Creating an Agricultural Market for Nova Scotia Compost

Final Report

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1.0 INTRODUCTION

In 1995, the Nova Scotia Solid Waste-Resource Management strategy was developed to divert 50% of waste material from landfills. Municipalities implemented composting programs to meet this goal by recycling their compostable organic wastes. There are 19 composting facilities across Nova Scotia.

A challenge to the compost industry has been that the cost of municipal composting often exceeds sales revenue. To move compost off-site, some facilities have reported providing compost at no charge depending on local demand. This can be a significant cost to municipalities.

There is an opportunity to work with Nova Scotia agriculture to promote compost as a soil amendment in farm crop production programs. Traditionally, there has been limited agricultural demand for compost because of perceived low fertilizer value, plastic contaminants, product inconsistency and equipment and labor costs to apply compost.

In recent years, there has been renewed interest in educating the agricultural industry on the benefits of compost. Agriculture has the acreages required for the tonnages produced by municipalities. Although there has been research on soil health benefits from using compost, the economic benefits have not been fully investigated.

Crop production input decisions are based on crop yield and quality potential and the financial input to achieve that potential. Compost programs can require a longer timeframe than other agricultural inputs for benefits to become apparent. Some jurisdictions have recognized the importance of working with agriculture and provided short-term funding programs to encourage farmers to evaluate compost in their production systems.

Knowing the regional agricultural commodities and soil conditions are essential for a successful agricultural compost marketing program. Most compost facilities and organizations do not have a working relationship with the agricultural industry and therefore lack the knowledge on what the industry requires. They may not have the proper testing information that a Professional Agrologist (P.Ag.) would require when recommending compost as a soil amendment to their farm clients. Agricultural testing and reporting is different than what is required for government compost quality regulations and the traditional potting and soil blending industries. This may have hindered successful agricultural programs.

DivertNS and Nova Scotia Environment funded the project “Creating an Agricultural Market for Nova Scotia Compost” to evaluate nine municipal compost programs and identify strategies for creating an agricultural market. Identifying the compost agricultural market potential should provide economic opportunities for both industries.

1.1 Project Goals

1. Review and evaluate compost testing programs and determine if further testing was required for the valuation and marketing of compost as an agricultural soil amendment.

2. Evaluate agricultural requirements in different Nova Scotia regions.

3. Identify challenges, barriers and opportunities for the use of compost in the agricultural industry.

4. Improve communications between the compost and agricultural industries.

2.0 BACKGROUND

2.1 Compost Production in Nova Scotia

Nova Scotia banned organics from landfills in 1998. This ban included food waste, leaf and yard waste and non-recyclable paper products. Nova Scotia Environment promoted the following benefits to banning compostable materials:

- fewer disposal sites
- reduction in landfill leachate
- reduction in methane production
- job creation
- enhancing soils

There are 19 composting facilities in Nova Scotia, across seven regions, that receive over 120,000 tonnes of compostable organics annually. Fifteen of the nineteen facilities compost source separated organics (SSO).

Table 1: Organic Composting Facilities in Nova Scotia.

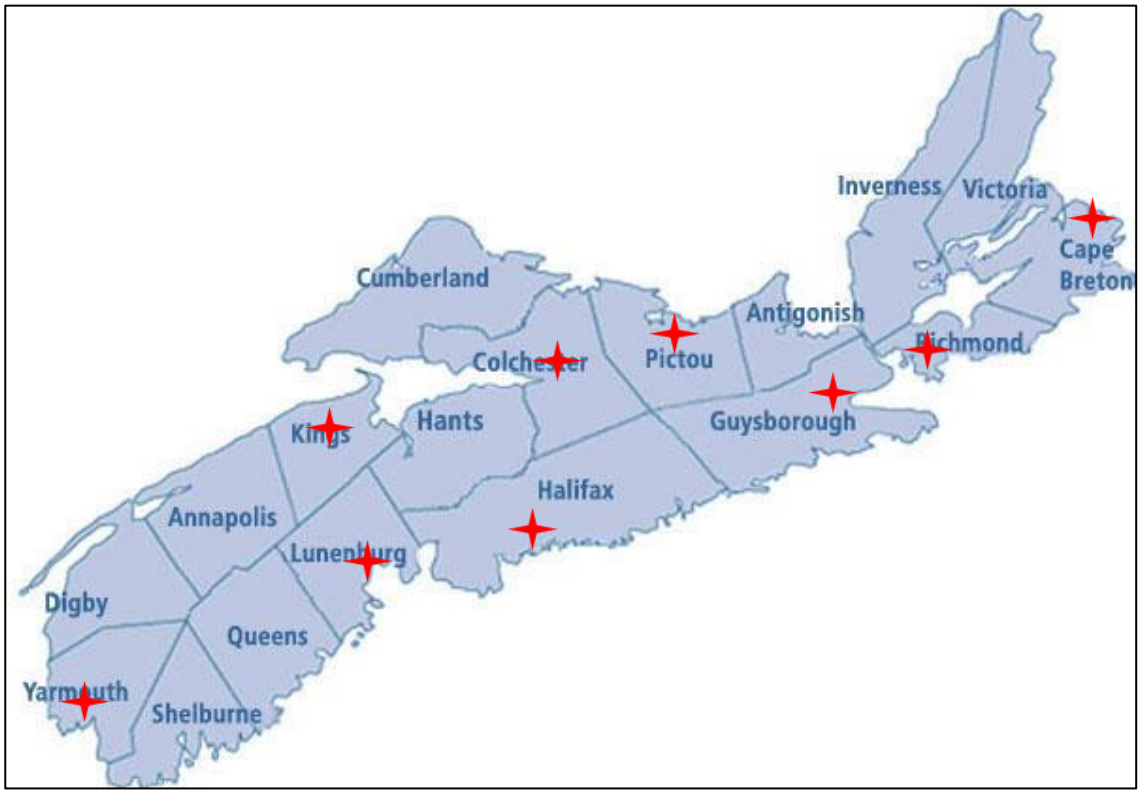
Organic Composting Facilities in Nova Scotia			
#	Facility	Location	Type of Operation
Cape Breton			
1	Baddeck Composting Facility	Baddeck, Victoria County	Food & Yard Waste
2	Dingwall Composting Site	Cape North, Victoria County	Food & Fish Waste
3	West Arichat Composting Facility	West Arichate, Richmond County	Food & Yard Waste
4	CBRM Composting Facility	Sydney, CBRM	Food & Yard Waste
5	Inverness Composting Facility	Kenloch, Inverness County	Food & Yard Waste, Fish Waste
Antigonish/Guysborough/Pictou			
6	Guysborough Composting Facility	Guysborough County	Food & Yard Waste, IC&I
7	Atlantic Country Compost (TE Boyle Farm & Forestry LTd)	Tracadie, Antigonish County	Food & Farm Waste, Fish Waste, Wood Chip composting
8	Antigonish County Solid Waste Resource Management Facility	Beech Hill, Antigonish County	ICI leaf and yard waste
9	Pictou County Solid Waste Management Composting Facility	Mount William, Pictou County	In-vessel Food &Yard Waste, Wood
Cumberland/Colchester/East Hants			
10	Colchester Balefill / Composting Facility	Kemptown, Colchester County	In-vessel Food &Yard Waste, Paper
11	Fundy Compost Incorporated	Brookfield, Colchester County	Food&Yard waste, biosolids, fish waste, sawdust
12	Cumberland Central Composting Facility	Little Forks, Cumberland County	Enclosed Food & Yard waste, Paper
Halifax Regional Municipality			
13	Miller Waste Systems	Burnside Industrial Park, HRM, Halifax Cty	In-vessel food & yard waste, wood chips, sawdust and bark, paper
14	New Era Farms	Ragged Lake Industrial Park, HRM, Halifax Cty	In-vessel food and yard waste, paper products
Valley Region			
15	Northridge Farms	Demsey Corners, Kings County	In vessel food and yard waste
South Shore			
16	Lunenburg Regional Recycling and Composting Facility	Whynott Settlement, Lunenburg County	In-vessel food/yard waste, papers, sewage sludge, sawdust, fish waste
17	Louisiana Pacific Resources Group Technology	East River, Chester	Wood waste processing
Yarmouth/Digby			
18	Town of Yarmouth Compost Facility	South Ohio, Yarmouth County	In-vessel food and yard waste, paper products
19	Spectacle Lake Concrete & Excavating Ltd. Campsite Environmental Inc. Compost Facility	Church Point, Digby County	Mink carcasses (mix with sawdust)

Nine municipal compost facilities were surveyed to determine the quantity of organic material received and processed, current end markets, existing testing procedures and results. Compost samples were taken at each compost facility and analyzed at two laboratories. Municipal reports were provided to each compost facility which evaluated their compost and identified agricultural opportunities and challenges in their region and provided marketing strategy recommendations.

The nine compost facilities that participated in the project were:

- Cape Breton Regional Municipality Solid Waste Management Facility
- Richmond County Solid Waste Management Facility
- Guysborough Waste Management Facility
- Pictou County Solid Waste Compost Facility
- Colchester Composting Facility
- Ragged Lake Compost Facility
- Lunenburg Regional Community Recycling Center
- Northridge Farms
- Town of Yarmouth Compost Facility

Figure 1: Location of the nine composting facilties that participated in the project.



2.2 Compost Regulatory Requirements

2.2.1 Federal Compost Quality Guidelines

The Canadian Council of Ministers of the Environment (CCME) developed national compost guidelines in 1996 to standardize minimum requirements for consistency, quality and safety. CCME based the compost guidelines on trace elements, pathogens, foreign matter and maturity. The guidelines are applicable to all compost, regardless if sold, given-away or used on-site.

The CCME guidelines were revised in 2005. The updated guidelines identify maturity requirements that result in mature compost suitable for bagging. Municipalities may be operating in compliance with either the 1998 or 2005 guidelines.

Compost that meets Category A criteria has unrestricted use and can be used for agricultural and residential applications. Compost that meets Category B criteria requires an approval and is restricted for use only on forest lands, landfills, highway medians and land reclamation projects. It cannot be used on food crops.

Compost that does not meet A or B criteria cannot be used and must be disposed according to provincial regulations.

Table 2. CCME Compost Quality Guidelines.

CCME Compost Quality Guidelines		
	Compost A	**Compost B**
Trace elements (mg/kg) DWB		
Arsenic	13	75
Cadmium	3	20
Cobalt	34	150
Chromium	210	NA
Copper	400	NA
Lead	150	500
Mercury	0.8	5
Molybdenum	5	20
Nickel	62	180
Selenium	2	14
Zinc	700	1850
Foreign Matter (FM)		
Sharp FM	No FM greater than 3 mm per 500 ml	FM less or equal to 3 pieces per 500 ml not greater than 12.5 mm
Other FM	No more than 1 piece FM greater than 25 mm per 500 ml	No more than 2 pieces of FM greater than 25 mm per 500 ml
Pathogens		
Two options:		
1. If only yard waste - shall undergo treatments such as:		
in-vessel composting or aerated static pile - 55oC or greater for 3 days		
Windrow - 55oC or greater for 15 days & turned at least 5 times		
2. Meet testing criteria of Fecal coliforms - less than 1000 MPN/g and		
no Salmonella sp (less than 3 MPN/4g)		
Maturity/Stability		
Compost shall be mature and stable at time of sale and distribution		
Cured for min of 21 days and meet one of the following 3:		
1. Respirataion rate less or equal to 400 mg of O2/kg/hr		
2. C02 evolution rat is less or equal to 4 mg of C in for of C02/gm of OM/day		
3. Temperature rise above ambient temp is less than 8oC		

2.2.2 Nova Scotia Compost Quality Regulations

Compost facilities must obtain a provincial operating approval before they can begin operations and must be in compliance with the terms and conditions under which CCME is referenced. The Nova Scotia Environment Composting Facility Guidelines (2010), indicates that compost is classified according to the CCME guidelines for compost quality (2005). Compost must be tested every 1,000 tonnes or every three months.

2.2.3 Compost Quality Alliance (CQA) Program

The Compost Council of Canada (CCC) encourages compost facilities to participate in the Compost Quality Alliance (CQA) testing program to improve compost marketability and user confidence. This is done through standardized product sampling, laboratory testing and identifying product attributes and use guidelines. This is a voluntary program for Canadian compost.

The CQA requirements are similar to CCME guidelines. Compost is tested based on the following timelines:

- 1,000-5,000 tonnes 4 times/year
- 5,000-15,000 tonnes 6 times/year
- >15,000 tonnes 12 times/year

It was identified that the CQA program benefits was not clearly understood by the compost facilities which may have limited participation in the program.

2.3 Benefits of Compost

Compost provides many soil health benefits to the agricultural industry.

- **Improves soil condition** by increasing soil tilth, aeration, drainage, water holding capacity and reduces hardpan. Hardpan is an issue in Nova Scotia, which is a dense layer of soil under the surface that can be formed through compaction from agricultural equipment. Sandy soils, with low organic matter and water holding capacity, are especially prone to drought conditions which limits agricultural production potential.

- **Adds organic matter** which is important for nutrient and water retention, reducing soil crusting, soil compaction, buffers against changes in soil pH and improves water and air movement within the soil structure. Loss of organic matter is one of the main contributing factors to declining soil productivity.

- **Stimulates microbial activity for a healthy soil environment**. Microbes play an important part in recycling nutrients, increasing availability to crops, degrading pollutants and naturally repelling disease and insects. They support healthy plant growth. Research has shown the organic fraction of municipal solid wastes provided a high number of spore-forming bacteria that have high activity against “bad” fungi. The influence of microbial activity on agricultural production potential has not been adequately communicated to the industry.

- **Provides nutrients** in agricultural regions that have limited manure or other organic product availability. Compost provides a nutrient bank by adsorbing and holding nutrients in plant available form as it decomposes.

- **A sustainable local product** that provides an economic alternative to inorganic fossil-fuel commercial fertilizers. World demand on fertilizers will increase as populations increase, which further increases fertilizer costs. There is a world-wide concern about the future availability of easily extractable phosphorus which is essential for crop production. Phosphorus is one of the top three nutrients provided by compost.

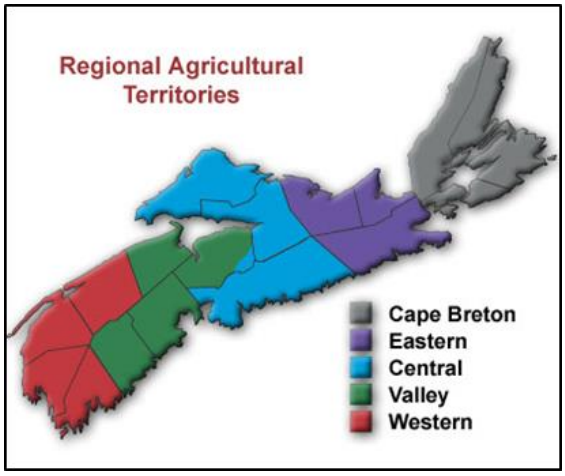
Although the benefits of compost have been known for almost as long as farming has existed, it has not always been adequately promoted and marketed to the agricultural community. The compost industry is relatively new and has mainly been utilized by the greenhouse and soil blending industries as well as by the public for potting media.

Compost testing requirements can be quite different depending on the end use; as a growing media or a soil amendment. The CCME maturity guidelines require that compost must be mature and finished to where it is suitable for bagging as a soil media. There is the potential to develop guidelines specifically for agricultural land application which can benefit agriculture and municipal facilities.

3.0 NOVA SCOTIA AGRICULTURAL INDUSTRY MARKET POTENTIAL

Evaluating the types of farms, land acreage and soil conditions within a compost facility region is required to successfully market to the local agricultural community. The average Nova Scotia farm size is 287 acres with 75% of farms grossing less than $100,000. Beef makes up 24% of the farms, followed by fruit (14%) and dairy (11.5%). Nutrient demand for growing most Nova Scotia crops are nitrogen, phosphorus, potassium, sulfur and boron.

Figure 2. Regional Agricultural Territories.



novascotia.ca/agri/programs-and-services/regional-services/

Nova Scotia has noncalcareous soils with naturally low pH and nutrient levels. More than half of the agricultural soils have good organic matter.

There is approximately 3.5 million acres (29% of Nova Scotia land area) of agricultural land in Nova Scotia. There is tremendous potential for an agricultural compost program.

The Nova Scotia Federation of Agriculture "2008 Nutrient Management Report**",** analyzed over 74,000 soil samples. The report indicated that there has been a significant decrease in soil pH and nutrient levels over the past 10 years. Most Nova Scotia farm fields have below optimum soil nutrient levels which has a significant impact on crop production.

The declining soil nutrient levels were also discussed in the "NSFA Environmental Performance of the Agriculture Sector in NS, 2009" report. The report stressed the importance of alternative soil amendments to reduce the use of fossil-fuel based commercial inorganic fertilizers. As fertilizer prices increase, nutrient levels may continue to decrease, as farms do not have the economic resources to improve, let alone maintain, one of Nova Scotia's most valuable resources, the soil.

The provincial report “Preservation of Agricultural Land in Nova Scotia, 2010”, identified that soil depletion was one of three serious land issues facing Nova Scotia agriculture (also development and abandonment). Over 80% of farmland was below optimum in pH and nutrients levels. It recommended that the Province take immediate steps to develop a comprehensive soil health improvement program to address the reduction in soil productivity and to improve and preserve the natural capital for today and for future agricultural endeavors.

In 2011, the Nova Scotia government recognized the importance of maintaining and improving soil health by announcing an $400,000 enhanced soil amendment program. This program assists with the trucking of lime to farms. Wood ash was also part of the program but has been removed from the funding program. Unfortunately, the program does not include other soil amendment products.

Healthy soils are important for productive agriculture, supporting biodiversity in our ecosystems, reducing greenhouse gases through carbon storage and maintaining environmental stability. Without healthy sustainable soils, agricultural programs cannot be stable in the long term and will not be able to meet the challenges of rising food costs. Compost can be an important resource to improve and maintain healthy soils.

Other governments have recognized the importance of improving soil health. Ontario has a program “Great Lakes Agricultural Stewardship Initiative” to support improvement in soil health and reduce soil and nutrient loss. This program is funded under the Growing Forward 2 federal program which is available to all provinces. The program provides 35-60% of the funding for the purchase, transportation and custom application of compost and other materials to increase organic matter on farms.

Other examples include Western Australia, where it is recognized that doing more research was not getting more farmers to use compost. To encourage more compost use in the agricultural industry, they provide compost funding programs. Compost can be more expensive and require a longer-term payback when compared to manure therefore these programs can bridge the time gap until farmers can measure the incentive to use compost. California has a CalRecycle healthy soils initiative program that provides financial incentives to implement carbon-beneficial practices, which includes applying compost to agricultural land.

3.1 Agricultural Crop Production Requirements

Successful compost facilities create a product that will meet local agricultural needs. Crop production requirements not only differ between provinces but also between regions within a province.

There are various factors that will influence agricultural use of compost within a region:

1. Soil health
    - soil nutrient levels
    - soil acidity level
    - soil types
    - organic matter
    - new cleared land or long-term production

2. Type of farms and crops grown
    - conventional and organic farms
    - crop and livestock farms
    - crop nutrient requirements

1. Soil health

Healthy soils are the foundation for sustainable crop production. Nova Scotia soils are naturally acidic with low nutrient levels therefore require inputs to improve crop production capacity. The number of livestock farms has decreased which has reduced the amount of manure that is applied to soils. Alternative sources of organic inputs are required to improve soil health for soil structure, diverse and active microbial communities for improved nutrient cycling, water holding capacity, compaction and resilience to degradation.

Soil organic matter levels contributes to the biological, chemical and physical properties of soil. Organic matter levels over 4.0% are ideal. Median levels range between counties from 3.0 – 6.3.% Sandy and sandy loam soils require more organic matter inputs than clay or clay loam soils. Compost applications are required annually to increase the organic matter content.

Grain crops, new seeded forages, vegetables and grapes would be the primary crops utilizing municipal compost. They require high nutrient and pH levels. Optimum soil nutrient levels to achieve high yields and quality in these crops would be 350-800 kg/ha P_20_5 (median levels range from 72-975 kg/ha, NS soils have high aluminum levels which “tie” up phosphorus), 350-500 kg/ha K_20 (median levels range from 136-830 kg/ha) and pH levels over 6.5 (median levels range from 5.4-7.3). Some crops require organic nitrogen that is available throughout the season, which compost can provide.

Table 3: Nova Scotia Soil Test Levels.

County	Clay vs Sand	Parameter	OM	pH	P2O5 (kg/ha)	K2O (kg/ha)	Sample Size
Annapolis	Primarily Sandy	Average	4.9	6.0	537	312	157
	High risk	Median	4.5	6.1	252	253	
Antigonish	60/40 clay/sand	Average	4.9	5.9	439	241	206
	Low risk	Median	4.6	6.1	259	180	
Cape Breton	Primarily Sandy	Average	6.3	5.5	260	185	583
	High risk	Median	5.6	5.5	72	136	
Colchester	40/60 clay/sand	Average	5.3	5.9	506	284	819
	high risk	Median	4.5	5.9	237	211	
Cumberland	Primarily Clay	Average	4.3	5.9	497	287	303
	Low Risk	Median	4.0	6.1	284	209	
Digby	Primarily Sandy	Average	3.8	6.0	1012	340	26
	High risk	Median	3.0	6.2	975	361	
Guysborough	40/60 clay/sand	Average	3.9	6.3	731	272	19
	high risk	Median	3.2	6.2	403	261	
Halifax	60/40 clay/sand	Average	4.3	6.1	834	329	140
	Low risk	Median	4.0	6.2	509	249	
Hants	Primarily Clay	Average	4.6	6.2	584	327	470
	Low Risk	Median	3.8	6.2	313	264	
Inverness	Primarily Clay	Average	5.5	5.8	533	256	67
	Low Risk	Median	4.4	5.8	220	183	
Kings	60/40 clay/sand	Average	4.4	6.1	784	348	1507
	low risk	Median	3.7	6.2	439	298	
Lunenburg	Primarily Clay	Average	4.1	6.0	551	288	86
	Low Risk	Median	3.5	6.1	201	192	
Pictou	40/60 clay/sand	Average	4.2	6.2	631	317	251
	high risk	Median	4.1	6.2	378	258	
Queens	60/40 clay/sand	Average	4.3	6.2	882	329	37
	Low risk	Median	3.5	6.1	675	282	
Richmond	Primarily Clay	Average	4.5	6.2	481	200	6
	Low Risk	Median	3.8	6.3	183	200	
Shelburne	Primarily Sandy	Average	5.1	6.1	686	276	10
	High risk	Median	4.6	6.4	238	264	
Victoria	Primarily Sandy	Average	3.4	7.3	365	830	1
	High risk	Median	3.4	7.3	365	830	
Yarmouth	Primarily Sandy	Average	4.7	5.5	264	185	12
	High risk	Median	4.6	5.4	155	175	

2011 NSDA laboratory results complied by LP Consulting, 4700 samples.

High risk indicates moderate to high risk for nutrient leaching and droughty conditions due to soil type. Low risk indicates low risk for nutrient leaching and droughty conditions.

2. Type of farms and crops grown in the regions

Farms that would be the early adopters of a municipal compost program are dairy and cash crop farms.

Although there has been favorable research on compost use in lowbush blueberries, there hasn't been much uptake in the industry. Marketing compost to lowbush blueberries will be difficult until the price of berries increases from the low 2017 prices.

Table 4. Numbers of Farms in Nova Scotia.

Types of Nova Scotia Farms	
Farm Type	**# of farms**
Beef	441
Dairy	257
Hog	21
Poultry/eggs	156
Sheep	80
Goat	24
Horses	199
Fur	128
Other animals	223
Grains	50
Vegetables	140
Fruit	971
Greenhouses	550
Maple	36
Other	629
Total Farms	**3905**

Nova Scotia Department of Agriculture, Research and Analytics reports, 2011

Table 5: Types of Farms and Acreages by County

County	Number of farms	Total Farm Hectares	Average Farm Size (Ha)	Top 5 types	Number of Farms	Percent of County total	Other
Annapolis	234	20,693	88.4	Hay	42	17.9	Veggie combo = 14 (6%)
				Fruit & Tree-nut	38	16.2	All grains = 11 (5%)
				Beef	35	15.0	
				Dairy	16	6.8	
				Livestock Combination	16	6.8	
Antigonish	235	26,067	110.9	Fruit & Tree-nut	46	19.6	Veggie combo = 3 (1%)
				Nursery & Tree	42	17.9	All grains = 0
				Beef	40	17.0	
				Dairy	34	14.5	
				Hay	27	11.5	
Cape Breton	90	5,431	60.3	Hay	18	20.0	Veggie combo = 8 (9%)
				Beef	12	13.3	All grains = 1 (1%)
				Nursery & Tree	10	11.1	
				Floriculture	8	8.9	
				Horse & other equine	7	7.8	
Colchester	455	58,005	127.5	Fruit & Tree-nut	163	35.8	Veggie combo = 6 (1%)
				Hay	59	13.0	All grains = 6 (1%)
				Dairy	50	11.0	
				Beef	48	10.5	
				Horse & other equine	22	4.8	
Cumberland	562	91,049	162.0	Fruit & Tree-nut	328	58.4	Veggie combo = 9 (1%)
				Hay	59	10.5	All grains = 0
				Beef	45	8.0	Potato = 1 (0.2%)
				All other misc crop	20	3.6	
				Horse & other equine	19	3.4	

County	Number of farms	Total Farm Hectares	Average Farm Size (Ha)	Top 5 types	Number of Farms	Percent of County total	Other
Digby	150	5,333	35.6	Fur-bearing animal	86	57.3	Veggie combo = 1 (1%)
				Fruit & Tree-nut	14	9.3	All grains = 0
				Beef	10	6.7	Potato = 1 (1%)
				Livestock Combination	7	4.7	
				Nursery & Tree	7	4.7	
Guysborough	99	11,856	119.8	Nursery & Tree	61	61.6	Veggie combo = 0
				Fruit & Tree-nut	26	26.3	All grains = 0
				Beef	3	3.0	
				Hay	2	2.0	
				Dairy	2	2.0	
Halifax	164	15,119	92.2	Fruit & Tree-nut	25	15.2	Veggie combo = 13 (8%)
				Nursery & Tree	21	12.8	All grains = 0
				Beef	21	12.8	
				Hay	19	11.6	
				Dairy	14	8.5	
Hants	342	37,724	110.3	Hay	62	18.1	Veggie combo = 16 (5%)
				Dairy	50	14.6	All grains = 2 (0.5%)
				Horse & other equine	40	11.7	Potato = 1 (0.3%)
				Beef	36	10.5	
				Fruit & Tree-nut	32	9.4	
Inverness	138	14,912	108.1	Beef	27	19.6	Veggie combo = 9 (7%)
				Hay	23	16.7	All grains = 1 (0.7%)
				Fruit & Tree-nut	19	13.8	
				Dairy	18	13.0	
				Livestock Combination	9	6.5	
Kings	614	49,631	80.8	Fruit & Tree-nut	139	22.6	Veggie combo = 52 (9%)
				Beef	67	10.9	All grains = 24 (4%)
				Broiler & other meat-type chicke	60	9.8	Potato = 10 (2%)
				Hay	49	8.0	
				Other veg (exc potatoes) & melo	43	7.0	
Lunenburg	342	30,155	88.2	Nursery & Tree	155	45.3	Veggie combo = 11 (3%)
				Hay	41	12.0	All grains = 0
				Beef	25	7.3	
				Fruit & Tree-nut	23	6.7	
				Livestock Combination	17	5.0	
Pictou	277	28,571	103.1	Fruit & Tree-nut	70	25.3	Veggie combo = 9 (3%)
				Hay	51	18.4	All grains = 4 (1%)
				Beef	40	14.4	
				Livestock Combination	21	7.6	
				Nursery & Tree	17	6.1	
Queens	37	4,333	119.8	Nursery & Tree	11	29.7	Veggie combo = 0
				Beef	6	16.2	All grains = 0
				Fruit & Tree-nut	5	13.5	
				Hay	5	13.5	
				Horse & other equine	4	10.8	
Richmond	18	1,193	66.3	Hay	5	27.8	Veggie combo = 1 (6%)
				Beef	4	22.2	All grains = 0
				Floriculture	2	11.1	
				Sheep	2	11.1	
				Fruit & Tree-nut	1	5.6	
Shelburne	17	3,046	179.2	Nursery & Tree	4	23.5	Veggie combo = 0
				Fruit & Tree-nut	4	23.5	All grains = 0
				Hay	2	11.8	
				Horse & other equine	2	11.8	
				Fur-bearing animal	2	11.8	
Victoria	40	3,771	94.3	Hay	9	22.5	Veggie combo = 3 (8%)
				Beef	6	15.0	All grains = 0
				Fruit & Tree-nut	5	12.5	
				Livestock Combination	4	10.0	
				Horse & other equine	3	7.5	
Yarmouth	91	5,012	55.1	Fruit & Tree-nut	27	29.7	Veggie combo = 6 (7%)
				Beef	15	16.5	All grains = 1 (1%)
				Hay	8	8.8	
				Fur-bearing animal	7	7.7	
				Livestock Combination	5	5.5	

Nova Scotia Department of Agriculture, Research and Analytics reports, 2011

4.0 CHALLENGES TO COMPOST USE IN AGRICULTURE

Although utilizing compost as a soil amendment in agriculture is not a new idea, it has not been considered a standard farming practice due to several perceived or real challenges:

1. Laboratory analysis
2. Contaminants
3. Trucking costs
4. Agriculture logistical requirements
5. Value versus cost of compost
6. Economics
7. Education and Marketing

4.1 Laboratory Analysis

Compost analysis can differ not only between compost facilities but also between batches of compost within the same facility. This is most prevalent at facilities that receive source separated organics from curbside programs. Depending upon the season, the amount of leaf and yard waste and seasonally generated wastes i.e. pumpkins in October and November, will change. Most facilities process what they receive daily, which can create difficulties in the process such as porosity, air flow, maintaining C:N ratios, etc. This can provide challenges when determining compost requirements for agricultural production. Consistent timely testing with historical results can help to increase agricultural user confidence in developing a crop management program.

There are various factors to consider when choosing a laboratory for analysis. Some laboratories may not be able to provide all the testing criteria for CCME but can provide the agronomic amendment testing requirements. Others may only provide the CCME testing requirements but do not provide agronomic amendment tests.

Laboratory reporting information that can cause misinterpretation of results include:

- testing as a growing media versus an amendment
- reporting part or total nutrient levels
- understanding the difference in reporting units

4.1.1 Testing as a media vs an amendment

Soil media is the material in which plants are grown. A soil amendment provides fertilizer and other components that will be added to the soil media to grow plants. Compost has been used in whole or in part, as a soil media in the nursery and horticultural sectors. Using compost as a soil amendment requires different testing and reporting to reflect this end- use. The test results will differ greatly depending on which analysis and reporting protocol is used.

It has been identified that the compost and agricultural industries may not be aware that there is a difference in the analysis reporting results. The lab reports do not always indicate which test has been conducted, therefore P. Ag's and farmers that rely on test results, may determine there isn't an economic return to using compost.

For example, the project identified that reports from the same lab were quite different depending on how the product was identified, as a compost or a manure. If the product was tested as a compost, the reported result was 0.13% P_20_5 but when tested as a manure, the result was 1.63% P_20_5 (both tests compared on "as is" result).

The misinterpretation of the compost analysis would significantly undervalue the compost as a soil amendment to the agricultural community.

When testing products that will be applied to the soil as an amendment, regardless if it is identified as a compost, manure, or other organic product, results should be similar. The compost facility must identify the purpose of their test when discussing a testing package with the lab to ensure they obtain the correct test results.

Nova Scotia compost should not only be tested to ensure it meets compost quality regulations, it should also be tested as an amendment (manure) if marketing to agriculture.

4.1.2 Reporting part or total nutrient levels

Some reports may not clearly identify if the test results are total nutrient content of compost or other amendment products. This can cause further misinterpretations in compost value.

The agricultural industry calculates the economic value of a soil amendment using the market price of inorganic commercial fertilizers as a comparison. The individual fertilizer nutrient cost is the total nutrient content, not what is available the first year of application.

For example, some laboratories may only report the amount of phosphorus that is available in compost the first year of application rather than reporting the total nutrient amount.

Approximately 40% of phosphorus is available the first year, regardless of nutrient source. Inorganic fertilizer analysis will report 100% of the phosphorus (P_20_5). If the lab only reports 40% of the total and does not indicate on the report that they have done so, the agricultural community will unfavorably compare it to inorganic fertilizer.

It's critical to know if the report is in total or available nutrients. If it is not identified on the lab report, contact the lab. The results cannot be interpreted without this information.

4.1.3 Understanding the difference in reporting units

Another misinterpretation that can occur is when compost facilities, P.Ag's or other specialists don't recognize that laboratories report in different units. Some labs report nutrients in parts per million (ppm), kilograms per hectare (kg/ha), pounds per acre (lbs/acre), milliequivalents per 100g (meq/100g), pure element % (P, K, etc) or plant available P_2O_5 and K_20.

For example, potassium can be reported in the following units: 1200 ppm K, 1440 ppm K_20, 1.4 kg/tonne K_20, 30.8 meq/100g, 0.12% K and 0.14% K_20. They all represent the same amount of potassium.

When comparing test results, they must be converted to the same unit for an accurate comparison. If the test evaluator does not conduct the proper conversions, the compost can be undervalued.

For example, if the report indicates that compost has 700 ppm of phosphorus, it must be converted to plant available phosphorus (P_20_5). This allows for comparison and valuation to inorganic commercial fertilizers. 700 ppm is multiplied by 2.29, which is 1603 ppm of P_20_5 or 0.16%. The potassium multiplier is 1.2.

Results are also reported either on a dry weight basis (DWB) or "as is"/"as received". DWB is when the lab dries the compost down to 100% solids. This is not what is going to be applied on the soil, therefore the data must be converted to "as is" for the actual application. The reported moisture content is used to convert DWB back to "as is". If a product that is reported in DWB is compared to a product that is reported "as is", it will incorrectly appear to have much higher nutrient levels. DWB is more concentrated.

For example, total nitrogen is reported as 1.5% on a DWB report. This would indicate that there is 15 kg of total nitrogen per tonne of compost which is not correct. If the moisture is 55%, then the actual "as is" application is only 0.68%, which is 6.8 kg/tonne of total nitrogen.

If the test report doesn't indicate DWB or "as is'/"as received", contact the lab. The results cannot be interpreted without this information.

4.2 Contaminants

Contaminants in the final product is a deterrent to using compost in agriculture depending on the type and size of the contaminant. There is a perception in agriculture that compost may have a lot of plastic and other contaminants.

This may be more an issue with source separated organic facilities than for industrial facilities.

4.3 Trucking Costs

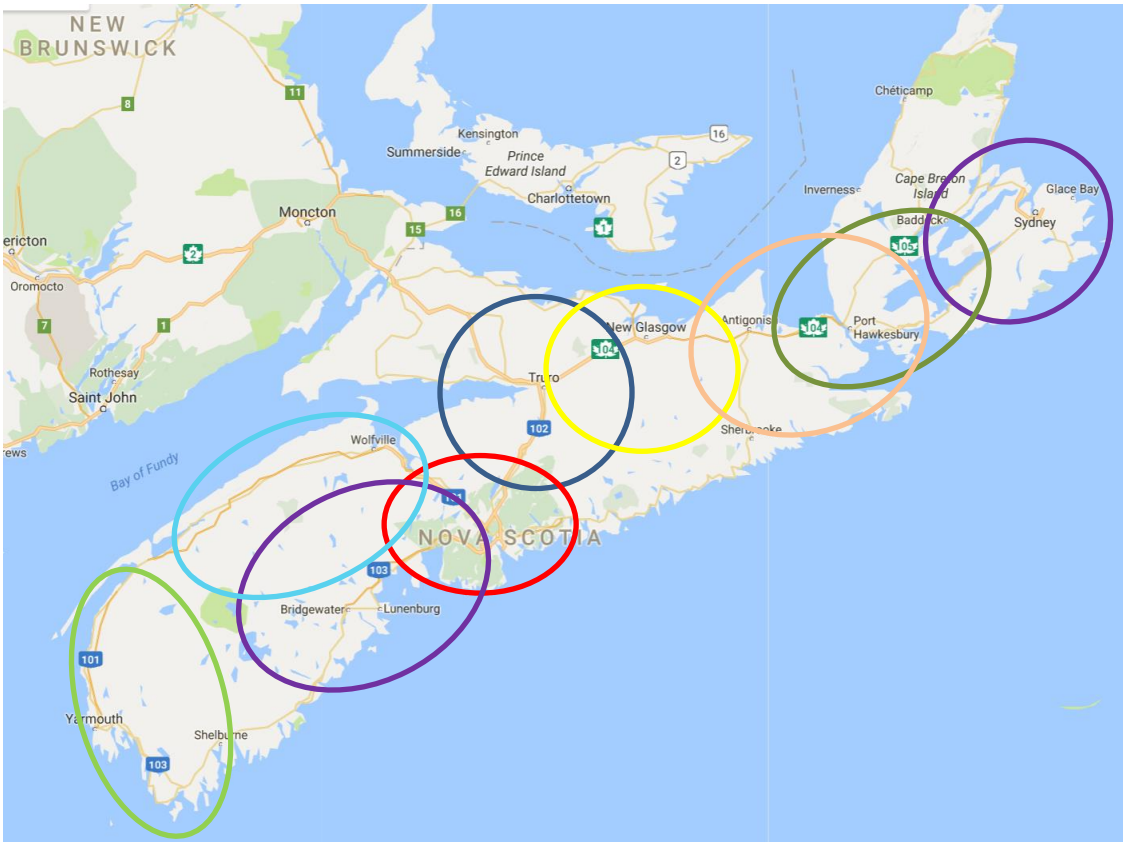
Farms located within 75-100 km from the compost facility provide the most opportunity for compost sales based on trucking costs. Trucking costs should be between $8-12/tonne to be cost effective for this type of product. The lack of understanding of timing and logistics of trucking compost to farmers has also impacted compost use.

Table 6: 2016 Amendment Trucking Prices (tri-axle truck) to farms

Distance to Farm – Km's (one way)	Cost/tonne
30	$8.50
60	$9.50
100	$11.50
130	$16.00

**based on 28 tonne loads*

Figure 3. Municipal compost facility marketing regions



Regional marketing area maps and agricultural profiles were developed for each compost facility which were based on type of agriculture, soil health and trucking costs.

4.4 Agriculture Logistical Requirements

Agriculture amendment requirements are seasonal. Application of amendments typically occurs from April to June (pre-plant) and from September to November, after the crops are harvested.

In the spring, there are two issues that can negatively affect sales of amendments; road closures and wet weather. If there is time to apply amendments, farms require significant tonnages in a short period of time to apply, till and plant once the soil is dry. Farms that have been using amendments can request up to 1500 tonnes within a couple of days, especially if they have rented spreading equipment.

In the fall, there is more time for application after crops are harvested from mid-August to November. A compost application strategy in Ontario is after corn harvest. In Nova Scotia, this is usually in November when wet weather can be an issue. Spring can also be wet during planting.

If tonnages are not shipped in a timely manner, farmers cancel their orders. Issues can also arise if truckers are not used to delivering to farm fields. They may unload in areas where they can get stuck.

Nova Scotia has successful waste-to-resource agricultural programs that have addressed these challenges and proven that alternative programs can achieve long-term success. Programs include wood ash from biomass-to-energy facilities, municipal biosolids and cement kiln dust and animal bedding produced from construction and demolition wood and wallboard waste.

4.5 Value versus cost of compost

The compost industry has focused on marketing compost on the organic matter and microbial benefits which has not worked for the conventional agricultural market. Their impact on soil health is significant and although this has a very high value for crop production, it has been difficult to determine an economic value.

These are excellent benefits to promote but to encourage agriculture to try compost, the replacement fertilizer value should be the first marketing strategy.

The cost of using compost (trucking, product and application) should be less than its fertility value. It requires more time and different equipment to apply 10 tonnes/ha of compost than 150 kg/ha of inorganic commercial fertilizer. Fertilizer spreading costs are approximately $20/ha while compost spreading costs are as high as $70-$120/ha (10 tonnes/ha application).

There must be a significant economic benefit for the farmer to choose compost over commercial fertilizer for their cropping program. The higher the fertility value of compost, the easier it is to market to the agricultural community.

The value to the farm changes according to their soil tests and crop requirements. Amendments that can also increase soil pH have higher value than those that do not.

4.6 Economics

Although there has been considerable compost research, it has not always evaluated economic applications or conveyed the results in a way that speaks to agricultural needs. Research needs to include economic models for the various benefits of utilizing compost as a soil amendment in farm cropping programs.

The cost of compost, trucking and spreading can be higher when compared to conventional agricultural products. Time required for implementing a compost program is a significant factor.

4.7 Education and Marketing

More educational programs on the value of compost to agriculture is require. There are misconceptions on what compost is, how it's made and how compost can improve soil health, thereby increasing crop yield and quality. There has also been a lack of education to the compost industry on the needs and concerns of agriculture. Until this is addressed, there will be little success in an agricultural compost program.

Compost facilities typically do not know the agricultural market in their regions and what farmers require, therefore marketing to farmers has not always been successful. Typically, compost facilities have not cultivated relationships with local P.Ag.'s who have a farmer clientele base. Under the Nova Scotia Agrologist Act, only P. Ag's. can provide agricultural advice to farmers. That advice must be within the field of Agrology in which they are qualified.

Compost facilities need to demonstrate the agricultural value of their compost. This can be done through long term testing, valuation of their product and setting up demonstration projects with local farmers. "Seeing is believing" is an important component of a successful agricultural marking program.

The agricultural industry requires a different marketing approach than traditional compost public programs. Rather than focusing on "feel good about using compost and saving the earth", marketing needs to focus on improving farm production and profitability.

The compost industry markets their compost in cubic yards ($yd^{3)}$ while the agricultural community uses tonnes when purchasing amendments. The compost industry needs to use the language of the market, when developing a market.

5.0 INCENTIVE PROGRAMS

Governments have recognized the importance of improving soil health, not only for the agricultural community but also for the good of society. They have implemented programs to encourage the use of compost by the agricultural community. Compost requires more time to identify the beneficial economic returns than other agricultural products therefore incentive programs to help to bridge the longer timeframe should be implemented. Programs have included:

- Product, transportation and application subsidies
- Tax deductions
- Environment incentives
- Subsidy to compost facilities to improve product quality

Nova Scotia government has banned organics from landfills. By providing incentives to the agricultural market, they could encourage more farmers to try compost in their agricultural programs thereby supporting municipalities in their composting programs.

6.0 MUNICIPALITY COMPOST FACILITY PROJECT RESULTS

For the purpose of this report, the nine compost facilities have been randomly assigned numbers to maintain confidentially.

Each facility was provided with a report that included:

- pre- and post-project test result analysis of their compost
- fertility value of their compost product
- types of farms and soil health requirements in their region
- identified markets and strategies
- recommendations for improvement to overcome local challenges

Most of the municipal compost facilities used in-vessel containers, aerated and non-aerated. Some facilities finished curing in static windrow piles.

Feedstock was mainly source separated organics (70-90%) with the remainder being leaf, yard and/or fish waste. The facilities in the project serve approximately 70% residential and 30% commercial. Compost sales ranged from free to $\$45/yd^3$.

6.1 Pre-project Test Results

All the facilities provided pre-project test results for trace elements, pathogens, maturity and foreign matter for evaluation. All facilities met CCME Class A requirements.

6.2 Project Test Results

Several subsamples were taken from various areas of the compost pile (about two feet deep) and mixed together. The sample was divided into four samples, two identified as compost and two as manure. These samples were sent to two laboratories, A&L Laboratories, London, Ontario and Nova Scotia Department of Agriculture Analytical Laboratories, Truro, Nova Scotia, for analysis comparison.

6.2.1 Laboratory Test Criteria

Testing packages were chosen at each laboratory to provide similar testing parameters. This included Compost S8C+S8 and Manure M2 from A&L Laboratories and Compost A2 and Manure A1 from Nova Scotia Department of Agriculture.

(1) A&L Laboratories Inc, London, Ontario. The testing packages included the following:

- **Compost S8C+S8** - pH, lime index, available organic matter, nitrogen (total) (N), phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), sulfur (S), boron (B), copper (Cu), zinc (Zn), manganese (Mn), iron (Fe), sodium (Na), nitrate (NO3-N), soluble salts (Sol Salts), moisture, carbon nitrogen ration (C:N ratio), cation exchange capacity (CEC), % base saturation, proportional equivalents, cation ratio

Data was reported on dry weight basis (DWB). Data was converted to "as is" to determine what will be applied to the soil and allow for similar comparison to the other test reports. The report did not indicate if total or available nutrients are reported.

- **Manure M2** – dry matter (DM), carbon nitrogen ratio (C:N), organic matter (OM), ammonium (NH4-N), nitrogen (total) N, total phosphorus (P), phosphate as P205 (plant available phosphate), total potassium (K), potash as K20 (plant available potassium), magnesium (Mg), calcium (Ca), sodium (Na), iron (Fe), copper (Cu), manganese (Mn), boron (B), aluminum (Al), zinc (Zn), Sulphur (S)

Data was reported on "as is" basis of total nutrients.

(2) Nova Scotia Department of Agriculture, Laboratory Services, Truro, NS. The testing packages included the following:

- **Compost A2** - dry matter (DM), nitrogen (N), calcium (Ca), phosphorus (P), plant available phosphorus (P205), potassium, (K), plant available potassium (K20), magnesium (Mg), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), boron (B) and sodium (Na).

Data was reported "as received" and dry weight basis (DWB). The report did not indicate if the total or available nutrients are reported.

- **Manure A1** –dry matter (DM), pH nitrogen (N), ammonium (N, NH4 -N), (Ca), phosphorus (P), plant available phosphorus (P205), potassium, (K), plant available potassium (K20), magnesium (Mg), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), boron (B) and sodium (Na).

Data reported "as received" and "dry weight" basis. The report did not indicate if the total or available nutrients are reported.

The "as received" test results, which are the same as "as is" were used for determining nutrient amount that is applied to the soil.

6.2.2 Laboratory Comparison for Agricultural Parameters

The laboratory test results of the project indicated that compost analysis reports were reported differently between laboratories. The reporting results were also quite different depending if the product was identified as a compost or a manure.

This difference in reporting can be misinterpreted and can cause the agricultural market to under-value compost as an amendment. This may have been a deterrent to selling compost to the agricultural industry as some lab reports have indicated low nutrient value when there are actually significant amounts nutrients in compost.

Table 7: Product analysis comparing two laboratory test results for product tested as a compost and a manure.

Sample ID	**Compost Facility #1**			
Sample Type	**Compost**		**Manure**	
Laboratory	**NSDA**	**A&L**	**NSDA**	**A&L**
Parameter	**AS IS (received)**			
Nitrogen (%)	1.3	1.3	1.2	1.4
Ammonium-N %	Not Reported	Not Reported	0.1	0.1
Calcium (%)	3.2	0.3	2.8	Not Reported
Potassium (%)	0.4	0.2	0.4	0.7
K2O (%)	0.5	0.3	0.5	0.9
Phosphorus (%)	0.4	0.1	0.5	0.5
P2O5 (%)	1.0	0.1	1.1	1.2
Magnesium (%)	0.5	0.0	0.4	Not Reported
Sodium (%)	0.3	0.1	0.3	0.5
Boron (ppm)	16.9	2.5	12.7	15.3
Copper (ppm)	28.2	0.8	12.1	69.8
Iron (ppm)	5740.6	122.5	4365.9	7942.4
Manganese (ppm	606.2	89.7	539.3	618.1
Zinc (ppm)	168.6	23.8	149.1	198.7
Sulfur ppm	Not Reported	390.9	Not Reported	3171.2

**see results for compost facilities 2-9 in the Appendix.*

The A&L Laboratory compost analysis was converted to ‘as is” as the results were reported in DWB. Product is not applied on a DWB. It also reported phosphorus and potassium which needed to be converted to P_20_5 and K_20 for accurate comparison to the NSDA compost and manure analysis, A&L manure analysis and inorganic commercial fertilizers.

The data highlighted in yellow indicates a significant difference in the result comparison.

- The NSDA analysis, regardless if the product was tested as a manure or a compost, had similar reported nutrient levels.
- The A&L manure analysis was similar to the NSDA manure and compost test results.
- The A&L compost test result was significantly lower than the A&L manure report and the NSDA manure and compost report (other than nitrogen).

Although it was not identified on the A&L compost report, investigation into the low nutrient levels of the A&L compost analysis indicated that the compost test was for use as a growing media, not as a soil amendment.

Results for all nine facilities were similar as those indicated for Compost Facility #1 in Table 6.

6.2.3 Fertilizer Value of Compost

Soil amendments, including compost, can provide a local sustainable economical resource that can replace a portion of inorganic fertiliziers in a farm cropping program.

Farmers and P.Ag.’s will calculate the value of amendments to ascertain if they can economically replace a portion of their crop fertilizer requirements. The value of compost will change depending upon what nutrients are required on individual farms.

In order for agriculture to determine the fertility value of a soil amendment, the cost of inorganic commerical nutrient fertilizers are used as they are based on world market prices. Inorganic commercial fertilizer nutrients are based on total nutrient content within the product and not what will be available the first year of application.

Table 8. Fertilizer Value (per tonne of compost) based on 2016 Nova Scotia inorganic commercial fertilizer prices, on an "as is" application.

Compost Facility #1									
		NSDA-Compost		A&L-Compost		NSDA-Manure		A&L Manure	
Nutrient	**Unit**		Value$		Value$		Value$		Value$
Nitrogen[1]	kg/tonne	2.64	$2.90	2.64	$2.90	2.42	$2.66	2.84	$3.12
Phosphorus ($P_2 0_5$)	kg/tonne	9.97	$14.46	1.40	$2.03	10.57	$15.33	12.05	$17.47
Potassium ($K_2 0$)	kg/tonne	4.71	$4.47	2.66	$2.53	4.68	$4.45	8.93	$8.48
Calcium	kg/tonne	32.20	$72.45	3.00	$6.75	28.50	$64.13	Not reported	$0.00
Magnesium	%	0.49	$31.79	0.04	$2.73	0.39	$25.16	Not reported	$0.00
Boron	%	0.0017	$0.22	0.0003	$0.03	0.0013	$0.17	0.0015	$0.20
Zinc	%	0.0169	$0.76	0.0024	$0.11	0.0149	$0.67	0.0199	$0.89
Sulfur	%	Not reported	$0.00	0.0391	$0.35	Not reported	$0.00	0.3171	$2.85
Nutrient Value			**$127.05**		**$17.43**		**$112.55**		**$33.01**
[1] only includes 20% of nitrogen. 20% of compost nitrogen is available in year 1, while 100% of fertilizer nitrogen is available.									
Organic matter and microbiology value is not included.									

2016 NS fertilizer prices: nitrogen $1.10/kg, $P_2 0_5$ $1.45/kg, $K_2 0$ $0.95/kg, calcium $2.25/kg, magnesium $65/1%, boron $130/1%, zinc $45/1%, and sulfur $9.00/1%.

The A&L compost analysis indicated the fertility value was only $17/tonne compared to $127/tonne for the NSDA compost analysis. Similarly, when tested as a manure, the NSDA analysis had a fertilizer value of $112/tonne whereas the A&L manure analysis was only $33/tonne.

A&L did not report calcium and magnesium in the manure test results for eight out of the nine facilities. If they had reported those nutrients on the manure report, the reports would have provided a higher fertilizer value, similar to the NSDA manure report.

Knowledge about the differences in laboratory test analysis and reporting is a significant factor in proper interpretation of test results. Laboratories can help to reduce incorrect interpretations by identifying if the compost analysis is for a media or an amendment on the report. The misinterpretation of compost analysis may have contributed to the perception that there was little nutrient value in compost.

Compost facilities should discuss the purpose of the compost test when submitting samples to the laboratory. This can help to ensure the appropriate test package has been chosen for the end-use.

If Nova Scotia compost facilities want to market to agriculture, they must test their compost as an amendment (manure) in addition to the testing requirements for compost quality regulations.

Table 9. Fertilizer Value (per tonne of compost) based on 2016 Nova Scotia inorganic commercial fertilizer prices, on an "as is" application for the nine Compost Facilities

Fertilizer Value - Per Tonne $ value based on 2016 NS fertilizer prices on "as is" application				
Plant	**NSDA-Compost**	**A&L-Compost**	**NSDA-Manure**	**A&L Manure**
1	$140.65	$16.10	$128.70	$31.86
2	$98.32	$13.08	$96.79	$29.71
3	$140.67	$21.69	$151.59	$39.07
4	$91.62	$15.97	$84.73	$23.92
5	$127.05	$17.43	$112.55	$33.01
6	$100.50	$18.88	$99.46	$25.07
7	$101.81	$14.80	$105.28	$22.68
8	$102.47	$20.37	$105.43	$26.20
9	$47.33	$9.90	$49.45	$16.60

The fertilizer value of compost from the nine Nova Scotia municipal compost facilities ranged from $45 - $140 fertilizer value per tonne. If the facility that tested quite low was removed, the range was $90-$140/tonne.

The nutrients that provided the highest fertilizer value were calcium, phosphorus and magnesium. Some facilities had significantly higher nitrogen, potassium and sulfur values depending upon their feedstock.

7.0 WORKSHOPS

Workshops were developed to bring both the compost and agriculture industries together to educate them on the benefits of compost and discuss the needs and challenges for each industry.

Workshops were held in three regional areas:

- Eastern Region – Antigonish, Claymore Inn, August 15, 2017 (20 participants)
- Central Region – Truro, Holiday Inn, August 16, 2017 (30 participants)
- Western Region – Berwick, Berwick Fire Hall, August 17, 2017 (25 participants)

The workshops included representatives from:

- Compost facility operators and managers
- Farmers
- Nova Scotia Department of Agriculture
- Nova Scotia Federation of Agriculture
- Dalhousie University, Agriculture Campus
- Divert NS
- Nova Scotia Environment
- Compost Council of Canada

The facilitators of the workshop were:

Lise LeBlanc, LP Consulting, Lower Sackville, NS. Lise worked with over 600 clients in the agriculture, forestry and industry sectors in Atlantic Canada, Ontario and Alberta. She has developed successful waste-to-resource programs that include wood ash, biosolids, compost, digestate, off shore drilling waste, rendering plant effluents, fishery waste, paper mill sludge, construction and demolition waste. LP Consulting has developed over 2000 nutrient management plans that includes farm specific soil amendment programs.

Mike Lishman, Arlington Farms, Jarvis, Ontario. Arlington Farms grows over 1000 acres of corn and soybeans using municipal compost. Mike also provides custom spreading for 15,000 tonnes of manure and 20,000 tonnes of municipal compost to the agricultural industry. He has worked with Christine Brown, the Nutrient Management lead with the Ontario Ministry of Agriculture, Food and Rural Affairs on-farm compost research trials.

The workshop agenda included:

- Introduction of participants
- Project goals
- Composting and Facility Locations
- Compost Regulations
- NAOW (Non-agricultural Organic Waste) amendments that can be applied to Ag Land,
- Importance of Amendments for Agriculture
- What do Agrologists talk to farmers about when making recommendations
- Challenges & Opportunities in working with Agriculture
- Compost Testing
- Compost project results
- Agriculture market in the workshop regions
- Successful programs
- Incentives

7.1 Soil in your Undies

As part of the agriculture education program, it was important to start the discussion that benefits of compost go beyond fertilizer value.

A fundamental soil health parameter is the soil microbial community (fungi, bacteria, actinomycetes, protozoa, etc). They are a complex ecosystem that play a necessary role for recycling nutrients, healthy plant growth, increasing yield and degrading organic pollutants. Compost helps to improve the levels and complexity of the microbial community.

This can be a difficult concept to promote because soil microbial activity cannot be seen and can be difficult to determine an economic value.

A simple educational tool that has been recently developed to educate the agricultural industry on the impact of the microbial community on soil health is “Soil in your Undies”. New 100% white cotton briefs are buried in farmers’ fields and removed after six to eight weeks. The higher soil microbial activity, the greater the degradation of the cotton briefs. Microbes eat the carbon in the underwear as a food source.

Underwear was buried in fields from Wolfville and Truro that had both low and good organic matter levels, fields that had manure application and fields that had not had organic products applied. They were removed after six weeks.

This provided a simple yet engaging way to have a conversation around the impact of compost on the microbial community in farm fields.

8.0 CONCLUSION

The results of the project and the success of the workshops clearly indicate that there is an opportunity and an enthusiasm for the compost and agricultural industry to work together.

One of the most significant challenges of developing agricultural compost programs was the perceived low fertilizer value. This project identified, not only for Nova Scotia, but for Canada, that this perception may have been due to the misinterpretation of compost test results that was intended as a media analysis, not an amendment analysis.

There is significant fertilizer value in compost. Compost contains good levels of phosphorus which is one of the most expensive nutrients that farmers purchase. There is worldwide concern about the 30-year availability of easily extractable phosphorus therefore it is important to find ways to recycle phosphorus back to agricultural soils.

In addition to fertilizer, there are other benefits that compost provides such as organic matter and soil microbiology. It can be difficult to calculate their economic returns but through continued work with the agricultural industry, the value of these benefits will become more apparent.

If both industries work together, the challenges identified by the project can be resolved. A successful agricultural compost program will:

- produce a clean, consistent quality product
- develop a communication plan
- implement demonstration projects
- recognize that truckers are an important part of the program
- work with agricultural leaders
- create demand in the market

8.1 Recommendations

8.1.1 Laboratory Analysis

Undervaluing fertility value in compost has been a significant deterrent to using compost in agriculture.

Recommendation #1– Facility operators should test their product as both a manure and a compost to ensure they have the proper information to market their product to agriculture.

- In addition to testing compost for provincial and CCME requirements (trace elements, pathogens, foreign material and maturity), compost facilities should test compost as an amendment. Some labs call this test a manure analysis.

- If the facility is not certain of the appropriate test they require for the agricultural market, they should contact the lab or their local P.Ag. to ensure they have requested the correct test package.

- When comparing compost to other amendments and fertilizers, the test and reporting units must be the same. If they are not, convert the results to the appropriate unit.

- Laboratories can reduce misinterpretation in the marketplace, if the reports indicate if results are reported as a soil media or an amendment, nutrients are total or partial and if the results are in DWB or "as is". The results cannot be interpreted by the compost facility or agriculture without this information.

8.1.2 Economics

Nova Scotia compost has excellent fertilizer value, ranging from $90-$140/tonne. The highest value can be attributed to three nutrients; calcium, phosphorus and magnesium with nitrogen, sulfur and micronutrients also adding value.

Recommendation #2 – The economic value of benefits other than nutrients need to be identified to increase demand in the agriculture market.

- The economic benefits of organic matter and microbial activity have not been identified which would considerably increase the value of the compost.

Recommendation #3 – The cost of compost should provide a good economic return to the farmer.

- The cost of compost should be consistent with other amendment programs. Although compost has a high value per tonne, trucking and application costs are much higher for compost, which affects sales potential.

- The market region should be within 75-100 km of the facility for economical trucking rates.

- Compost must be delivered in a short timeframe during spring and fall, otherwise sales orders will be cancelled.

8.1.3 Product

Regardless of the value and benefits of compost for agricultural crop production, if the compost is not consistent and reasonably contaminate free, success will be limited.

Recommendation #4 – Assess the processing method for opportunities to reduce contamination levels.

- Produce a clean consistent product with a record of test results.

Recommendation #5 – Investigate the opportunity for a new classification that can provide an amendment product to the agricultural community.

- The agriculture market may not require the same product that is sold to traditional compost markets which include bagging and soil blending.

- If government were to support a new product classification, it is essential that strict quality and end-use requirements are placed on the product. Poor quality product damages the marketplace for all industries. The high-end compost markets should not be jeopardized. This could be achieved by:
    - maintaining the same quality requirements for trace elements, pathogens and foreign material,
    - only approved for agricultural land application,
    - not calling the product compost to avoid misidentifying both products as the same,
    - requiring farms to have a nutrient management plan (NMP),
    - facilities maintaining records of farm, NMP recommendations and delivered tonnages.

8.1.4 Education & Marketing

Nova Scotia has the potential to utilize significant compost tonnages. Depending upon soil tests, less than 6,000 hectares (15,000 acres of land) would be required. This amounts to less than 3% of the Canadian Land Inventory (CLI) agricultural class 2, 3 and 4 land base that is used for agriculture. Nova Scotia does not have class 1 soil.

Recommendation #6 – Develop agricultural marketing strategies which are different than the traditional compost market program.

- Although organic matter and microbiology are excellent benefits, they are not the first benefits to promote to the agricultural industry. Fertilizer value should be the first benefit with discussion about the other benefits.

- The primary market would be grain, new seeded forage crops, orchards and grapes. Dairy and grain farms would be the early adopters. There is potential in the lowbush blueberry market when blueberry prices increase.

- Set up field demonstration projects and agricultural tours. If conducting a farm tour of the facility, prepare the facility to promote success.

- Work with Professional Agrologists (P.Ag.) who are innovators, work closely with the agricultural community and have farm clientele.

- Communicate with farmers if they have concerns or issues with the compost. There is only once chance to fix an issue.

- Measure success in the agriculture market through sales, savings to the municipality, reputation and innovation.

8.1.5 Incentive Programs

Healthy soils are important, not only for agriculture but also for the public good through productive agriculture, supporting biodiversity, reducing greenhouse gases through carbon storage and maintaining environmental stability. Compost can be an important local sustainable resource to improve and maintain healthy soils.

Governments have recognized the importance of improving soil health and have implemented programs to encourage farmers to evaluate compost for long-term benefits.

Recommendation #7 – Work with agriculture to develop a proposal to encourage government to invest in healthy soil incentive programs.

Appendix

Product analysis comparing two laboratory test results for product tested as a compost and a manure for compost facilities 2-9.

Sample ID	Compost Facility #2			
Sample Type	Compost		Manure	
Laboratory	NSDA	A&L	NSDA	A&L
Parameter	"AS IS"			
Nitrogen (%)	1.73	1.94	1.87	2.28
Ammonium-N %	Not Reported	Not Reported	0.06	0.08
Calcium (%)	3.89	0.41	4.29	Not Reported
Potassium (%)	0.53	0.27	0.54	0.63
K_2O (%)	0.65	0.32	0.66	0.75
Phosphorus (%)	0.65	0.06	0.81	0.13
P_2O_5 (%)	1.50	0.13	1.84	1.63
Magnesium (%)	0.32	0.05	0.27	Not Reported
Sodium (%)	0.30	0.15	0.34	0.46
Boron (ppm)	14.06	3.05	14.57	10.90
Copper (ppm)	36.93	0.90	33.21	61.80
Iron (ppm)	6759.38	100.03	4920.09	9367.60
Manganese (ppm)	301.65	35.94	324.26	350.70
Zinc (ppm)	122.03	18.51	112.93	172.30
Sulfur ppm	Not Reported	237.20	Not Reported	2703.00

Sample ID	Compost Facility #3			
Sample Type	Compost		Manure	
Laboratory	NSDA	A&L	NSDA	A&L
Parameter	"AS IS"			
Nitrogen (%)	1.31	1.28	1.37	1.28
Ammonium-N %	Not Reported	Not Reported	0.04	0.10
Calcium (%)	1.24	0.16	1.29	1.46
Potassium (%)	0.33	0.12	0.34	0.36
K2O (%)	0.40	0.14	0.41	0.43
Phosphorus (%)	0.20	0.02	0.23	0.25
P2O5 (%)	0.45	0.05	0.53	0.57
Magnesium (%)	0.09	0.02	0.09	0.13
Sodium (%)	0.19	0.07	0.20	0.28
Boron (ppm)	8.70	0.96	8.08	6.20
Copper (ppm)	13.30	0.55	13.98	25.50
Iron (ppm)	1763.08	86.56	1635.50	2644.80
Manganese (ppm)	65.60	10.53	65.23	91.80
Zinc (ppm)	39.29	7.60	36.36	71.10
Sulfur ppm	Not Reported	72.36	Not Reported	1168.00

Sample ID	Compost Facility #4			
Sample Type	Compost		Manure	
Laboratory	NSDA	A&L	NSDA	A&L
Parameter	"AS IS"			
Nitrogen (%)	1.19	1.13	1.24	1.34
Ammonium-N %	Not Reported	Not Reported	0.01	0.01
Calcium (%)	3.00	0.47	2.91	Not Reported
Potassium (%)	0.11	0.07	0.10	0.15
K2O (%)	0.14	0.09	0.12	0.18
Phosphorus (%)	0.50	0.06	0.53	0.55
P2O5 (%)	1.14	0.13	1.21	1.25
Magnesium (%)	0.18	0.04	0.18	Not Reported
Sodium (%)	0.05	0.03	0.05	0.11
Boron (ppm)	11.16	2.42	9.78	8.90
Copper (ppm)	16.65	2.48	16.15	64.30
Iron (ppm)	5273.85	177.89	6020.79	8002.30
Manganese (ppm)	327.12	30.14	346.09	360.20
Zinc (ppm)	97.66	25.77	102.55	119.70
Sulfur ppm	Not Reported	89.24	Not Reported	1775.50

Sample ID	Compost Facility #5			
Sample Type	Compost		Manure	
Parameter	"AS IS"			
Nitrogen (%)	1.13	1.28	1.24	1.06
Ammonium-N %	Not Reported	Not Reported	0.01	0.01
Calcium (%)	3.06	0.46	3.17	Not Reported
Potassium (%)	0.14	0.11	0.12	0.18
K_2O (%)	0.17	0.13	0.14	0.22
Phosphorus (%)	0.54	0.07	0.57	0.57
P_2O_5 (%)	1.24	0.15	1.32	1.31
Magnesium (%)	0.17	0.05	0.16	Not Reported
Sodium (%)	0.09	0.06	0.08	0.14
Boron (ppm)	10.85	3.11	9.03	9.30
Copper (ppm)	27.29	2.35	25.97	44.90
Iron (ppm)	4267.67	134.32	5253.91	6413.70
Manganese (ppm)	191.10	26.75	201.81	193.90
Zinc (ppm)	101.26	28.94	102.52	113.70
Sulfur ppm	Not Reported	258.26	Not Reported	2369.90

Sample ID	Compost Facility #6			
Sample Type	Compost		Manure	
Laboratory	NSDA	A&L	NSDA	A&L
Parameter	"AS IS"			
Nitrogen (%)	1.69	1.43	1.62	2.12
Ammonium-N %	Not Reported	Not Reported	0.06	0.13
Calcium (%)	2.88	0.27	2.90	Not Reported
Potassium (%)	0.30	0.10	0.30	0.36
K_2O (%)	0.36	0.12	0.36	0.43
Phosphorus (%)	0.46	0.03	0.42	0.56
P_2O_5 (%)	1.05	0.06	0.97	1.28
Magnesium (%)	0.16	0.03	0.16	Not Reported
Sodium (%)	0.17	0.06	0.18	0.26
Boron (ppm)	9.15	1.15	8.52	8.40
Copper (ppm)	29.17	0.74	31.96	49.10
Iron (ppm)	3331.90	68.54	2710.80	4188.10
Manganese (ppm)	174.89	19.32	158.38	186.10
Zinc (ppm)	96.20	11.50	78.68	131.10
Sulfur ppm	Not Reported	71.76	Not Reported	1864.20

Sample ID	Compost Facility #7			
Sample Type	Compost		Manure	
Laboratory	NSDA	A&L	NSDA	A&L
Parameter	"AS IS"			
Nitrogen (%)	1.41	1.20	1.34	1.49
Ammonium-N %	Not Reported	Not Reported	0.01	0.01
Calcium (%)	2.42	0.31	2.21	Not Reported
Potassium (%)	0.37	0.17	0.33	0.44
K_2O (%)	0.45	0.21	0.40	0.53
Phosphorus (%)	0.38	0.05	0.37	0.38
P_2O_5 (%)	0.87	0.12	0.84	0.88
Magnesium (%)	0.25	0.04	0.24	Not Reported
Sodium (%)	0.22	0.09	0.22	0.29
Boron (ppm)	15.01	2.88	14.15	12.10
Copper (ppm)	34.72	1.67	37.34	61.00
Iron (ppm)	6257.48	143.93	5840.48	9764.30
Manganese (ppm)	390.97	34.85	380.80	369.00
Zinc (ppm)	125.52	23.89	133.27	149.00
Sulfur ppm	Not Reported	208.06	Not Reported	2239.90

Sample ID	Compost Facility #8			
Sample Type	Compost		Manure	
Laboratory	NSDA	A&L	NSDA	A&L
Parameter	"AS IS"			
Nitrogen (%)	1.02	0.99	1.10	1.15
Ammonium-N %	Not Reported	Not Reported	0.01	0.01
Calcium (%)	3.09	0.35	3.35	Not Reported
Potassium (%)	0.18	0.08	0.17	0.24
K2O (%)	0.22	0.10	0.20	0.29
Phosphorus (%)	0.39	0.03	0.40	0.35
P2O5 (%)	0.90	0.08	0.92	0.80
Magnesium (%)	0.21	0.026	0.17	Not Reported
Sodium (%)	0.11	0.03	0.09	0.15
Boron (ppm)	35.53	6.88	28.40	28.80
Copper (ppm)	37.53	1.82	31.36	55.10
Iron (ppm)	4261.73	122.54	3960.67	6238.10
Manganese (ppm)	472.44	39.96	455.11	485.80
Zinc (ppm)	146.99	29.22	138.20	142.40
Sulfur ppm	Not Reported	740.15	Not Reported	5318.90

Sample ID	Compost Facility #9			
Sample Type	Compost		Manure	
Laboratory	NSDA	A&L	NSDA	A&L
Parameter	"AS IS"			
Nitrogen (%)	0.8	0.6	0.7	0.8
Ammonium-N %	Not Reported	Not Reported	0.01	0.01
Calcium (%)	4.1	0.4	3.9	Not Reported
Potassium (%)	0.04	0.01	0.05	0.00
K_2O (%)	0.05	0.01	0.06	0.00
Phosphorus (%)	0.9	0.1	0.7	0.9
P_2O_5 (%)	2.1	0.2	1.7	2.0
Magnesium (%)	0.2	0.04	0.2	Not Reported
Sodium (%)	0.03	0.00	0.03	0.1
Boron (ppm)	7.2	0.9	5.3	5.9
Copper (ppm)	7.9	0.5	9.5	19.1
Iron (ppm)	3680.4	52.0	3736.6	5845.3
Manganese (ppm)	423.7	27.1	386.9	431.1
Zinc (ppm)	57.8	8.9	55.6	63.4
Sulfur ppm	Not Reported	35.3	Not Reported	1169.3