Biological Systems

At the beating heart of Mezzacello are the biological systems of the six inter-connected and sustainable ecosystems. From the formal gardens and swales and the allee ecosystem, to the herbal parterres, to the pond, to the livestock and their manures, the potager gardens and planters, and finally to the compost and the abatoir. Everything has a purpose and a place.

These are the biological systems at Mezzacello

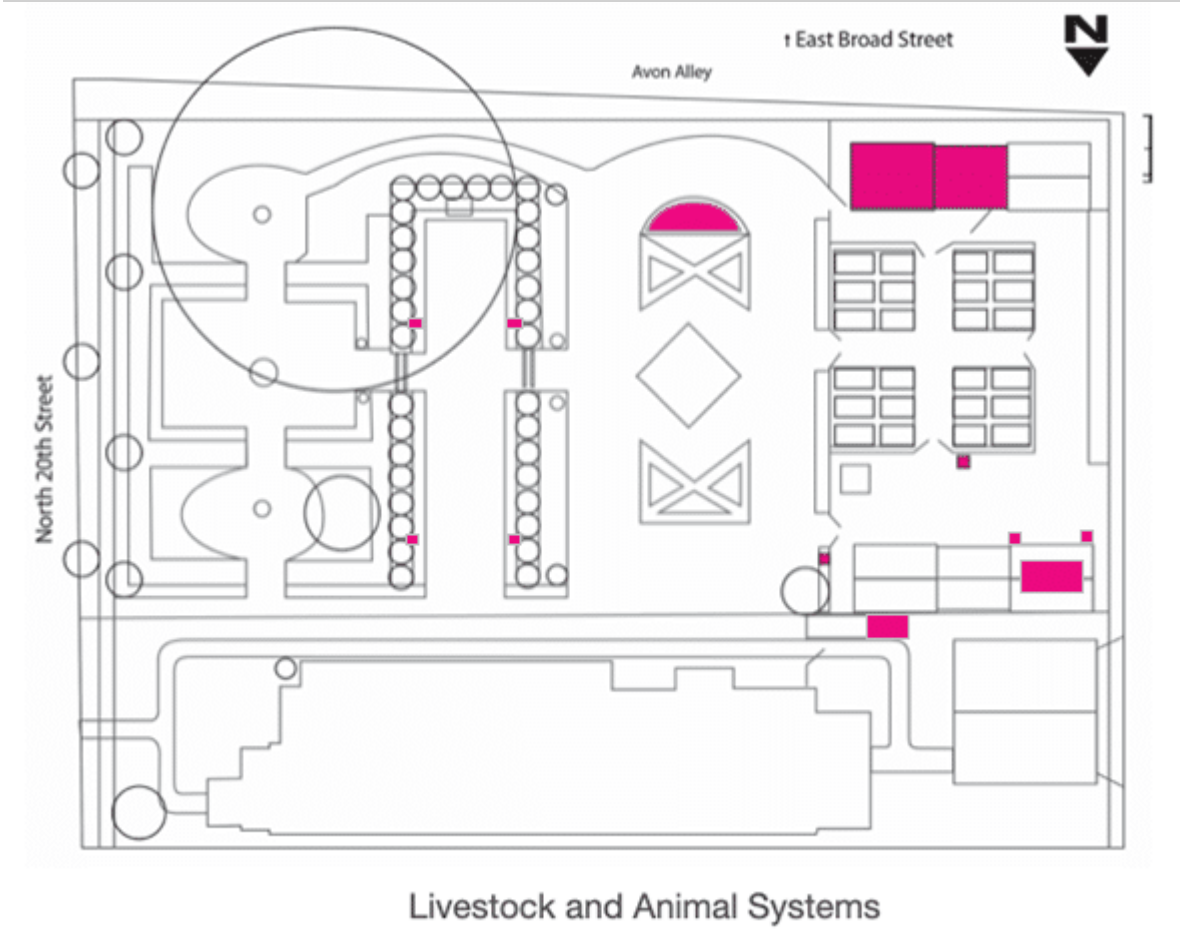
- Livestock
- Chicken Coop Tour >>
- Water Management
- Gardens
- Feed & Additives
- Gates at Mezzacello

- Compost
- Biohazards
- Pantry
- Pantry Tour >>
- Preservation

Livestock

The livestock at Mezzacello are housed mostly in Building 1 in

the southwest quadrant of Mezzacello. The animals that reside in the livestock shed are mainly, chickens, ducks, and rabbits. The poultry reside in the coop section to the west while the rabbits reside in warrens on the west wall.



Livestock and Animal Systems

Areas in magenta hold livestock and animals, pollinators, birds, and an abatoir.

Flooring

The livestock shed has a linoleum floor for ease of maintenance and cleaning. Floors can be swept, mopped and squeezed and wastes are collected outside the two doors in a french drain that empties into a leech pit. This helps recycle wastes and control ammonia and pathogens.

The animals occupy both sides of the livestock shed (Building 1). The rabbits have plastic trays for collecting their wastes, and the chickens and ducks have plastic trays to collect their wastes. In the winter, I add deep litter to manage the wastes during freeze.

Isolation and Veterinary Needs

Injured or sick animals can easily be isolated in cages kept on hand in the livestock shed. The medical cabinet contains all of the basic antiseptic and medicinal drugs each animal typically needs. Isolation cages are stored in the rafters of the livestock shed.

Windows and Doors

The livestock shed (building 1) has two southern facing windows and two sets of doors. The doors are double on the north facade and open into the walkway between the shed and the potager garden. The chicken door opens to the west and is a single door that opens into the attached chicken run.

Coop Sliding Doors

The coop section has sliding doors to create two coops. This is used primarily to separate chicks and ducklings from aggressive older animals, as well as helps manage their feed and water. All poultry also has access to a coop door with a drop door to also opens into the attached run.

Egg Laying Shelf

The chickens lay their eggs on a shelf that opens into the livestock shed. Three large nesting boxes with straw are set against welded wire panels that hinge open to make egg collection easy. There is a collapsible table that rests behind the egg laying shelf and makes it easy to collect eggs.

The Chicken Run

The run is an enclosed fenced in area that lies between the livestock shed (building 1) and the tool shed (building 2). The run is lined with a 6′ welded wire kennel panels with a door on the north and south sides. The run is covered over with a tarp for protection from the sun and predators.

The northern door of the run can be opened to direct animals

to the eastern walkway and isolate them there. It has the added benefit of making it easy to marshal poultry back into the run. Both doors to the run swing in and out for adaptable use.

The entire poultry run is covered in rubber mattes that grade towards the livestock shed and empty into a french drain, which also drains into a leech pit. In warm weather it is easily sprayed and swept. in colder weather, this system is not as effective, but still controls mud better than just dirt.

Free Ranging Access

The animals have access to grass and weeds. When they are released into the western orchard section of Mezzacello or in the strip of grass between the livestock shed (building 1) and the tool shed (building 2) that abuts the fence and hedge. Fresh water is available in a heated nippled waterer and in warm months various troughs of water.

Abatoir and Processing

The abatoir is located in the service yard directly behind the house and to the north of the greenhouse (building 4). This space is used to temporarily house animals for isolation, and has equipment required for processing animals for meat, feathers, fur, and offage.

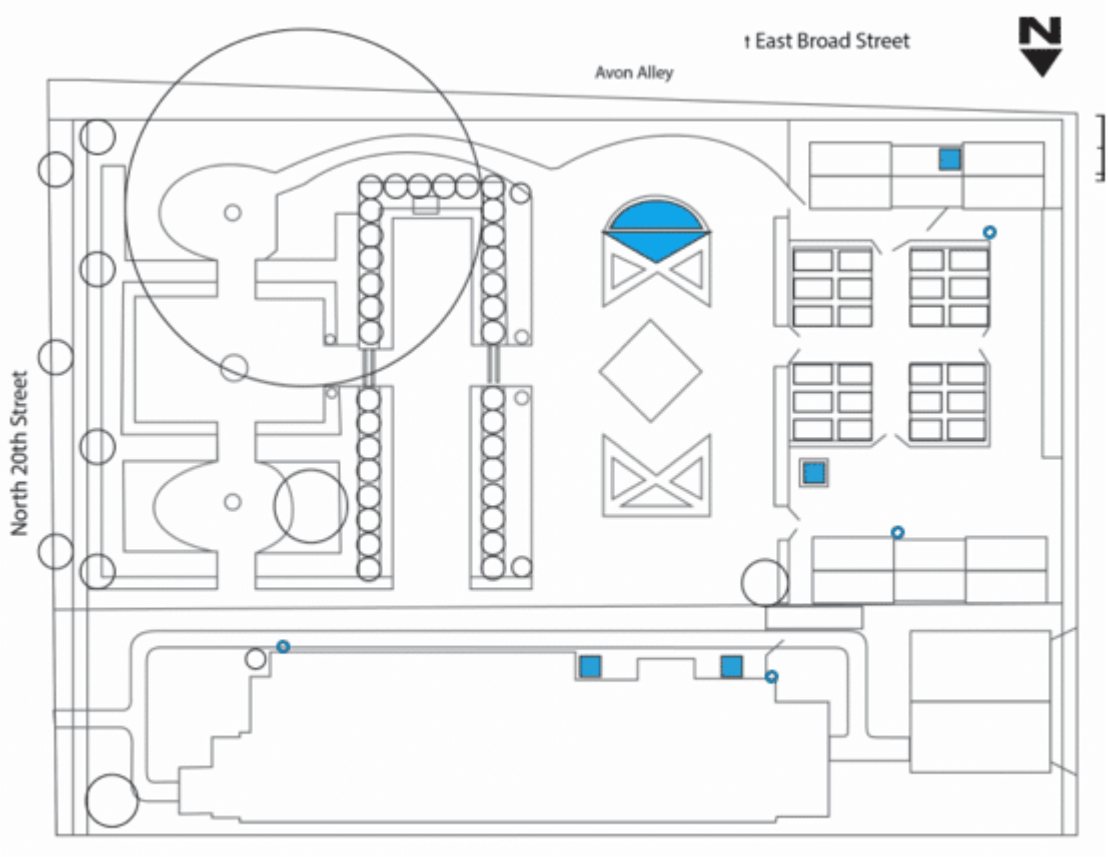
The abatoir is OFF limits to all visitors, campers, and tours. It requires a license and skills that are very specific. See biohazards and compost.

For a much deeper dive into animal health and care see Animal Health and Maintenance

Water Management

Water is available in three distinct ways at Mezzacello, via city tap, from the pond, or via one of four 1,000L IBC tanks

arranged around the farm. The water is increasingly less potable as you move from tap to IBC, to the pond. But animals can be watered from any of these sources without harm.



Water Access Systems

Areas in blue are water sources. Blue bullseyes are spigots for potable water.

City Taps

Water from the city is available in three locations at Mezzacello (not counting from the house). The first is at the southeastern edge of the house where there is a tap. There is also a tap at the southwest corner of the house. The last location is at the southwest corner of the outdoor greenhouse (building 4) – with and extension hose that runs to the chicken run.

IBC Rain Barrels and the Bioreactor Tower

Each of the three 1000L IBC tanks are fillable at the top, have a steel cage to support their weight, are raised on 35cm

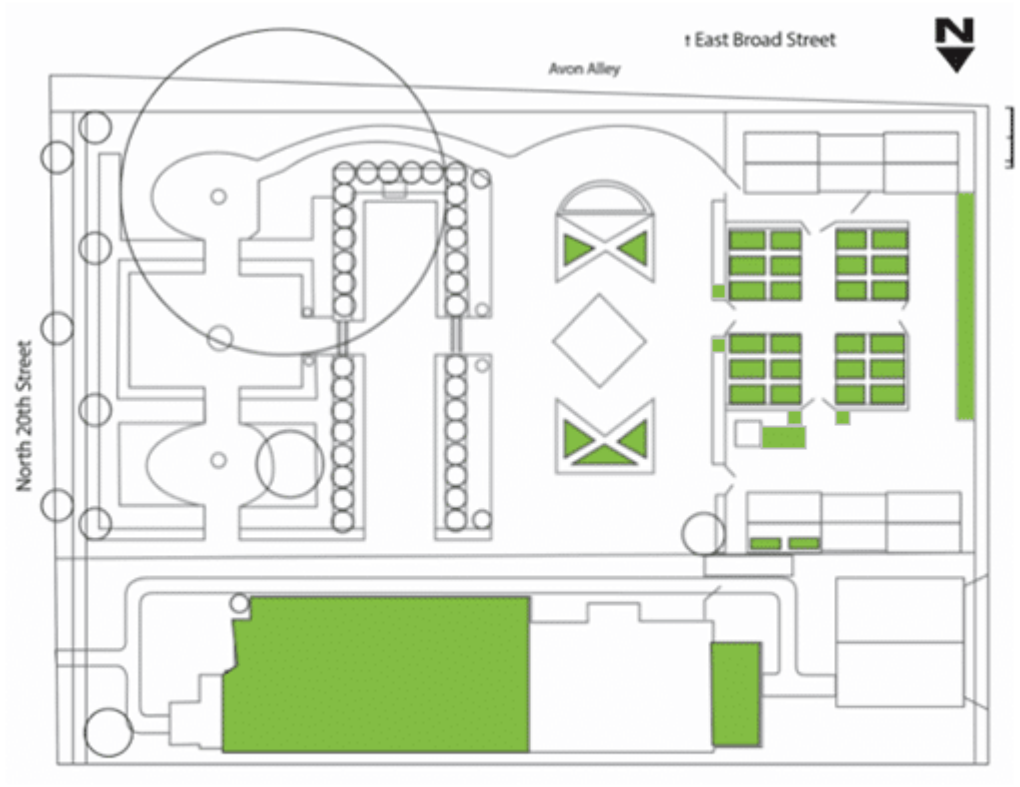
plinths and have an adjustable nozzle at their base. Some of the IBCs have fittings for a hose, but have low pressure, save the Bioreactor tank which is raised 2 Meters and has better pressure. The IBC tank in the chicken run is filled with water from the sheds and features heating elements that keep water thawed all winter and the nozzle is also heated so one always has access to water in the run.

The Pond

The pond, located in the grassy area between the potager gardens, the allee and the parterre gardens is a 3,000L 1.65m deep pond that has it’s own biofilter and koi fish. The pond is deep enough to always have lick=quid water – even in the depth of winter. The pond is almost always refilled with rain water, or city tap so it is largely potable, just not for human consumption.

Gardens

There are five types of gardens at Mezzacello. The formal gardens, the boxwood parterres which are microclimates, the potager garden beds, the planting boxes, the hydroponic gardens. Each has distinct methods for care and resources.



Food Growing Systems

Areas in green are used to actively grow food products at Mezzacello.

Formal Gardens

Of all the gardens these are the easiest to care for. They require very little water (Due to swales placed beneath the beds) and the types of plants and flowers in them are largely drought tolerant. In the rare case they do need water, there is a water hose attached to the front spigot.

The exception to this rule are the potted cultivar urns which do need water. The trellis plants on the house. geranium window boxes, and nasturtiums, and the various water feature philodendrons by the lion fountain also require watering. We water newly planted plants to get them established and that is all.

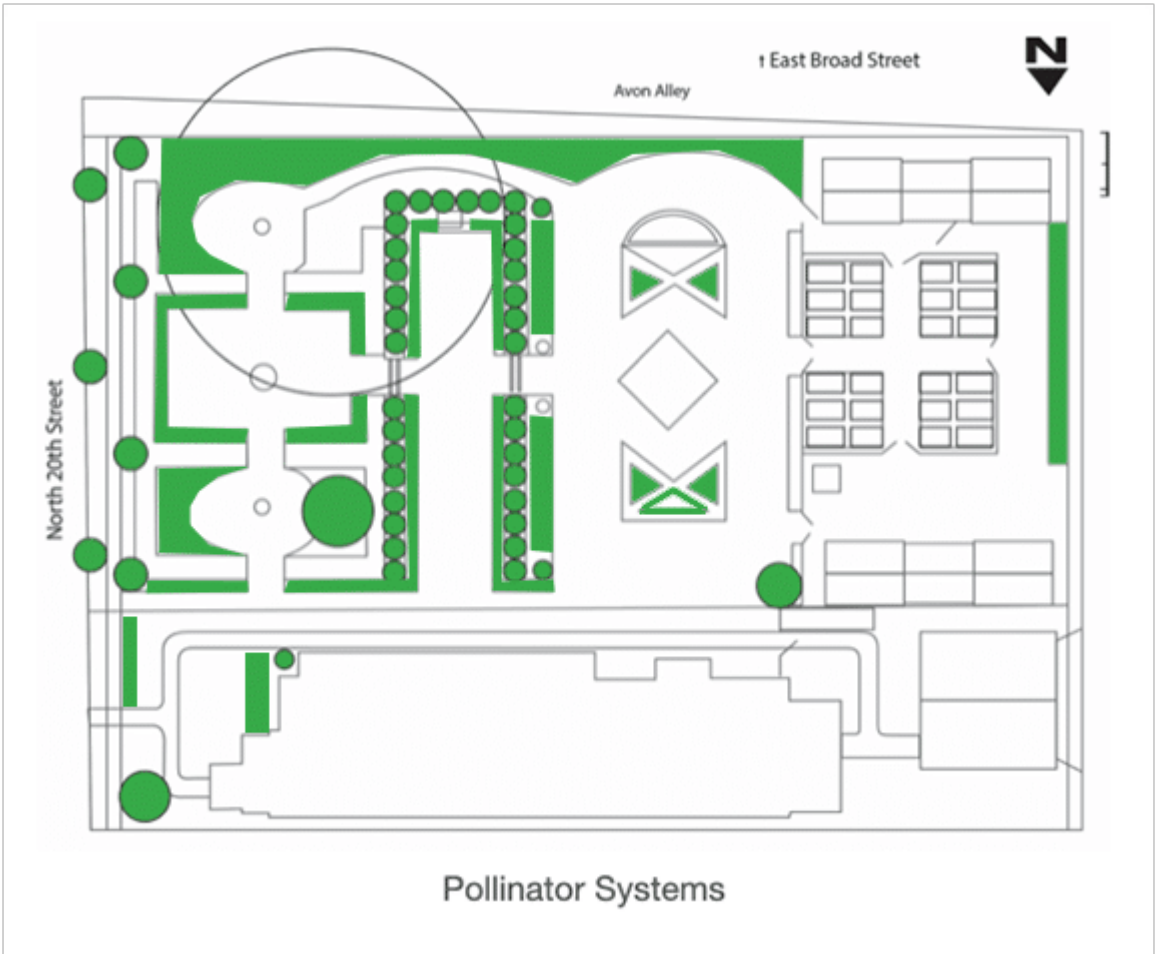
The poppies, allium, foxglove, anemones, gladiolus, quince and roses all reseed themselves. Trimming and thinning is the only maintenance these plants require, and the deadheading in the

end of their season.

Mulching and compost as well as fertilization is done in the spring and fall. Eden’s Ghost from the bioreactor, is diluted 1 cup to 1 gallon of water and added to every plant. Egg shells banana and coffe ground fertilizer is added to all bushing flowers. Acid fertilizer is added to the boxwoods and evergreen glossy leaf plants.

All bush and flower plants are cut down and processed at the end of their season. Half are used as greens and half are left to brown next to the bioreactor to insure a balanced compost content. Grass is used consistently as are shredded leaves.

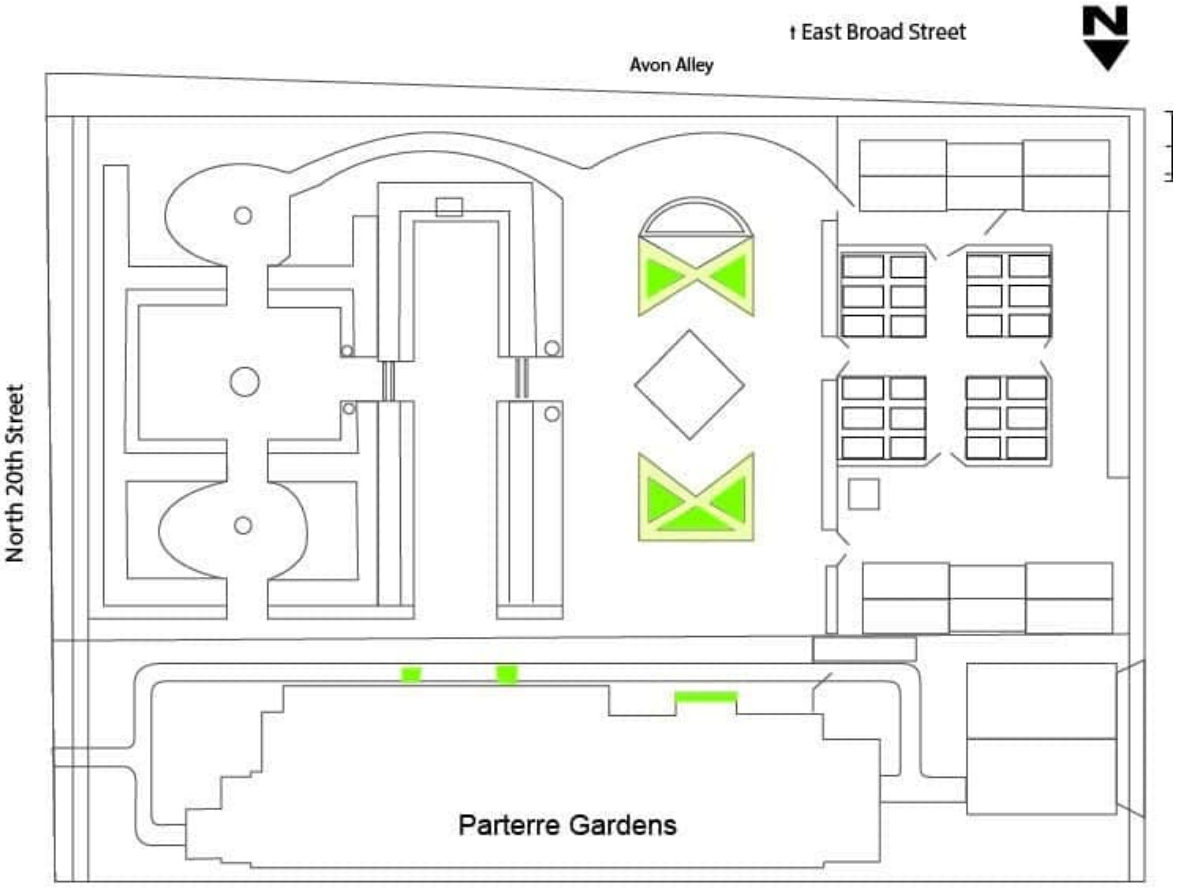
Lastly the allee hornbeams, boxwoods, and southern yew hedge are kept trimmed and trained. The clippings are recycled or in the case of the yew hedge placed back on the ground to root anew and add to the thickness of the hedge. All hedges get a dose of Eden’s Ghost in Spring.



Areas in green contain flowers and trees that attract birds and pollinators to Mezzacello. Note the fruit orchard on the western flank.

Parterre Gardens

Each of the parterre triangles are a microclimate with related planting groups. In general they require little watering and are easily watered with a hose, or a few 2 gallon watering cans pulled from the rain water in the house IBC. There are three zones in the culinary (northern) parterre.



Parterres and Herbs and Fruits

Culinary (North) Parterre

East zone is tropical and Mediterranean herbs like cilantro, oregano, dill, and tarragon. They require some water once a week. They also require processing regularly to encourage growth, usually cutting and then drying in the greenhouse.

The north zone is northern European and North American herbs, Parsley, thyme, watercress, lemon grass, celery root, chives,

and borage. These require watering once a week and are used most often throughout the year. Their habit is very hardy and they will flourish through almost all seasons until the snow as long as they are watered and cut regularly.

The west zone is the hardy herbs, sage and thyme. They never need watered as rain is sufficient. Almost indestructible herbs.

The middle urns are both forms of rosemary, creeping and Italian. They get fertilized once a year and watered once a week. They are the only herbs that come in for the winter until I am sure they can survive a winter.

Medicinal (South) Parterre

This parterre has only two zones, east and west, as the southern triangle is committed to a wetland area and base for the pond biofilter for the pond to the south of the parterre. This parterre is committed to largely hardy and easy to grow perennials and herbs used to make tinctures and teas.

The East zone is of course surrounded by boxwoods. It contains dry Mediterranean perennials like Yarrow, Lavender, Savory, and Comfrey. These are rarely watered and I find the draining of the biofilter and pond are sufficient to this purpose.

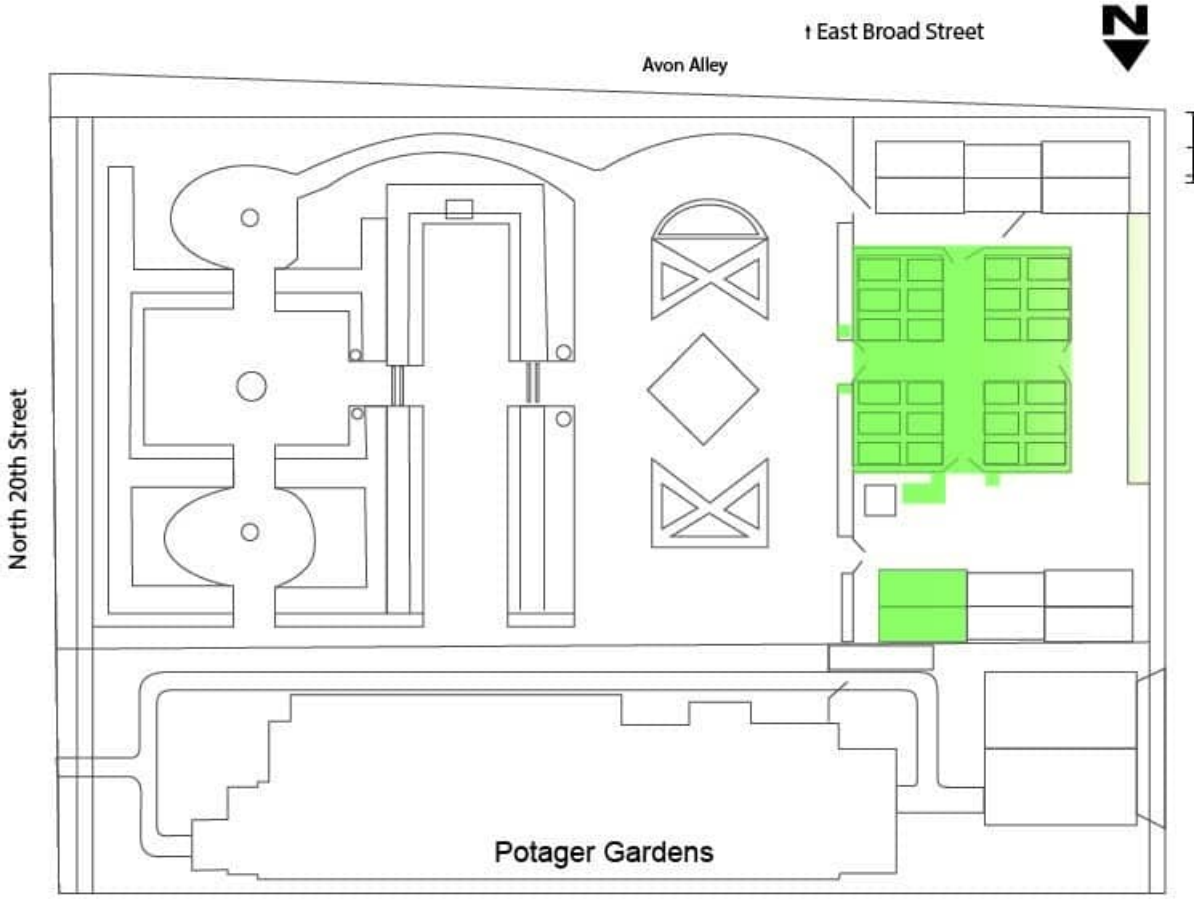
The West zone is almost a carbon copy of the East in that it contains Yarrow and lavender, but also borage, and various specimen plants that I am experimenting with. All are drought tolerant, but do benefit from occasional watering beyond rain.

The central urns contain mints. These mints are isolated as they are voracious spreaders. They are also largely drought tolerant plants and thrive in the urns with just occasional watering other than rain.

Potager Gardens

These are the most water intensive gardens at Mezzacello. It

was impractical to build swales beneath the 24 beds that comprise this garden. These beds are actually modified raised beds and compost/lasagna garden beds. They require little maintenance and the system is designed to discourage weed growth.



Potager Gardens, Growing beds, planters, and hydroponic Systems

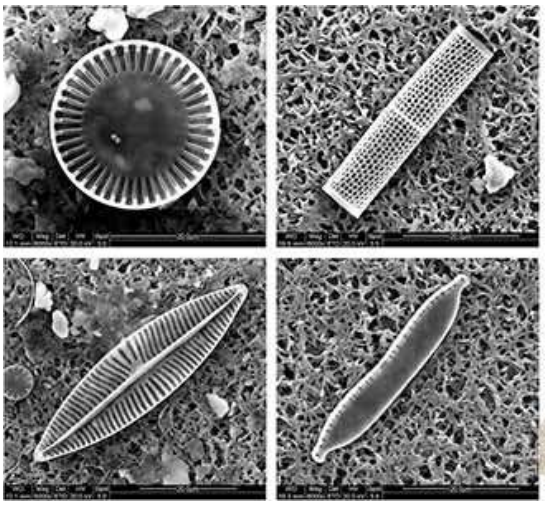
Each bed is 30cm (18″) deep and is dug into dense compacted clay. It is lined with pine 2×4 to create a raised lip. The submerged bed allows the soil to remain warm, but pliable and nutrient dense.

The soil structure is composed of compost and soil and mineral amendments, including gypsum, and diatomaceous earth. This is an optimized mixture for growing roots, cruciferous, and iron-rich leafy greens. I am still evolving this strategy for legumes.

Each of the beds has a tarp over it made of burlap or weed

barrier, depending on availability. The tarp is secured to the wooden frame of the bed. Pathways between the beds are covered in cardboard, weed barrier and pine shavings. Problem areas in the walkways remain grass and clover spread and weeds that grow on the northern and eastern fence line and are difficult to manage.

The bed's covering blocks stray spores from taking root from the air, and blocks sunlight to the stray weed that attempts to grow from beneath. There is an added layer of protection of 3mm cover of diatomaceous earth that discourages pests from burrowing and destroys young shoots that attempt to grow up and through it.





Diatoms, Diatomaceous Earth, Squash Bugs

A Note on PESTS!

There is a significant issue with this soil and squash beetles. I do not know the exact issue but it is significant. I dust the squash and cucumbers with DE and spray with Neem and soapy water. It is a chronic issue and will be a primary area of research in the coming 2022 season.

The plants that are intentionally planted are planted in slits cut through this layer and the DE barrier is moved out of the way. The DE provides both molecular calcium and phosphorous and keeps pests from tender shoots until they have established themselves and their true leaves are out in the sunlight.

The final benefit of the wood rails in these potager beds is that it makes it easy to assemble and remove cold frames on the spot, and growing supports. The wood provides dynamic tension for the pex tubing I use for the hoop structures, and I can staple netting if needed to protect from nibbling herbivores and birds. The rails also help keep grass out of the beds but are not infallible at doing this.

The sprinkler system is fed from a hose at the greenhouse (building 4) and runs to a centrally mounted telescoping sprinkler. The sprinkler is on an automatic timer and manages itself. There is a sensor on the sprinkler to disable it if it is raining.

Occasional spot watering will be necessary of course. there are watering cans and a hose for this use at the greenhouse (building 4) spigot. this alternate hose is also used to water the four tomato and basil container gardens deployed around the potager at the west and north gates. These require watering daily, and there is no plan as of yet to automate this.

At each axis of the potager garden are double gates. These gates are to be closed and locked at all times to prevent rodents and pests from getting into the gardens. There is a security system that is trained on this, but it’s useless if the gates are not kept closed.

Planting Boxes

There are multiple planting boxes and urns at Mezzacello, all of which require attention and watering from time to time. These boxes are arrayed around the entire property and include the front and back porches, the side of the house, the west and north gates of the potager, the allee fountain area, and the urns in the boxwood parterres.

They require a gallon of water each every other day and that should be sufficient. The food containers (like the

nasturtiums, the lemon, lime, rosemary cultivars, and tomato/basil) require a daily dose of water. this optimizes their growth. Most of these containers have structures that will allow the plants to grow and thrive and not hang.

The rose trellis is a special condition. There are four Don Juan roses that are growing over the pergola between the parterres. These require watering every other day and constant pruning as they are a thorn hazard.

Hydroponic Gardens

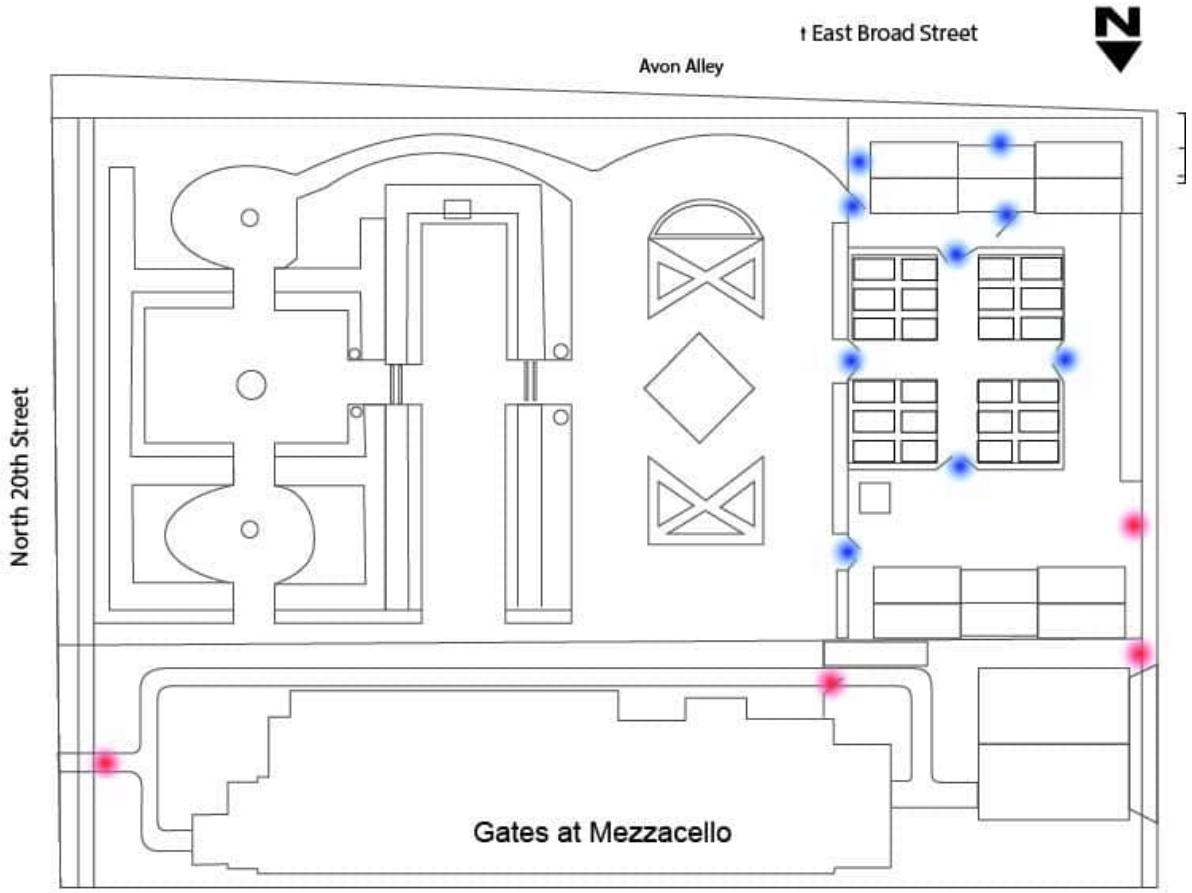
There are two types of hydroponic gardens at Mezzacello, one in the greenhouse (building 4) and one in the main house. These are used to grow microgreens and spinach as those crops take up a lot of space in the potager that is better used to grow long term storable root crops. Both of these systems use a combination of Eden’s Ghost and rabbit manure that has been diluted and processed fro use in the hydroponic pumps.

The pumps run right now on house AC power as their load draw on the DC inverter and solar panels is pretty intense. I will be working on that issue this 2022 season. The nutrient matrix is collected, diluted and finely blended in a vitamix to insure there is no bulk bits that could clog the pumps and to optimize nutrient uptake by the roots of growing plants.

The greenhouse (building 4) is actually sub-optimal as a hydroponic site as the temperature fluctuates wildly, especially in summer sun. I am also looking into this situation. The outdoor hydroponics system is the most unstable of all of the gardens at Mezzacello.

Gates at Mezzacello

There are 13 gates at Mezzacello. All of them must be closed after opening, and two of them are secured, locked and monitored. As a general rule of thumb, gates exist to be closed after being used.



Gates at Mezzacello. Red Gates are external Armed gates, blue gates are interior gates.
The RED external gates of Mezzacello include the front wrought iron gate (the handle is a spring, pull back on the spring and it will open) and the rear double gate for heavy equipment, and the service yard gate which both open into the alley behind Mezzacello. The front gate is the way ALL guests must enter Mezzacello.

Then there are the blue rear farm gates which include the double gates at the greenhouse (building 4) and the Bioreactor tower, and the livestock access gate. It is imperative that these gates remain closed at all times to protect livestock and deter large predators. The livestock gate is at the pond entrance to the south of the potager gardens.

There are three livestock run gates located on the welded wire covered run between the livestock shed (building 1) and the tool shed (building 2). In addition there is a west gate located at the back of the tool shed that allows the poultry

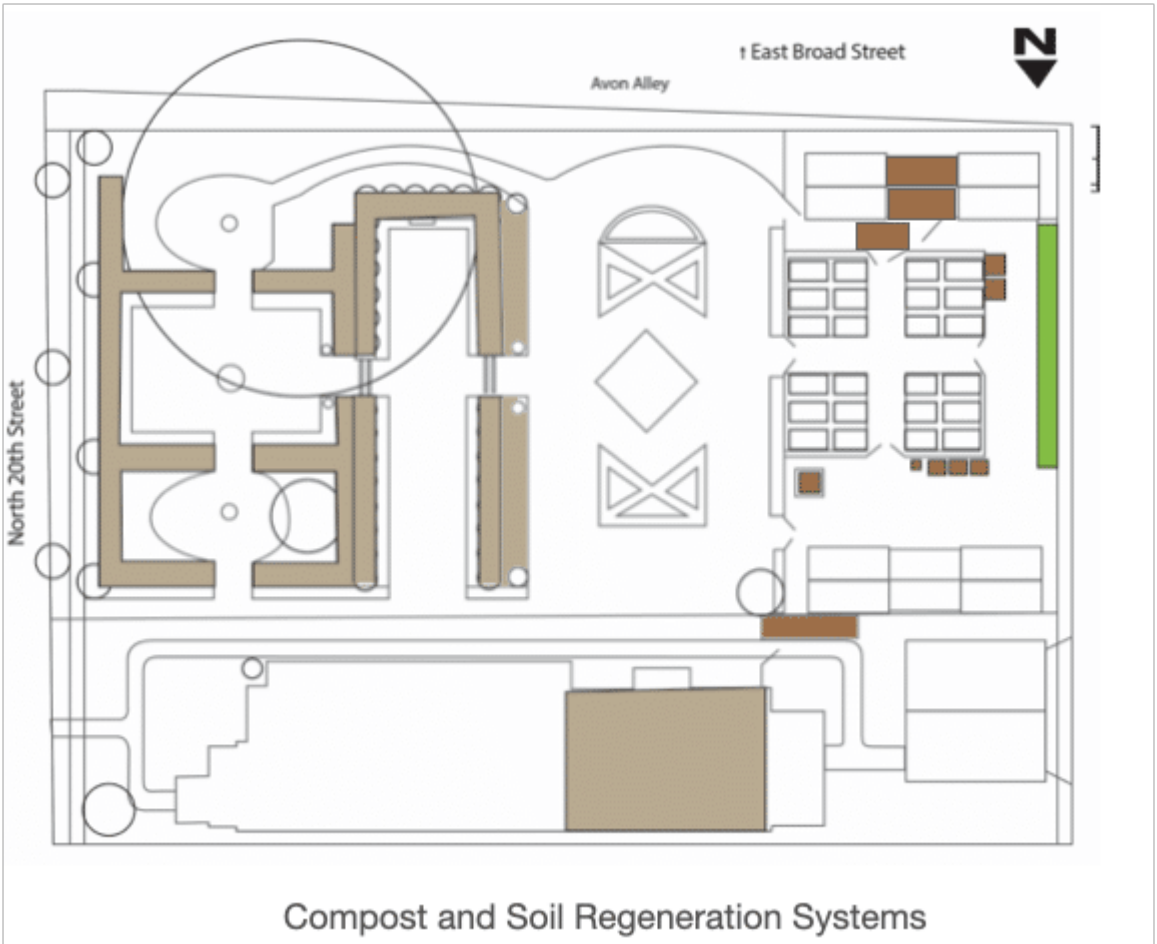
to roam in a protected uncovered space. The gate on the south face of the run is the only gate exception: It should remain open while poultry are in the rear open run so they have access to the run, food and water.

The large kennel gate on the chicken run has two purposes: It allows access into the run with large wheelbarrows and visitors. It also swings out a creates a controlled sterile run space for poultry on the sterile rubber mattes for vet treatments and to easily marshal birds back into the run by closing off access to the west lawn and fruit trees beyond.

The final series of gates are the four double gates that grant access to the potage garden on all four cardinal faces of the garden. These gates are in place to keep poultry either in or out as they turn the soil and hunt for tasty pests. They also serve to discourage rodents and large pests from entering the garden.

Compost

There are three primary methods of developing compost at Mezzacello: Traditional compost, Manure Matrix compost, and Accelerated compost. All three are in use in the west back sections of Mezzacello.



The production compost areas (dark) and source compost (light) areas of Mezzacello.

Traditional Compost

This is the compost most people are probably familiar with. It is the layering of greens and browns and occasional turning to promote the biological process of compost. Compost at Mezzacello is collected in 1,000L 1 meter cubed IBC's with a steel cage and a door hatch that can be opened and closed.

The layers are started and water is allowed in through a 20cm hole at the top so it can percolate through the compost. At the base there is a nozzle that allows water and nutrients to escape or be collected for fermentation into Eden's Ghost fertilizer.

Generally there are always two of these IBC systems going at Mezzacello. The end result is @500L of compost after a 3 month settling. It is a pretty efficient system and easy to load and unload and largely UV resistant.

The secondary type of traditional compost is the sealed roller compost bins at the northwest edge of the potager garden. This system is optimal for greens and browns and food scraps. They lock down and are largely predator resistant.

This rolling composter has less mass and therefor heat than the larger 1 cubic meter composters, but they are effective, just slower. They also handle more volatile food sources, like animal scraps, and oils.

Manure Matrix Compost

This is the most controversial type of compost at Mezzacello. It combines manure runoffs and the well-rotted leech pits from the livestock gardens with recycled paper, greens, bananas, egg shells, and coffee grounds and produces a very nitrogen rich compost that must be activated and turned in the sun.

It is actually one of the oldest types of compost in use. But it requires a much larger surface area than other forms of compost and must be managed to promote the microbacterial transformation of hot chicken and duck wastes with the benign rabbit wastes and other nutrient streams.

It is also the smelliest of the composters. But that smell diminishes exponentially with time and UV exposure. This compost is also a great breeding ground for mealworms and crickets who are naturally attracted to it – as are flies.

The fly issue is a real issue with this form of compost. I really dread NOT reusing animal wastes, but an anerobic (no air) digester is just too cost prohibitive at this time. This is the system that George Washington used at Mount Vernon and I am determined to give it a solid go.

Accelerated Compost (AKA BioReactor)

This is the most technologically advanced form of compost at Mezzacello. It is similar to the Traditional Compost in that it is manually layers greens and browns, collected and placed

in a 1000L IBC tank with a hatch. The difference is that this compost once it is activated takes only 21 days to rot down into rich compost.

This is due to an accelerant that is added to the IBC and water from the Bioreactor water tower that automatically waters the matrix and inserts quantities of the accelerant automatically. The entire system is wind and solar powered and self-sufficient.

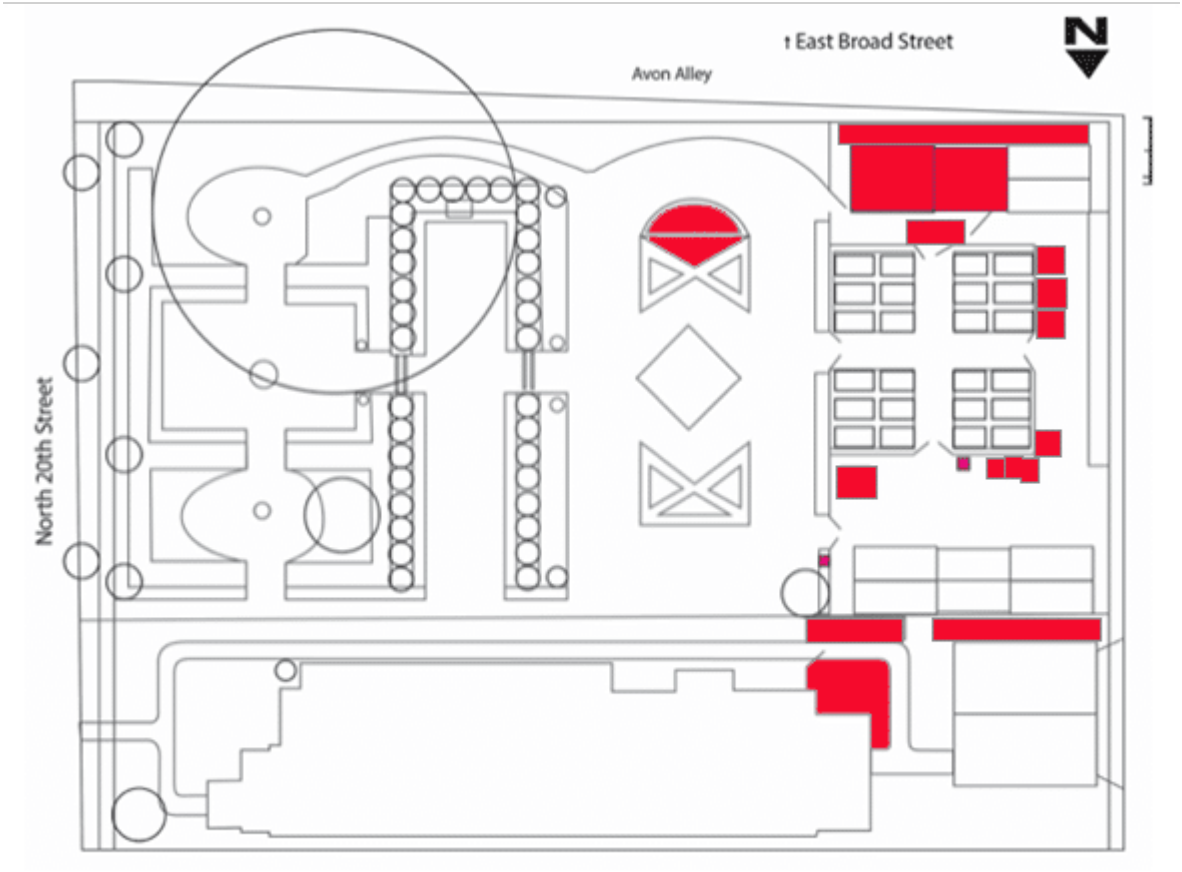
At the end of the cycle, the IBC is removed from the bioeactor and a new IBC is put into place and the system begins anew. The prepared IBC is drained of it’s Eden’s Ghost concentrated fertlizer and left to site for one week. Then it is is processed and deployed around the farm.

This system is not yet infallible. It is technology that is new and there are complex mechanical and micro-controller variables that still need to be ironed out, but the proof of concept is sound. The batteries in winter are a pain as well.

Battery performance in cold weather was not a factor I had taken into account when I designed this system. nor was heating the bioreactor to prevent freezing. Lessons learned and still learning, more on that later.

Biohazards

While Mezzacello is not dangerous by any means, there are places and stations that must be accessed with caution. these include the stations that deal with waste products, manure, and water/algae/toxin clarification, and the abatoir.



Biohazards Areas

The Biohazard Areas of Mezzacello. Note only the Abatoir is strictly off limits, the rest just require boots and gloves.

Manure Biohazards

The livestock shed (building 1) and the chicken as well as the leech pit in front and the area behind buildings 1 and 2 are off limits to anyone not wearing sterile footwear and gloves. The waste products here are easily transferable to other birds and potential harmful to humans as well. Activity that happens in any red area must be monitored by a responsible adult.

Compost Biohazards

There are multiple areas in the western edge of Mezzacello that deal in compost. Compost itself is technically not a biohazrd, there are waste products associated with compost and the Bioreactor that are fertilizer-bases and are toxic in large doses. That is why compost is on this list.

The byproducts of the of compost, specifically the manure and

the Eden’s Ghost fertilizer are kept behind a locked gate in a fenced off area where children and guests cannot easily access them.

While it is technically NOT compost, the biofilter for the pond also produces mild toxins and algae by-products, including ammonia. These are collected and dried behind the potager gate on the east face of the Livestock shed (building 1) where they air dry and get UV treated for drying and reuse in the gardens of Mezzacello.

Abatoir

I will not go into great detail on this section. It is a complete biohazard, and is kept behind a privacy fence and within a locked fenced in area. The service yard to the north of the greenhouse (building 4) and classroom (building 3) is STRICTLY off limits to all students, guests, and unauthorized visitors.

This is a rather nebulous concept at Mezzacello as animals are “fed” a great many things in the course of a day. But technically speaking the “feed” for the animals is stored in the livestock shed (building 1) on a rolling trolley tucked in underneath the drop-down table in front of the hen egg hutch doors.

There are four primary 29L (10 gallon) plastic-lid bins that hold rabbit feed, chicken feed, scratch grains, and seed and catfood amendments. Additionally there are mealworm bins, crickets, and various treats available in a cabinet next to the southwest window of the shed.

Located in the chicken run is the metal bird treadle feeder. this is to be filled with chicken and duck feed ONLY. Do not fill the treadle feeder with scratch grains as they will be wasted by the chickens and ducks picking through for the best bits and the rest will remain on the mattes in the run.

This is an issue because grains left laying about attracts small birds (who bring mites and lice) and rats and raccoons. Scratch grains are only provided in the morning and only in a green pan to control the spread of the grain. To reduce tensions, I will often add another bin to place scratch grains in another spot to ease congestion.

Niacin

The final amendment to cover here is Niacin. Ducks REQUIRE niacin or they will die. There are FOUR important sources of Niacin I use at Mezzacello.

Biological sources of niacin include the water hyacinth that grows on the pond is a great source of niacin, as are meal worms and crickets. Ducks love both of these biological sources of niacin.

Canned or fresh peas are also a great source of niacin. I buy these for $.50 a can at discount stores and keep them on hand with a can opener in the livestock shed. The ducks love to gobble them up!

Wheat germ is another great source of niacin for the ducks. It’s fairly affordable and stores well. I keep it in the livestock shed with the peas and sprinkle it on the scratch grains and feed occasionally for the ducks.

Lastly are water additives and electrolytes are a great way to provide ducks with necessary sources of Niacin. These are my least favorite as they are individually packaged and expensive. A lot of work, cost and waste just to give ducks what they need.

Pantry

The pantry at Mezzacello is an ongoing experiment in replicating the ways that 19th Century America grew, processed and stored food. It includes three standalone cabinets, a dry goods and a grain cabinet, and a wire mesh root cellar that

stores a lot of long-lasting root vegetables in a small call space.

Wire bin storage units, wall mounted, climate controlled and moisture managed.

Preservation

The preservation of food and the preparation that it requires is a very important part of the Biological Systems at Mezzacello. The three main preservation methods in use at Mezzacello are Canning, Dehydrating, and vacuum-sealing technologies.

Canning is the most labor-intensive. We can 10 jars at a time and it consumes a lot of energy and time. The preservation is pretty fool-proof but is limited to greens and wet vegetables. Canning extends food well into the winter, but is space and labor intensive. The jars are a big capital cost, as are the lids and parafin wax rings and canning pans and pressure canning tools.

Dehydration requires the most amount of time. It takes about a day to dehydrate food, and not all food is a good candidate for dehydration. Usually it is hearty greens, herbs, meats, and fruits. Dehydration allows us to extend food and herbs well into the winter and takes up little space.

Vacuum-sealing extends food for several months and is perfect for locking in freshness and freezing food safely with little chance of freezer burn. The vacuum sealing process is easy and allows us to store soups, meats, and greens flat and easily.