Diggers Cooperative, Inc
845 Garvin Rd.
Acton, Maine 04001

Attn: City of Everett MA

Re: Main St Meadow Project

Report By:
Scott Guzman (Diggers Cooperative)
Dominic Ouellette (Diggers Cooperative)

Consulting Support By:
Navona Gallegos (Soil Food Web Consultant)
Spero Latchis (The Living Soil Company)
Cheyanne Rico (National Resources Conservation Service)

Comprehensive Soil Plan

Diggers Cooperative, Inc
845 Garvin Rd.
Acton, Maine 04001

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The Importance of Soil Focused Planning

Soil is the basis of every healthy ecosystem. Soil has its own dynamic ecosystem of bacteria, fungi and insects that can be easily degraded when polluted and neglected. It can just as easily be improved and maintained when it is well tended. When soil is well tended, the larger ecosystems of plants and higher order animals can thrive.

Today's urban soils have experienced historic and continual destruction and neglect. However, with what is known about soil ecosystems today, dead dirt can become healthy living soil again. Despite years, even decades, of neglect, healthy and robust microbial communities can be reintroduced to remediate the soil back to productive capacity.

The ability to bring vital soil resources back into productive use has a number of benefits to urban areas where open space is in short supply. The cooling effect of shade trees, the calming effect of botanical aromas, and the comforting effect of beautiful vegetation improve the lives of everyone in the community. On a structural level, a major benefit to soil remediation is the capturing of contaminants before they pollute the watershed. Fungal rich soil ecosystems act as a filter for storm runoff that feeds into local water supplies, rivers, estuaries, and eventually the ocean. The presence of healthy birds, amphibians, and fish feeds back on the overall health of the plants and the soil. A virtuous cycle where the contribution of each part of the community benefits the whole is the end product of a well designed soil remediation plan. It is the greater goal of the Main St Meadow Project.

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History of the Site

The site of Main St Meadow is a sharp contoured hillside separating a residential building from a busy highway. This hill was constructed to build up the road so it is not a natural feature on the landscape. The dirt and debris that were used as fill for this construction are of unknown origin. It is possible that it contains litter and various building materials from any building that were present prior to the highway.

An event of relevance to the soil quality is the wreck of an oil truck that spilled its contents down the hillside in December of 2007. The spill fueled a fire in the neighborhood that burned the adjacent homes and cars. No presence of contaminants from this event have been discovered in our initial investigation.

Stewardship of this site has been split between the Massachusetts Department of Transportation and the City of Everett, sharing responsibility for maintenance and upkeep. Being in the middle of a heat island, this site has been targeted by the City of Everett as an afforestation project in an effort to offer cooling to the adjacent neighborhoods.

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Current Soil Conditions

Currently the site has proliferated many grasses and weed species. Vines are growing on the sides of the concrete structures built into the hill. Maple saplings were planted on site close to the upper sidewalk but do not appear to be surviving.

A soil analysis was conducted by Living Soil Networks of Cape Elizabeth, Maine, to determine the diversity of microbial life in the soil. Their full report can be found in Attachment A. The analysis measured bacteria, fungi, protozoa, and nematodes. The analysis concluded that the native soil on site is highly bacterially dominant. There is almost no presence of fungal life in the native soil. This outsized imbalance makes it impossible for anything but the earliest successional plants (weeds) to thrive.

Protozoans, which predate bacteria, were counted in fair numbers although that may be attributed to recent disturbance of the soil. There are not sufficient numbers to reduce the bacterial population by their effort alone.

No nematodes, flatworms, were counted in the sample. Nematodes predate many different microbes and are essential for making plant-available nutrients.

A soil analysis conducted by the University of Maine found an abundance of certain essential nutrients and an absence of others. Their full report can be found in Attachment D. Microbes convert organic nutrients into plant available forms but only at the direction of the plant species that are available. The analysis is consistent with the nutrient profile that best feeds a weed dominant environment.

This second analysis also revealed minor lead contamination which poses no risk with non edible plants.

Regarding Lead: It is generally believed that most edible plants do not take up toxic levels of lead. The greatest risk of lead contamination is through exposure to the soil itself. Recommendations on lead remediation are present in following sections.

Other contaminants: Diggers Cooperative is recommending further analysis of heavy metals in the soil through the University of Maine which may impact further cautions and species recommendations.

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Ideal Conditions for Planned Installation

Soil conditions that are pertinent to which species of plants will thrive include composition, texture, and water infiltration.

The composition of the soil refers to the soil microbiome. We have seen a need for more fungal communities in the soil on site in order to support more complex plant life beyond simple weeds. For species such as prairie grasses of the proposed varieties a minimum ratio of 1:1 fungal to bacterial biomass is required. Shrubs and berry bushes require a ratio of 2:1 - 5:1. The trees proposed on this site prefer a 10:1 ratio. Soil biology must be reestablished ahead of any planting and then tended specifically to the needs of each plant species.

Soil texture refers to the particle size of the constituent parent material. Characterized by the mixture of sand silt and clay. Different textures can provide better root establishment as well as drainage for water. The texture of the soil on site is considered sufficient for the proposed purposes. There is heavy compaction but no indication that it will interfere with new plantings, with proper soil preparation. A significant amount of top dressing with high quality soil amendments is being proposed that should adapt well to the native soil’s texture.

Reliable water infiltration is key for controlling the growing conditions on site. The site has been observed in wet conditions and appears to become quite soft and muddy. There is potential that heavy rains will produce runoff to local waterways and in extreme cases flooding. The proposed soil plan will allow for deeper plant roots and more fungal life that will improve infiltration and mitigate adverse conditions during storms.

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Process of Site Improvement

Improving the soil on site is a matter of restructuring the site with material conducive to the desired microbial populations. For Main St Meadow, new fungal communities are the most desirable addition to the site. Once a diverse microbial community is in place the new plant communities on site will do the work of cultivating the best ratios of microbes to each microenvironment.

The process for establishing new fungal communities is simple and proven. The soil composition is set down in layers with carbon rich material that will feed the fungal communities once they are introduced through compost and liquid amendments.

Prairie and Garden Bed Prep

- Dig TopSoil 6" Deep: This will break up near surface compaction, remove unwanted weed species and their seed bank.
- Use a 3' drill bit to drill holes across the site. Deep drilled holes permit aeration and allow new soil amendments to penetrate more easily.
- Lay down 3" Sheet of Carbon (Wood Chips/Cardboard): Starting with carbon heavy material is ideal for promoting fungal communities. It also creates a soil texture with better water infiltration and aeration to avoid anaerobic pathogens.
- Treat Carbon Layer with Biocomplete Liquid Amendment: The carbon layer is the food and the liquid amendment delivers the desired populations to their food.
- Cover Carbon Layer with 3" of Soil Mixed with a Fungal Dominant Compost Blend: Soil and Compost are mixed to become the medium for planting seeds, starts, and saplings. This layer also protects the nascent fungal communities.
- Seed with Fast Growing Short Cover Crop and Early Successional Plants: Soil should never be left bare. A fast growing cover crop will shade the new soil and immediately help feed the microbiome through their roots.
- Mulch With Straw: Mulch is necessary to keep the soil covered in the early stages. It is continuously used to keep the ground cool and moist while providing habitat for beneficial insects.
- Apply Soil Drench of Biocomplete Liquid Amendment: With all the layers in place, another drench of liquid amendment is used to ensure a healthy biome on the surface of the new plants and soil. The above ground biome is just as essential for protecting plants from airborne pests and pathogens.

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Hillside and Miyawaki Forest Prep

The topography of the site requires slightly different preparations for the steeper portions than the gentler portions. In order to ensure success for the trees planned for this hillside, especially the Miyawaki saplings, there must be erosion control measures in place as well as a thriving fungal community in the soil. The overall idea is to introduce as much organic matter that specifically feeds fungi, aerates the soil without creating too much disturbance, and establish structures that will mitigate erosion.

A simple solution is log barriers on contour. They could be single logs or bundles of smaller logs and branches held in place with vertical posts buried in the ground. Their position on the hillside will create small pockets that will be backfilled with compost and soil. It will not be necessary to cut and reshape the hillside. With five of these log barriers in a row at six foot spacing down the hill there will be ample erosion protection and plenty of fresh planting space for new trees. Once established, the root systems of these new trees will ultimately brace the hillside even more than the log barriers.

Building and Backfilling Barriers

- Dig trenches 6” - 8” deep and 1’ wide along contour with the erosion barriers on the uphill side
- Backfill with woody material like mulch, small branches, leaves, etc.
- Apply compost extract or slurry
- Pack with small amounts of native dirt to fill in spaces
- Backfill until it reaches ground level (it will settle some and make a shallow trench)

Between Barriers

- Broadfork so that the ground cracks but does not turn
- Inoculate with a soil drench of compost extract or slurry
- Mulch with any woody materials (not so heavily that it will easily overtop erosion barriers)

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Monitoring Progress on Site

As the plants get established and the initial attempts to improve the soil mature, a plan for monitoring this progress will be necessary. Trees and plants can be monitored by their rate of growth and their appearance. Observations will be recorded on a monthly basis and compared to well known standards of care.

Soil quality must be monitored through a microscope. Samples will be collected on a monthly basis, or more frequently if a problem is detected. Soil microscopy is used to count the biomass of beneficial and pathogenic organisms. Fungal to bacterial ratios, number of protozoa and nematodes, presence of ciliates and actinobacteria are all crucial factors in determining soil health. Soil microscopy and analysis will be performed by Diggers Cooperative with consultation support from Living Soil Company.

In addition to microbial analysis, further lab testing will be conducted and compared to the previous soil tests to determine the progress of the chemical and physical properties of the soil.

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Attachments

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A: Soil Report and Data Sets (Spero Latchis, The Living Soil Company)

This report is a summary of the soil sample analysis conducted by The Living Soils Company in the Fall of 2022. Samples from the Main Street Meadow project site as well as three compost amendments were analyzed using shadow microscopy. Diggers Cooperative collected the samples to evaluate what amendments are needed to create healthy soil for thriving plants and wildlife at the project site. The report includes The Living Soil Company's recommendations for successfully treating the soil using compost and liquid amendments.

Sample 1: Native Soil - Main Street Meadow, Oct 22. 2022

Fungal:Bacterial Ratio- This ratio determines the preferred conditions for different varieties of plant species.
The current ratio is .0022:1 F:B. Extremely low.
The ideal ratio should be at least 1:1 for healthy prairie grasses and 10:1 for trees.
The fungal levels need to increase and the bacterial levels need to decrease.
Bacteria- The bacterial levels are extremely high (6,583 µg/g of soil) especially in light of low fungi numbers. Healthier numbers would be in the range of 300-600 µg/g with equivalent fungal biomass.
Fungi- The fungal levels in the soil are almost non-existent. (15µg/gram of soil). These need to significantly increase in order to support the types of plants desired.
Protozoans- There were ok numbers of flagellates present in the sample. Disturbing the soil tends to bring them out of dormancy. It is good that they are present since they consume bacteria.
Nematodes- None observed. Appropriate levels must be added as they are crucial to the soil ecosystem.
Others- There were no actinobacteria observed. Also no pathogenic fungi, nor any ciliates, or other indicators of anaerobic conditions.

Sample 2: Diggers Co-op Compost - Acton, ME. Oct 21. 2022

F:B Ratio. This number is critical if the compost will be expected to transform the unhealthy dirt into fertile soil that will support the growth of prairie grasses and trees. The F:B ratio of **.14:1** will most likely not move the soil F:B ratio far enough in the direction of Fungal balance.
Bacteria- The bacterial levels (1570µg/g. of compost) would not be too high if the fungal levels were much higher.
Fungi- The fungal levels were too low (230µg/g. of compost). If the bacterial levels were also very low then the fungal numbers would be bare minimum. However this is not the case.
Protozoans- The protozoan numbers (505,424) should be much higher in order to reduce the bacterial populations. Both flagellates and testate amoeba were seen.

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Actinobacteria- Actinobacteria is present in the soil, but is not a concern.
Nematodes- No nematodes were detected in the sample. Healthy compost should have at least 100 beneficial nematodes present in a gram of material.
Others- No pathogens were detected, and no ciliates were detected.

Sample 3: Black Earth Compost - Gloucester, MA. Oct 22. 2022

Color- The first thing noticed is the blackish color of the compost. This could indicate an excess of ammonia gasses in the production. At some point this compost went anaerobic and produced the gasses which stain the organic material black. This process loses a great deal of nutrients into the atmosphere which should have been captured in the compost.
F:B Ratio. This number is critical if the compost will be expected to transform the unhealthy dirt into fertile soil that will support the growth of prairie grasses and trees. The F:B ratio of .006:1 will strongly reinforce the bacterial quality of the existing soil.
Bacteria- The bacterial levels (4912µg/g. of compost) were ***extremely high.*** **Fungi-** The fungal levels were ***basically non-existent*** (27µg/g. of compost).
Protozoans- The protozoan numbers were low for compost (32,608).
Actinobacteria- Actinobacteria is not present in the sample,
Nematodes- No nematodes were detected in the sample. Healthy compost should have at least 100 beneficial nematodes present in a gram of material.
Others- No pathogens were detected, and no ciliates were detected.

Sample 4: Garden World Compost - Saugus MA. Oct 22. 2022
F:B Ratio. This number is critical if the compost will be expected to transform the unhealthy dirt into fertile soil that will support the growth of prairie grasses and trees. The F:B ratio of .004:1 will strongly reinforce the bacterial quality of the existing soil.
Bacteria- The bacterial levels (1876µg/g. of compost) were high.
Fungi- The fungal levels were ***basically non-existent*** (8µg/g. of compost).
Protozoans- The protozoan numbers were low for compost (73,386).
Actinobacteria- Actinobacteria is present in the sample, but only trace amounts.
Nematodes- No nematodes were detected in the sample. Healthy compost should have at least 100 beneficial nematodes present in a gram of material.
Others- Strands of possibly pathogenic fungi were detected in the sample. Normally the amount would be insignificant, however in this case since there was next to zero amount of beneficial fungus the presence of any amount of potential pathogen warrants attention. In healthy compost the beneficial fungus will always out-complete a small amount of pathogenic fungi.

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Summary and Recommendations

The native soil in this location is extremely depleted in beneficial microbes, especially fungi. It is recommended that any compost products and soil amendments return beneficial microbes to the soil. Unfortunately, none of the composts tested will likely accomplish this goal. The native soil as well as the compost from both BlackEarth and Garden World are dominated by bacteria. Digger's compost has a small fungal biomass and that is likely too low to make any significant impact any time soon. The Black Earth Compost and the Garden World Compost are not recommended for this project because the result will likely be unhealthy plants susceptible to pests and disease. In addition, there will be many weeds attracted to this site. The buried wood (Hugelkultur) may help attract fungi in the long run, but additional diverse fungal material is needed for the plants and trees to flourish. .

If the Digger's Co-op compost is used, we recommend an additional 8-10 soil drenches a year with any BioComplete ™ compost extract for the next 2-3 years. Each application would require about 5 lbs of BioComplete ™ compost, for a total of 40-50lbs per year. Diggers Coop or Todd Harrington are two local vendors that can supply BioComplete ™ compost products.

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Data Sets: Soil Sample Reports

Sample 1: Native Soil - 66 Main St Everett, MA	
Beneficial Microorganisms	**Sample Results**
Bacterial Biomass (µg/g)	6583.223
Bacterial Standard Deviation Biomass (µg/g)	1076.177
Bacterial Standard Deviation as Percentage of Mean	16.30%
Actinobacterial Biomass (µg/g)	0
Actinobacterial Standard Deviation Biomass (µg/g)	0
Actinobacterial Standard Deviation as Percentage of Mean	0.00%
Fungal Biomass (µg/g)	15.118
Fungal Standard Deviation Biomass (µg/g)	33.806
Fungal Standard Deviation as Percentage of Mean	223.60%
Fungal Average Diameter - Weighted Mean (um)	5
F:B Ratio	0.002
Total Beneficial Protozoa (number/g)	159779
Flagellates (number/g)	159779
Flagellates Standard Deviation (number/g)	236661
Flagellates Standard Deviation as Percentage of Mean	148.10%
Amoebae (number/g)	0
Amoebae Standard Deviation (number/g)	0
Amoebae Standard Deviation as Percentage of Mean	0.00%
Bacterial-feeding Nematodes (number/g)	0
Fungal-feeding Nematodes (number/g)	0
Predatory Nematodes (number/g)	0
Detrimental Microorganisms	
Oomycetes Biomass (µg/g)	0
Oomycetes Standard Deviation Biomass (µg/g)	0
Oomycete Standard Deviation as Percentage of Mean	0.00%
Oomycetes Average Diameter - Weighted Mean (um)	0
Ciliates (number/g)	0

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Ciliates Standard Deviation (number/g)	0
Ciliates Standard Deviation as Percentage of Mean	0.00%
Root-feeding Nematodes (number/g)	0
Total Beneficial Protozoa Standard Deviation (number/g)	236661
Total Beneficial Protozoa Standard Deviation as Percentage of Mean	148.10%

Sample 2: Diggers Cooperative Compost	
Beneficial Microorganisms	**Sample Results**
Bacterial Biomass (µg/g)	1570.31
Bacterial Standard Deviation Biomass (µg/g)	152.66
Bacterial Standard Deviation as Percentage of Mean	9.70%
Actinobacterial Biomass (µg/g)	1.06
Actinobacterial Standard Deviation Biomass (µg/g)	0.857
Actinobacterial Standard Deviation as Percentage of Mean	80.90%
Fungal Biomass (µg/g)	229.692
Fungal Standard Deviation Biomass (µg/g)	233.844
Fungal Standard Deviation as Percentage of Mean	101.80%
Fungal Average Diameter - Weighted Mean (um)	3.542
F:B Ratio	0.146
Total Beneficial Protozoa (number/g)	505424
Flagellates (number/g)	228256
Flagellates Standard Deviation (number/g)	176731
Flagellates Standard Deviation as Percentage of Mean	77.40%
Amoebae (number/g)	277168
Amoebae Standard Deviation (number/g)	169043
Amoebae Standard Deviation as Percentage of Mean	61.00%
Bacterial-feeding Nematodes (number/g)	0
Fungal-feeding Nematodes (number/g)	0
Predatory Nematodes (number/g)	0

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Detrimental Microorganisms	
Oomycetes Biomass (µg/g)	0
Oomycetes Standard Deviation Biomass (µg/g)	0
Oomycete Standard Deviation as Percentage of Mean	0.00%
Oomycetes Average Diameter - Weighted Mean (um)	0
Ciliates (number/g)	0
Ciliates Standard Deviation (number/g)	0
Ciliates Standard Deviation as Percentage of Mean	0.00%
Root-feeding Nematodes (number/g)	0
Total Beneficial Protozoa Standard Deviation (number/g)	323009
Total Beneficial Protozoa Standard Deviation as Percentage of Mean	63.90%

Sample 3: Black Earth Compost	
Beneficial Microorganisms	**Sample Results**
Bacterial Biomass (µg/g)	4912.252
Bacterial Standard Deviation Biomass (µg/g)	661.611
Bacterial Standard Deviation as Percentage of Mean	13.50%
Actinobacterial Biomass (µg/g)	0
Actinobacterial Standard Deviation Biomass (µg/g)	0
Actinobacterial Standard Deviation as Percentage of Mean	0.00%
Fungal Biomass (µg/g)	27.645
Fungal Standard Deviation Biomass (µg/g)	61.816
Fungal Standard Deviation as Percentage of Mean	223.60%
Fungal Average Diameter - Weighted Mean (um)	4
F:B Ratio	0.006
Total Beneficial Protozoa (number/g)	32608
Flagellates (number/g)	32608
Flagellates Standard Deviation (number/g)	34102
Flagellates Standard Deviation as Percentage of Mean	104.60%

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Amoebae (number/g)	0
Amoebae Standard Deviation (number/g)	0
Amoebae Standard Deviation as Percentage of Mean	0.00%
Bacterial-feeding Nematodes (number/g)	0
Fungal-feeding Nematodes (number/g)	0
Predatory Nematodes (number/g)	0
Detrimental Microorganisms	
Oomycetes Biomass (µg/g)	0
Oomycetes Standard Deviation Biomass (µg/g)	0
Oomycete Standard Deviation as Percentage of Mean	0.00%
Oomycetes Average Diameter - Weighted Mean (um)	0
Ciliates (number/g)	0
Ciliates Standard Deviation (number/g)	0
Ciliates Standard Deviation as Percentage of Mean	0.00%
Root-feeding Nematodes (number/g)	0
Total Beneficial Protozoa Standard Deviation (number/g)	34102
Total Beneficial Protozoa Standard Deviation as Percentage of Mean	104.60%

Sample 4: Garden World Compost - Saugus MA	
Beneficial Microorganisms	**Sample Results**
Bacterial Biomass (µg/g)	1876.607
Bacterial Standard Deviation Biomass (µg/g)	270.704
Bacterial Standard Deviation as Percentage of Mean	14.40%
Actinobacterial Biomass (µg/g)	0.497
Actinobacterial Standard Deviation Biomass (µg/g)	0.703
Actinobacterial Standard Deviation as Percentage of Mean	141.40%
Fungal Biomass (µg/g)	7.937
Fungal Standard Deviation Biomass (µg/g)	17.748

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Fungal Standard Deviation as Percentage of Mean	223.60%
Fungal Average Diameter - Weighted Mean (um)	3.5
F:B Ratio	0.004
Total Beneficial Protozoa (number/g)	73368
Flagellates (number/g)	73368
Flagellates Standard Deviation (number/g)	164056
Flagellates Standard Deviation as Percentage of Mean	223.60%
Amoebae (number/g)	0
Amoebae Standard Deviation (number/g)	0
Amoebae Standard Deviation as Percentage of Mean	0.00%
Bacterial-feeding Nematodes (number/g)	0
Fungal-feeding Nematodes (number/g)	0
Predatory Nematodes (number/g)	0
Detrimental Microorganisms	
Oomycetes Biomass (µg/g)	5.183
Oomycetes Standard Deviation Biomass (µg/g)	11.591
Oomycete Standard Deviation as Percentage of Mean	223.60%
Oomycetes Average Diameter - Weighted Mean (um)	2
Ciliates (number/g)	0
Ciliates Standard Deviation (number/g)	0
Ciliates Standard Deviation as Percentage of Mean	0.00%
Root-feeding Nematodes (number/g)	0
Total Beneficial Protozoa Standard Deviation (number/g)	164056
Total Beneficial Protozoa Standard Deviation as Percentage of Mean	223.60%

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B: Soil Treatment Plan (Navona Gallegos, Soil Food Web Consultant)

Winter Soil Prep

The purpose of the process outlined below is to establish soil fungi over the winter in order to provide the ecology and nutrients for the Miyawaki saplings to thrive when planted next spring while also taking into account that the site is on a 45 degree slope. High rates of decomposition happen in the winter under snow cover, so the overall idea is to introduce as much organic matter that specifically feeds fungi, aerate the soil without creating too much disturbance, and establish structures that will mitigate erosion.

Erosion Control

The structures would be simple log barriers built on contour. They could be single logs or bundles of smaller logs and branches held in place with vertical posts buried in the ground. Bundles of smaller material are better at catching debris and are easier to source. Single logs, though, may be more aesthetically appealing for the park. The photos on the last page show some examples of similar ideas. Terracing with earthmovers can assist with erosion control but isn't required. The log barriers may create terraces over time as they backfill. That said, simply planting a hillside densely is also very effective at holding soil together. If the site is 30' x 30' square, I recommend five log barriers placed every six feet. The same soil prep is recommended whether building terraces or not.

Soil Prep

The more compost you can use across the site, the better. If the whole site was just covered in 3-6 inches of compost and mulched over, that would be ideal. Compost extracts could be sprayed as a follow up after planting.

Step 1 - **Create compost extract or slurry on site**
-Fill a tank with about 300 gallons of water (if possible, let water sit out for a day or two to reach ambient temperature before adding compost)
- Humic acid for water if using city water (about 1 drop/5 gallons) - Minimum 5 lb. High F vermipost from Diggers
- Minimum 5 lb. BioComplete compost and 5 lb. Forest floor duff and soil
- Stir 15 minutes with paint mixing attachment on hand drill on lowest setting
- Strain through a minimum 4 micron mesh bag/screen if necessary for spraying or simply spread as slurry. Give a quick stir every 15 minutes to maintain aeration or have a bubbler going. It's important the mix does not go anaerobic while it's sitting–fungi can be lost in as little as 20 minutes.

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It would be good to add a few pounds of forest floor duff to the vermicompost a couple weeks before application; this is to add fungal diversity and, hopefully, mycorrhizal fungal spores. Forest floor inoculant should come from a healthy, long-standing forest that is also zone 6b or similar.

Step 2 - Hugel Trenches
- Dig trenches 6” - 8” deep and 1’ wide along contour with the erosion barriers on the uphill side
- Backfill like a Hugelkultur mound with layers of:
- Woody material like mulch, small branches, leaves, etc.
- Compost extract or slurry
- Small amounts of native dirt to fill in spaces
- Backfill until it reaches ground level (it will settle some and make a shallow trench)

Step 3 - Between Trenches
- Broadfork so that the ground cracks but does not turn
- Inoculate with a soil drench of compost extract or slurry
- Mulch with any woody materials (not so heavily that it will easily overtop erosion barriers)

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C: Soil Maps and References

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 22, Sep 9, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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Middlesex County, Massachusetts

603—Urban land, wet substratum

Map Unit Setting

National map unit symbol: 9951
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land over alluvium and/or marine deposits

Minor Components

Udorthents, loamy

Percent of map unit: 10 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

655—Udorthents, wet substratum

Map Unit Setting

National map unit symbol: vr1n

Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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Udorthents, wet substratum, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Wet Substratum

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Urban land

Percent of map unit: 8 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Freetown

Percent of map unit: 4 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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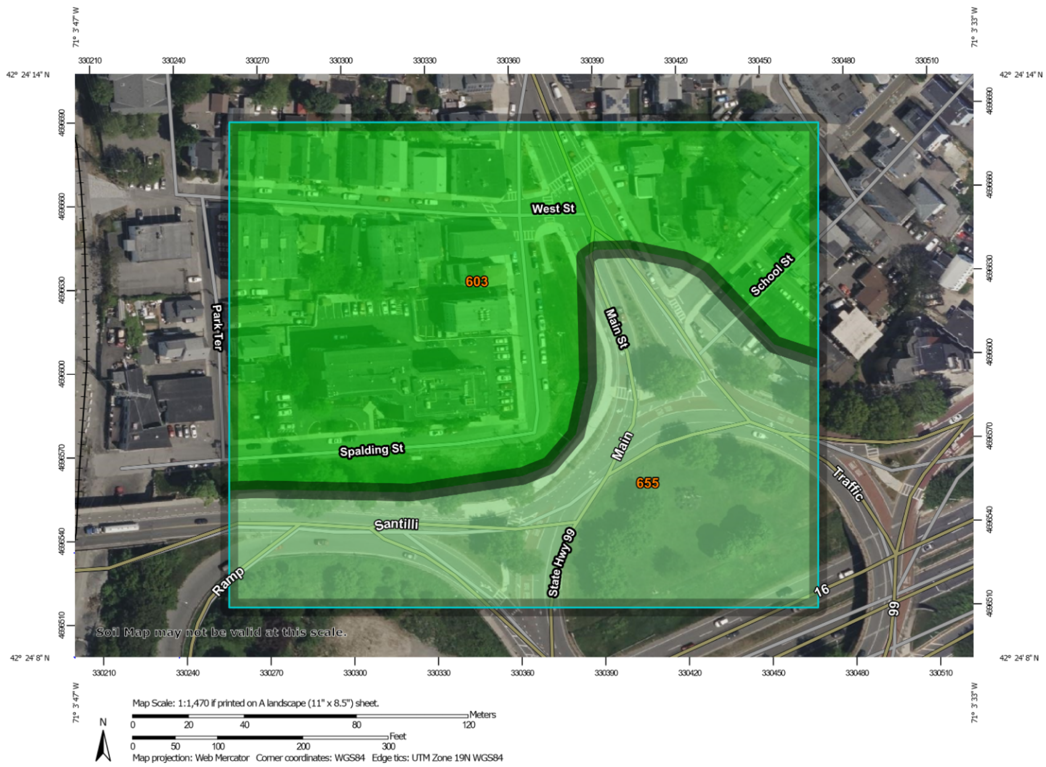
Hydric Map Surrounding Main Street Meadow



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Lines
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Soil Rating Points
- Hydric (100%)
- Hydric (66 to 99%)
- Hydric (33 to 65%)
- Hydric (1 to 32%)
- Not Hydric (0%)
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 22, Sep 9, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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Hydric Rating by Map Unit

This rating indicates the percentage of map units that meets the criteria for hydric soils. Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

Main st Meadow does not exhibit any of the indicators of hydric soils, making it clearly non hydric. Whereas, the adjacent parcels exhibit clear signs of hydric soils, which is reflected in the map above. Wetland ecosystems are a critical component of water cycling and wildlife habitat, making them beneficial neighboring properties in our efforts to jumpstart biodiversity on site.

Table—Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
603	Urban land, wet substratum	0	5.3	58.5%
655	Udorthents, wet substratum	7	3.8	41.5%
Totals for Area of Interest			**9.1**	**100.0%**

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7/11/2022	4687	SAMPLE 1	YORK	20000 sq. f
PRINT DATE	LAB NO.	SAMPLE IDENTIFICATION	COUNTY	ACRES OR SQ. FT.

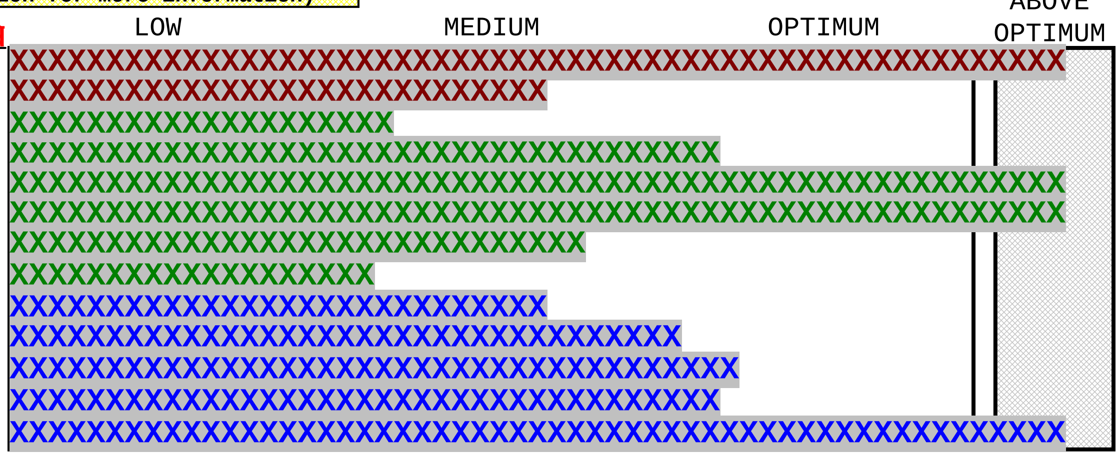
SOIL TEST REPORT FOR:

DIGGERS COOPERATIVE
845 GARVIN ROAD
ACTON ME 04001

MAINE SOIL TESTING SERVICE
UNIVERSITY OF MAINE
5722 DEERING HALL
ORONO,MAINE 04469-5722

SOIL TEST SUMMARY & INTERPRETATION
(see Numerical Results section for more information)

		Level Found
Soil pH		6.7
Organic Matter(%)		4.4
Major nutrients		
Nitrate-N	(ppm)	12
Phosphorus	(lb/A)	17.0
Potassium	(% Sat)	5.2
Calcium	(% Sat)	86.1
Magnesium	(% Sat)	8.7
Sulfur	(ppm)	8
Micronutrients		
Boron	(ppm)	0.4
Copper	(ppm)	0.28
Iron	(ppm)	7.1
Manganese	(ppm)	4.8
Zinc	(ppm)	7.7



RECOMMENDED ADDITIONS FOR CONSERVATION/WILDLIFE - Crop Code # 170

No lime recommended. Soil pH is at or above the optimum level for this crop.

To improve the magnesium level, use a magnesium lime when lime is needed again.
Recommended major nutrient application rates as follows:

0 pounds nitrogen per acre
40 pounds phosphate per acre
0 pounds potash per acre

Particle size analysis:
68 % sand, 22 % silt, 10 % clay
Texture = Sandy loam

For information on micronutrient management and recommendations, see enclosed form.

NUMERICAL RESULTS

(Test methodology: pH in water and Mehlich buffer, available nutrients by modified Morgan extract)
(Organic matter measured by LOI, P determined colorimetrically, all others measured by ICP-OES)

CEC and nutrient balance calculations are based on present pH of 6.7

	Soil pH	Lime Index 2	Phosphorus (lb/A)	Potassium (lb/A)	Magnesium (lb/A)	Calcium (lb/A)	CEC (me/100 g)	K (% Saturation)	Mg (% Saturation)	Ca (% Saturation)	Acidity
Level Found	6.7	6.18	17.0	358	189	3085	8.9	5.2	8.7	86.1	0.0
Optimum Range	5.5-6.5	N/A	10-40	see % Saturation levels			> 5	3.5-5.0	10-20	60-80	< 10

	Organic Matter(%)	Sulfur (ppm)	Copper (ppm)	Iron (ppm)	Manganese (ppm)	Zinc (ppm)
Level Found	4.4	8	0.28	7.1	4.8	7.7
Normal Range	5 - 8	> 15	.25-.60	6 - 10	4 - 8	1 - 2

(Extras)	Boron (ppm)	Sodium (ppm)	Soluble Salts (mmhos/cm)	Nitrate-N (ppm)	Ammonium-N (ppm)
Level Found	0.4	N/A	N/A	12	79
Normal Range	0.5-1.2			20-30	< 10

Additional Results or Comments:

Soil Microbial Biomass Test: 110 ppm CO2-C
MEDIUM BIOMASS See enclosed information.

7/11/2022	4688	SAMPLE 2	YORK	20000 sq. f
PRINT DATE	LAB NO.	SAMPLE IDENTIFICATION	COUNTY	ACRES OR SQ. FT.

▪SOIL TEST REPORT FOR:

DIGGERS COOPERATIVE
845 GARVIN ROAD
ACTON ME 04001

MAINE SOIL TESTING SERVICE
UNIVERSITY OF MAINE
5722 DEERING HALL
ORONO,MAINE 04469-5722

▪SOIL TEST SUMMARY & INTERPRETATION
(see Numerical Results section for more information)

LOW | MEDIUM | OPTIMUM | ABOVE OPTIMUM

		Level Found
Soil pH		6.0
Organic Matter(%)		3.6
Major nutrients		
Nitrate-N	(ppm)	6
Phosphorus	(lb/A)	13.8
Potassium	(% Sat)	6.7
Calcium	(% Sat)	80.6
Magnesium	(% Sat)	12.7
Sulfur	(ppm)	4
Micronutrients		
Boron	(ppm)	0.4
Copper	(ppm)	0.50
Iron	(ppm)	8.2
Manganese	(ppm)	3.8
Zinc	(ppm)	11

▪RECOMMENDED ADDITIONS FOR STANDARD SHRUBS - Crop Code # 705

No lime recommended. Soil pH is at or above the optimum level for this crop.

To improve the magnesium level, use a magnesium lime when lime is needed again.
To meet major nutrient requirements, broadcast in a 4 ft. circle around each plant:
1/3 lb urea (46-0-0) fertilizer/100 sq. ft. in early spring.

When planting a new tree or shrub: Apply lime (or sulfur) at the recommended rate and till in thoroughly. Add peat or compost at 1/3 - 1/4 by volume to the soil in the planting hole. Also add fertilizer at the per plant rate recommended. Mix all materials together thoroughly before planting.
Water in very well.
Apply fertilizer between April 15 and June 1. Later application may cause winter kill.

Particle size analysis:
65 % sand, 23 % silt, 12 % clay
Texture = Sandy loam

For information on micronutrient management and recommendations, see enclosed form.

▪NUMERICAL RESULTS

(Test methodology: pH in water and Mehlich buffer, available nutrients by modified Morgan extract)
(Organic matter measured by LOI, P determined colorimetrically, all others measured by ICP-OES)

CEC and nutrient balance calculations are based on present pH of 6.0

	Soil pH	Lime Index 2	Phosphorus (lb/A)	Potassium (lb/A)	Magnesium (lb/A)	Calcium (lb/A)	CEC (me/100 g)	K (% Saturation)	Mg (% Saturation)	Ca (% Saturation)	Acidity
Level Found	6.0	6.07	13.8	376	220	2312	7.1	6.7	12.7	80.6	0.0
Optimum Range	5.5-6.5	N/A	9-13	see % Saturation levels			> 5	2.1-3.0	10-20	60-80	< 10

	Organic Matter(%)	Sulfur (ppm)	Copper (ppm)	Iron (ppm)	Manganese (ppm)	Zinc (ppm)
Level Found	3.6	4	0.50	8.2	3.8	10.6
Normal Range	5 - 8	> 15	.25-.60	6 - 10	4 - 8	1 - 2

(Extras)	Boron (ppm)	Sodium (ppm)	Soluble Salts (mmhos/cm)	Nitrate-N (ppm)	Ammonium-N (ppm)
Level Found	0.4	N/A	N/A	6	1
Normal Range	0.5-1.2			20-30	< 10

Additional Results or Comments:

Metals scan:
MINOR LEAD CONTAMINATION INDICATED -
no health risk with non-edible plants.
Soil Microbial Biomass Test: 80 ppm CO2-C
MEDIUM BIOMASS See enclosed information.

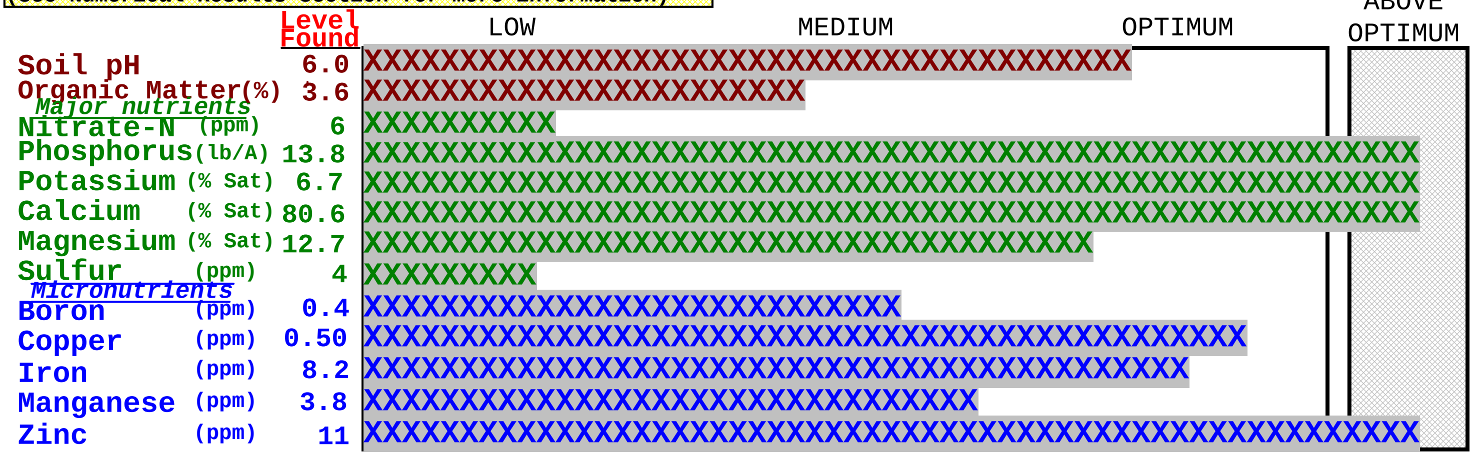
7/11/2022	4688	SAMPLE 2	YORK	20000 sq. f
PRINT DATE	LAB NO.	SAMPLE IDENTIFICATION	COUNTY	ACRES OR SQ. FT.

▪**SOIL TEST REPORT FOR:**

DIGGERS COOPERATIVE
845 GARVIN ROAD
ACTON ME 04001

MAINE SOIL TESTING SERVICE
UNIVERSITY OF MAINE
5722 DEERING HALL
ORONO,MAINE 04469-5722

▪**SOIL TEST SUMMARY & INTERPRETATION**
(see Numerical Results section for more information)



▪**RECOMMENDED ADDITIONS FOR** SHADE TREES-HARDWOOD - Crop Code # 706

No lime recommended. Soil pH is at or above the optimum level for this crop.

To improve the magnesium level, use a magnesium lime when lime is needed again.
To meet major nutrient requirements, apply:
Broadcast 1/3 lb urea (46-0-0) fertilizer/100 sq. ft.

When planting a new tree or shrub: Apply lime (or sulfur) at the recommended rate and till in thoroughly. Add peat or compost at 1/3 - 1/4 by volume to the soil in the planting hole. Also add fertilizer at the per plant rate recommended. Mix all materials together thoroughly before planting.
Water in very well.
Apply fertilizer between April 15 and June 1. Later application may cause winter kill.

For information on micronutrient management and recommendations, see enclosed form.

▪**NUMERICAL RESULTS** (Test methodology: pH in water and Mehlich buffer, available nutrients by modified Morgan extract) (Organic matter measured by LOI, P determined colorimetrically, all others measured by ICP-OES)

CEC and nutrient balance calculations are based on present pH of 6.0

	Soil pH	Lime Index 2	Phosphorus (lb/A)	Potassium (lb/A)	Magnesium (lb/A)	Calcium (lb/A)	CEC (me/100 g)	K (% Saturation)	Mg (% Saturation)	Ca (% Saturation)	Acidity
Level Found	6.0	6.07	13.8	376	220	2312	7.1	6.7	12.7	80.6	0.0
Optimum Range	5.5-6.5	N/A	9-13	see % Saturation levels			> 5	2.1-3.0	10-20	60-80	< 10

	Organic Matter(%)	Sulfur (ppm)	Copper (ppm)	Iron (ppm)	Manganese (ppm)	Zinc (ppm)
Level Found	3.6	4	0.50	8.2	3.8	10.6
Normal Range	5 - 8	> 15	.25-.60	6 - 10	4 - 8	1 - 2

(Extras)	Boron (ppm)	Sodium (ppm)	Soluble Salts (mmhos/cm)	Nitrate-N (ppm)	Ammonium-N (ppm)
Level Found	0.4	N/A	N/A	6	1
Normal Range	0.5-1.2			20-30	< 10

Additional Results or Comments:

Metals scan:
MINOR LEAD CONTAMINATION INDICATED -
no health risk with non-edible plants.
Soil Microbial Biomass Test: 80 ppm CO2-C
MEDIUM BIOMASS See enclosed information.