is used almost exclusively for annual vegetable production. There are a few perennial herbs. The establishment of several productive tree and bush guilds would help to bring a diversity of wildlife and food production (temporal diversity as well) to the garden site. Placed with care, such elements would not interfere with annual production space, but would bring great diversity and interest to the site.

Intrinsic factors: Height, footprint, shade, fruit production, blossoming season.

Inputs: Labor for establishment, water, mulch, plant material.

Outputs: Fruit, blossoms, nectar, leaf drop, aesthetic interest, insect and wildlife fodder.

**Social Systems** - A college campus by its nature has a transient population. For gardens to be productive, they need to be consistently managed over time. For a permaculture garden, it is perhaps more critical that knowledge of the history of the site be maintained and passed down from one generation of students to the next. Techniques, plant selections, experiments, techniques, seed saving, and the evolution of the design are all pieces of information that, if transferred to subsequent generations of students, will collectively contribute to the abundance of yields through time. For this to occur, it is critical that the social systems associated with the garden site be established to account for the transience of the people involved and yet maintain the garden in a highly productive state.

Intrinsic factors: Social dynamics (organization, conflict, communication, documentation, custom).

Inputs: Time, creativity, communication, documentation, conflict resolution, leadership.

Outputs: Skills (leadership, design, horticultural practices, ecological thinking, ), social cohesion, satisfaction, camaraderie, knowledge, more permaculturists.

**Phase 2 Design**

Phase 2 design elements are primarily geared towards major projects that would enhance the versatility of the site, or provide educational opportunities for the Georgia Tech community. They are not necessarily only to be implemented after all of Phase 1 is complete, but can be layered in as interest and resources become available. Some of the smaller phase 2 projects are likely to become recurring in the form of educational or skill building workshops. This list is not exhaustive, by any means, but serves as a starting point for discussion of the types of phase 2 activities that are possible.

- Greenhouse
- Rainwater catchment and storage
- Hugelkultur
- Stand-alone perennial herb bed
- Mushroom log cultivation
- Mushroom bed
- Wicking beds
- Garden towers
- Solitary pollinator, insect predator hotel
- Bird houses
Phase 3 Design

Georgia Tech has plans to recreate some of the natural water features near to where they once were before the campus was developed. They are calling this part of the Campus Master Plan the "Eco Commons." I suggest that as part of the strategy of this design that enough success will be achieved with the student garden site that sufficient trust will be gained so that we will be given the opportunity to show how permaculture can inform the Eco-Commons projects as they move from concept to construction.

Also, the current site might be afforded the opportunity to expand beyond its current boundaries into the surrounding green space. Below is a list of elements that might be incorporated into a future expanded site plan.

Technical note: The swales in the drawing below do not connect directly with the small ponds. This drawing is meant to be conceptual rather than schematic. The swales definitely could be connected to the ponds, though it might not be necessary. The soil under the turf appears to be sufficiently compacted such that strategically placed ponds would likely fill up without any additional catchment from swales. It might be advantageous to connect them, especially as a demonstration of function, but also as the surrounding soil becomes less compacted under the forest garden management regime, the amount of runoff might be reduced sufficiently such that the ponds would not remain full without them.

- Swales and food forest systems
- Aquaponics system
- Water features
- Solar PV systems
Aerial view from the west of garden with proposed greenhouse, fence and major phase 2 and 3 elements.

Concluding Thoughts

There are many idioms regarding the seeming futility of making plans. One such idiom is, “No battle plan ever survives contact with the enemy.” Nonetheless, planning is indispensable to the exploration of constraints, degrees of freedom, creativity, problem solving, goals, aspirations and benchmarking. Plans are jumping-off points. Reiteration is the key to good design. In the language of permaculture, the design principles of observation and accepting of feedback are the most important considerations in implementing a design for an intentionally complex system. But in some ways, complexity can be regarded as simple. The key is to understand which are the most important elements that contribute to the emergence of complexity. Once that is understood, designing the conditions for those elements to yield the complex systems we want are not as difficult as it may seem. In other words, we don’t need to understand every single one of the thousands of connections and interactions of an oak tree in its wider environment. We just need to understand the conditions under which that tree will thrive, and design the conditions for those conditions to be present.

I have learned tremendous amounts throughout this PDC process. I have learned mostly that this certification is not a license to design permaculture gardens. It is an transition of the mind from a culture of incrementalism, reductionism, and segregation into the possibility that humans can reintegrate our species and culture into the whole of the community of life, and that the way we can accomplish this is first to realize that we are a necessary participant in the ecosystems we inhabit. I also have come to accept that it is not my responsibility to change the world, but I can change my little piece of it.

Humbly submitted,

Brent A. Verrill