Increasing Crop Quality and Production on a SBCMALA's Farm in Lewiston, Maine

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Increasing Crop Quality and Production on a SBCMALA’s Farm in Lewiston, Maine

Presented to the Faculty of the
Environmental Studies Program

Bates College

In partial fulfillment of the
Requirement for the degree of the
Bachelor of Arts

By

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Lewiston, Maine
December 14, 2017
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Executive Summary

The Somali Bantu Community Association of Maine Lewiston / Auburn (SBCMALA) is a non-profit organization founded in 2005 (SBCMALA, 2017). The goal of the association is to empower Somali Bantu families to lead successful and healthy lives in the United States. The organization runs several programs to benefit Lewiston’s Somali Bantu community such as the Community Farming Program which began in 2014. Currently the program lease farming sites in New Gloucester, Auburn, and Lewiston which allow Somali Bantu families to grow their own produce. The program also helps farmers gain familiarity in Maine’s landscape.

Currently, thirty families farm on the six acre site in Lewiston. Each family receives 0.1 acres plot (0.04 hectares) and can autonomously decide which crops to plant and in what quantities on their parcel of land. There are currently four fields that have been cultivated on the Lewiston property; only one of which has been consistently productive. The overall lack of productivity may be attributed to several pressures on the crops such as pests, nutrient-deficient soil, water availability, and inefficient crop pairings. The goal of our research was to identify solutions to increase both the quality and productivity of crops, as well as increase the overall land value in a culturally relevant and cost-efficient manner.

One way to maximize yield is to supplement the soil through nutrient amendments such as lime and manure. Given our soil tests and site visits, we recommend an application of non-magnesium calcitic lime applied once every year for the next two years. This will increase pH and calcium content of the soil. The soil is also deficient in a number of macronutrients. An application of manure can help to replenish these important macronutrients and support greater plant growth, thus increasing crop yield. In addition to amending the soil, a crop rotation plan could be employed in order to decrease the susceptibility of crops to pests and pathogens. Implementing rotation techniques can allow soil nutrients to replenish and potentially increase productivity in successive years. Examples of rotation techniques include rotating crop sections through each family’s parcel, and leaving a field or a portion of a field fallow each season. Productivity can further be increased through the use of chicken tractors on the fallow field. Chicken tractors may provide an additional source of subsistence for the families while simultaneously increasing soil nutrients.

Crop quality can be improved by mitigating the effect of pests. This may be done through the installation of fencing, as well as strategically pairings crops. An offset electric fence can prohibit deer from entering the field and eating the crops. A plastic barrier fence is an inexpensive solution for keeping out smaller pests such as porcupines from the cultivated areas, possibly increasing crop security. Additionally, tactfully pairing crops that are culturally relevant and are already in rotation could divert pests from the main crops towards the less desirable crop.

Through these recommendations, we hope to improve the quality and quantity of crops available to SBCMALA’s farmers. Additionally, introduce new sustainable farming techniques which may improve the productivity of SBCMALA’s Lewiston farm.
Introduction

The goal of our project was to aid Somali Bantu farmers in their transition to central Maine, while remaining true to SBCMALA’s mission to help “preserve pride in their cultural traditions.” (SBCMALA, n.d.) By continuing their farming traditions in the United States, these farmers are able to grow culturally significant crops. However, due to differences in soil, climate, economic challenges, and accessibility to farmland, farming practices that were used in Somalia could be adapted to be more effective to this new environment. Learning how to navigate Maine’s agricultural challenges while maintaining traditional practices is essential for their success as new Mainers.

SBCMALA’s six-acre farm is located on Old Webster Road in Lewiston, Maine (44.074740, -70.136254). The Lewiston farm is currently in its second year of a five year lease. Currently, three acres are being used in production. The farm is divided into four unequally divided fields which we have identified as: irrigated, non-irrigated 1, non-irrigated 2, dead zone, and expansion zone. The irrigated field is the largest with 22 family plots. It has a drip irrigation system originating from No Name Stream which lies to the southeast of the property. Last winter, winter rye was used as a cover crop on the irrigated field. Non-irrigated 1 was cleared of common juniper (Juniperus comminus) and white pine (Pinus strobus). Non-irrigated 2 was incorporated into production during the 2017 growing season. The expansion zone will be incorporated in the 2018 growing season. The dead zone featured unsubstantial crop growth. The current state of the soil at SBCMALA’s Lewiston site is unable to sustainably support the quantity of crops desired by the Somali Bantu farmers. Soil provides the structure and nutrients in which crops are supported and grown; therefore, it is important to address these deficiencies (Singer and Munns, 2014).

Productivity and quality can further be impacted by the presence of pests such as deer, porcupines, insects, and plant pathogens. Currently, these unwelcome organisms plague SBCMALA’s crops, thus impacting their harvest. Pest management practices, which were effective in Somalia are no longer feasible in Maine. Adapting preventative measures, which are effective locally may help reduce pest pressures for these farmers.

Our research objectives can be framed in three goals: increasing crop quality, productivity, and land value. In order to increase productivity, we hoped to identify the specific deficiencies within the soil composition and develop suggestions for potential nutrient amendments. In order to improve soil quality, we spoke with local farmers for recommendations regarding nutrient supplement implementation. We created a suggested method for crop rotation and organization, which will further address issues of soil nutrient depletion. In order to address the challenges of overall crop quality and productivity, we offer solutions to pest pressures including fencing and crop pairings. Through these strategies we hope to improve the farming success of the SBCMALA farmers and allow them to adapt their cultural traditions to their new Maine home.
Methodology

As an organization composed of refugees, members of SBCMALA may be considered a historically disadvantaged population. As a result of this, we applied for certification through the Institutional Review Board (IRB) to ensure that our methods protected the rights of our community partners throughout the course of our project. To learn more about the personal experience of Somali Bantu farmers in Lewiston, we held a focus group on October 27th, 2017 to which all 30 families farming on the Lewiston land plot were invited. Of the 30 families, 15 individuals attended who represented 13 different family groups. By the suggestion of Bates Anthropology professor Elizabeth Eames, we split the attendees into two groups based on gender in order to ensure that all voices were given equal weight. Mohiba Samathar translated between Somali and English in the women’s group, while Muhidin Libah translated for the men’s group. Julia Nemy and Drew Perlmutter facilitated the women’s group discussion while Dylan Thombs led the respective men’s group.

Specific questions about soil quality, growing practices, and pest pressures were asked in English and then translated into Somali. Responses were translated back into English by Samathar and Libah. We recorded handwritten notes simultaneously (see Appendix 1 for focus group questions and Appendix 2 for focus group notes).

The soil assessment methods consisted of two site visits to the property to determine soil quality and site characteristics. The first site visit was a walkthrough of the property on September 14 with Libah where he outlined the relative success of each field in production. The second visit was a more thorough analysis of the property. During this visit, the Bates College soils class (ENVR 310) took four relevant soil samples across the four agricultural fields of concern (irrigated, non-irrigated 1, dead zone, and expansion). These soil samples were sent to the University of Maine Cooperative Extension Testing Service in Orono, Maine where they were analyzed for macro and micro nutrient concentrations. Additionally, soil pH, organic matter concentration, and cation exchange capacity (CEC) were also measured. The Cooperative Extension sent a number of recommendations for soil amendments that included applications of organic manure and synthetic fertilizers. These recommendations led to further conversations with Extension Educator Tori Jackson and Sustainable Agriculture professional Jason Lilley of Androscoggin and Cumberland County Cooperative Extension branches. The Cooperative Extension also put us into contact with several dealers and farmers of soil nutrient amendments throughout Maine. We called these producers in order to determine and compare the prices of their products including manure, biosolids, compost, and lime.

To more fully understand the extent of soil quality, specific landscape features, and cropping practices used by SBCMALA farmers, a drone was used to map the property. With the help of Kai Evenson from the Bates Imaging and Computing Center, we were able to fly a drone over the property to produce a digital map (Appendix 3). This map was used in conjunction with later field research, which helped to formulate a more well-rounded understanding of current cropping patterns.
It was essential to identify the cropping patterns used in 2017 in order to formulate a crop rotation plan. This was done through extensive surveying of the irrigated field. Each family’s parcel was divided into 4’ x 6’ sections, 124 sections for every family, and 2728 sections for the entire irrigated field. Within each section, crops were catalogued and coded to simplify the mapping process. This data was entered into Excel spreadsheets in order to observe current cropping practices. This information was then overlaid on the drone map image using Procreate software to show which crops were planted where in the 2017 growing season (Appendix 3). The drone maps were used in combination with data collected from the cropping survey above to create more accurate understanding of current farming practices while demonstrating possible future methods for cataloguing crops.
Results and Discussion

Increasing crop productivity

Soil results

Overview

In general, we found pH values across the property to range from 5.2 to 6.0 (Table 1A). Additionally, non-irrigated field 1 demonstrated the lowest overall concentration of macro and micro nutrients across all five locations (Table 1B). There was an unusually high concentration of organic matter found in the dead zone and extension (Table 1B). Sulphur was found in the highest concentration across all four sites (Table 1B). Calcium was found in low to medium concentration across all sites (Table 1B). More extensive soil results provided by the University of Maine Cooperative Extension can be found in Appendix 4.

Irrigated field:

The irrigated field is the oldest field on the SBCMALA Lewiston site. It has now been in production for two years and has been cover cropped with winter rye (*Secale cereale*) during the first year of production (Personal communications with Muhidin Liba, 2017). The site is irrigated using a drip irrigation system, which is fed from No Name Stream. The site is currently the most productive field on the property and will be expanded in the 2018 growing season.

The irrigated field is characterized by moderate pH values (6) and major macronutrient concentrations, compared to concentrations under optimal soil conditions. Sulphur concentrations for this location are considered to be at optimum levels, but may be acting as a toxin to crop plants compared to other nutrient concentrations (Personal Communication with Tori Jackson, 2017). The irrigated field also contains moderate concentrations of organic matter which is supported with onsite observations in October (Table 1B). The micronutrients in the irrigated field are present in low to medium concentrations (Table 2A). Boron and iron are both present in moderate levels compared to optimal soil for agricultural use (Table 2A). The soil at the irrigated site is deficient in copper, manganese and zinc (Table 2A).

Non-irrigated field 1:

The first non-irrigated field is located to the southeast of the irrigated field and was recently cleared of juniper bushes (*Juniperus communis*). This site was not cover cropped and is currently the second most productive field.

Similar to the irrigated field, the non-irrigated field 1 is also characterized by moderate levels of major macronutrients and moderate pH values based off of optimal soil conditions (pH 6-7) (Table 1B). Sulphur is also at above optimal levels and may be a toxin to plants considering its abundance compared to other nutrient concentrations (Personal Communications with Tori Jackson, 2017) (Table 1B). The micronutrients, boron, copper, manganese, and zinc, are all present in low concentrations in the non-irrigated field compared to optimum levels needed for
agriculture (Table 2A). The soil in the non-irrigated site also has an overabundance of iron which may act as a toxin to plants considering the additional deficiencies that are also present (Personal Communications with Tori Jackson, 2017) (Table 2A).

Non-irrigated field 2:

This second non-irrigated field is located southwest of the irrigated field. The second non-irrigated field was not tested for soil macronutrients or pH by the cooperative extension. Thanks to soil results based around this location on the property we may be able to infer that nutrient concentrations will be similar to other nutrient concentrations found on the property. Due to these similarities, production was similar to that found in the non-irrigated field 1. This site is also in its first year of production and was recently cleared in 2016.

Dead Zone:

The dead zone area is currently being used as a parking lot for the entire farm site due to its inability to support crop life. The site was previously cleared of mixed deciduous coniferous tree species prior to being cultivated. Consequently, the topsoil has an abundance of wood chips, which may have artificially increased measurements of organic matter. The area was put into production at the beginning of the 2017 growing season but was ultimately unproductive as the majority of crops that were planted failed and those that did grow were severely stunted.

The dead zone field is characterized by moderate pH values and relatively low macronutrients (Table 1B). The area was deficient in calcium and also contained above optimum levels of sulphur, which as previously stated may be considered a toxin due to its overabundance (Personal Communication with Tori Jackson, 2017) (Table 1B). The site also contains above optimum levels of iron and zinc which also may act as toxins to plants (Personal Communication with Tori Jackson, 2017) (Table 2A). Finally, the site contains a high amount of organic matter which is likely the result of woodchips on the surface from the recent clearing and preparation of the site.

Extension Zone:

The extension zone is located directly north of the irrigated field and has recently been tilled for production. This zone is characterized by relatively moderate levels of macronutrients with a deficiency in phosphorus (Table 1B). The pH values in the extension zone were moderate compared to optimum soil pH readings (Table 1B). Similar to the dead zone the extension zone also has a high abundance of organic matter (Table 1B). This is likely due to the recent tillage of the site and the large amount of grass material present in the topsoil. Also similar to the dead zone and several other fields on the site the, the iron concentrations are above optimum (Table 2A). The soil is also lacking in other micronutrients such as boron, manganese, and zinc all of which are at moderate concentrations in the soil (Table 2A). The site is also deficient in copper which is present in low concentrations (Table 2A).
Table 1. Soil results collected from SBCMALAs Lewiston, Maine, property on (September 25, 2017) and analyzed by University of Maine Cooperative Extension. Tables 1A and 2A represent the specific measurement results of summary tests. Tables 1B and 2B represent whether values in Tables 1A and 2A are in low concentrations, medium concentrations, optimum concentrations, and above optimum concentrations.

1A)

<table>
<thead>
<tr>
<th>Summary</th>
<th>Irrigated</th>
<th>Non-Irrigated 1</th>
<th>Non-irrigated 2</th>
<th>Dead Zone</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.0</td>
<td>5.6</td>
<td>n/a</td>
<td>5.2</td>
<td>5.9</td>
</tr>
<tr>
<td>Organic Matter (%)</td>
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<td>3.9</td>
<td>n/a</td>
<td>11.8</td>
<td>8.3</td>
</tr>
<tr>
<td>Phosphorus (1b/A)</td>
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<td>3.1</td>
<td>n/a</td>
<td>5.7</td>
<td>2.3</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>50.7</td>
<td>21.6</td>
<td>n/a</td>
<td>17.7</td>
<td>50.6</td>
</tr>
<tr>
<td>Sulfur (ppm)</td>
<td>15.0</td>
<td>22.0</td>
<td>n/a</td>
<td>52.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Potassium (%)</td>
<td>1.6</td>
<td>1.1</td>
<td>n/a</td>
<td>1.8</td>
<td>3.0</td>
</tr>
<tr>
<td>Magnesium (%)</td>
<td>7.9</td>
<td>3.0</td>
<td>n/a</td>
<td>4.4</td>
<td>6.8</td>
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</tbody>
</table>

1B)

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<th>Summary</th>
<th>Irrigated</th>
<th>Non-Irrigated 1</th>
<th>Non-irrigated 2</th>
<th>Dead Zone</th>
<th>Extension</th>
</tr>
</thead>
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<tr>
<td>pH</td>
<td>Medium</td>
<td>Medium</td>
<td>n/a</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Organic Matter</td>
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<td>Medium</td>
<td>n/a</td>
<td>Above Optimum</td>
<td>Above Optimum</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Low</td>
<td>Low</td>
<td>n/a</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Calcium</td>
<td>Medium</td>
<td>Low</td>
<td>n/a</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Sulfur</td>
<td>Optimum</td>
<td>Optimum</td>
<td>n/a</td>
<td>Above Optimum</td>
<td>Medium</td>
</tr>
<tr>
<td>Potassium</td>
<td>Low</td>
<td>Low</td>
<td>n/a</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Medium</td>
<td>Low</td>
<td>n/a</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Crop pairing results

During our initial site visit, we observed crops that were planted intermittently among the corn (*Mays sp.*) that dominates the vast majority of these fields. In addition to these crops, most families had a non-corn vegetable patch. Species prominently featured in these vegetable patches include: broccoli (*Brassica oleracea var. italica*), Brussel sprout (*Brassica oleracea var. gemmifera*), cabbage (*Brassica oleracea var. capitata*), collard greens (*Brassica oleracea*), chili pepper (*Capsicum annuum*), eggplant (*Solanum melongena*), green onion (*Allium cepa*), kale (*Brassica oleracea var. sabellica*), molokhia (*Corchorus olitorius*), pepper (*Capsicum spp.*), red lettuce (*Lactuca spp.*), swiss chard (*Beta vulgaris subsp. vulgaris*), tomato (*Solanum spp.*), zucchini (*Cucurbita pep var. cylindrica*). Each plot was approximately 30’ x 15’ (9.1 m x 4.5 m). There was no observable pattern to the location of the vegetable patch. However, during our
focus group, we learned that some of the farmers are already employing a crop rotation plan, which had been recommended to them by members of University of Maine Cooperative Extension. Additionally, we learned that there has been no specific effort to pair crops.

*Increasing crop quality*

It was made clear during the focus group the extent to which the crops were being affected by pests. The farmers of SBCMALA identified several pests that were plaguing their crops during the 2017 growing season. These include: white-tailed deer (*Odocoileus virginianus*), porcupines (*Erethizon dorsatum*), aphids (*Aphidoidea spp.*), corn worms (*Helicoverpa zea*), and squash beetles (*Acalymma vittatum*). The farmers emphasized their desire for a solution to these pest challenges, particularly one that combats the deer problem.

When asked if the farmers had experienced similar pest problems in Somalia, they explained that they faced challenges including: deer (unspecified), warthogs (*Phacochoerus africanus*), monkeys (unspecified), hippos (*Hippopotamus amphibius*), and donkeys (*Equus asinus*). In Somalia, farmers would remain in the field or in close proximity at all times of the day in order to scare off potential pests. However, this is not feasible in Lewiston due to the location of the farm and Maine’s climate.
Discussion and Recommendations for Next Steps

Productivity and Quality

Soil Amendments

Based on the results and communications with the Cooperative Extension, we recommend that SBCMALA purchase six tons of a low magnesium calcitic lime to address the low pH and calcium deficiency of their soil. This six ton application should be broken up into two, three ton applications over the course of two years. See Appendix 5 for supplement prices. However, it should be noted that the Cooperative Extension's recommended lime dealers prefer to deliver their product in 4 - 6 ton applications. Therefore, negotiations may have to be made with these suppliers in order to accommodate SBCMALA’s needs. Following the second year’s application, an additional soil test should be conducted. We recommend that SBCMALA continue to use the services provided by the University of Maine’s Cooperative Extension to determine future goals for maintaining or improving the quality of soil.

In addition to the low magnesium calcitic lime application, we also recommend an application of chicken manure to address the additional nutrient deficiencies in the soil. In addition to manure, we also contacted several compost companies and biosolid processing plants. These proved to be less fruitful as compost was more costly than the alternatives and biosolids required the navigation of strict regulation and licensing process, which would have restricted SBCMALA’s ability to consume and sell their own produce (Appendix 8). Our communications led us to determine that Cassella Organics’ Chris Bales and Hilandale Farm were the most cost-effective producers of chicken manure in the area. Based on our conversations with the Cooperative Extension, we recommend that SBCMALA purchase 45 yards worth of chicken manure. This purchase will be delivered in a large eight-axle vehicle which may have difficulty accessing the property. Therefore, we recommend using a local gravel company as a possible solution to the access problem (Appendix 4). It should be noted that this purchase only includes the delivery to site and an additional cost of spreading will have to be considered. We recommend that SBCMALA spread the manure as possible to prevent nitrogen loss (Personal Communications with Lilley, 2017). Adding these amendments to increase soil quality will ideally lead to an increase in crop productivity.

Crop placement

Taking advantage of specific mutualistic and mycorrhizae relationships between crops can increase nutrient flow and thus improve productivity. One example of these relationships is leguminous plants (Fabaceae spp.) which use nitrogen fixing bacteria within root nodules in order to fix nitrogen from the atmosphere (Bethlenfalvay, 1992). Planting crops near these legumes can improve the productivity of the surrounding crops. Developing farming practices which promote complementary relationships between plants could improve overall ecosystem health (Ferguson and Lovell 2013). For example, in the Native American practice of “the Three
Sisters” (maize, beans, and squash) the maize acts as a structure on which the beans can climb while fighting off weeds, the beans fix nitrogen in the soil which benefit all crops and the large squash leaves shade the soil and prevent weeds from invading (Hart 2008). All root structures occupy different layers within the soil, thus minimizing competition (Hart 2008). Exploring these relationships could potentially compensate for the nutrient deficiencies of certain plants while marginally reducing reliance on soil amendments.

The use of cover crops during both the summer and the winter months could increase soil fertility while decreasing the presence of pests, diseases, and weeds (Canali, 2015). Specifically, cover crops have been found to increase carbon and nitrogen availability and retention while improving poor physical soil properties (Hubbard et al. 2013). While the soil results showed an unexpectedly high amount of organic matter, this data could have been artificially inflated due to the presence of wood chips in the soil; consequently, it could be valuable to use these nutrient-rich sources of organic matter, such as cover crops, in order to improve overall soil quality and thus plant health. The high nitrogen content of green manure and chicken manure will aid in the breakdown of carbon stored within these woodchips, further increasing the health of the soil. In order to increase nutrient availability to the site, leguminous cover crops should be used (Pérez-Álvarez, 2015). Examples of leguminous cover crops include: crimson clover (*Trifolium incarnatum*), field peas (*Pisum sativum*), subterranean clover (*Trifolium subterraneum*), red clover (*Trifolium pratense*), and white clover (*Trifolium repens*) (SARE, n.d.).

Additionally, we recommend rotating crops in order to reduce pest pressures and thus increase the overall quality of crops. This can be done by moving the vegetable patch throughout each family’s plot over the course of several years (Appendix 6). We recommend that SBCMALA use flagging tape in order to delineate the boundaries of each family’s vegetable patch in order to facilitate in the annual recording of crop location. Ideally this would be done annually and the data compiled in order to create a record of crop placement. This may be an appropriate task for SBCMALA’s farm manager. Keeping the same species in the same location increases the likelihood that pests and pathogens will affect the crops in successive years (Bullock, 1992).

We also recommend a field rotation, which may also aid in overall soil fertility by reducing the nutrient caused by successive placement of in the same space. By leaving a field or a portion of a field fallow each year, necessary nutrients can be reintroduced to the soil. These locations could be the site for other land management practices such as chicken tractors.

**Pests**

In addition to returning nutrients to the soil, crop rotation can help mitigate pest pressures (Parker, 2013). By using companion planting, insects can be diverted from the host cash crop towards a less valuable crop, thus reducing the effect of pests on these valuable plants. Crops that may draw pests away from cash crops are known as “trap crops” as they interfere with insects’ ability to correctly identify their target plant (Table 3) (Parker, 2013). Other types of diverting include plants that mask the scent of the cash crop while others actively repel the insects due to
secondary metabolites (Parker, 2013). It should be acknowledged that relying on diverting plants will not significantly reduce the effect of insect pests. Consequently, we recommend potential further research into the use of pesticides which will effectively reduce pest presence on the property.

Due to the results from our focus group, we learned that white-tailed deer and porcupine are a major pest for SBCMALA farmers. After consulting with Tori Jackson at the University of Maine Cooperative Extension, we recommend the construction of an off-set electric fence in order to deter deer. Due to deer’s weak depth perception, they are unable to navigate through the different levels of fencing and possibly inhibit the deer from accessing the crops (Personal Communication, Tori Jackson, 2017). If a deer were to attempt passing through the fence, they would be shocked with an electrical current, which would further discourage them from entering the property. To address the porcupine problem on the property, we recommend SBCMALA install a plastic retaining fence which will provide a physical barrier between the pests and the crops. This fence should be installed on the inside of the electric fence. Both fences should be relatively easy to expand with the expansion of the farmed property.

Table 3. Crops and their companion species that can be used to divert common pests. (Modified from Parker, 2013 and Suskiw, 2014)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Pest</th>
<th>Diverting species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collard greens, tomato, salad greens</td>
<td>Hover flies and aphids</td>
<td>Sweet Alysum (USDA)</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Cabbageworm (<em>Pieris rapae</em>)</td>
<td>Indian mustard (<em>Brassica juncea</em>)</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Cabbage root fly (<em>D. radicum</em>)</td>
<td>Peas (<em>Pisum sativum</em>) or Ryegrass (<em>Lilium perenne</em>) or Clover</td>
</tr>
<tr>
<td>Broccoli</td>
<td>Crucifer flea beetle (<em>Phyllotreta cruciferae</em> Goeze)</td>
<td>Pacific gold mustard (<em>Brassica juncea</em>), Pac choi (<em>Brassica rapa subsp. pekinensis</em>), or rape (<em>Brassica napus</em>) * Crops planted together are more effective</td>
</tr>
<tr>
<td>Tomato</td>
<td>Tomato hornworms</td>
<td>Basil (<em>Ocimum basilicum</em>) and other aromatic herbs</td>
</tr>
</tbody>
</table>

**Chicken Tractors**

Using chicken tractors on the field that is kept fallow would allow families to increase productivity in two ways. The first is to provide a supplemental source of subsistence for those
families whose farming plots may be kept fallow on a given year. Additionally, the manure that the chickens would produce from the tractors would further increase nutrient concentrations within the soil, thus increasing crop production for the following year. Assuming that up to only one acre of farmland would be kept fallow each year, 500 chickens could be kept on the land (Damerow, 1995). These chickens could feed on specific cover crops and allow nutrients to return to the soil through both the cover crop and the manure. Chickens should only be introduced to the fallow field once the summer cover crop reaches 6 inches (15.2 cm) tall (Damerow, 1995). Examples of cover crops suitable for chickens include: red clover \((Trifolium pratense)\), and white clover \((Trifolium repens)\), orchard grass \((Dactylis spp.)\), Kentucky bluegrass \((Poa pratensis)\), Perennial ryegrass \((Lolium perenne)\), and alfalfa \((Medicago sativa)\) (Darre, n.d.).

Paris Farmers Union sells two different broiler breeds: White Jumbo Cornish Rock Cross Cockerels and Red Rangers (Paris Farmers Union, 2017). Cornish Crosses are a faster-growing species and reach maturity after only 8 weeks of growth while Red Rangers reach maturity at 12 weeks. While it may be appealing to select a bird which requires the least amount of resource investment, this may come with its own challenges. Birds which are faster to reach maturity more frequently have health problems and thus are more vulnerable in outdoor environments (Damerow, 1995, Darre, n.d.). Therefore, the benefits of investing more time into longer-lived birds could outweigh the negatives.

Feed is one of the largest investments of keeping chickens. Most feed is priced at $0.09 to $0.18 per pound (Sustainable Agriculture Network, 2012). A single broiler will consume approximately ten pounds of feed within its lifetime or about two pounds of feed per pound gained; consequently, feeding 500 chickens to maturity could cost between $450 and $900 (Damerow, 1995). Due to chickens’ foraging habits, they have a tendency to continually return to their feeding trough for small meals which causes them to burn energy rapidly (Poole, n.d.). As a result, pellets are best for feed because they force the chickens to consume more food per trough trip (Poole, n.d.). Additionally, it is recommended their feed include supplemental grit which will allow them to digest the high-fiber diets resulting from their consumption of organic matter (Poole, n.d.). The bird’s diet should be highest in protein when they are youngest and should decrease slightly with age (Poole, n.d.). For more information regarding how to raise chicks, visit the Iowa State University Extension or Storey’s Guide to Raising Chickens (Hartsook, 2013 and Damerow, 1995).

If half an acre is kept fallow a year, the land could support approximately three chicken tractors containing roughly 100 birds each. These chicken tractors would require three to four people to move them. The process of removing food and water, and moving the containments takes about 20 minutes (Personal Communication, Megan Phillips, 2017). The water should be refilled as needed (Personal Communication, Megan Phillips, 2017). As chickens age, their tractors should be moved more frequently (Damerow, 1995). Therefore, it is important to keep this time commitment in mind when considering the introduction of chicken tractors to the property. See Appendix 7 for an example of a chicken tractor design with instructions.
Resources
Darre, M. J. Almost Everything You Need to Know About Raising Broiler Chickens. University of Vermont.
Poole, T. E. Introduction to Developing a Free-Range Poultry Enterprise. in U. o. M. Extention, editor.
Appendix 1 - Focus Group Questions

Somali Culture / Agricultural Practices
1. How is farming in Lewiston different from in Somalia?
2. What kind of crops do you plant in Somalia?
3. What crops do you plant in Lewiston?
4. What do you do with the crops you harvest?
5. Do you ever record / write down what crops you have grown and in which areas of the land?
6. How do you currently think about fertilizing your crops?

Pest Management
1. What kind of pests harm your crops
2. Are you doing anything now to prevent these pests
3. Do you have these same pest problems in Somalia? If so, what do you do to prevent them?
4. We understand there is a deer problem in this area. Do you think buying an electric fence would be a possibility here?

Plants
1. What is your irrigation system? How much are you planning on expanding it?
2. In what specific order or pattern are you planting your crops?
   a. Why are you doing it this way? Is it because it’s how you always have done it or is it because you think works the best?
3. Do you save seeds?
   a. Where do you currently get your seeds from?
4. What tools are you using for farming? Where do you store them?
5. Are there crops you are planning on adding?
6. What do you think of having a communal plot and sharing the crops you produce?
   a. When we visited your property we noticed you have sections without corn growing in them. How did you decide where to place these? Would you be willing to move this patch annually?
7. What are your thoughts on keeping a part of the field without any crops on it each year in order to make the land more fertile the next year?
Appendix 2 - Focus Group Notes

A. Men’s Focus Group Notes

- Big difference between farming in Somalia and farming in Lewiston
- Never added any fertilizer to soil in Somalia
- Soil is much more fertile in Somalia
- 2 different kinds of planting methods: large factory farming vs. family farming
- 4 kernels of corn put into hole when planting the corn
- 7-10 seeds of sorghum in a hole when planting sorghum
- Other crops grown in Somalia: corn, sesame, pumpkin, sweet potatoes, squash, beans
- Sell sesame for profit
- 3 seasons for different growth:
  - Winter: sesame, pumpkins, beans
  - Spring: watermelon
  - Fall: sesame
  - Summer: burn crop residue → also clears land
- 70-80% of corn goes to families
- 40-60% of tomatoes goes to families
- Some crops sold at farmers markets
- Some crops sold at wholesale
- The vegetable patch is decided on based off what section of the soil appears best (may explain why vegetable patch locations differ so much by plot)
- Fertilizing is based on the whole field
- Pest problems
  - Deer
  - Potato beetle
  - Tomato worms
  - Porcupines
- Vegetable pests
  - Corn worms
  - Worms that attack tomatoes
  - Potato worms
  - Aphids
  - Worms attacking squash
  - Beetles attacking squash
- Electric fence possibility
- Cropping pattern
  - “We don’t have enough space”
- Keep seeds? Save corn, bean and pumpkin seeds.
- Get vegetable seeds from ASL Falmouth
- Tools used:
  - hoes
  - rakes
  - shovels
- Crops to be added in future
  - garlic → higher profit
- Pay contractor $125 / hour
- Just hired a production manager named Anna

B. Women’s Focus Group Notes

- Plants grown in Somalia: corn, bananas, sugar, tomatoes, papaya, lemon, grapefruit, lime, sesame
- Farm in Lewiston is much smaller than in Africa
- Different seasons in Somalia than in Maine
- Would sell sesame oil
- Can’t grow banana, papaya, or grapefruit in Maine
- Could sell corn in Maine
- Not good income in Maine
- Difficult to sell corn
- Corn is usually shared with others in the Somali Bantu community, “everyone knows everyone”
- Give corn to neighbors, freeze corn, keep corn for family
- Severe deer and porcupine problem
- One woman said she almost stopped farming because of the deer
- Nothing to prevent pests in Lewiston
- Pests in Somalia included: deer, pigs, hippos, elephants, donkeys, monkeys
- People stayed at farm all day and all night to scare away pests (lived next to field)
- Liked electric fence idea
- Rely on rain to water crops and some irrigation
- Buy seeds, don’t save seeds
- Buy seeds from Walmart
- Buy African corn seeds from Somali stores on Lisbon Street
- If there was a market for a particular crop, we would grow it ie: cherry tomatoes
- Have a tractor to use
- Buy tools from stores here, like Walmart
- Buy clippers from Home Depot
- Each family has a section of the land
- Rotate vegetable patch, someone came to SBCMALA and told them they should rotate crops
- Interested in having goats or other animals on property
- Currently do not fertilize field
- Did not fertilize field in Somalia
- Would fertilize field if it meant the crops would grow better
- Want to have a market to sell crops
- Need more tools such as a hose to water crops
- Like fencing idea
Appendix 3 - Drone Maps
Drone map taken October, 2017 at Old Webster Rd, Lewiston, Maine. Map A shows the four fields currently in production as well as the expansion area. Map B shows the location of corn (yellow) and vegetable (green) patches in the 2017 growing season as well as each of the 22 family’s plots on the irrigated field (indicated with black lines).
## Appendix 4 - Soil Amendment & Gravel Providers Details

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<th>Amendment</th>
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<th>Amount to Acquire</th>
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<td>40 yds³</td>
<td>$500 / 3 acre</td>
<td>once a year</td>
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<td>once a year</td>
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<td>Lime</td>
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<td>Varies on compost analysis</td>
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<td>Needs to be priced out.</td>
<td>Call for quote.</td>
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<td>(207)-783-1567</td>
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Quote for Pricing of Chicken Manure from Casella Organic’s (Chris Bales)

STANDARD PRODUCT SALES QUOTE/AGREEMENT

Date: 11/10/2017
Salesperson: Chris Bales
Manager:

Customer Information

Company: SBC Mela
Contact: Dillon Thombs
Address: 268 Old Webster Rd
Email: dtomths@bales.edu
City: Lewiston
State: ME
Zip: 04123
Phone: 207-485-2566
Fax: Cell: (207) 485-2566
Delivery Location: 268 Old Webster Rd, Lewiston ME
Comments: Contact Dillon Thombs. 485-2566. Has soil tests for this farm, recommended "add 40 yds poultry manure". Previously a fellow hay farm with no manure used. Leased land, side of River Rd, just below the I-95 bridge over the Andro River.

Product Information

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<th>Product</th>
<th>Source</th>
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<th>Quantity</th>
<th>Price</th>
<th>Unit</th>
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<td>Turner Laying Houses</td>
<td>17314031</td>
<td>1</td>
<td>$450.00</td>
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Payment Terms: COD
Price Valid Through: 12/10/2017
Notify by Date:
Tax Exempt Certificate: (tax exempt certificate must be provided or tax will be charged)
Tax Exempt ID#: 

Credit Terms:
1) All orders are based on approved credit and available inventory.
2) All accounts are due in 30 days following delivery. Questions regarding order or quantity must be reported to Casella Organics within 24 hours of delivery.
3) Price is contingent upon customer allowing deliveries to begin unloading within 15 minutes of arrival. Safe access, tipping area and adequate truck turn-around for delivery vehicles are customer's responsibility.
4) Casella Organics agrees to supply the above product(s) at the price(s) quoted at the quantities and delivery schedule specified above. Fuel surcharge may apply to cover increases in fuel prices.
5) Customer shall handle and use the product(s) in accordance with all applicable laws and regulations and is responsible for compliance with all local permits, site restrictions and state regulations. Shipment is subject to all necessary approvals being in place prior to delivery.
6) Customer warrants that it has the legal rights to accept delivery of the product(s) at the above price.
7) Customer agrees that Casella Organics will be the exclusive provider of the above product(s) for the term of this agreement.

Limited Warranty
Customer has been provided with the Product Information Literature (PIL), Best Management Practices (BMP) and Product Label (where applicable), or the product(s) listed above. Casella Organics warrants that this product(s) conforms to the written description in the PIL. If either representation is made by Casella Organics. This limited warranty disclaims all other expressed or implied warranties and customer agrees to use the product(s) in accordance with the Product Label and BMP. Except for the limited warranty set forth above, customer assumes all risk associated with the use of the product(s). Customer's sole remedy for any breach of this limited warranty shall be a refund of the purchased price of the product(s). In no event whatsoever shall Casella Organics be liable for loss of profit or any other incidental, consequential or special damages in connection with the use of this product(s).

To secure this quote and confirm this is an order, sign and return this form to Casella Organics within 30 days from the first date written above.

I order and agree to accept delivery of the product(s) as described above. I have read the above Sales Agreement and agree to its terms and conditions.

Authorized Customer Signature

Date

Casella Organics

Landowner Signature (Ag use only)

110 Main Street, Suite 100, Saco, ME 04072, 800-93-6474, FAX 207-28-9166
48 Liberty Dr, Suite A, Hanson, MA 02340, 800-28-9166, FAX 207-28-9166
47 4th Street, Suite 200, Concord, NH 03301, 800-276-7496, FAX 603-229-2010
68 Clifton County Road, Suite 200, Clifton Park, NY 12065, 518-385-0137, FAX 518-371-1590

23
Appendix 5 – University of Maine Soil Results

10/10/2017 | 6286 | 007 | ANDROSCOGGIN

**SOIL TEST REPORT:**

**CAMILLE PARRISH- BATES COLLEGE**

7 ANDREWS RD.

LEWISTON ME 04240

**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)

<table>
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<tr>
<th>Soil pH</th>
<th>Organic Matter (%)</th>
<th>Phosphorus (lb/A)</th>
<th>Potassium (% Sat.)</th>
<th>Calcium (% Sat.)</th>
<th>Magnesium (% Sat.)</th>
<th>Sulfur (ppm)</th>
<th>Boron (ppm)</th>
<th>Copper (ppm)</th>
<th>Iron (ppm)</th>
<th>Manganese (ppm)</th>
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<td>3.9</td>
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<td>1.1</td>
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<td>8.6</td>
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**RECOMMENDED ADDITIONS FOR ORGANIC GROWING**

Crop Code # 392

To raise soil pH to 6.5, apply 90 pounds of lime per 1000 sq. ft.

Magnesium source note: if you use K-Mag, use a low-magnesium (calcitic) lime.

To meet major nutrient requirements, apply (on each 1000 sq. ft.):
- Nitrogen (2.5 lb) - from 20 lb bloodmeal or 35 lb soybean or 25 lb fishmeal.
- Phosphorus (3.9 lb) - from 24 lb bone meal/bone char or 130 lb rock phosphate.
- Potassium (3.9 lb) - from 18 lb K-Mag (langbeinite) or 78 lb dry wood ash.

Wood ash acts as a liming material. Reduce lime amount by 1.5 lb for each 1 lb used.

15 bushel cow or horse manure or 7-9 bushel poultry, sheep, goat, or rabbit manure/1000 sq. ft. can substitute for 1/4-1/3 recommended nutrients (apply in fall).

Broadcast lime uniformly, in spring or fall, and till in 6-7 in.

Fertilizer may be broadcast in spring, but is best banded 2-3 in. below & beside rows.

Till in manure, compost, or leaves each year to build and maintain soil organic matter.

This will improve the nutrient and water holding capacity of your soil.

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

**NUMERICAL RESULTS**

([Test methodology: pH in water and Mohr’s buffer, available nutrients by modified Morgan test])

Organic matter measured by TKN, 9 determined colorimetrically, all others measured by ICP-AES

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<th>Level Found</th>
<th>Soil pH</th>
<th>Lime Index</th>
<th>Phosphorus (lb/A)</th>
<th>Potassium (lb/A)</th>
<th>Magnesium (lb/A)</th>
<th>Calcium (lb/A)</th>
<th>CEC (me/150 g)</th>
<th>K (% Saturation)</th>
<th>Mg (% Saturation)</th>
<th>Ca (% Saturation)</th>
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Additional Results or Comments:

Lead scan: NORMAL BACKGROUND LEVEL - no health risk.

Soil Microbial Biomass Test: 48 ppm CO2-C

* MEDIUM BIOMASS* See enclosed information.

Full payment received for this sample. Thank you.
SOIL TEST REPORT FOR:
CAMILLE PARRISH-BATES COLLEGE
7 ANDREWS RD.
LEWISTON ME 04240

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)

Major Nutrients
- Phosphorus (lb/A): 2.3
- Potassium (% Sat): 3.0
- Calcium (% Sat): 50.6
- Magnesium (% Sat): 6.8
- Sulfur (ppm): 20

Micronutrients
- Iron (ppm): 20
- Manganese (ppm): 3.0
- Zinc (ppm): 0.8

RECOMMENDED ADDITIONS FOR ORGANIC GROWING - Crop Code # 392
To raise soil pH to 6.5, apply 90 pounds of lime per 1000 sq. ft.

Magnesium source note: if you use K-Mag, use a low-magnesium (calcitic) lime.
To meet major nutrient requirements, apply (on each 1000 sq. ft.):
- Nitrogen (2.5 lb) - from 20 lb bloodmeal or 35 lb soybean or 25 lb fishmeal.
- Phosphorus (4.4 lb) - from 28 lb bone meal/bonechar or 147 lb rock phosphate.
- Potassium (3.1 lb) - from 14 lb K-Mag (langbeinite) or 62 lb dry wood ash.

Wood ash acts as a liming material. Reduce lime amount by 1.5 lb for each 1 lb used.

Broadcast organic matter credit: 1/2 or less of recommended N should be needed.

Fertilizer may be broadcast in spring, but is best banded 2-3 in. below & beside rows.

NUMERICAL RESULTS
(see enclosed form)

CEC and nutrient balance calculations assume the pH will be raised to 6.5

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<tr>
<td>Manganese</td>
<td>(ppm)</td>
<td></td>
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<td></td>
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<tr>
<td>Zinc</td>
<td>(ppm)</td>
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</tr>
</tbody>
</table>

NORMAL RANGE
- Organic Matter (%): 5 - 8
- Sulfur (ppm): 15 - 25
- Copper (ppm): 3.0 - 13.6
- Iron (ppm): 6 - 10
- Manganese (ppm): 1 - 4
- Zinc (ppm): 0.8 - 2

Additional Results or Comments:
- Lead scan: NORMAL BACKGROUND LEVEL - no health risk.
- Soil Microbial Biomass Test: 113 ppm C02-C
- MEDIUM BIOMASS: See enclosed information.

Full payment received for this sample. Thank you.
**SOIL TEST REPORT FOR:**
CAMILLE PARRISH-BATES COLLEGE
7 ANDREWS RD.
LEWISTON ME 04240

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

<table>
<thead>
<tr>
<th>Level</th>
<th>Soil pH</th>
<th>Organic Matter (%)</th>
<th>Phosphorus (lb/A)</th>
<th>Potassium (%)</th>
<th>Calcium (%)</th>
<th>Magnesium (%)</th>
<th>Sulfur (ppm)</th>
<th>Micronutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>6.0</td>
<td>4.5</td>
<td>3.0</td>
<td>1.6</td>
<td>50.7</td>
<td>7.9</td>
<td>15</td>
<td>Boron (ppm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Copper (ppm)</td>
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<td></td>
<td></td>
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<td>Iron (ppm)</td>
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<td></td>
<td></td>
<td></td>
<td>Manganese (ppm)</td>
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<td>Zinc (ppm)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABOVE OPTIMUM</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

**RECOMMENDED ADDITIONS FOR ORGANIC GROWING - Crop Code # 392**
To raise soil pH to 6.5, apply 60 pounds of lime per 1000 sq. ft.

Magnesium source note: if you use K-Mag, use a low-magnesium (calcitic) lime.
To meet major nutrient requirements, apply (on each 1000 sq. ft.):
Nitrogen (2.5 lb) - from 20 lb bloodmeal or 35 lb soybean or 25 lb fishmeal.
Phosphorus (4.0 lb) - from 25 lb boneash/bonechar or 133 lb rock phosphate.
Potassium (3.9 lb) - from 18 lb K-Mag (langbeinite) or 78 lb dry wood ash.

Wood ash acts as a liming material. Reduce lime amount by 1.5 lb for each 1 lb used.

15 bushel cow or horse manure or 7-8 bushel poultry, sheep, goat, or rabbit manure/1000 sq. ft. can substitute for 1/4-1/3 recommended nutrients (apply in fall).
Broadcast lime uniformly, in spring or fall, and till in 6-7 in.

Fertilizer may be broadcast in spring, but is best banded 2-3 in. below & beside rows.

Till in manure, compost, or leaves each year to build and maintain soil organic matter.
This will improve the nutrient and water holding capacity of your soil.

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

**NUMERICAL RESULTS**
(Test methodology: pH in water and Bellish buffer, available nutrients by modified Morgan extract.
Organic matter measured by 101, P determined colorimetrically, all others measured by ICP-OES)

| CEC and nutrient balance calculations assume the pH will be raised to 6.5 |

<p>| Optimum Range | 6.0-7.0 | N/A | 20-40 | See % Saturation levels | &gt; 5 | 3.5-5.0 | 10-20 | 60-80 | &lt; 10 |</p>
<table>
<thead>
<tr>
<th>Level Found</th>
<th>Soil pH Index 2</th>
<th>Phosphorus-Magnesium (lb/A)</th>
<th>Calcium (lb/A)</th>
<th>Natron (lb/mg)</th>
<th>Mg (ppm)</th>
<th>Ca (ppm)</th>
<th>K (ppm)</th>
<th>Na (ppm)</th>
<th>Acidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Range</td>
<td>0.3</td>
<td>0.05</td>
<td>6.0</td>
<td>1.6</td>
<td>0.6</td>
<td>5 - 8</td>
<td>&gt; 15</td>
<td>25-60</td>
<td>6 - 10</td>
</tr>
<tr>
<td>Level</td>
<td>Organic Matter (ppm)</td>
<td>Sulfur (ppm)</td>
<td>Copper (ppm)</td>
<td>Iron (ppm)</td>
<td>Manganese (ppm)</td>
<td>Zinc (ppm)</td>
<td>0.5-1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra</td>
<td>Boron (ppm)</td>
<td>Sodium (ppm)</td>
<td>Soluble Salts (ppm)</td>
<td>Nitrate-N (ppm)</td>
<td>Ammonium-N (ppm)</td>
<td>0.0</td>
<td>0.5-1.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Additional Results or Comments:**
Lead scan: NORMAL BACKGROUND LEVEL - no health risk.

Soil Microbial Biomass Test: 52 ppm CO2-C
*MEDIUM BIOMASS* See enclosed information.
Full payment received for this sample. Thank you.

26
SOIL TEST REPORT:
CAMILLE PARRISH-BATES COLLEGE
7 ANDREWS RD.
LEWISTON ME 04240

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 | LOW | MEDIUM | OPTIMUM | ABOVE
|-------|-----|--------|---------|------
| Soil pH | 5.2 | 5.7 | 6.0 | 
| Organic Matter (%) | 11.8 | 
| Phosphorus (lb/A) | 5.7 | 
| Potassium (% Sat) | 1.8 | 
| Calcium (% Sat) | 17.7 | 
| Magnesium (% Sat) | 4.4 | 
| Sulfur (ppm) | 52 | 
| Micronutrients | 
| Boron (ppm) | 0.4 | 
| Copper (ppm) | 0.13 | 
| Iron (ppm) | 27 | 
| Manganese (ppm) | 7.2 | 
| Zinc (ppm) | 2.1 | 

RECOMMENDED ADDITIONS FOR ORGANIC GROWING - Crop Code # 392

To raise soil pH to 6.5, apply 190 pounds of lime per 1000 sq. ft.

Magnesium source note: if you use K-Mag, use a low-magnesium (calcitic) lime.

To meet major nutrient requirements, apply (on each 1000 sq. ft.):
- Nitrogen (2.5 lb) from 20 lb bloodmeal or 35 lb soybean or 25 lb fishmeal.
- Phosphorus (2.8 lb) from 18 lb bone meal/bone char or 93 lb rock phosphate.
- Potassium (6.4 lb) from 29 lb K-Mag (langbeinite) or 128 lb dry wood ash.

Wood ash acts as a liming material. Reduce lime amount by 1.5 lb for each 1 lb used.

Provisional organic matter credit: 1/2 or less of recommended N should be needed.

Broadcast lime uniformly, in spring or fall, and till in 6-7 in.

Limit lime to 125 lb/1000 sq. ft. in any one year. Total can be split up over 3 years.

Fertilizer may be broadcast in spring, but is best banded 2-3 in. below & beside rows.

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

Additional Results or Comments:
- Soil Microbial Biomass Test: 108 ppm CO2
- MEDIUM BIOMASS* See enclosed information.

Full payment received for this sample. Thank you.

27
Appendix 6 - Crop Rotation Example
Appendix 7 - Chicken Tractor Design
**Basic instructions for implementation:**

<table>
<thead>
<tr>
<th>Board Label</th>
<th>Board Length</th>
<th>Dimensional Lumber</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>12 ft (3.66 m)</td>
<td>2x3</td>
</tr>
<tr>
<td>A2</td>
<td>12 ft (3.66 m)</td>
<td>2x3</td>
</tr>
<tr>
<td>A3</td>
<td>12 ft (3.66 m)</td>
<td>2x3</td>
</tr>
<tr>
<td>A4</td>
<td>12 ft (3.66 m)</td>
<td>2x3</td>
</tr>
<tr>
<td>A5</td>
<td>12 ft (3.66 m)</td>
<td>2x3</td>
</tr>
<tr>
<td>B1</td>
<td>10 ft (3.05m)</td>
<td>2x3</td>
</tr>
<tr>
<td>B2</td>
<td>10 ft (3.05m)</td>
<td>2x3</td>
</tr>
<tr>
<td>B3</td>
<td>10 ft (3.05m)</td>
<td>2x3</td>
</tr>
<tr>
<td>B4</td>
<td>10 ft (3.05m)</td>
<td>2x3</td>
</tr>
<tr>
<td>C1</td>
<td>7.81 ft (2.38m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>C2</td>
<td>7.81 ft (2.38m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>C3</td>
<td>7.81 ft (2.38m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>C4</td>
<td>7.81 ft (2.38m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>D1</td>
<td>2 ft (60.96cm)</td>
<td>2x4 (stud material)</td>
</tr>
<tr>
<td>D2</td>
<td>2 ft (60.96cm)</td>
<td>2x4 (stud material)</td>
</tr>
<tr>
<td>D3</td>
<td>2 ft (60.96cm)</td>
<td>2x4 (stud material)</td>
</tr>
<tr>
<td>D4</td>
<td>2 ft (60.96cm)</td>
<td>2x4 (stud material)</td>
</tr>
<tr>
<td>E1</td>
<td>6.32 ft (1.93m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>E2</td>
<td>6.32 ft (1.93m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>E3</td>
<td>6.32 ft (1.93m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>E4</td>
<td>6.32 ft (1.93m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td></td>
<td>6.32 ft (1.93m)</td>
<td>Strapping or halved 2x3</td>
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<tr>
<td>----</td>
<td>-----------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>F1</td>
<td>6.32 ft (1.93m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>F2</td>
<td>2 ft (60.96cm)</td>
<td>2x3</td>
</tr>
<tr>
<td>G1</td>
<td>2 ft (60.96cm)</td>
<td>2x3</td>
</tr>
<tr>
<td>G2</td>
<td>2 ft (60.96cm)</td>
<td>2x3</td>
</tr>
<tr>
<td>G3</td>
<td>2 ft (60.96cm)</td>
<td>2x3</td>
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<tr>
<td>G4</td>
<td>2 ft (60.96cm)</td>
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</tr>
<tr>
<td>G5</td>
<td>2 ft (60.96cm)</td>
<td>2x3</td>
</tr>
<tr>
<td>G6</td>
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<tr>
<td>G7</td>
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<tr>
<td>G8</td>
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</tr>
<tr>
<td>G9</td>
<td>2 ft (60.96cm)</td>
<td>2x3</td>
</tr>
<tr>
<td>G10</td>
<td>2 ft (60.96cm)</td>
<td>2x3</td>
</tr>
<tr>
<td>G11</td>
<td>2 ft (60.96cm)</td>
<td>2x3</td>
</tr>
<tr>
<td>H1</td>
<td>5.38 ft (1.64m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>H2</td>
<td>5.38 ft (1.64m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>H3</td>
<td>5.38 ft (1.64m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>H4</td>
<td>5.38 ft (1.64m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>I1</td>
<td>5.38 ft (1.64m)</td>
<td>Strapping or halved 2x3</td>
</tr>
<tr>
<td>I2</td>
<td>5.38 ft (1.64m)</td>
<td>Strapping or halved 2x3</td>
</tr>
</tbody>
</table>

Instructions for construction:

The chicken tractor design above has been adapted from Joel Salatin, who has used this design successfully to farm chickens and other poultry. The construction of this model would require the use of hand tools and some hand held power tools (cordless drill or impact driver). The use of table saw may be needed for the stripping of the “halved 2x3” but is not required if whole 2x3s are chosen. In addition to the purchase of materials above, chicken wire will be need
to be purchased to cover the structure, keeping chickens in and predators out. Along with chicken wire, aluminum roofing material may be used as shade cover, and as an additional barrier to keep the chickens within the enclosure. In some cases a tarp may be used as a shade cover as well. The use of decking screws (star head screws) is recommended for the construction process.

The chicken tractor can be broken into 6 panels: Top, Side 1, Side 2, Front, Back, and Bottom. These panels are brought together with the use of D1-4 studs which provide points for attachment. F1, F2 and I1, I2 also help to hold the structure together and provide important structural support.

The top panel is constructed first by attaching A1 and A2 to the respective B1 and B2 pieces, this will produce the frame of the outside top. B3 and A3 pieces will be attached through the middle of the rectangular top forming four equal smaller rectangles. These are then supported with the use of cross pieces (C1-4). The D1 studs should be placed in each of the four corners as they will be important with later construction.

Side panels 1 and 2 are constructed in the same manner. A1 used in the previous top panel will be attached to G1 and G3 which is then attached to the bottom runner, A4. This process is repeated on the opposite side. G2 and G5 will bisect the newly formed rectangles on either side providing structural support. E1-4 will be attached from the lower corners formed with A5 and G5 to the upper corners formed by G6, G4, G3, G1 and A1, A2, this too will provide important structural support. G1, G3, G4, and G6 will all be attached to the vertical D1-4 studs.

Front and back panels are also constructed in the same manner. G7, 9, 10, and 12 will be attached to the top B1 and B2 boards. These will then be connected to the bottom runners, B3 and B4, forming two rectangular front and back panels. These will both be bisected by G11 (back panel) and G8 (front panel). These bisected boards act as structural support. H1-4 will be connected in a similar manner as E1-4 on side 1 and side 2. G7, G9 G10, and G12 will all be attached to the vertical D1-4 studs.

The bottom panel (A4, A5, B4, and B5) runners should now all be in place. These components should be attached to the D1-4 studs. The final component is adding the last four structural pieces within the structure (F1, F2, I1, and I2). These pieces are within the structure and it may be helpful to flip the entire chicken tractor onto its top so that one can access the area within. The F1 and F2 boards should be attached in the middle of the structure starting at the intersection of A3 and B3. These pieces will then connect to the ground runners B1 and B2 where they intersect with G11 and G8. The I1 and I2 boards should be attached in the same location as the F1 and F2 boards. These should then be attached to the ground runners of A4 and A5 where they are both bisected by G2 and G5. A final high gauge wire should be placed horizontally along the ground runners at the point of bisection by G5 and G2.

After turning the chicken tractor upright, chicken wire should be stapled to all sides with the exception of the bottom panel. Aluminum roofing or tarping may be used on portions of the top and sides to provide shade and protection from the elements and predators. Additional
chicken wire may be used around the base of the structure in the form of skirting to prevent predators from accessing the chickens. A chicken wire/aluminum/wooden hatch may be constructed on the top panel for easy access to the chickens for watering and feeding.
Appendix 8 - Legal Documents

01-001  DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY

Chapter 565: NUTRIENT MANAGEMENT RULES

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CHAPTER 565
NUTRIENT MANAGEMENT RULES

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§1. Background and Purpose of the Rules

These rules establish the standards for nutrient management plans required under 7 MRSA §4204 for Maine farms, the process for certifying persons to write and approve nutrient management plans, the requirements for obtaining a livestock operations permit and the procedures for implementing the requirements of the Nutrient Management Act. Nothing in these rules is intended to supersede or affect rules, license conditions or other legal requirements of the Department of Environmental Protection or other federal, state or local regulatory authorities.

§2. Authority

These rules are adopted pursuant to 7 MRSA Chapter 747, Nutrient Management Act.

§3. Definitions

Unless the context otherwise requires, the following terms have the following meanings as used in these rules:

1. Animal feeding operation - A lot or facility where animals are confined and fed for a total of at least 45 days in a 12 month period. Animal feeding operation does not include an aquatic animal production facility.


3. Best Management Practices (BMP) - Those agricultural practices that are determined by the Commissioner to be environmentally acceptable based upon best reasonably available and economically feasible methods and technologies.

4. Certified Nutrient Management Planning Specialist - A person who has been certified by the Commissioner to prepare and/or approve a nutrient management plan.

5. Commissioner - The Commissioner for the Department of Agriculture, Conservation and Forestry.


7. Concentrated feeding area - Barnyards, feedlots, loafing areas, exercise lots or other animal containment areas that do not have a growing crop sufficient to utilize the nutrients in manure deposited in that location. The term excludes pasture access ways, except in areas where there is a direct flow of nutrients to surface water or groundwater.

8. Confine/Confinement - Animals are considered to be confined if they are housed or kept in a concentrated feeding area for at least 45 days in a calendar year.
9. Crop Farm - A farm or farming operation involved in crop production and having less than 50 animal units of livestock or poultry.

10. Department - The Department of Agriculture, Conservation and Forestry.

11. EPA - The United States Environmental Protection Agency.

12. Farm or farming operation - The aggregate of all agricultural land, equipment and all related facilities, crops and animals, regardless of their location or ownership, that form part of an integrated agricultural business or enterprise.

13. Farm nutrient - A substance or recognized plant nutrient, element or compound that is used or sold for its plant nutritive content or its claimed nutritive value for use in growing crops. The term includes, but is not limited to, livestock and poultry manures, compost as fertilizer, commercially manufactured chemical fertilizers, sewage sludge, residuals or combinations of these.

14. FSA HEL compliance plan - A Food Security Act, Highly Erodible Land Plan used by farmers to control soil erosion on highly erodable land and maintain their eligibility for USDA programs.

15. Livestock farm - A farm or farming operation that raises livestock or poultry and does not meet the definition of a crop farm.

16. Nutrient management plan (NMP) - A written document that outlines how farm nutrients are stored, managed, and utilized on the farm for which the plan is written.

17. Nutrient Management Review Board - The board established pursuant to 7 M.R.S.A. §4203.

18. Off-farm nutrients - Nutrients not generated by the farm.

19. Regulated residuals - A residual whose application to land is regulated by the Department of Environmental Protection pursuant to Title 38, Chapter 15, and that is primarily used for its nitrogen and phosphorus value as determined by the Department. Wood ash or compost are not considered to be regulated residuals under these rules.

20. Residual - Any material generated as a byproduct of nonagricultural production or treatment process that has value as a source of crop nutrients or soil amendments.

21. Right to farm law - 17 MRSA §2805

22. SWCD - A Soil and Water Conservation District.

23. Undue Hardship - An exceptional financial or operational burden that, in the judgment of the Commissioner, requires a departure from strict compliance with a requirement of these rules, provided that the hardship is based upon unusual circumstances of a particular farming operation that have not been caused by the action or neglect of the owner or operator.
24. UMCE - University of Maine Cooperative Extension
25. USDA/NRCS - United States Department of Agriculture/Natural Resources Conservation Service.
26. Verified complaint of improper manure handling - A complaint of improper manure handling investigated in accordance with Title 17, section 2701-45 and resulting in a determination by the Commissioner that the manure has been stored or handled in a manner that does not conform with best management practices.
27. Waterway - A vegetated natural or constructed drainage way in a field that carries water during and after rainfall or snow melt.

§4. Nutrient Management Plans Required

Unless exempted by statute or these rules, a person who owns or operates a farm shall have and implement an approved nutrient management plan for that farm if it meets one or more of the following criteria:

1. The farm confines and feeds 50 or more animal units at any one time;\(^1\)

2. The farm utilizes more than 100 tons of manure per year not generated on that farm;

3. The farm is the subject of a verified complaint of improper manure handling;\(^2\)

4. The farm stores or utilizes regulated residuals.

The nutrient management plan must be prepared by a certified NMP specialist or approved and signed by a certified NMP specialist, pursuant to the provisions of §7 of these rules.

---

\(^1\)Note: This means that the farm confines and feeds any combination of animals totaling 50,000 lb. live animal weight. Without limitation, some examples are:
- 24 dairy cows (plus an equivalent number of young cattle) (1400 lb/mature animal)
- 35 dairy cows with no young cattle (1400 lb/animal)
- 50 beef cows (1000 lb/animal)
- 125 sows or finishing pigs (400 lb/animal)
- 1000 feeder pigs (50 lb/animal)
- 50 horses (1000 lb/animal)
- 500 sheep (100 lb/animal)
- 2800 turkeys (18 lb/animal)
- 10,000 laying hens/broilers (5 lb/animal).

\(^2\)Note: Complaints are usually handled under the “Right to Farm Law”, 17 MRSA §2805.
§5. Winter Manure Spreading Ban

In accordance with 7 MRSA §4207, a person may not spread manure on agricultural fields between December 1 of a calendar year and March 15 of the following calendar year.

1. Variance. The Commissioner may grant a variance on the Winter Manure Spreading Ban.

   A. Request for variance. A person requesting a variance shall submit a written request to the Commissioner. The request must include:

      (1) The operation for which the variance is sought;

      (2) The reason(s) for the variance request; and

      (3) Any relevant information supporting the request.

   B. Emergency. In case of an emergency request for variance, the request shall be made verbally to the Commissioner (or designee), followed by a written request application to the Commissioner within 10 days of the verbal request.

   C. Decision. Upon receipt of a variance request, the Commissioner shall make a decision and shall notify the person requesting the variance in writing, within 7 days. In time sensitive situations, the Commissioner (or designee) may verbally inform the person making the request of the decision, followed by a decision in writing as indicated.

   D. Notice of variance denial. When the Commissioner denies a variance, the notice shall include:

      (1) The name and address of the person whose request for a variance has been denied;

      (2) A statement or list of reason(s) why the variance is denied; and

      (3) A reminder of the Winter Spreading Manure Ban effective dates.

   E. Extent of variance. All variances issued by the Commissioner for a specific calendar year shall be valid for the dates specified by the Commissioner, and as requested for each calendar year.

3The Commissioner’s decision shall include, but not be limited to, consideration of such factors as farm inspection, protection of groundwater and surface water, availability of financial assistance, financial hardship or the variance applicant’s proposal when provided.
§6. Nutrient Management Plans

1. Standards for Nutrient Management Plans

   A. General Contents and Requirements of Nutrient Management Plans

   (1) The NMP must include all nutrients produced on or brought onto the farm.

   (a) For livestock farms, the NMP must address storage and utilization of manure and off farm nutrients on all land including leased and/or rented land.

   (b) For crop farms, the NMP must address storage and utilization of manure and off farm nutrients on land to which regulated residuals or more than 100 tons of manure in any one calendar year are applied.

   (2) For each field the NMP must show the calculation of nutrients required to grow a crop in accordance with procedures approved by the Commissioner.

   (3) The NMP must recite the number of each type of animal and an estimate of the number of corresponding animal units on the farm at the time the NMP is prepared.

   (4) A soil erosion control plan must be developed for land used for growing annual crops and be part of the NMP. This plan must have been approved by an SWCD, or be an FSA HEL compliance plan approved by NRCS, or be a privately developed plan utilizing one or more erosion control BMPs approved by a certified Commercial/Public Nutrient Management Planning Specialist to minimize sedimentation and phosphorus transport to the maximum extent feasible.

   (5) The NMP must include soil tests for each field where manure or other crop nutrients will be applied. Soil testing must be repeated for each field at least every 5 years. More frequent testing is recommended for fields with soil phosphorus levels above 40 lb/ae. 4

   (6) The NMP must identify the limiting nutrient for determining nutrient application rates that are environmentally sound, using the decision matrix included in the Attachment A, “N and P manure priority matrix”.

   (7) Where constructed filter strips are included as part of the plan, the specifications outlined in Attachment B must be followed unless otherwise

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Note: Soil test numbers refer to results obtained using the Maine soil test procedure used by the University of Maine Plant and Soil Testing Lab. Soil test values from other testing methods will be different and would need to be converted to be consistent with these values.
approved by the Commissioner. Filter strips must be inspected and repaired each year. Phosphorus must not be added within these areas except as necessary to maintain adequate plant growth.

(8) The NMP must include site-specific dates recommended for the spreading of manure and spraying or irrigation of liquid manure. Recommended spreading must comply with §5 of these rules.

(9) The NMP must include a recommended timetable for implementing the plan.5

B. Nutrient Management Plan Provisions That Apply to Nutrients Other than Regulated Residuals. In addition to the requirements in Section 6.1(A), nutrient management plans must contain the following provisions that apply to manure storage, management and use:

(1) The NMP must provide for manure testing at least every 5 years or when a significant management change will affect manure nutrient values (for example, changing from a solid manure handling system to a liquid manure handling system, or changing the type of bedding used from sawdust to shredded paper, or changing the source of manure that is used.) Manure must, at a minimum, be analyzed for Nitrogen, Phosphorus, Potassium and moisture content.

(2) The NMP must identify and establish setbacks for spreading, stacking and storing manure. The setback distances must be determined using site specific BMPs to establish different setbacks approved by a certified NMP specialist as effective in controlling run-off and in preventing contamination of surface water. Setbacks from property lines must also be determined based on site specific factors. Justification for the site specific setbacks must be provided. 6

(3) Setbacks for manure application sites, storages and stacking sites to drinking water wells must be a minimum of 100 feet.

(4) The NMP must provide for manure storage for a minimum of 180 days, using containment structure(s) and/or stacking site(s) approved by NRCS or SWCD or as otherwise approved by the Commissioner.7

5The recommended timetable for the plan implementation must be in accordance with the time frame included in the Nutrient Management Law, MRSA 7 §4204 subsection 4 to 7.

6For example, the certified nutrient management planning specialist may choose a reduced setback in a cornfield when the adjacent property is also a cornfield, a hay field or a woodlot and the neighboring land owner has given permission to reduce the setback. The certified nutrient management planning specialist may choose an increased setback on a hayfield that is adjacent to a day care center.

7Note: The standards and specifications used by NRCS are in Attachment C (USDA-NRCS Specifications 312, 313).
(5) The NMP must include provisions for effective odor and insect control associated with manure storage, management and utilization at the facility and at landspraying sites.

C. Nutrient Management Plan Provisions That Apply to Regulated Residuals. In addition to compliance with §6.1(A), if the NMP contemplates the use of regulated residuals the plans for setbacks, stacking sites, storage facilities, limitations on use based on constituents in the regulated residual and other provisions in the plan that apply to regulated residuals must comply with rules adopted by the Department of Environmental Protection concerning the agronomic utilization of residuals and other legal requirements of that department.

D. Calculation of crop nutrient needs. The calculation of nutrients to be applied must be based on soil tests, manure tests, crop to be grown and realistic yield goals. A realistic yield goal must be no more than 100% of the state average for the crop in question as determined by the Commissioner, unless the producer can demonstrate that in at least 2 out of 5 years that yields have been greater than 100% of the state average, in which case nutrients may be recalculated to meet the higher yields actually experienced. Each field must have its own calculation. The calculation of nutrient needs must take into account the mineralization of organic nitrogen in the soil and in the nutrient material to be applied as well as inorganic nitrogen, following procedures approved by the Commissioner.

E. Record Keeping. Record keeping, as provided in the NMP, must, at a minimum, address the amount of manure applied to each field, amount of other nutrient sources applied to each field, results of soil and manure tests and yields at end of each harvest season. These records must be provided to the Department on request.

2. Frequency for nutrient management plan updates. The nutrient management plan must be updated at least once each year and must be approved by a certified NMP specialist at least every 5 years. The nutrient management plan must be updated and approved sooner if:

A. There is an increase of 50 animal units or more over the number shown in the original plan;

B. There is a change greater than 15% in the acreage upon which nutrients are to be spread; or

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Some examples of provisions that might appear in a NMP would be:
- Immediate incorporation of manure spread on tilled land.
- Timing applications to avoid creating nuisances.
- Maintenance programs for water bodies to keep manure dry in poultry houses.
- A spray program for insect control during warm months.

*Notes: The method outlined in USDA-NRCS code 590 'Nutrient Management', July 1993 is an approved method. Other approved methods will be presented as part of the training and certification process for NMP specialists. A pre-side dress nitrate test for field corn and other crops for which the test is calibrated is recommended to determine adequate levels of available nitrogen.
C. There is any other significant change in the operation that renders the existing NMP no longer relevant.

The Department must be notified that an update was done and its effective date anytime an update is done for the above reasons.

The farm owner or operator may update or revise the plan anytime conditions on the farm warrant a change.

3. Variances. The Commissioner may grant a variance from the dates for the preparation and/or the implementation of Nutrient Management Plans under the Nutrient Management Law, (7 M.R.S.A. § 4204 subsection 4 to 7) when the Commissioner finds undue hardship.

A. Request for variance. A person requesting a variance shall submit the request in writing to the Commissioner. The request shall include:

   (1) The operation for which the variance is sought;

   (2) The reason(s) for the variance request; and

   (3) Any relevant information supporting the request.

The Commissioner may, as part of the decision-making process, ask for additional information or request a site visit from the Agricultural Compliance Officer.

B. Public notice\textsuperscript{19}. When the Commissioner considers granting a request for a variance from the October 1, 2007 implementation date, a public notice shall be published, followed by a 10 day comment period.

C. Decision. The Commissioner shall make a decision whether undue hardship exists such as to justify a variance\textsuperscript{20}, and shall notify the person making the request in writing within 30 days of the decision. The written notice shall be sent by certified mail, return receipt requested, and shall include:

   (1) The name and address of the person whose variance has been granted or denied;

   (2) A statement of why the variance is granted or denied;

   (3) The effective date of implementation; and

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\textsuperscript{19}The public notice provision does not apply to the variances granted for the January 1, 2001 deadline for having a Nutrient management Plan written and certified.

\textsuperscript{20}The Commissioner’s decision shall include, but not be limited to consideration of such factors as protection of groundwater and surface water, cost of implementing the plan, availability of financial assistance, financial hardship or the variance applicant’s proposal when provided and any public comments received.
(4) The right to appeal the Commissioner's decision to the Nutrient Management Review Board in accordance with §9 of these rules.

D. Extent of variance. All variances must be issued for a time period of five years, unless the Commissioner or the Board prescribes a shorter period. A variance granted by the Commissioner or the Board may not extend an implementation date beyond December 31, 2008.

§7. Certification of Persons to Prepare Nutrient Management Plans

All nutrient management plans must be prepared and approved or reviewed and approved by a person who has been certified by the Commissioner. (7 MRSA §4204) Certification of persons will be for a five year period starting from the date when the original certification is awarded.

1. Categories for Certification. Persons may become certified in one of two certification categories. These are:

   A. Commercial/Public NMP specialist - A person who may develop and approve NMPs for another and may approve NMPs prepared by another. Includes commercial NMP specialists and public agency employees (e.g. SWCD, UMCE, NRCS).

   B. Private NMP specialist - A person who may develop and approve a NMP only for his or her own operation.

2. Education and Training Requirements. Persons seeking to become Certified Nutrient Management Planning Specialists must meet the education and training requirements outlined in either A or B below:

   A. Persons seeking certification as Nutrient Management Planning Specialists shall provide proof of certification by a national certifying program for nutrient management planning approved by the Commissioner such as:

      (1) The National Alliance of Independent Crop Consultants

      (2) The American Society of Agronomy

      (3) The American Registry of Certified Professionals in Agronomy, Crops and Soils.

   B. Persons seeking certification may become certified through a Maine state training and certification program approved by the Commissioner. All persons seeking certification through a Maine state program must pass the appropriate Nutrient Management Planning Certification Test and have either:

      (1) Successfully completed a pre-certification training workshop offered by the Department, UMCE or other agency approved by the Commissioner, or
2. Demonstrated a good understanding of agricultural subjects including soil fertility, crop management and manure management from past education, training and/or experience by passing a test approved by the Commissioner for this purpose.

3. Submission Requirements. Applicants meeting the above requirements shall submit an application for certification on a form approved by the Commissioner, proof that the above requirements have been met and a $35 certification fee to the Department.

4. Requirements of Certified Persons

A. A certified person must comply with the standards and requirements provided in these rules and in the enabling statute when preparing nutrient management plans required under these rules.

B. A certified person must send a signed notification to the Department of all nutrient management plans prepared or reviewed and approved by that person as meeting the requirements of these rules. The notification must include the name and address of the owner and, if different, the operator of the farm, the location and address of the farm for which the plan was prepared or approved, the number of animal units on the farm, the name and address of the certified NMP specialist and a signed statement that the plan is in conformity with these rules.

C. Persons certified under §7.2(A) must maintain certification through the appropriate national certifying programs.

5. Revocation of Certification

A. Basis for revoking certification. The Commissioner may revoke certification to prepare and approve nutrient management plans if the certificate holder:

   (1) Is no longer qualified;

   (2) Fails to comply with these rules;

   (3) Fails to notify the Department after a plan is developed or approved; or

   (4) Fails to use appropriate BMPs to minimize contamination of ground and surface water.

B. Notice. When the Commissioner decides to revoke a certification, he shall give the certificate holder a written notice of the certification revocation immediately following the decision. The notice shall be sent by certified mail, return receipt requested, and must include:

   (1) The name and address of the person whose certification is revoked;

   (2) The certification number being revoked;

   (3) The effective date of certification revocation;
(4) A statement or list of reason(s) why certification is being revoked; and

(5) Notice of the right to request a hearing in accordance with Section 7.5(C) of these rules.

C. Hearing on Certification Revocation

(1) The Commissioner shall hold a hearing on a certification revocation when:

(a) A person receiving a notice of revocation requests a hearing in writing to the Commissioner

(b) The request for a hearing is made no later than 30 days after receipt of the revocation notice required under §7.5 (B) of these rules.

(2) The Commissioner shall notify the person requesting a hearing in writing of the date, time and location of the hearing.

(3) The hearing shall be held in accordance with the requirements of 5 M.R.S.A. chapter 575, subchapter IV (Administrative Procedure Act). Evidence may be presented at the hearing that might justify reinstatement of the certification.

D. Decision. If the Commissioner finds the certificate holder has complied with §7.4 of these rules, the certification shall be reinstated. The Commissioner shall notify the certificate holder of the decision, in writing, within 30 days of the decision. The written notice shall be sent by certified mail, return receipt requested, and shall contain notice of the right to appeal the Commissioner’s decision to the Nutrient Management Review Board in accordance with §9 of these rules.

E. A certificate holder aggrieved by the decision of the Commissioner to revoke a certification may waive the hearing before the Commissioner and may appeal the decision directly to the Nutrient Management Review Board in accordance with §9 of these rules. A waiver of the hearing before the Commissioner must be in writing and must be signed by the certificate holder.

6. Recertification

A. Unless certification has been revoked in accordance with these rules, recertification will be granted upon appropriate application every five years based on the applicant’s obtaining the necessary requisites for recertification and submittal of the $35 recertification fee. In order to obtain the necessary requisites for recertification, the applicant must either:

(1) Retake the certification exam,
(2) Earn credits at workshops, courses or seminars preapproved for credit by the Department in accordance with Section 6.B below. The number of credits needed are:

(a) Commercial/ Public NMP Specialist - 10 credits per 5 year recertification interval.

(b) Private NMP Specialist - 6 credits per 5 year recertification interval; or

(3) In the case of persons certified in accordance with §7.1 (2)(A) of these rules, maintain their certification through the appropriate national certifying program.

B. Recertification credits

(1) Recertification credits will be available only through the attendance of workshops, courses or seminars pre-approved by the Department. The workshop, course or seminar must include the presentation of Nutrient Management topics.

(2) Nutrient Management topics includes, but is not limited to:

(a) Nutrient Management

(b) Applicable laws and regulations

(c) Water quality

(d) Soil management

(e) Erosion control

(f) Agricultural Best Management Practices

(g) Composting of farm material or regulated residuals

(3) Approval of seminar, course or workshop for recertification credits. To qualify for Departmental approval of recertification credits, the following minimum requirements must be met:

(a) A syllabus or outline of the seminar, course or workshop must be provided to the Department in advance and must, at a minimum, identify the length of the program, the nutrient management topics to be discussed and the presenter(s); and

(b) "Recertification Attendance and Credit Form(s)", available from the Department of Agriculture-OANRR or other affiliates, must be obtained for distribution at the seminar, course or workshop. The attendees should be told before the seminar, course or workshop
that credits are being offered towards recertification. The forms should be distributed at the end of the seminar, course or workshop, and

(c) The organizer of a qualified seminar, course or workshop must provide an attendance report to the Department.

(d) The Department will review the seminar, course or workshop agenda/curriculum, and if it qualifies, will assign a credit value. The Department may send a copy of the submitted form to the person requesting the credits, with information such as qualification of the event and amount of credits awarded.

(4) Qualification of attendees for recertification credits. To qualify for Departmental approval of recertification credits awarded at qualifying seminar, course or workshop, attendees must:

(a) Complete a "Recertification attendance and credit form(s)" provided at the seminar, course or workshop. If the seminar, course or workshop is given over several days, the attendee must fill out one form for each day he/she has attended.

(b) Attach a certificate of successful completion or any other valid proof of successful completion to the form, if none was submitted under §7.6.B.3(c).

(c) Submit the completed form and proof of successful completion to the Department-OANRR.

(5) An individual who conducts or presents at a seminar, course or workshop for which the Department assigns credits may be eligible for extra credits for each hour-long presentation on appropriate topics.

(6) A person who fails to accumulate the necessary credits shall re-apply to take the exam required for initial certification.

§8. Livestock Operations Permits

1. Operations requiring a permit

A. The owner or operator of a Concentrated Animal Feeding Operation shall obtain a Livestock Operations Permit or a provisional Livestock Operations Permit from the Commissioner.

B. The owner or operator of any animal feeding operation having more than 300 animal units shall obtain a Livestock Operations Permit or a provisional
Livestock Operations Permit from the Commissioner, unless that operation
confined and fed that same number of animal units prior to April 15, 1998.12

C. Any animal feeding operation that proposes to expand or expands beyond its
manure storage capacity or land base used for spreading must obtain a Livestock
Operations Permit or a provisional Livestock Operations Permit from the
Commissioner. The proposed expansion of an operation beyond its current
manure storage capacity or land base used for spreading must be determined as a
part of an update to the nutrient management plan that is required under section
6(2) of these rules.13

2. Submission requirements - The owner or operator of an animal feeding operation seeking
a livestock operations permit shall submit the following to the Commissioner:

A. A copy of an approved Nutrient Management Plan for the operation for which a permit
is being sought.14 The Nutrient Management Plan must meet the requirements
established in §6.1 of these rules.

B. Application Form. A completed and signed copy of the Livestock Operations
Permit Application Form as prescribed by the Commissioner.

C. Other information. After the Nutrient Management Plan and application form
have been reviewed, the Commissioner may notify the applicant if additional
information is necessary to make a determination on issuing the permit.

3. Inspection Requirements

A. Inspection of Existing Farms. Prior to issuing a permit or a provisional permit to
an existing operation, the Commissioner (or designee) shall inspect the livestock
operation to determine that it has an adequate nutrient management plan and is
following that plan and to insure that adequate provisions have otherwise been
made for the storage, handling and spreading of all nutrients generated or used
on the farm. The inspection may also determine if there are or may be impacts on

12Note: An operation is considered to have 300 animal units if it confines and feeds any combination of
animals totaling 300,000 lb. live animal weight. Without limitation, some examples are:
145 dairy cows (plus an equivalent number of young cattle) (1400 lb/ mature animal)
215 dairy cows with no young cattle (1400 lb/animal)
300 beef cows (1000 lb/animal)
750 sows or finishing pigs (400 lb/animal)
6000 feeder pigs (50 lb/animal)
300 horses (1000 lb/ animal)
3,000 sheep (100 lb/animal)
16,500 turkeys (18 lb/animal)
60,000 laying hens/broilers (5 lb/animal)

13Note: The owner or operator may use design standards outlined in NRCS Code 313, 5:96 to determine
if the operation will exceed design capacity of the manure storage.

14Note: The Nutrient Management Plan submitted as a requirement for a Livestock Operation Permit is
confidential and is not a public record.
the environment or other uses in the area associated with manure and other nutrient management on the farm.

B. Inspection of New Operations. Prior to issuing a permit or a provisional permit to a proposed new livestock operation, the Commissioner (or designee) shall make a site visit to the proposed location for the livestock operation to determine that the plans for the proposed operation will adequately deal with impacts on the environment and other uses in the area. After the facility has been constructed and is in operation, the Commissioner (or designee) shall inspect the operation to determine that it is being managed in accordance with the nutrient management plan submitted to the Department and to determine that adequate provisions have been made for the storage, handling and spreading of all nutrients generated or used on the farm. The inspection may also determine if there are or may be impacts on the environment or other uses in the area associated with manure and other nutrient management on the farm.

C. Inspection Items. The inspector shall, at a minimum, examine:

(1) The nutrient management plan to determine if it is consistent with existing conditions on the farm at the time of inspection.

(2) Records (or projections for new operations) of amount of manure produced or brought on to the farm

(3) Records (or projections for new operations) of amount of other nutrients produced or brought on to the farm

(4) Storage facilities

(5) Manure handling procedures and equipment

(6) Spreading sites, including buffers and setbacks

(7) Field stacking sites, if applicable

(8) Location of neighbors, water bodies, wetlands, wells and any other sensitive resources or activities

4. Application review and approval process

A. Operations with less than 1000 Animal Units\textsuperscript{16}. Upon receipt of an application and nutrient management plan for a livestock operation with less than 1000 animal units, the Department shall:

(1) Send the applicant a letter acknowledging receipt within 5 working days of receiving the application.

\textsuperscript{16}Note: A livestock operation permit is not automatically required for all farms under 1000 animal units, but only for those falling in one of the categories stated in §8.1.
(2) Review the application and nutrient management plan for a
determination of completeness within 30 days of receipt.

(3) Notify the applicant in writing of the determination of completeness
within 10 days of completing the review.

(4) Schedule a site review or facility inspection to be conducted within 30
days of the determination of completeness, weather and site conditions
permitting. Note: Inspections may not be possible during the winter, thus
delaying the scheduling of the site review or inspection.

(5) Conduct site review or facility inspection based on the inspection
requirements in these rules.

(6) Make a determination within 30 days of site review or facility
inspection, on whether to issue a Livestock Operation Permit and what
conditions will be included in the permit. The Commissioner shall issue
such a permit if he finds that:

(a) The Nutrient Management Plan is complete, correctly prepared
and approved by a certified Nutrient Management Planning
Specialist;

(b) The operation has adequate storage capacity for the manure that
will be generated or used on the farm during the permit period;

(c) The manure storage structure(s) and stacking sites conform to
the requirements of these rules;

(d) The operation has adequate land base for the manure that will be
generated or used on the farm during the permit period or that
alternate uses have been identified for any surplus manure;

(e) The handling, storage and utilization of manure and other
nutrients will not cause an unreasonable impact on the
environment or existing uses in the area; and

(f) For proposed operations on new sites, the site proposed is
suitable for an animal feeding operation based on soils, slopes,
location and other factors affecting sensitive resources and
existing uses.

(7) Notify the applicant within 10 working days of the Commissioner’s
decision to issue or deny the permit.

(8) In the event that one or more of the requirements stated in §8.4 (A)(6) are
not met or are incomplete, the Commissioner (or designee) may issue a
provisional Livestock Operation Permit, as specified in §8.7 of these rules.
B. Operations with Greater than 1000 Animal Units. The process for issuing a permit for operations with greater than 1000 animal units includes all the requirements for operations involving less than 1000 AU and may include additional steps set by the Commissioner to enable adequate review including a requirement to provide public notice by the facility owner or operator and a requirement for a public hearing or meeting prior to issuing the permit. The Commissioner may require special permitting conditions for new or existing operations with over 1000 animal units or operations expanding to greater than 1000 animal units.

C. Designation of a CAFO. The Department may designate an operation as a CAFO in situations where there are unresolved problems of Water Quality or Nutrient Management. This designation will be based on an inspection of the operation by the Commissioner (or designee) and other relevant information available to the Department. The information will be shared with DEP, to be used in joint decision processes related to CAFOs. An operation designated as a CAFO under this section must apply for a Livestock Operation Permit following the procedure outlined in §8.4 of these rules.

D. MPDES Requirements for CAFOs. When an operation is defined as a CAFO by the Department, copies of relevant material will be provided to DEP to determine its eligibility for a MPDES permit.

E. Note: The Department intends to develop additional rules that provide for this process in future rule-making.

5. Issuance of a Livestock Operation Permit

A. Permit Content. The Livestock Operations Permit authorizes the named livestock operation to operate at the location designated in the permit for a period of 5 years from the issue date and under the conditions set forth in the permit, with which the permittee must comply. Without limitation, the permit will contain the following conditions unless the Commissioner otherwise determines:

1. A condition that the operation must operate in accordance with the approved nutrient management plan as submitted to the Department, unless the Commissioner otherwise prescribes, and otherwise must comply with all applicable legal requirements.

2. A condition that the operation must prepare and submit to the Department periodic updates of the nutrient management plan as required by these rules.

3. A condition that the operation must not degrade the quality of ground or surface waters through failure to properly use and maintain Best Management Practices.

4. Specific conditions established by the Commissioner in order to protect the environment and other uses in the area.
B. Term of Permit. Livestock Operation Permits are valid for 5 years from the issue date so long as their conditions are met. Any livestock operation that is required to have a permit under these rules must obtain a new Livestock Operations Permit before the expiration date of the previous permit.

C. Permit Application Fee. The owner or operator of a livestock operation having less than 1000 animal units shall pay a permit fee of $50 at the time of submission of the application. The owner or operator of a livestock operation with 1000 or more animal units shall pay a permit fee of $200 at the time of submission of the application.

D. Effective Date. Any livestock operation requiring a permit under these rules must have a permit and an approved nutrient management plan in compliance with these rules no later than May 1, 1999.

6. Revocation of a Permit

A. Basis of permit revocation. A Livestock Operations Permit may be revoked if:

(1) The livestock operation fails to comply with any of the conditions of the permit or;

(2) Any of the information upon which the permit is based is false, misleading or inaccurate.

B. Notice of Permit Revocation. The Commissioner shall give the Permittee a written notice of the permit revocation immediately following a decision to revoke. The notice shall be sent by certified mail, return receipt requested, and must include:

(1) The name and address of operation whose permit is revoked;

(2) The permit number being revoked;

(3) The effective date of permit revocation;

(4) A statement or list of the reason(s) why the permit is being revoked; and

(5) A notice of the right to request a hearing in accordance with Section 8.6(C) of these rules.

C. Hearing on Permit Revocation

(1) The Commissioner shall hold a hearing on a permit revocation when:

(a) An operation receiving a notice of revocation requests a hearing in writing to the Commissioner and;

(b) The request for a hearing is made no later than 30 days after receipt of the revocation notice required under §8.6(B).
B. Term of Permit. Livestock Operation Permits are valid for 5 years from the issue date so long as their conditions are met. Any livestock operation that is required to have a permit under these rules must obtain a new Livestock Operations Permit before the expiration date of the previous permit.

C. Permit Application Fee. The owner or operator of a livestock operation having less than 1000 animal units shall pay a permit fee of $30 at the time of submission of the application. The owner or operator of a livestock operation with 1000 or more animal units shall pay a permit fee of $200 at the time of submission of the application.

D. Effective Date. Any livestock operation requiring a permit under these rules must have a permit and a approved nutrient management plan in compliance with these rules no later than May 1, 1999.

6. Revocation of a Permit

A. Basis of permit revocation. A Livestock Operations Permit may be revoked if:

(1) The livestock operation fails to comply with any of the conditions of the permit or;

(2) Any of the information upon which the permit is based is false, misleading or inaccurate.

B. Notice of Permit Revocation. The Commissioner shall give the Permittee a written notice of the permit revocation immediately following a decision to revoke. The notice shall be sent by certified mail, return receipt requested, and must include:

(1) The name and address of operation whose permit is revoked;

(2) The permit number being revoked;

(3) The effective date of permit revocation;

(4) A statement or list of the reason(s) why the permit is being revoked; and

(5) A notice of the right to request a hearing in accordance with Section 8.6(C) of these rules.

C. Hearing on Permit Revocation

(1) The Commissioner shall hold a hearing on a permit revocation when:

(a) An operation receiving a notice of revocation requests a hearing in writing to the Commissioner and;

(b) The request for a hearing is made no later than 30 days after receipt of the revocation notice required under §8.6(B).
(2) The Commissioner shall notify the operation requesting a hearing, in writing, of the date, time and location of the hearing.

(3) The hearing shall be held in accordance with the requirements of M.R.S.A. chapter 375 subchapter IV (Administrative Procedure Act). Evidence may be presented at the hearing that might justify reinstatement of the permit.

D. Decision. If the Commissioner finds the permit holder has complied with the requirements in §8.4 the permit shall be reinstated. The Commissioner shall notify the operation of the decision, in writing, within 30 days of the decision. The written notice shall be sent by certified mail, return receipt requested, and shall contain notice of the right to appeal the Commissioner’s decision to the Nutrient Management Review Board in accordance with Section 9 of these rules.

E. A permit holder aggrieved by the decision of the Commissioner to revoke a Livestock Operation Permit may waive the hearing before the Commissioner and may appeal the decision directly to the Nutrient Management Review Board in accordance with §9 of these rules. A waiver of the hearing before the Commissioner must be in writing and must be signed by the permit holder.

7. Provisional Livestock Operations Permit. The Commissioner may issue a provisional Livestock Operations Permit if one or more of the submission requirements stated in §6 of these rules is incomplete, not submitted or does not conform to the approved Nutrient Management Plan for the named operation. In issuing a provisional permit, the Commissioner shall consider existing nutrient management practices on the farm, the protection of groundwater and surface water, the cost of implementing the plan and the availability of financial assistance to implement the plan.

A. Limitations of the Provisional Livestock Operations Permit. A provisional permit does not replace a livestock Operations Permit nor does it guarantee that a Livestock Operations Permit will be obtained if the submission requirements for the latter are not met when the provisional permit expires.

B. Provisional Livestock Operations Permit Content. The provisional Livestock Operations Permit authorizes the named livestock operation to operate at the location designated in the permit for a maximum period of one year or until all the requirements to obtain a Livestock Operations Permit are met, whichever comes first.

C. Term of Provisional Permit. Provisional Livestock Operations Permit are valid for a maximum of one year from the issuance date as long as their conditions are met and actions are taken to fulfill the Livestock Operations Permit requirements. Provisional permits can be renewed one time provided the extension is solely to complete and conform to submission requirements stated in §6. Any livestock operation that is required to have a permit under these rules must obtain a Provisional Livestock Operations permit or a new Livestock Operations Permit before the expiration date of the previous permit.
D. Revocation of a Provisional Livestock operation Permit.

(1) Basis for revoking provisional permit. A provisional Livestock Operations Permit may be revoked if:

(a) The livestock operation fails to comply with any of the conditions stated in the Provisional Permit.

(b) Any of the information upon which the permit is based is false, misleading or inaccurate.

(2) The Commissioner shall follow the same procedures in revoking a provisional permit as outlined in Section 8.6 above.

(3) The notice of revocation, hearing provisions and appeal process for a provisional permit revocation shall follow the same procedure as for the full Livestock Operation Permit, as described in §8.6 (B) to (E).

§9. Appeals to the Nutrient Management Review Board

1. The decision of the Commissioner to deny a variance, to revoke a certification to prepare and approve Nutrient Management Plans, or to revoke a full or provisional Livestock Operation Permit, may be appealed to the Nutrient Management Review Board by filing a notice of appeal with the Board.

2. The notice of appeal must be in writing and must be received by the Board no later than thirty (30) days of receipt from the Commissioner of notice of the decision being appealed. The appeals notice must contain:

   A. Reference to the decision that is being appealed;

   B. The basis for making the appeal; and

   C. Information that shows why the decision should be changed.

3. Public Hearing. Unless the right is waived by all parties to the appeal, a public hearing on the appeal shall be conducted by the Nutrient Management Review Board.


5. Process for Making the Determination. The Nutrient Management Review Board shall make a determination on the appeal as expeditiously as possible and shall notify the person filing the appeal of the outcome in writing. In doing so, the Board shall consider whether the requirements of these rules and the Nutrient Management Law have been met, may request such additional information as it deems necessary for the determination of the issue(s), and may affirm, overturn or alter the Commissioner’s decision. The Board’s decision shall be a final agency action.
STATUTORY AUTHORITY: These rules are adopted under the statutory authority contained in 7 M.R.S.A. Chapter 747, Nutrient Management Act.

EFFECTIVE DATE: December 14, 1998 - (APA Office Note: §§8(6), §8, §9, and Attachment E, were major substantive parts of this chapter and required legislative review.)

NON-SUBSTANTIVE CORRECTIONS: January 20, 1999 - minor spelling and formatting; attachments split into a separate file.

AMENDED: February 17, 2001
May 7, 2002 - Section 7

NON-SUBSTANTIVE CORRECTIONS: January 24, 2007

CORRECTIONS: February, 2014 – agency names, formatting

(APA Office Note: the attachments are in a separate file.)
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY

Chapter 56b: STANDARDS FOR COMPOST PRODUCTS

Developed by
The Maine Department of Agriculture,
Conservation and Forestry

In Conjunction With
The Maine Department of Transportation,
The Maine Department of Environmental Protection,
and
The Soil and Water Conservation Commission

January 16, 1991

Section

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STANDARDS FOR COMPOST PRODUCTS

The Maine Department of Agriculture,
Conservation and Forestry

1. AUTHORIZATION

The Department of Agriculture, Conservation and Forestry was given the responsibility for developing compost standards in Public Law 1989, Ch. 585 subsection 1812-C (5 MRSA subsection 1812-C).

2. PURPOSE

These compost standards are intended to be used by state agencies in purchasing compost products made from organic waste products or for writing specifications for licenses, permits and contracts that may call for the use of such products. These standards have been developed and adopted by the Department of Agriculture, Conservation and Forestry as mandated. They may be voluntarily used or adopted by other agencies for their own programs.

3. USE OF SPECIFICATIONS REQUIRED

All projects supported by funding from the Maine Department of Agriculture, Conservation and Forestry shall use the compost product specifications outlined in Section 6 of these rules, when purchasing compost products in volumes greater than 10 cubic yards.

4. DEFINITIONS

Compost - Organic materials which have undergone biological decomposition, and have been disinfected using composting or similar technologies, and have been stabilized to a degree which is potentially beneficial to plant growth.

Compost Grades - Classifications of compost materials based on nutrient content.

Some suggested grades are:

Nutrient grade compost - A compost applied to soil as a nutrient source. Nutrient levels are measurable and meet state's minimum levels to qualify for fertilizer status (see Appendix). Conductivity is greater than 4 mnhos/cm. It may contain appreciable lime equivalent.

Topsoil grade compost - Compost or compost soil mixture with organic content 4 - 40%, conductivity less than 2 mnhos/cm. Used as a soil replacement. Density is normally 1000-1600 lbs. per cubic yard.

Horticultural grade - A compost with organic matter greater than 25%. Conductivity is less than 1 mnhos/cm or mixed with other materials to achieve this level. Density is normally less than 1000 lbs. per cubic yard.
Composting - The process by which biological decomposition of organic materials is carried out under controlled aerobic conditions, and which stabilizes the organic fraction into a material which can easily and safely be stored, handled and used in an environmentally acceptable manner. (The presence of anaerobic zones within the composting material will not cause the process to be classified as something other than composting.) Simple exposure of solid waste under uncontrolled conditions resulting in natural decay is not composting.

Conductivity - A measure of the soluble salts in the soil. This is used as an overall indicator of the level of macro and micro nutrients in the soil. Conductivity is measured in units of millims per centimeter (mmhos/cm).

D.E.P. - The Department of Environmental Protection including the Board of Environmental Protection and the Commissioner.

Foreign Matter - Sticks, stones, clods, roots, glass, plastic, metal or other unwanted non-compostable materials that may be present in compost.

Heavy Metals - Those elements that are regulated because of their potential for human, plant or animal toxicity including but not limited to cadmium (Cd), copper (Cu), chromium (Cr), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn).

Loam. Soil textural class that consists of a mixture of sand (52%), silt (28-50%), and clay (7-27%) measured on a weight basis.

Mesophilic Stage - The stage of the composting process in which the rate of biological activity is high enough to maintain an average pile temperature of at least 90 degrees F (32 oC). This stage follows the thermophilic stage. It is in this stage that continued decomposition and stabilization occurs.

Mulch - A protective covering of various substances, especially organic, placed around plants to prevent erosion, compaction, evaporation of moisture, and freezing of roots and to control weeds.

On-site mixing - The practice of creating a soil mixture by spreading compost on the surface of the site to be prepared and tilling it into the top 3 to 6 inches of the existing soil. This practice would be used primarily for establishing grass cover (or other crop) on large open areas.

Pathogen - An organism, chiefly a microorganism, including viruses, bacteria, fungi, and all forms of animal parasites and protozoa, capable of producing an infection or disease in a susceptible plant or animal host.

PCB's - Polychlorinated Biphenyls; A class of chlorinated aromatic hydrocarbons representing a mixture of specific biphenyl hydrocarbons which are thermally and chemically very stable.
**PFRP - A Process to Further Reduce Pathogens.** The D.E.P. considers the following compost processes to qualify as a PFRP.

<table>
<thead>
<tr>
<th>Method</th>
<th>Minimum Temperature</th>
<th>Minimum Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Aerated Pile</td>
<td>55°C</td>
<td>3 days*</td>
</tr>
<tr>
<td>Within Vessel</td>
<td>55°C</td>
<td>3 days*</td>
</tr>
<tr>
<td>Windrow</td>
<td>55°C</td>
<td>15 days*</td>
</tr>
</tbody>
</table>

Using the windrow composting method, there will be a minimum of five turnings of the windrow during the high temperature period.

* Aerated static piles must remain in the pile for at least 21 days. All three approaches are required to retain compost in a curing pile for at least 21 days following the active composting period.

Attaining a PFRP is essential for composts containing sludge or septage if the compost is to be distributed to the public.

**PSRP - A Process to Significantly Reduce Pathogens.** The D.E.P. considers the following composting processes to qualify as a PSRP.

<table>
<thead>
<tr>
<th>Method</th>
<th>Minimum Temperature</th>
<th>Minimum Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Aerated Pile</td>
<td>40°C</td>
<td>5 days</td>
</tr>
<tr>
<td>Within Vessel</td>
<td>40°C</td>
<td>5 days</td>
</tr>
<tr>
<td>Windrow</td>
<td>40°C</td>
<td>5 days</td>
</tr>
</tbody>
</table>

For four hours during this period the temperature exceeds 55 degrees C.

Compost attaining a PSRP may be spread only on restricted sites.

**Putrefactive -** As result of the partial decay of organic matter.

**Saturated Paste Extract Method -** An approach for analyzing compost materials in which water is added to the compost until it just reaches saturation. This mixture is then allowed to sit for about 1 1/2 hours prior to performing tests. Conductivity, soluble nutrients and pH are often tested using this approach.

**Stabilized -** Means that the compost has at least passed through the thermophilic stage, and that biological decomposition of the organic materials has occurred to a sufficient degree that will allow
beneficial use. See Section 5.A. for a description of stability levels and the methods for distinguishing them.

**Static Aerated Pile Method** - A method of composting in which materials are piled over perforated pipes or air ducts so that the piles may be aerated using blowers to either force air up through or draw air down through the compost mass.

**Thermophilic Stage** - The stage of the composting process in which the rate of biological activity is high enough to maintain an average pile temperature of at least 130 degrees F (55°C). This stage favors decomposition by thermophilic (heat loving) bacteria. It is in this stage that the most rapid destruction of pathogenic organisms occurs.

**Topsoil** - Soil that consists of various mixtures of sand, silt, clay and organic matter. Normally considered to be the nutrient rich top layer of soil that supports plant growth.

**Windrow Method** - A method of composting in which materials are placed in long narrow piles (windrows) and aerated by physically turning the materials.

**Within-vessel Method** - A method of composting in which compostable materials are placed in an enclosed drum, bin or other vessel. Aeration is accomplished through rotation of the drum or through forced aeration.

5. **COMPOST QUALITY INFORMATION**

Several quality measures are suggested in the sections describing materials for particular purposes. Some of these quality measures are described here for the convenience of anyone using these standards.

5.A. **Compost Stability Levels**

Three compost stability levels are recognized. These are:

**Mature** - Highly stabilized, generally will not reheat to 20 degrees C above ambient, reduction of organic matter greater than 60 percent by weight.

**Semi-mature** - In the mesophilic stage (has passed through thermophilic stage but has not completed the mesophilic stage). Generally will reheat to 20 degrees C above ambient temperature. Reduction of organic matter by 40-60 percent by weight.

**Fresh** - Through thermophilic stage but still in the early part of the mesophilic stage, partial decomposition. Material will easily reheat to 20 degrees C above ambient level. Reduction of organic matter by 20-40 percent by weight.

5.B. **Measuring Stability**

Stability may be determined by checking for reheating and measuring the reduction in organic matter content. An alternative approach that may be used is to have a laboratory perform an oxidation/reduction test or other test that would measure the level of respiration that is taking place.
5.B.1. Reheating Test

To determine if the material will reheat to 20 degrees C above the ambient temperature, follow the following procedure:

Re-pile compost into a pile at least six feet in diameter and four feet high. Provide aeration to this pile. Moisture content of the material in this pile must be between 35 and 60% in order for this test to be valid. Three days after the pile has been formed, the temperature of the compost should be measured at a point about two feet into the pile. This temperature should be compared to the ambient temperature.

5.B.2. Reduction of Organic Matter

The percent reduction of organic matter is a measure of the loss of decomposable material in comparison to the amount present prior to composting. To make this comparison, use the following procedure:

Prior to composting and again following composting, have material tested for the percent organic matter on a dry weight basis. Use these before and after figures to calculate the percent reduction in organic matter using the following formula:

\[ \text{percentage reduction} = \frac{1 - \frac{\% A (100 - \% B)}{\% B (100 - \% A)}}{\% B (100 - \% A)} \times 100 \]

Where A is organic matter percentage after composting and % B is organic matter percentage before composting. E.g. using this formula we have calculated the percent of organic matter in the final product necessary to meet various levels of reduction if we started out with 65 percent organic matter.

<table>
<thead>
<tr>
<th>% organic matter in original mix (before composting)</th>
<th>% reduction in organic matter</th>
<th>% organic matter in final product (after composting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65%</td>
<td>20%</td>
<td>59.8%</td>
</tr>
<tr>
<td>65%</td>
<td>40%</td>
<td>52.7%</td>
</tr>
<tr>
<td>65%</td>
<td>60%</td>
<td>42.6</td>
</tr>
</tbody>
</table>

5.C. pH and CaCO3 Equivalency

For most applications, a pH near neutral is desirable so it is important to know the acidity or basicity of the amendment being used. In cases where the pH of the compost material is not close to neutral, (≤6.1 or ≥7.8) the supplier should provide data on either its Liming value or the amount of lime needed to neutralize the product both on a calcium carbonate equivalency basis. For example, if the pH of the material was 5.5, the supplier would be required to indicate
how many pounds (CaCO₃ equivalents) of liming materials would be needed to bring 100 lbs. of this product to a pH of 7.0. If, on the other hand, the pH was reported to be 8.5, the supplier should indicate how many pounds of CaCO₃ equivalents would be provided by 100 pounds of the product.

**Measurement of pH.** When measuring the pH on compost products, it to test them on an "as is" basis rather than drying them first, since this may affect the results. Given the sample "as is", the pH should be tested by the saturated paste extract method.

5.D. Contaminants

The contaminants that must be measured are those regulated by D.E.P. These are listed in the table below. Acceptable levels of other contaminants will be determined by the use for the product and are discussed in the sections covering specific uses.

**D.E.P. ALLOWABLE CONCENTRATIONS OF HEAVY METALS AND ORGANIC CHEMICAL POLLUTANTS**

<table>
<thead>
<tr>
<th>Element</th>
<th>Maximum Permissible Concentrations (mg/kg dry weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium (Cd)</td>
<td>.................................................. 10</td>
</tr>
<tr>
<td>Chromium (Cr)</td>
<td>.................................................................. 1,000</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>.................................................................. 1,000</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>.................................................................. 700</td>
</tr>
<tr>
<td>Mercury (Hg)</td>
<td>.................................................................. 10</td>
</tr>
<tr>
<td>Nickel (Ni)</td>
<td>.................................................................. 200</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>.................................................................. 2,000</td>
</tr>
</tbody>
</table>

**Maximum Permissible Concentrations of Organic Chemical Pollutants**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Maximum Permissible Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polychlorinated Biphenyls (PCB's)</td>
<td>.................................................. 10 ppm</td>
</tr>
</tbody>
</table>

**Dioxin Equivalent**

- Food Chain Crops: .................................................. 27 ppt
- Non-Food Chain: .................................................. 27 - 250 ppt

*See DEP Landspreading Rules (Chapter 567) for restrictions on the use of land on which this material has been spread.*

5.E. Foreign Matter

In many cases, the acceptability of compost based on its foreign matter content can be determined by visually inspecting representative samples of the product. In cases where a more precise approach is needed to determine foreign matter content, the following method, developed by the Florida Department of Environmental Regulations, may be used:

Foreign matter content may be determined by passing a dried, weighed sample of the compost product through a one-quarter inch or six millimeter screen. The material remaining on the
screen is visually inspected, and the foreign matter that can be clearly identified is separated and weighed. The weight of the separated foreign matter divided by the weight of the total sample multiplied by 100 is the percentage dry weight of the foreign matter content.

5.F. Reporting Nutrient Content

Section 6 of these rules includes requirements that suppliers provide information on nutrient content of their compost product. Maine fertilizer law, however, requires that products labeled with a nutrient analysis or advertised based on nutrient content must be registered as a fertilizer. This registration requires both the provision of guarantees for the nutrient analysis and the payment of a tonnage tax. It is not the intent of these rules to force compost suppliers to register their product as a fertilizer if, in fact, they are selling it as a soil amendment.

The following standard will be used to determine if a product must be registered as a fertilizer:

1. If the nutrient analysis appears on the product label or any promotional material used to advertise the product, it will be considered to be sold for its nutrient content and so will be required to register as a fertilizer.

2. If the nutrients appear on a fact sheet or laboratory analysis sheet provided to a buyer upon a buyer's request so that the buyer may know how to properly mix or apply the material, this will not be considered to constitute making claims based on nutrient content and will not require the material to be registered as a fertilizer.

6. COMPOST PRODUCT SPECIFICATIONS

6.A. Compost Product - Topsoil/topsoil Substitute Class A

Nutrient grade or topsoil grade compost may be mixed with mineral soil to create topsoil. By the appropriate blending, a topsoil of the desired characteristics may be created. The mixture of the compost with mineral soil to create topsoil will depend on nutrients, soluble salt levels and organic matter content. See APPENDIX A for suggested mix ratios.

Use for Materials - Any use for topsoil where public is likely to be in direct contact with the material, e.g., seedbed for slope stabilization, roadside revegetation, backfill for tree and shrub planting, turf establishment on ballfields and playgrounds and other landscaping applications.

6.A.1. Characteristics to Consider

A good compost material for this purpose will be mature, loose and friable, dark brown or black in color and low enough moisture content to handle easily. Odors should be minimal. It will have virtually no human pathogens. (For composts that contain municipal sludge, septage, or animal manures, this can be achieved by meeting DEP's PFRP requirements. For areas such as playgrounds and ballfields where children may frequently be in close contact with the soil, extra precautions may be warranted. This could include actions such as requiring suppliers to provide additional testing of the material for Shigella sp. and/or E. coli if compost containing sludge or septage is used.) It will also have few or no weeds, viable seeds, roots, or rhizomes. Water holding
capacity will normally be quite high in these products. (Note: Some seeds such as
tomato seeds are very resistant and may survive even though PFRP requirements have
been met. Most weed seeds, however, will be killed in the composting process.)

Suppliers should be required to provide a list of all the ingredients in the original
compost mix in the order of their relative proportions on a weight basis. (i.e. all bulking
agents, nitrogen sources, and other additives, such as ash or stabilizers should be listed.)

In addition, suppliers of these materials should be asked to provide assurances that they
meet DEP heavy metal, PCB and dioxin limits and do not contain levels of any
chemicals that are harmful to plants or humans.

6.1.2. Measurements to Consider

Suppliers of compost products should be expected to provide data based on laboratory
analyses for each of the following measurements:

pH - Most composts fall into the 6.1 to 7.8 range. Some plantings require a pH outside
this range. See the Horticultural Recommendations for the type of plantings in
question.

CaCO3 equivalency - In cases where the pH of the compost material is not close to
neutral, (<6.1 or >7.8) the supplier should provide data on either its liming value or
the amount of lime needed to neutralize the product on a calcium carbonate
equivalency basis. Some composts with a higher pH have very little or no liming ability
while others may have a substantial liming effect. The desirability of having a liming
capacity will depend on the pH of the native soil and the requirements of the vegetation
to be established.

Coarseness - Virtually all particles should pass through a 3/8 inch sieve.

Nutrients - The NPK levels for the compost material should be provided by the
supplier.

Soluble Salt Concentrations - < 2 mmho/cm. in the final mix (See Appendix A.)

Density/Weight per Cu Yd - Compost would normally be 1,000-1,300 lbs/cu yd at
moisture content of 40 to 60%.

Moisture Content - If the compost has a moisture content between 40 and 60%,
handling characteristics should be acceptable.

Foreign Matter - less than 2 percent foreign matter on a dry weight basis.

6.1.3. Mixing with Mineral Soil

Organic Matter Content - When mixed with mineral soil, organic matter should be at
least 3 percent of final mix.
Premixed vs. On-site mixing - For many applications such as establishing planting beds for ornamentals or backfill for tree planting, artificial topsoil should be premixed. On-site mixing will be practical when relatively small quantities of compost will be used on large relatively flat areas as is done with turf establishment. See Appendix A for suggested mix ratios.

6.B. Compost Product - Topsoil/Topsoil Substitute Class B

Nutrient grade or topsoil grade compost may be mixed with mineral soil to create topsoil. By the appropriate blending, a topsoil of the desired characteristics may be created. The mixture of the compost with mineral soil to create topsoil will depend on nutrients, soluble salt levels and organic matter content. See APPENDIX A for suggested mix ratios.

Use for Material - Any use for topsoil where public contact is minimal, e.g. seedbed for slope stabilization, roadside revegetation, tree and shrub planting, gravel pit reclamation, reseeding logging landings, final landfill cover.

6.B.1. Characteristics to Consider

A good compost material for this purpose will be mature or semimature, loose and friable, brown or black in color and low enough in moisture content to handle easily. It may have an odor as long as it is not foul or putrefactive. It will have few, if any, human pathogens. (For composts that contain municipal sludge, septage, or animal manures, this can be achieved by meeting DEP’s PFRP requirements.) It will also have few or no weeds, viable seeds, roots, or rhizomes. Water holding capacity will normally be quite high in these products. (Note: Some seeds such as tomato seeds are very resistant and may survive even though PFRP requirements have been met. Most weed seeds, however, will be killed in the composting process.)

Suppliers should be required to provide a list of all the ingredients in the original compost mix in the order of their relative proportions on a weight basis. (i.e. all bulking agents, nitrogen sources, and other additives, such as ash or stabilizers should be listed.)

In addition, suppliers of these materials should be asked to provide assurances that they meet DEP heavy metal, PCB and dioxin limits and do not contain levels of any chemicals that are harmful to plants.

6.B.2. Measurements to Consider

Suppliers of compost products should be expected to provide data based on laboratory analyses for each of the following measurements:

pH - Most composts fall into the 6.1 to 7.8 range. Some plantings require a pH outside this range. See the Horticultural Recommendations for the type of plantings in question.

CaCO3 equivalency - In cases where the pH of the compost material is not close to neutral, (≤6.1 or ≥7.8) the supplier should provide data on either its liming value or
the amount of lime needed to neutralize the product on a calcium carbonate equivalency basis. Some composts with a higher pH have very little or no liming ability while others may have a substantial liming effect. The desirability of having a liming capacity will depend on the pH of the native soil and the requirements of the vegetation to be established.

Coarseness - All particles should pass through a one inch sieve and 90% should pass through a half inch sieve.

Nutrients - The NPK levels for the compost material should be provided by the supplier.

Soluble Salt Concentrations - < 2 mmho/cm. in the final mix (See Table 1.)

Density/Weight per Cu Yd - Compost would normally be 1,000-1,300 lbs/cu yd at moisture content of 40 to 60%.

Moisture Content - If the compost has a moisture content between 40 and 60%, handling characteristics should be acceptable.

Foreign Matter - less than 4 percent foreign matter on a dry weight basis.

6.B.3 Mixing with Mineral Soil

Organic Matter Content - When mixed with mineral soil, organic matter should be at least 3 percent of final mix.

Premixed vs. On-site mixing - For many applications such as establishing planting beds for ornamentals or backfill for tree planting, artificial topsoil should be premixed. On-site mixing will be practical when relatively small quantities of compost will be used on large relatively flat areas as is done with turf establishment. See Appendix A for suggested mix ratios.

6.C. Compost Product - Topsoil/Topsoil Substitute Class C

Use for Material - Daily landfill cover

Compost may be mixed with mineral soil to create topsoil or may be used as produced. The mixture of the compost with mineral soil to create topsoil will depend on nutrients and soluble salt levels. See APPENDIX A for suggested mix ratios.

Landfill operators considering the use of materials other than soil for daily cover are required by D.E.P. Solid Waste Management Regulations to obtain D.E.P. approval before use.

6.C.1 Characteristics to Consider

A good compost material for this purpose may be mature or semimature. (Operators should consult with the D.E.P. Bureau of Solid Waste Management if they wish to use fresh compost.) It should also be loose and friable, and low enough in moisture content to
handle easily. It may have an odor as long as it is not foul or putrefactive. For composts that contain municipal sludge, or septage, DEP's PSRP requirements must be met.

Suppliers should be required to provide a list of all the ingredients in the original compost mix in the order of their relative proportions on a weight basis. (i.e. all bulking agents, nitrogen sources, and other additives, such as ash or stabilizers should be listed.)

In addition, suppliers of these materials should be asked to provide assurances that they exceed DEP heavy metal limits by no more than 200 percent, and that they meet the D.E.P. limits for dioxin and PCB's. Should materials exceed these levels, the D.E.P. Bureau of Solid Waste Management should be consulted prior to use.

6.C.2 Measurements to Consider

Suppliers of compost products should be expected to provide data based on laboratory analyses for each of the following measurements:

**pH** - Composts falling anywhere in the 5.5 to 8.5 range should be acceptable.

**Coarseness** - All particles should be less than 12 inches in largest dimension. At least 80 percent should pass through a one-inch sieve.

**Soluble Salt Concentrations** - < 10 mmho/cm. in the final mix (See Table 1.)

**Moisture Content** - If the compost has a moisture content under 60%, handling characteristics should be acceptable.

**Foreign Matter** - less than 50 percent foreign matter on a dry weight basis.

6.C.3. Mixing with Mineral Soil

Premixed vs. on-site mixing For daily landfill cover, artificial topsoil should be premixed. See Appendix A for suggested mix ratios.

6.D. Compost Product - Wetland Substrate

Use for Material - Reclamation of wetland areas.

Compost may be used as is, or mixed with naturally occurring soil to create a wetland substrate. By the appropriate blending, a soil of the desired characteristics may be created. The mixture to create the soil will depend on nutrients, soluble salt levels and organic matter content. Requirements for species to be established should be checked prior to determining the desired mixture.

6.D.1. Characteristics to Consider

A good compost material for this purpose will be mature or semimature, loose and friable, brown or black in color and low enough in moisture to handle easily. It may have an odor as long as it is not foul or putrefactive. It will have few, if any, human
pathogens. (For composts that contain municipal sludge, septage, or animal manures, this can be achieved by meeting DEP’s PFRP requirements.) It will also have few or no weeds, viable seeds, roots, or rhizomes. Water holding capacity will normally be quite high in these products. (Note: Some seeds such as tomato seeds are very resistant and may survive even though PFRP requirements have been met. Most weed seeds, however, will be killed in the composting process.)

Suppliers should be required to provide a list of all the ingredients in the original compost mix in the order of their relative proportions on a weight basis. (i.e. all bulking agents, nitrogen sources, and other additives, such as ash or stabilizers should be listed.)

In addition, suppliers of these materials should be asked to provide assurances that they meet DEP heavy metal, PCB and dioxin limits and do not contain levels of any chemicals that are harmful to plants. If composts proposed for use in wetlands has been made from materials thought to contain dioxin, the D.E.P. Bureau of Solid Waste Management should be contacted for guidance prior to use.

6.D.2. Measurements to Consider

Suppliers of compost products should be expected to provide data based on laboratory analyses for each of the following measurements:

pH - Most composts fall into the 6.1 to 7.8 range. Wetland soils normally have a pH of 3.6 to 4.4. To duplicate these soils, most composts would require pH adjustment. The pH of similar naturally occurring soils should be tested and substitute material should be adjusted to achieve the same pH level.

CaCO3 equivalency - For all composts being considered for use in wetland reclamation, the supplier should provide the CaCO3 equivalency. Some composts have very little or no liming ability while others may have a substantial liming effect. For this purpose, composts having little or no liming effect are preferred.

Coarseness - 85 - 95% should be less than 3 inches. Of the fraction less than 3 inches, the normal proportions passing different sieve sizes are as follows:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (0.25 in)</td>
<td>75 - 100</td>
</tr>
<tr>
<td>10 (0.10 in)</td>
<td>60 - 100</td>
</tr>
<tr>
<td>40 (0.025 in)</td>
<td>30 - 80</td>
</tr>
<tr>
<td>200 (0.005 in)</td>
<td>0 - 30</td>
</tr>
</tbody>
</table>

A similar size distribution should be acceptable in most cases.

Nutrients - The total and soluble NPK levels for the compost material should be provided by the supplier.

Soluble Salt Concentrations - < 1 mmho/cm. in the final mix.
Density/Weight per Cu Yd - Organic soils would normally be between 635 and 1590 lbs/cu yd when moist.

Moisture Content - If the compost has a moisture content between 40 and 60%, handling characteristics should be acceptable.

Foreign Matter - less than 2 percent foreign matter on a dry weight basis.


Organic Matter Content - When mixed with naturally occurring soil, organic matter should be 40 percent or more of final mix (if an organic substrate is required).

Premixed vs. on-site mixing - For most applications, artificial organic soil should be premixed. The practicality of on-site mixing may be limited by the ability of the site to support machinery and the depth of the organic layer to be established.

6.E. Compost Product – Mulch Class A

Use for Material - Soil stabilization on slopes.

6.E.1. Characteristics to Consider

A good compost material for this purpose will be mature, loose and friable, dark brown or black in color and low enough in moisture to handle easily. Unlike composts for other uses, mulch for slope stabilization should be fairly coarse and contain a high proportion of durable materials, such as wood chips. If used in areas where public contact is likely, odors should be minimal and there should be virtually no human pathogens. (For composts that contain municipal sludge, septage, or animal manures, this can be achieved by meeting DEP's PFRP requirements. For areas such as playgrounds where children may frequently be in close contact with the soil, extra precautions may be warranted. This could include actions such as requiring suppliers to provide additional testing of the material for Shigella sp. and/or E. coli if compost containing sludge or septage is used.) It will also have few or no weeds, viable seeds, roots, or rhizomes. (Note: Some seeds such as tomato seeds are very resistant and may survive even though PFRP requirements have been met. Most weed seeds, however, will be killed in the composting process.)

Suppliers should be required to provide a list of all the ingredients in the original compost mix in the order of their relative proportions on a weight basis. (i.e. all bulking agents, nitrogen sources, and other additives, such as ash or stabilizers should be listed.)

In addition, suppliers of these materials should be asked to provide assurances that they meet DEP heavy metal, PCB and dioxin limits and do not contain levels of any chemicals that are harmful to plants or humans.
6.E.2 Measurements to Consider

Suppliers of compost products should be expected to provide data based on laboratory analyses for each of the following measurements:

pH - Most composts fall into the 6.1 to 7.8 range. Some applications require a pH outside this range.

CaCO3 equivalency - For all composts being considered for use as mulch, the supplier should provide the CaCO3 equivalency. Some composts have very little or no liming ability while others may have a substantial liming effect. For this purpose, composts having little or no liming effect are preferred.

Coarseness - Virtually all particles/pieces should pass through a 6 inch sieve but more than 50 percent should be retained by a 1 inch (#1) sieve and more than 75 percent should be retained by a 1/4 inch (#4) sieve.

Nutrients - The NPK levels for the compost material should be provided by the supplier. Lower nutrient content is desirable.

Soluble Salt Concentrations - < 1 mmho/cm. in the final mix.

Density/Weight per Cu Yd - Coarse compost would normally be 800-1,300 lbs/cu yd at moisture content of 35 to 65%.

Moisture Content - If the compost has a moisture content between 35 and 65%, handling characteristics should be acceptable.

Foreign Matter - less than 2 percent foreign matter other than pieces of wood on a dry weight basis.

6.F. Compost Product - Mulch Class B

Use for Material - To conserve moisture; prevent surface compaction or crusting; reduce runoff; control weeds; and help establish plant cover.

6.F.1. Characteristics to Consider

A good compost material for this purpose will be mature, loose and friable, dark brown or black in color and low enough in moisture to handle easily. Compost based mulch for these purposes should contain a high proportion of durable materials, such as wood chips. If used in areas where public contact is likely, odors should be minimal and there should be virtually no human pathogens. (For composts that contain municipal sludge, septage, or animal manures, this can be achieved by meeting DEP’s PFRP requirements. For areas such as playgrounds where children may frequently be in close contact with the soil, extra precautions may be warranted. This could include actions such as requiring suppliers to provide additional testing of the material for Shigella sp. and/or E. coli if compost containing sludge or septage is used.) It will also have few or no weeds, viable seeds, roots, or rhizomes. (Note: Some seeds such as tomato seeds are
very resistant and may survive even though PFRP requirements have been met. Most weed seeds, however, will be killed in the composting process.)

Suppliers should be required to provide a list of all the ingredients in the original compost mix in the order of their relative proportions on a weight basis. (i.e. all bulking agents, nitrogen sources, and other additives, such as ash or stabilizers should be listed.)

In addition, suppliers of these materials should be asked to provide assurances that they meet DEP heavy metal, PCB and dioxin limits and do not contain levels of any chemicals that are harmful to plants or humans.

6.F.2. Measurements to Consider

Suppliers of compost products should be expected to provide data based on laboratory analyses for each of the following measurements:

**pH** - Most composts fall into the 6.1 to 7.8 range. Some applications require a pH outside this range.

**CaCO3 equivalency** - For all composts being considered for use as mulch, the supplier should provide the CaCO3 equivalency. Some composts have very little or no liming ability while others may have a substantial liming effect. For this purpose, composts having little or no liming effect are preferred.

**Coarseness** - Virtually all particles/pieces should pass through a 6 inch sieve but more than 75 percent should be retained by a 1/4 inch (#4) sieve.

**Nutrients** - The NPK levels for the compost material should be provided by the supplier. A low nutrient horticultural grade compost is desirable.

**Soluble Salt Concentrations** - conductivity < 1 mmoles/cm. in the final mix.

**Density/Weight per Cu Yd** - Coarse compost would normally be 8001,300 lbs/cu yd at moisture content of 35 to 65%.

**Moisture Content** - If the compost has a moisture content between 35 and 65%, handling characteristics should be acceptable.

**Foreign Matter** - less than 2 percent foreign matter, other than pieces of wood on a dry weight basis.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Topsoil Class A</th>
<th>Topsoil Class B</th>
<th>Topsoil Class C</th>
<th>Wetland Substrate</th>
<th>Mulch Class A</th>
<th>Mulch Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>High contact areas</td>
<td>Low contact areas</td>
<td>Landfill daily cover</td>
<td>Wetland restoration</td>
<td>Stabilize slopes</td>
<td>General Mulching needs</td>
</tr>
<tr>
<td>Stability</td>
<td>Mature</td>
<td>Mature or semi-mature</td>
<td>Mature, semi-mature or fresh</td>
<td>Mature or semi-mature</td>
<td>Mature</td>
<td>Mature</td>
</tr>
<tr>
<td>Odor</td>
<td>A</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>A,B</td>
<td>A,B</td>
</tr>
<tr>
<td>Pathogens</td>
<td>C,D</td>
<td>C,D</td>
<td>E</td>
<td>C</td>
<td>C,D</td>
<td>C,D</td>
</tr>
<tr>
<td>Heavy metals PCBs, dioxin</td>
<td>F</td>
<td>F</td>
<td>G</td>
<td>F</td>
<td>F</td>
<td>F</td>
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<tr>
<td>pH</td>
<td>6.1-7.8 H</td>
<td>6.1-7.8 H</td>
<td>5.5-8.5 H</td>
<td>3.6-4.4 H</td>
<td>6.1-7.8 H</td>
<td>6.1-7.8 H</td>
</tr>
<tr>
<td>Texture*</td>
<td>Sieve %Pass</td>
<td>Sieve %Pass</td>
<td>Sieve %Pass</td>
<td>Sieve %Pass</td>
<td>Sieve %Pass</td>
<td>Sieve %Pass</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>0.5&quot;</td>
<td>90</td>
<td>90</td>
<td>80</td>
<td>80</td>
<td>60</td>
<td>60</td>
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<tr>
<td>1&quot;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0.25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Soluble Salt content (mmhos/cm)</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>40-60</td>
<td>40-60</td>
<td>65</td>
<td>40-60</td>
<td>35-65</td>
<td>35-65</td>
</tr>
<tr>
<td>Foreign matter (%)</td>
<td>2</td>
<td>4</td>
<td>50</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Organic matter (%)</td>
<td>Y3 I</td>
<td>Y3 I</td>
<td>J</td>
<td>Y40 K</td>
<td>J,L</td>
<td>J,L</td>
</tr>
</tbody>
</table>

* Note: Sieve numbers correspond to the following size openings:

<table>
<thead>
<tr>
<th>Sieve #</th>
<th>Opening Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.25 inch</td>
</tr>
<tr>
<td>10</td>
<td>0.10 inch</td>
</tr>
<tr>
<td>40</td>
<td>0.025 inch</td>
</tr>
<tr>
<td>200</td>
<td>0.005 inch</td>
</tr>
</tbody>
</table>
CODES:

A - Minimal odor in areas of high public contact.

B - Odors are allowed in areas of low public contact, but must not be foul or putrefactive.

C - Materials containing municipal sludge or septage must meet DEP’s PFRP requirements.

D - Extra cautions may be desired where people will be in direct contact with material containing municipal sludge or septage (e.g. on playgrounds).

E - Materials containing municipal sludge or septage must meet DEP’s PSRP requirements.

F - Meets DEP's requirements for heavy metals, PCB's, and dioxins as established in the Rules for Land Application of Sludge and Residuals, Chapter 567.

G - Exceeds the DEP limits for heavy metals by no more than 200% and meets the requirements for PCB's and dioxins as established in the Rules for Land Application of Sludge and Residuals, Chapter 567.

H - Specific purposes may require a pH outside this range. See horticultural recommendations for the specific use.

I - After mixing with mineral soil, the final topsoil mix should have at least 3% organic matter.

J - Organic matter % will be acceptable if other characteristics are met.

K - Acceptable organic matter levels will depend on the needs of the types of vegetation to be re-established.

L - High proportion of wood or other resistant material is desirable.

EFFECTIVE DATE:
January 16, 1991

EFFECTIVE DATE (ELECTRONIC CONVERSION):
May 4, 1996

CONVERTED TO MS WORD:
May 21, 2008

CORRECTIONS:
February, 2014 – agency names, formatting
APPENDIX A

MIX RATIOS FOR CREATING ARTIFICIAL TOPSOIL USING COMPOST

<table>
<thead>
<tr>
<th>Compost Conductivity</th>
<th>Ratio of Mineral Soil to Compost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class A or B</td>
</tr>
<tr>
<td>mmhos/cm</td>
<td></td>
</tr>
<tr>
<td>&lt; 0.5</td>
<td>*</td>
</tr>
<tr>
<td>0.5-1</td>
<td>*</td>
</tr>
<tr>
<td>1-2</td>
<td>*</td>
</tr>
<tr>
<td>3-4</td>
<td>0.5:1 to 0.75:1</td>
</tr>
<tr>
<td>4</td>
<td>1.0:1 to 1.25:1</td>
</tr>
<tr>
<td>5</td>
<td>1.5:1 to 1.75:1</td>
</tr>
<tr>
<td>6</td>
<td>2.0:1 to 2.25:1</td>
</tr>
<tr>
<td>7</td>
<td>2.5:1 to 2.75:1</td>
</tr>
<tr>
<td>8</td>
<td>3.0:1 to 3.25:1</td>
</tr>
<tr>
<td>9</td>
<td>3.5:1 to 3.75:1</td>
</tr>
<tr>
<td>10</td>
<td>4.0:1 to 4.25:1</td>
</tr>
</tbody>
</table>

* Mixture with mineral soil is not essential at these lower salt concentrations.
APPENDIX B

MAINE DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
FERTILIZER NUTRIENT REQUIREMENTS

To qualify as a fertilizer, a material must:

(1.) have at least 1 (one) percent of one of the three plant macronutrients, nitrogen, phosphoric acid or potash measured on a dry weight basis

or

(2.) have a minimum percentage of one or more micronutrient as follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>1.00</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.50</td>
</tr>
<tr>
<td>Sulfur</td>
<td>1.00</td>
</tr>
<tr>
<td>Boron</td>
<td>0.02</td>
</tr>
<tr>
<td>Chlorine</td>
<td>0.10</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.0005</td>
</tr>
<tr>
<td>Copper</td>
<td>0.05</td>
</tr>
<tr>
<td>Iron</td>
<td>0.10</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.05</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>0.0005</td>
</tr>
<tr>
<td>Sodium</td>
<td>0.10</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Acknowledgements

We would like to acknowledge Muhidin Libah for granting us the opportunity to work with SBCMALA on this project. His willingness to work with our group and make available important information has helped to make this process easier and more enjoyable.

We would also like to thank the farmers of SBCMALA for participating in the focus group and sharing with us important information about their lifestyle and farming methods.

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Finally, we would like to thank our Capstone classmates for their invaluable feedback and support throughout this process.