

**Attachment B – Organics Recycling Feasibility Study**

+ impressive Reference letter  
+ Local expert  
+ Real life experiences

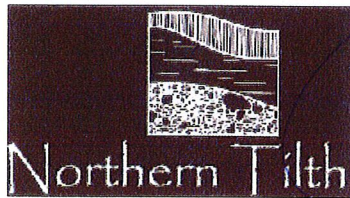
## PROPOSAL TO CONDUCT AN ORGANICS RECYCLING FEASIBILITY STUDY

Prepared For:

**ecomaine**

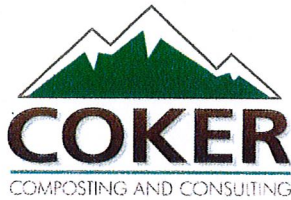
Portland, ME

Prepared By:



**Northern Tilth**  
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In Association With:



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**Integrated Waste Management Consulting**, Nevada City, CA



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September 20, 2012

# INTRODUCTION

## OVERVIEW

**ecomaine** is a non-profit waste authority that provides solid waste disposal capacity and recycling services to over 335,000 people in the greater Portland, ME area and nearby jurisdictions in southern Maine. The primary infrastructure at **ecomaine** is a 550 ton/day waste-to-energy (WTE) plant generating 105,000 MW-hr per year and a single-stream materials recovery facility that recycles almost 40,000 tons/yr. **ecomaine** is committed to integrated solid waste management and wishes to offer its customers access to viable organics recycling systems using either anaerobic digestion to capture the energy component of organic wastes (biogas) and/or composting to produce a soil amendment that will restore and maintain the health of Maine soils. At this time, **ecomaine** is seeking the services of a qualified consulting firm to complete a feasibility study that will provide a practical, cost-effective path forward for developing increased organics diversion and recycling capacity.

## THE NORTHERN TILTH TEAM

Northern Tilth (Belfast, ME) offers **ecomaine** a truly outstanding team of national experts in organics recycling:

- Andrew Carpenter (Northern Tilth) – Mr. Carpenter has been developing and managing organic waste recycling programs in New England since 1992. Mr. Carpenter has managed a wide array of organics recycling programs, ranging from large-scale food processing by-products, biosolids and paper mill residuals projects, to smaller scale on-farm manure and food waste composting operations.
- Craig Coker (Coker Composting & Consulting, Vinton VA) – Mr. Coker is a nationally-recognized authority on organics recycling technologies, process design and control, and efficient organics management operations. He has over 32 years' experience developing facilities plans and designs for composting or digesting food scraps, yard trimmings, biosolids, and other organic feedstocks.
- Matt Cotton (Integrated Waste Management Consulting, Nevada City, CA) – Also nationally recognized in the organics recycling industry, Mr. Cotton has over twenty-five years of experience in solid waste management facility planning, permitting, policy, regulatory compliance, and composting. He was the primary developer of, and is principal instructor for, SWANA's Organics Collection training

program. He designed his first organics collection program in 1986 in response to Minnesota's proposed yard trimmings ban

- Mike Lannan, P.E. (Tech Environmental, Waltham, MA) – Mr. Lannan has over 18 years' experience in waste-to-energy plant evaluations and air quality projects. In addition to traditional solid waste landfill and waste-to-energy experience, he has been intimately involved in the diversion of food waste and food waste processing facilities for the last few years.
- Dana Buske, Ph.D. (Tech Environmental, Waltham, MA) – Dr. Buske has over ten years' experience in evaluating waste-to-energy facility air emissions and Title V operating permits.

A project organizational chart is shown in Figure 1. Complete resumes and letters of recommendation for all team members are included in the Appendix.

#### APPROACH TO PROBLEM-SOLVING

Each team member approaches problem solving in a similar fashion: to carefully examine all aspects of a problem, develop potential alternative solutions, evaluate the viability, impact and cost of each solution, and then recommend a solution that is closest to the balance point of a workable solution, at a reasonable price, that has the support of a majority of stakeholders to a process, and is implementable in a reasonable time frame. Each of the Northern Tilth team members share a philosophical approach that simple solutions are often best. While high-technology, complex systems are interesting to look at and study, in the real world of day-to-day solid waste management, rarely do such high-profile approaches "pencil out".

The primary team members of the Northern Tilth team are problem-solvers by nature and have chosen careers that constantly offer them new challenges. Operating consulting practices allows our team to have a broad exposure to solutions in a real-world context, in a variety of situations. This breadth of experience allows us to quickly identify those options which warrant further consideration. The Northern Tilth team is committed to working with **ecomaine** to engage stakeholders to assure that options evaluated have practical application in the communities that **ecomaine** serves.

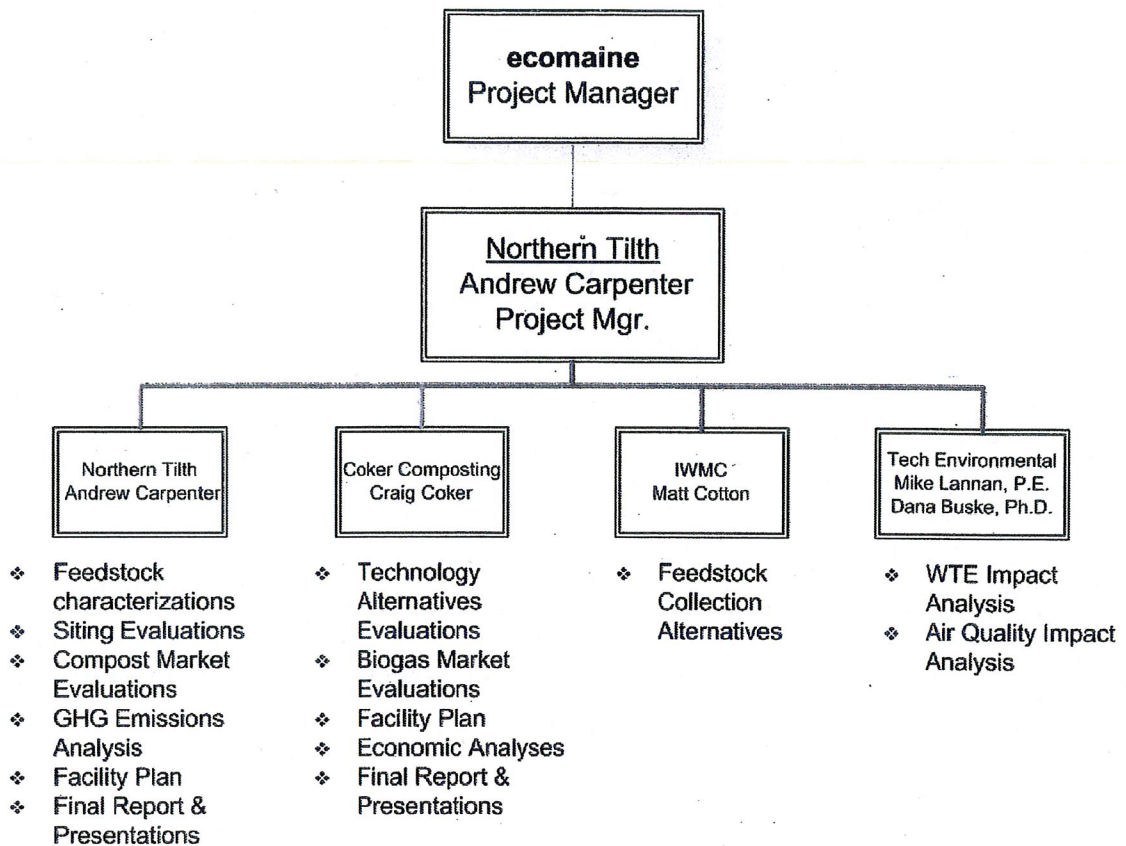


Figure 1. Project Organizational Chart

## SCOPE OF WORK

The Northern Tilth (NT) team is dedicated to the principles of sound project management, which include detailed project work planning, careful documentation of meetings and phone calls, and thorough organization of all project files. As the team is working at various locations around the U.S., the following project protocols will be put into place so that **ecomaine** will be assured of a well-documented project:

- ❖ A Project Management Plan will be prepared as the first deliverable so all project protocols, schedules, task scopes of work, analytical methods, and communication procedures will be documented for consistent application throughout the project.
- ❖ All communications (personal, telephonic, electronic) will be documented with meeting minutes or conversation notes and copies of all documents will be filed with the NT office in Belfast, ME
- ❖ Detailed status reports of all work performed will be provided to the **ecomaine** project manager monthly, or on request
- ❖ At the conclusion of the project, copies of all project files will be delivered to **ecomaine** in an electronic medium.

### TASK 1 – ORGANIC WASTE IN THE ECOMAINE SERVICE AREA: WASTE COMPOSITION AND CURRENT STATUS OF COLLECTION AND RECYCLING

The member towns serviced by **ecomaine** represent a complex network of hauling arrangements, collection equipment and containers, transfer stations, and recycling programs. Yard trimmings, a significant portion of the organic waste stream, appear to be successfully diverted from the solid waste streams of many of **ecomaine's** member communities (for example many of the towns offer seasonal yard trimmings collection). Additionally, in many member towns some smaller food scraps collection and composting programs are already in place, including Resurgam Zero Waste's commercial food waste composting operation in Portland, Yarmouth's food scrap composting program, and several school food scraps composting operations in the area.

In order to understand the potential volume of organic feedstock that could be delivered to an organics recycling facility, the NT Team proposes to review the current status of organics diversion programs for all of **ecomaine's** member communities. This task will help the Team understand the baseline from which a successful organics recycling program

can be built upon. In order to properly plan an efficient organics collection and processing system, it is critical to understand the available feedstocks, the existing collection programs, existing collection equipment and containers, the available capacity of existing facilities, and future jurisdiction and contract hauler plans. To the extent possible this would be done with internet based research, but will also require contacting participating jurisdictions to fully understand existing conditions.

The next step in the process will be to make some assumptions about the potentially capturable organics in the **ecomaine** waste stream. The most recent, relevant waste characterization study for the **ecomaine** service area is the *2011 Maine Residential Waste Characterization Study* completed by the University of Maine's School of Economics. While the actual inputs to **ecomaine's** WTE have not been methodically characterized relative to the percentages of compostable and non-compostable materials, the NT Team will be able to use existing published studies to provide a practical assessment of the realistic quantities of organics in **ecomaine's** waste stream that could be diverted to anaerobic digestion (AD) and/or composting.

The 2011 University of Maine study indicated that the fraction of food scraps in Maine's residential waste is, at 28%, significantly higher than the 2009 EPA national estimate of 14.1%, and the 13.7% reported from residential solid waste in the *Connecticut Statewide Solid Waste Composition and Characterization Study* from 2010. This is also higher than the statewide waste characterization in Georgia in 2009 which found that 12% of the MSW stream was food scraps, or recent studies from largely rural areas of Alaska, which estimated 14% of the MSW was food scraps. A review of the data with Dr. Criner from the Univ. of Maine revealed that he only evaluated bagged waste, excluding bulk solid wastes, so the percentage attributable to food scraps is artificially high.

Using **ecomaine** delivery records, the NT Team will separate the incoming solid waste stream into commercial versus residential loads, and the residential deliveries will further be categorized as either "rural" or "urban" based on population density. The NT Team will then use several pertinent waste generation studies from around the country, with a demographic make-up similar to the **ecomaine** service area as guidance for this task. In determining the solid waste composition, we will also take into account the current diversion programs in place in member communities. In addition, the project team is familiar with how waste characterization studies translate into participation/capture rates and actual tons collected in typical organics collection programs.

The deliverable for this scope will be a report that includes

- a summary of the current collection systems and organic waste diversion and processing programs in place in **ecomaine's** service area

- an estimate of the total amount of potentially recoverable organics from the **ecomaine** waste stream.
- an analysis of how the potentially recoverable organics waste stream might be different, depending on whether the end process is composting or AD. For example, most food scraps collection programs in place in the US can be considered “inclusive” and tend to include a broad spectrum of organics including food-soiled paper, wet strength cardboard, and other food-related packaging. A food scraps collection program based on AD might have limitations on included materials (for example compostable plastic bags).
- high and low range estimates, based on case studies from existing municipal food scraps collection programs, of the practically achievable diversion rates for organics that has the potential to be collected for composting and/or AD. Estimates will further be refined based on qualitative factors (i.e., whether a given food scraps program is inclusive – accepting meat, dairy, food-soiled paper, etc or exclusive – accepting only vegetative food scraps).

## TASK 2 – FEEDSTOCKS COLLECTION ALTERNATIVES

Collection can often be the most significant cost in a source-separated organics (SSO) diversion program. Given the mix of urban, suburban, and rural communities that comprise the **ecomaine** service area, it is likely that a broad range of collection alternatives will need to be evaluated to find the best mix for each community. This is likely to consist of two basic approaches:

- 1) An analysis of options for collecting SSO from residential and commercial businesses using traditional collection methods (i.e., drop-off, co-collection, dedicated collection, etc). Fundamentally collecting organics is similar to collecting other materials, often utilizing the same trucks and techniques as garbage collection.
- 2) A description of novel approaches that smaller communities are using to collect organics via non-traditional means. This will also include up to three case studies of programs that may provide models for communities in the **ecomaine** service area.

Based on the estimates of waste composition and potentially compostable material developed in Task 1, the project team will review potential organics collection alternatives, document the existing organics collection infrastructure, and describe options which might be considered by **ecomaine** communities.

Our understanding is that each **ecomaine** community is responsible for collection of residential and sometimes commercial waste. While costs of **ecomaine** facilities are spread

*Not always*



across the service area, the costs of collection are borne by the individual communities' rate base. There is no reason to expect this to change if and when organics diversion facilities are constructed – **ecomaine** will allocate the cost of developing the needed facility and amortize that over time and based on the communities or haulers using the facility. The Northern Tilth team will develop an estimate for the cost of a collection program in areas where waste generation route density would support a separate collection effort, which will include exploration of regulatory issues (permits, licensing, etc.); the team will also explore how existing private haulers serving **ecomaine** communities could expand into SSO collection.

Since food scraps is a significant part of some food-generating businesses waste stream (i.e., restaurants, grocery stores, food processing businesses, etc.), it is likely that new organics collection programs will focus first on the commercial fraction of the service area. In many cases businesses will be able to realize cost savings by separately collecting food scraps.

The deliverables under this task include:

- A high level analysis of organics collection options (drop-off, commingled, dedicated collection, etc.) that can serve as a resource for **ecomaine** community's and their haulers in evaluating options and designing pilot collection studies. This analysis will also include the advantages of providing inclusive vs. exclusive collection programs and which decisions might impact the eventual composting or anaerobic digestion alternative.
- Up to three case studies of organics collection programs that can be adapted for use by **ecomaine** communities.
- Cost estimates for identified practical collection programs and recommendations for cost allocations to member communities

### TASK 3 – TECHNOLOGY ALTERNATIVES EVALUATION

The main processing alternatives for source-separated organics (SSO) are AD and composting which have been around for centuries and there are a wide number of different technologies available for each process. Broadly speaking, AD systems can be categorized as either high solids or low solids systems; the appropriateness of each depends in part on the feedstock and in part on the planned use of the digested solids (called digestate). While historically sewage sludge has the longest track record with relatively low solids digestion, there is increased interest in adapting high solids digestion technologies to manage

municipal organics in the US. The vast majority of operating composting facilities in the US use a turned windrow process, but again, as municipal food scraps are increasingly collected, composting technologies are being adapted to increase process control, including turned windrow, passively aerated static pile, forced aeration static pile (in aerated bins, individual piles, or extended piles), in-vessel (in drums, boxes, channels, and similar engineered systems), or a combination of these systems.

This task will focus on identifying proven (at a commercial scale) AD and composting technologies with demonstrated cold weather performance at a size similar to the expected organics waste stream in the **ecomaine** service area. The project team will develop up to eight (8) project profiles of successful composting and/or AD technologies currently operating in the northeastern U.S, Canada, and in northern European countries. Profiles will be developed based on publicly available information (e.g. EPA Ag-Star program, U.S. Composting Council data and Canadian Composting Council data), internet, and telephone research. Information will be gathered from technology vendors offering approaches not yet in the market long enough for profiles to be developed, from existing contractors operating “merchant” facilities, and from project developers offering design/build, design/build/operate, and design/build/own/operate organics processing systems.

This task will include an evaluation of odor control strategies used in other organics recycling facilities. These strategies include: proper siting, good process design and management, proactive site and operations management, technologies (biofiltration, biotrickling filters, chemical scrubbers, odor neutralizer sprays, etc.), and proactive community education and outreach.

A weighted-matrix evaluation technique will be used to focus on those digestion and/or composting technologies, odor control approaches, and possible partners that have the greatest potential to meet the needs of **ecomaine** in processing SSO feedstocks. The weighted criteria matrix is a decision-making tool that is used to evaluate alternatives based on specific evaluation criteria weighted by importance. By evaluating alternatives based on their performance with respect to individual criteria, a value for the alternative can be identified. The values for each alternative can then be compared to create a rank order of their performance related to the criteria as a whole. The tool is important because it treats the criteria independently, helping avoid the over-influence or emphasis on specific individual criteria. The evaluation criteria will be jointly developed by the Northern Tilth team and **ecomaine** staff, but the weighting factors will be assigned by **ecomaine**. This approach has been successfully used by the Northern Tilth team on feasibility studies in Alaska, Oklahoma, and Minnesota.

The deliverable for this task will be a task report, containing detailed process descriptions for both AD and composting, the project profiles for compatible technologies, the weighted criteria matrix evaluation and a list of potential private-sector project developers with experience in composting, AD, or both.

#### TASK 4 – SITING EVALUATIONS

**ecomaine** is interested in exploring several potential arrangements including **ecomaine** being the owner and operator of an organics processing facility, developing a partnership with a private entity in expanding a current facility, or contracting with a private firm or existing facility for organic waste recycling services.

The Northern Tilth team will investigate suitable processing sites with all of these potential operating arrangements in mind. As the traditional approach at **ecomaine** has been to both own and operate facilities under their purview, the main focus of this task will be to explore options on **ecomaine**-owned properties. Northern Tilth has visited both the 260-acre ash landfill off of County Rd. and the 258-acre undeveloped parcel of land that **ecomaine** owns in the town of Gorham. Both of these sites have potential areas that may be suitable for composting and/or AD, but in both cases there are limitations that need to be thoroughly explored. Although, Northern Tilth understands that the DEP would be very cautious in reviewing proposals that involve building any processing infrastructure on top of either of the closed landfill cells at the ash landfill<sup>1</sup>, some areas on the capped cells may provide a good site location, especially for composting, consequently a cursory investigation, based in part on post-closure monitoring records, of this option will be included in the report. Even though regulatory siting requirements for processing facilities may be easily met in some areas at either of these two locations, practical limitations, including neighbor relations, and infrastructure needs require thorough investigation. The information reported in Tasks 1 and 3 will inform the process of site evaluation in this task. Larger facilities will obviously require a larger footprint, greater accessibility, and greater setbacks to potential odor receptors.

Due to the large geographic area serviced by **ecomaine** and the relatively sparse population in many of the outlying communities, a de-centralized strategy for processing organic wastes may be a more cost-effective approach than delivering all organic wastes to one facility. For instance, developing relationships with on-farm composting operations in more rural locations, especially for municipalities that currently consolidate waste at a

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<sup>1</sup> Personal Communication, Randy McMullen, ME DEP August 22, 2012

transfer station prior to delivery to **ecomaine**, may be a more cost-effective approach. Similarly, the Northern Tilth Team will investigate the potential for developing partnerships with existing operations that have the capacity to manage additional organic wastes. For instance, the Lewiston Auburn Water Pollution Control Authority (LAWPCA) is currently constructing anaerobic digesters for recovering energy from their biosolids. LAWPCA may be open to the idea of accepting outside organic wastes for the digesters for a tip fee, provided the material will increase energy production and have the physical characteristics<sup>2</sup>.

Finally, the Northern Tilth team will investigate opportunities with composters local to the Portland Area, including Resurgam Zero Food Waste and Benson Farms, LLC to determine their ability and willingness to expand (or relocate) and/or partner with **ecomaine** in a long-term organics recycling program.

The deliverable from this task will include

- a detailed assessment of the opportunities and limitations associated with siting composting and/or AD infrastructure at both of the **ecomaine**-owned parcels mentioned above relative to the requirements of the Maine Department of Environmental Protection's (ME DEP) Chapters 409 and 410 Processing and Composting Facilities regulations.
- an assessment of the practical considerations associated with building composting and/or AD facilities at either of these sites, including odor/air quality impacts, equipment movement and infrastructure limitations, etc.
- a discussion of existing capacities and expansion opportunities or limitations as they relate to critical siting parameters for other private and public operations that may provide partnering opportunities for **ecomaine**.

## TASK 5 – WTE IMPACTS ANALYSIS

In waste-to-energy operations, there is a balance between the energy benefits of the heat content of food and vegetative waste and the energy consumed to evaporate the water and bring to combustion temperature. While food and vegetative waste have good caloric value, they contain more water than other organic materials. Sometimes even “dewatered” organic solids might contain more than three parts water to one part solids, even though the appearance is that of a cake-like material. The project team will evaluate the impact on

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<sup>2</sup> Personal Communication, Mac Richardson, LAWPCA Superintendent August 13, 2012

both the air quality emissions and on the changes in energy balance resulting from removal of high-moisture organic material from the waste-to-energy fuel.

This first task will be to examine the potential food and vegetative waste streams and sort them into different categories and assess the potential change in energy output by diverting this material to another facility. The waste categories will be site-specific, but could be based on the percent moisture, percent simple sugars, biochemical oxygen demand, etc. Once the categories are defined, a few mixtures of new waste streams will be created based on potential tonnage ranges. This will be done, in part, because it is likely that a fraction of the food waste stream and not the entire food waste stream can be easily diverted. These mixtures will be analyzed by the laboratory for caloric content and percent moisture. It is assumed that the current range of heat value and moisture content is known for the mixed waste stream today, but a sample of the typical waste will be sent for analysis anyway to establish a study baseline for comparison.

The net energy savings/costs should consider not only the impact or changes to the WTE process but also, the net energy savings/costs for the diverted material. The energy analysis will also compare the final results of the potential energy benefits from shifting food and vegetative wastes to composting or AD as defined in other tasks. Essential right now if one "draws a box" around the waste-to-energy facility, the net energy from waste-to-energy system can be determined. To make an apples-to-apples comparison, it is important to draw the same box around the waste-to-energy facility with the diversion and also the organic waste stabilization process. This task will compare the net energy from the current waste-to-energy facility to the waste-to-energy with diversion combined with a composting facility, and also to the waste-to-energy with diversion combined with an AD facility.

No diversion recommendations would be made that would compromise the existing waste-to-energy facility's operations with respect to its current air permits, so the second task will be to consider how the potential changes will affect the air emissions from the waste-to-energy process. The new change in system enthalpy will have to be quenched or there will be a change in temperature. Typically, there are temperature range requirements to maximize destruction and minimize the formation of products of incomplete combustion (PICs) in the exhaust emissions. It is possible that changes in fuel composition will have an effect on criteria pollutants carbon monoxide, nitrogen oxides, or sulfur dioxides. This task will start with an analysis of the current stack and boiler(s) permits, the permitted fuel source, and the quarterly stack testing results. Our experience with other WTE facility's stack test reports is that fuel changes can cause different emission spikes, so it is important to look at several years of historical data. Specifically, we will examine the change in

criteria pollutants and potential changes in the PICs, as well as any other parameters identified during the examination of the air permits and emission testing.

The deliverable for this task will include a report that summarizes

- the predicted changes in the net energy balance of the ecomaine facilities associated with food waste diversion from the WTE and processing by either AD and/or composting
- the predicted impact to the WTE emissions and performance related to the diversion of organic waste from the WTE waste stream

## TASK 6 – MARKETS EVALUATION

As with any recycling project there is no point in collecting an item unless it can be returned to the product stream. With food scraps, the end result can be biogas (from AD) and compost and/or digestate from composting. In most cases digestate from an AD facility accepting municipal and commercial food scraps may need to be composted before it can be sold. The following describes the Northern Tilth team's approach to evaluating the markets for these various components:

### *COMPOST MARKETS*

The existing compost market in Maine includes a wide range of physical and chemical quality as well as price. On the high end, seafood and manure-based compost that are certified by the Maine Organic Farmers and Gardeners Association (MOFGA) for use in organic agriculture and landscaping sell for as high as \$50.00 per cubic yard in the Portland area on a retail basis. On the lower end of the price range, some biosolids composts and leaf and yard waste compost sell for less than \$10 per cubic yard in bulk sales. It is not realistic to expect that composts derived from the organic waste in **ecomaine's** waste stream could be marketed on the high end of the existing range in the first few years of a composting program. While systems will be in place for removing contaminants (such as plastic utensils and non-compostable bags), it will likely take some time to produce compost marketable to high-end projects.

For this task, our team will provide a general review of the current quality and associated ranges in costs of compost being sold in the **ecomaine** service area. Based on the findings of the market research, our team will provide realistic pricing estimates for bulk sales of the finished compost including an average and a predicted range. Additionally, drawing on experience from similar programs around the U.S., such as Howard County, MD and Dubuque, Iowa we will provide estimates for the increasing value of the compost as the program matures.

### *BIOGAS MARKETS*

The three main outlets for biogas, or Recycled Natural Gas (RNG) are: electrical production, gas cleanup followed by pipeline injection or clean-up followed by compression for vehicle fuel. The production of electricity is the most common use of RNG. Insofar as **ecomaine** has an agreement with Constellation for electricity produced by the WTE plant, adding to that production could be a viable alternative. However, **ecomaine** is only getting an average of \$0.044 per kilowatt-hour (kWh) for its produced electricity, which, if that price held, is likely below the cost of production for electricity from an AD system.

The extremely low prices of natural gas in the U.S. at present, and in the foreseeable future, may make biogas clean-up to RNG with pipeline injection equally non-competitive. However, the Portland metro area has demonstrated willingness by the Transit District and the School Board to invest in Compressed Natural Gas (CNG) trucks, and a fueling station has been built to support those converted buses. A possible market to explore would be the conversion of City of Portland waste collection trucks to RNG fueling. There may be sites relatively close to **ecomaine** where a RNG refueling station could be built and may be a suitable public-private partnership with as few as 30 trucks and/or buses refueling per day<sup>3</sup>. All three RNG options will be carefully evaluated in this task.

### *DIGESTATE MARKETS*

If AD is determined to be a cost-effective processing approach for **ecomaine's** diverted food waste, the digestate may be managed by composting or by direct land application (use as an agricultural soil amendment). If composting is chosen, then the compost markets referred to above will be applicable to the composted digestate. In order to provide a comprehensive assessment of the costs associated with AD, the Northern Tilth team will also investigate the potential market and associated costs for land application of the digestate.

The farms within an approximately 40-mile radius of Portland have, in the past, provided enough land base to support biosolids land application programs for the cities of Portland, South Portland, and Westbrook. It is likely that the agricultural market in this area would also be able to support the land application of a nutrient-rich, de-watered digestate. In the case of the digestate, the market assessment will determine the land base requirements for the digestate that would be generated at **ecomaine's** facility and provide an assessment of permitting requirements and estimates for all the costs associated with delivery, spreading and program management of the land applied digestate.

The different end use markets will be evaluated using the same type of weighted criteria matrix analysis used in Task 3. Evaluation criteria could include: potential revenues,

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<sup>3</sup> Personal Communication, Mr. Steve Linnell, Portland Clean Cities Coordinator, Sept. 11, 2012

market stability and maturity, risk of competition, implementation issues, etc. The deliverable of this task will be a report that documents all findings and analyses, and containing detailed information on the markets for recovered energy and products, along with preliminary estimates of potential annual revenues.

## TASK 7 – CONCEPTUAL ORGANICS RECYCLING PLAN & ECONOMIC ANALYSIS

The Northern Tilth team will take the work completed in Tasks 1 – 6 and develop up to six (6) conceptual alternative configurations of collection-processing-markets for organics recycling systems that will be evaluated on a macroeconomic basis for **ecomaine** to consider. Each alternative will also be evaluated relative to risk, implementability, and environmental impact. Additionally, the evaluation will take into consideration case studies and lessons learned from existing programs in northern climates including integrated solid waste management programs that include WTE and organic waste recycling such as Vancouver Metro and Prince Edward Island in Canada. The Northern Tilth team will develop recommendations and meet with **ecomaine** stakeholders in a one-day charrette, or similar meeting format of **ecomaine**'s choice to review the alternatives in order to attempt to define the "best" alternative to carry forward into the conceptual facilities plan.

Based on the results of this charrette, the Northern Tilth team will develop a Conceptual Organics Recycling Plan (CORP) for the recommended collections alternative, recommended processing technology and recommended site/s that includes:

- Definition of potential collection system components (diversion strategies, infrastructure, education, training, & outreach, etc.)
- Site plan, layout, manufacturing plan, and preliminary sizing of all components for the recommended organics processing technology
- Pilot program considerations and full-scale implementation issues
- Transportation improvements plan (if needed)
- Equipment plan (number, type, size of equipment needed, candidate sources, likely prices)
- Utilities plan (water, sewer, electric)
- Environmental protection plan (storm water, air, ground water, etc.)
- Final permitting requirements
- Product(s) utilization market development plan

The team will prepare facility-plan level cost estimates (i.e. +50% / -30% level of accuracy) for:

- Capital costs (site development, buildings and fixed equipment, mobile equipment)



- Operational costs (labor, fuel, power, water, other expenses)

This task will include a proposed estimated annual operations and maintenance budget for the facility and an evaluation of how it might affect other O&M budgets within **ecomaine**. A draft facilities plan with schematic diagrams and site plans will be prepared and submitted to **ecomaine** for review and approval.

The Northern Tilth team has specialized capabilities in the field of greenhouse gas accounting. Northern Tilth was instrumental in developing the Biosolids Emissions Assessment Model (BEAM) that is currently used by the Canadian Council of the Ministers of the Environment. Additionally, Mr. Cotton helped to draft the Methane Avoidance from Composting Issue Paper for the Climate Action Reserve. The diversion of food scraps from the **ecomaine** WTE will have an impact on the carbon footprint of the overall operations. Changes in the carbon footprint will come from the change in the recovered energy from the WTE, energy generated from biogas if AD is used, and carbon sequestration and fertilizer replacement in digestate and/or compost made from the organic wastes.

As part of Task 7, the Northern Tilth team can provide a detailed accounting of the projected changes to the **ecomaine** facility's' carbon footprint from the organic waste recycling program using the CORP as the basis for predicted changes in carbon emissions. The Northern Tilth team can provide greenhouse accounting with site-specific data that will provide much more accuracy than currently available models, such as EPA's WARM emissions calculator. Additionally, this greenhouse gas emissions accounting report will be written in a format that would allow it to be used as an additional outreach tool in **ecomaine**'s library of educational materials.

## TASK 8 –FINAL REPORT & PRESENTATION TO **ECOMAINE** BOARD

Based on all of the information gathered in the previous tasks and drawing on the CORP developed for Task 7, the Northern Tilth team will complete a final report for **ecomaine**. The final report will act as a stand-alone document that will summarize the findings from Tasks 1 through 6 and the CORP. The report will outline the practical, economical and regulatory considerations that form the basis for the CORP including:

- how the team determined the most promising collection system alternatives for the blend of rural and urban residential and commercial customers that **ecomaine** serves

- the economic, operational and market-driven reasoning behind the technology choice/s for processing diverted organic wastes, including the proven ability of the chosen technology to perform in a climate similar to southern Maine
- regulatory siting requirements (state and local) that are relevant to the construction and operation of the recommended processing facility, or facilities, including an explanation of how the siting standards and general design standards in ME DEP Solid Waste Rules Chapter 409 2A. and 2B for AD and/or Chapter 410 2A. and 2B. for composting will be met
- a summary of potential odor, dust and other nuisance concerns and how they have been taken into account in the recommended plan
- the relevant requirements for facility and product monitoring from the ME DEP Solid Waste Rules Chapter 405 and the Chapter 419 Program License requirements necessary for permitting the use and marketing of digestate and/or compost from the selected organic waste management processes

In reaching the recommendations of the CORP, the Northern Tilth team will have drawn on practical knowledge gained through our collective experience in developing food scraps recycling programs as well as from the experiences, case studies, and profiles that we will have highlighted in Tasks 2, 3 and 6. The final report will summarize how the experience from these past projects informed the development of the CORP including some of the likely obstacles to be faced during start up (non-compostable contaminants, low participation rates, etc.), and some of the more successful educational and outreach efforts that have been used to increase participation rates and decrease contamination.

The final report will include a summary of the facility-plan level costs from the CORP and projections for volumes of organic wastes managed and products marketed from pilot project initiation through full-scale implementation of the organics recycling program. **ecomaine** will be able to take this final report and, upon approval, move either into design of an **ecomaine**-owned operation or to develop a Request For Proposals for a privatized operation.

In addition to the final report, the Northern Tilth team will give a presentation to the **ecomaine** board that summarizes the findings from Tasks 1 through 7, provides a thorough explanation of all components of the CORP, and which details the cost estimates of implementing the plan. The Northern Tilth team is also available to help **ecomaine** staff make presentations to interested public stakeholders.

## PROJECT SCHEDULE

### PROJECT GANTT CHART

The Northern Tilth team estimates it will take 6-7 months to complete this project in order to be comprehensive and thorough enough for **ecomaine** to make an informed decision about a future organics recycling component to their integrated solid waste management system. A proposed project Gantt Chart is shown in Figure 2 with an anticipated project start date in early December, 2012.

### RESOURCES DEMAND AND ALLOCATION

The project team has reviewed the proposed schedule in Figure 2 and has committed to make the needed resources available to conduct the work in accordance with the proposed schedule. As Messrs. Carpenter, Coker, and Cotton are self-employed individuals, their schedules are flexible and adaptable to meet **ecomaine's** needs. The WTE analysis to be done by Tech Environmental is not on the critical path, but Tech Environmental management has committed to making Mr. Lannan and Dr. Buske available as needed.

FIGURE 2. PROPOSED PROJECT SCHEDULE

ID	Task Name	Start	Finish	Duration	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013
1	Waste Composition & Current Status	12/3/2012	2/22/2013	60d							
2	Feedstock Collection Plan	1/7/2013	3/29/2013	60d							
3	Technology Alternatives Evaluation	1/21/2013	3/22/2013	45d							
4	Siting Analysis	2/25/2013	4/12/2013	35d							
5	WTE Plant Impacts Analysis	2/25/2013	4/12/2013	35d							
6	Markets Evaluation	4/15/2013	5/24/2013	30d							
7	Conceptual Organics Recycling Plan and Economic Analyses	5/6/2013	6/14/2013	30d							
8	Final Report & Presentations	6/14/2013	6/27/2013	10d							

## EXPERIENCE OF PROJECT TEAM

### NORTHERN TILTH

Andrew Carpenter has been recycling organic residuals in New England since 1992 and he opened Northern Tilth in 2003. Andrew has extensive experience in both the technical and practical issues involved in developing successful organic waste recycling programs. Andrew received an M.S. in Plant, Soil and Environmental Science at the University of Maine where his research focused on the biogeochemistry of topsoils manufactured from paper mill residuals and animal manure. With a strong background in soil and agronomy, Andrew is well-versed in the soil, plant and water interactions that occur in the process of amending soils with composts and other organic matter-based residuals. Developing cost-effective solutions that maximize resource recovery and environmental integrity in organic waste recycling programs has been one of his areas of focus during the past two decades. Andrew specializes in problem-solving to match organic waste recycling goals with the chemical and physical qualities and market demands of particular organic wastes and the operational realities associated with working in a northern climate.

Andrew has experience in developing recycling programs for a wide variety of materials ranging from biosolids and combustion by-products to food processing residuals and digestate from anaerobic digesters to the by-product from a micro-crystalline cellulose manufacturing plant. Andrew has completed extensive work related to greenhouse gas emissions accounting as it relates to organic waste management. The design and implementation of field trials and pilot projects for determining compost feedstock recipes and soil application rates for organic wastes is an area in which Andrew excels. Andrew regularly consults on the marketing of organic matter-based soil amendments to both large-scale bulk outlets and higher-end retail sales.

In addition to working in the private sector, Andrew has maintained a working relationship with academic and agricultural institutions in New England. Andrew taught the introductory Soil Science course at both the University of Maine in Orono (2003) at Unity College in Unity, Maine (2004 - 2006). Additionally, Andrew has served on the oversight committees for several research projects in New England, including studies investigating the nutrient impacts to soils and water quality from the field storage and utilization of biosolids and manures. Andrew was also an active stakeholder in the complete revision of the Maine Department of Environmental Protection's solid waste rules in the late 1990s and in more recent revisions over the past two years.

### Relevant Projects Completed by Northern Tilth -

- **Food Processing By-Product Recycling Program.** *FMC BioPolymer, Rockland, ME.*  
Developed and initiated a land application program for 23,000 tons per year of

seaweed residual generated during the production of carrageenan. Work included field trials, pilot project implementation, all aspects of permitting and matching soil fertility needs to the material.

- **Water Treatment Residual Recycling Program.** *Kennebunk, Kennebunkport and Wells Water District, Kennebunk, ME.* Designed and permitted the first water treatment residual recycling program in Maine. The recycling program currently uses 100% of the water treatment residual in manufactured topsoils used in re-vegetation and landscaping applications. Work included technical assistance for developing an innovative residuals freeze-drying program.
- **Design, Planning and Grant Procurement for Dairy Manure Composting Operation.** *Otter River Farm, Winchendon, MA.* Worked with Otter River Farm to design a 10,000 ton per year covered windrow composting operation. Successfully procured \$325,000 in grant money from the USDA NRCS and Massachusetts Department of Agricultural Resources for the farm to help build the facility.
- **Combined Manure Composting and Land Application Program.** *Strategic BioSolutions, Windham, Maine.* Developed a manure management plan for a bioscience industry production farm located within a residential area in southern Maine. The resulting plan included a combination of land application and composting to match manure management needs to the land-based restrictions of the farm.
- **Planning and Permitting for a Food Processing By-Product Storage Site.** *FMC BioPolymer (site in Washington, ME).* Northern Tilth planned and permitted a year-round un-covered storage site for a food processing residual in support of a land application program for the material. Work included design assistance, local and state permitting, developing an operations plan and facilitating start-up operations.
- **Greenhouse Gas Emissions Calculator Development.** *Canadian Council of the Ministers of the Environment.* As a sub-contractor to Sylvis (a Canadian environmental consulting firm), Northern Tilth worked on the development of the Biosolids Emissions Assessment Model (BEAM) which calculates greenhouse gas emissions from all aspects of biosolids management, including stabilization, drying, land application, composting, landfilling and incineration.
- **Product Marketing Tools for Organic Wastes.** *RMI, Holderness, NH.* Through laboratory analysis, bench-scale and field-scale testing, Northern Tilth developed marketing tools and product guarantees for a wide range of organic matter-based soil amendments, including compost, biosolids, wood ash and manufactured topsoil.
- **Anaerobic Digestion Feasibility Study.** *Confidential Private Client, New England Region.* Conducted a macro-level study investigating the feasibility of developing an AD facility in conjunction with an existing power plant. The study included an

inventory of available waste materials and their associated energy generating potential, as well as costs associated with managing the digestate.

- **On-Farm Composting Management Plans, *Farms in Maine*.** Northern Tilth has performed site characterization reports and developed compost management plans for several farms in Maine, which compost a combination of manures, agricultural wastes and food wastes.
- **Biomass Plant Wood Ash Recycling Program, *Boralex Athens Energy, Athens, ME*.** Managed a wood ash land application program for 100% of the fly and bottom ash from a wood to energy plant in central Maine. Services included permitting, developing partnerships with local farms and coordinating deliveries and spreading schedules.
- **Biosolids Digestate Land Application Program Services, *RMI, Holderness, NH, (sites in NH and MA)*.** Providing agronomic recommendations, soil consulting and permitting services for the digestate from the AD of biosolids for use in agricultural applications.
- **Paper Mill Residuals Composting Pilot Project, *IP Ticonderoga, Ticonderoga, NY*.** Designed and executed a windrow composting pilot project using 100% mill residues to create a mature, nutrient-balanced compost meeting NY DEC compost quality specifications.

#### COKER COMPOSTING & CONSULTING

Coker Composting & Consulting (CC&C) is a one-person consultancy founded by Craig Coker in 2005 to give organic materials recovery and recycling facilities access to qualified professional consulting assistance at affordable prices. CC&C can handle a wide variety of specialized projects for the digestion and composting industries, including: site evaluations using Geographic Information Systems (GIS) mapping technology, facility planning including local and state permitting and public participation, design and conduct of pilot tests, preparation of cost estimates, equipment alternatives evaluations, design and construction management of full-scale facilities, facility operations manuals, start-up support, operator training, and product marketing and sales support.

Mr. Coker has over 32 years' experience in the planning, permitting, design, construction and operation of organics recycling facilities processing animal manures, animal mortalities, food wastes, biosolids, yard trimmings and source-separated organic solid wastes, as well as in the marketing and sales of compost and compost-amended horticultural soil products. He has experience with both aerobic and anaerobic digestion, along with windrow composting, aerated static pile composting, aerated composting bins, and in-vessel composting systems.

The firm has successfully completed projects in 18 states since 2005, as far west as Utah and California. CC&C has completed four feasibility studies for source-separated organic

solid wastes (SSO) anaerobic digestion, 30 feasibility studies or business planning efforts for SSO composting facilities, 21 projects involving composting facility design, construction or operations, and 18 projects evaluating markets for composts and pelletized organics, made from both biosolids and solid waste composts.

Mr. Coker has extensive municipal waste management experience; as he has worked for local and state government agencies managing solid wastes. Mr. Coker has experience in organic wastes recycling and solid waste management infrastructure planning as the Organics Recycling Coordinator for the State of North Carolina and as a Composting Project Manager with a County government in the Maryland suburbs of Washington D.C. Mr. Coker received an Award of Merit from the Montgomery County Government for his leadership in developing the Dickerson Interim Biosolids Composting Facility in 1982. He was awarded the Hi Kellogg Award from the U.S. Composting Council in 2010 for his service to the composting industry.

Mr. Coker is a licensed Waste Management Facility Operator, a certified Nutrient Management Planner and a USCC/SWANA Certified Compost Systems Manager. He holds an undergraduate degree in Environmental Science from the University of Virginia and a Master's Degree in Sanitary Engineering from George Washington University. He serves on the Boards of Directors of the U.S. Composting Council, the Virginia Composting Council and the Bedford County (VA) Economic Development Authority. Mr. Coker is also a Contributing Editor to *BioCycle* magazine.

CC&C is proud to have adopted business practices that minimize the firm's environmental footprint. Practices include minimizing travel by using internet-based meeting software (GoToMeeting.com), operating the firm out of personal residences to eliminate commuting to an office (and the attendant energy costs of that office), and electronic communications in lieu of postal mailings. Other adopted practices include minimizing printing by only printing needed documents and always printing on both sides of paper, and recycling all glass, metal, plastics, organics, paper, and electronics used by the firm.

Similar projects underway or recently completed by Mr. Coker include:

- **Organics Recycling Feasibility Study, Kenai Peninsula Borough, Alaska** – Mr. Coker is a subcontractor to a local engineering firm conducting a comprehensive feasibility study exploring both AD and composting options for the SSO fraction (food and fish processing wastes) of the municipal solid waste stream in a Borough (County) in southern Alaska with a population of 55,400 in an area of 24,800 square miles (project underway, expected completion March 2013).
- **Composting Feasibility Study, City of Edmond, OK** – Mr. Coker was the project manager for a study of the feasibility of developing a composting facility for greenwaste, biosolids and food wastes generated in a community of 80,000 on the



north side of Oklahoma City. Feasibility study was completed in 2010 and design of Phase 1 greenwaste windrow composting was completed in 2011.

- **Composting Facility Design & Technical Support, Blue Hen Organics LLC, Dagsboro, DE** – Mr. Coker has been providing technical and permitting support to a 30,000 ton/year aerated static pile greenwaste, food scraps and poultry manure composting operation in Sussex County since 2007, including process and site design, and obtaining all State and local approvals.
- **Composting Facility Design & Technical Support, Black Bear Composting, Crimora, VA** – Mr. Coker designed the 3,000 ton/yr open-air turned windrow food scraps composting facility in the Shenandoah Valley of Virginia in 2010 and provides ongoing technical process support to the facility.
- **Solid Waste Anaerobic Digestion and Composting Feasibility Studies, Randy's Sanitation, Delano, MN** – Mr. Coker completed a study in 2007 of alternative AD and several composting technologies for source-separated food and green wastes. The study evaluated eight alternative AD and twelve alternative composting technologies on the basis of several evaluation criteria of importance to the client. The evaluation used the weighted criteria matrix evaluation technique. This study was updated in 2009 to add evaluations of European dry fermentation reactor AD technologies and updated again in 2011 to reflect technology changes in the AD industry as part of a larger project to evaluate production of densified refuse-derived fuel from a materials recycling facility with AD and composting of separated organics.
- **Air Emissions Potential to Emit Analysis, Dry Fermentation Anaerobic Digestion and Enclosed Composting facility, Confidential Client, New Jersey** – in 2011, Mr. Coker prepared a Potential to Emit Analysis for a proposed 60,000 ton/year combined dry fermentation AD and enclosed aerated static pile composting facility. The work involved a detailed review of uncontrolled air emissions data for both criteria and hazardous air pollutants, evaluation of pollutant removal efficiencies of air pollution control devices, and support in preparing a permit application.

#### INTEGRATED WASTE MANAGEMENT CONSULTING

Matthew Cotton is Principal Consultant and Owner of Integrated Waste Management Consulting, LLC (Nevada City, California). Mr. Cotton has over twenty-five years of experience in solid waste management planning, permitting, policy, regulatory compliance, and composting. During this time he has worked as a consultant, educator, researcher, and advocate for new and expanded organics recycling and composting programs in California and beyond.

Mr. Cotton's experience ranges from evaluating regional solid waste management plans, to

managing the complex issues of regulatory compliance, to the nuts and bolts of commercial compost manufacturing. He has completed hundreds of significant organic waste projects, including permitting and aiding in the development of some of the major composting and organics processing facilities in California. In over 25 years of work, Matthew Cotton has become a respected resource for all aspects of the composting industry. From providing permitting and regulatory compliance assistance to new and expanding composting, AD, and organics processing facilities; to providing hand's on odor control mitigations at composting facilities; to conducting important statewide studies of the California composting industry.

In addition to his consulting assignments, Mr. Cotton teaches Compost Operator and Manager Training courses for the Solid Waste Association of North America, the California Resource Recovery Association, the US Composting Council and others. As mentioned above, Cotton recently developed a two-day Organics Collection training course under contract to SWANA. The course was taught for the first time in Washington DC at Wastecon.

Mr. Cotton has served on the US Composting Council Board of Directors since 1999, he was elected President of the Board in 2006, 2007, and 2008. Mr. Cotton also serves on the Board of Directors of Californians Against Waste.

Representative projects completed by Matthew Cotton and IWMC that are directly relevant to this project include:

- **Survey and Analysis of Composting Industry Best Management Practices and Market Conditions, California Integrated Waste Management Board.** IWMC completed a comprehensive statewide survey of the California's Compost and Mulch Producing Industry. The focus was on composting practices and responses to recent regulatory challenges, including pending Air and Water Board regulations. This project involved contact most of the commercial composters in California. The Final Report can be downloaded from the CalRecycle website.
- **Co-collected Food Scraps Characterization, Alameda County Waste Management Authority, San Leandro, California.** IWMC determined the set-out and participation rates for a pilot food scraps and green material co-collection project along two collection routes in Castro Valley, California. Project involved random selection of food material containing carts for sorting and weighing to determine impact on diversion rates.
- **SWANA's Organics Collection Training Course.** *Solid Waste Association of North America.* IWMC was hired by SWANA to develop a two-day Training Course on all aspects of Organics Collection. The course was presented for the first time at Wastecon, in Washington DC., August 13, & 14, 2012. The course covers the steps necessary to design, plan, and operate a collection program for organic materials, including the critical importance of a public education program, end-uses for organic materials – composting, AD, etc. and the impact of different collection

methods on end product quality.

- **Methane Avoidance from Composting Issue Paper**, *Climate Action Reserve, Sacramento, California*, as a subcontractor to SAIC, IWMC participated in drafting portions of the Methane Avoidance from Composting Issue paper developed by the Climate Action Reserve. The Issues Paper will be used in the ultimate development of a Composting Protocol for greenhouse gas accounting for composting facilities.
- **Lifecycle Assessment of Organics Diversion Alternatives**, *California Integrated Waste Management Board*. As a subcontractor to Research Triangle Institute, IWMC participated in this comprehensive lifecycle assessment of organics diversion alternatives as a major part of the CIWMB's climate change initiatives.
- **Diversion Program Evaluation**, *Nevada County Department of Transportation and Sanitation, Nevada City, California*. In collaboration with Jim Greco of California Waste Associates, IWMC reviewed and evaluated planned and existing diversion programs being implemented by Nevada County and its private hauler. Scope of work included evaluating existing diversion programs, documenting progress being made toward fulfilling diversion goals, making recommendations, and developing a work plan.

#### TECH ENVIRONMENTAL

Tech Environmental specializes in air quality, odor control, noise abatement, and environmental due diligence. Founded in 1984, the company is located in Waltham, Massachusetts and has hundreds of private and public sector clients throughout the United States.

Our general services include facility siting, licensing, permitting, compliance auditing, monitoring, and environmental impact studies. Our client base includes the manufacturing and energy industries, municipalities, architectural, engineering and transportation design firms, commercial developers, and government agencies.

Tech Environmental is currently working directly for several town Board of Health agencies as their technical air quality reviewer. Project tasks include examining waste-to-energy emissions and throughput assumptions, and identifying potential air quality and nuisance concerns.

Dr. Buske has extensive experience performing air emission and energy estimates for solid waste facilities. She has worked for both solid waste facilities and as an independent reviewer for local regulators. The two required references are from a local board of health and the Massachusetts Department of Environmental Protection where Dr. Buske was responsible for reviewing facility operations, source emission estimates, and energy efficiency, and compiling tables of suggested emission factors for facilities to use in their environmental emissions reporting. Prior to joining the staff at Tech Environmental, Dr. Buske conducted research in organic chemistry at the Massachusetts Institute of Technology Department of Chemistry and the Cornell University Department of Chemistry.

Mr. Lannan is a chemical engineer who has solved air quality, odor, noise and dust problems at solid waste facilities for over two decades. He has expertise in all aspects of air quality management, including air permitting, compliance assessments, control technology evaluations and air pollution control designs, dispersion modeling and air monitoring. Mr. Lannan has completed a wide variety of solid waste air quality related projects. In addition to traditional solid waste landfill and waste-to-energy experience, he has been intimately involved in the diversion of food waste and food waste processes facilities for the last few years. He serves on the MassDEP food waste disposal ban stakeholder's committee.

Recently, Mr. Lannan completed a comprehensive food waste and organics management plan for a proposed facility in Pepperell, Massachusetts. As part of this plan, he completed an energy balance that examined biogas production potential, electrical production and usage requirements. He also explored potential digester feed streams and final compost end users. He was also the air quality expert for a proposed food waste to energy project in Waterbury, CT, and was available to testify at the Connecticut state house to explain both the potential benefits of food waste to energy as well as how the neighbor's potential concerns would be addressed.

- **Incinerator Monitoring for the Town of North Andover, Board of Health,** Tech Environmental is the lead technical analyst under a contract to propose and execute a multi-year monitoring plan for the 1,500 ton per day municipal solid waste incineration facility located in the Town. As part of the comprehensive monitoring plan, the project manager suggested conditions to the Town for monitoring the operations of the facility. The monitoring plan execution has included witnessing stack testing, reviewing test reports and emissions information, and preparing an annual report for presentation to town officials and the community.
- **Incinerator and Landfill Monitoring for the Town of Saugus, Board of Health ,** Tech Environmental is the lead technical analyst under a contract to monitor and assess air quality concerns from a 1,500 ton per day municipal solid waste incineration facility and adjacent ash landfill located in the Town. As part of the monitoring plan, the project team witnesses stack testing, reviews test reports and emissions information, and prepares an annual report for presentation to town officials and the community.
- **Green Mountain Power,** Tech Environmental prepared the Title V Operating Permit renewal application for the Berlin Vermont Generation Station. This work included reviewing applicable regulations, and calculating emissions and energy efficiencies. Tech also worked with GMP Berlin to submit their emissions of carbon dioxide on-line using the EPA's Emission Collection and Monitoring Plan System (ECMPS). This reporting was required by the Vermont Department of Environmental Conservation, and required the creation of a monitoring plan for the

Berlin station that included three years of historic emissions data for NO<sub>x</sub> and SO<sub>2</sub> to demonstrate low emitter status. Once this monitoring plan had been developed, the fuel usage data and operating hours needed to calculate the CO<sub>2</sub> emissions could be reported.

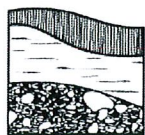
- **Biosolids Heater Dryer Facility, Cumberland Maryland,** Tech Environmental prepared Maryland Department of the Environment (MDE) permit-to-construct and permit-to-operate applications for a 14 dry-ton-per-day (DTPD) biosolids heat drying facility which was built at the City of Cumberland WWTP in Cumberland, Maryland. The facility is operated and maintained by the New England Fertilizer Company (NEFCO). As part of these applications, Tech calculated emissions and performed a toxics air pollutant screening modeling evaluation. After the facility was built, Tech prepared the annual emissions reporting for the MDE permit requirement.
- **AGreen Energy Cow Manure and Food Waste to Energy Project,** AGreen Energy built the first cow manure and food waste to energy facility in the country at the Jordan Dairy Farm in Rutland, MA. Tech Environmental was responsible for meeting with MassDEP, discussing potential air quality, odor, and noise concerns, and recommending new BACT standards for agricultural waste to energy projects. The grand opening was attended by the governor, local representatives, and many MassDEP officials. The facility produces enough power to supply one home with electricity for every cow on the “grid”.
- **Department of Energy Emissions Inventory,** Tech Environmental staff performed an emissions inventory for approximately 200 emission points at the Department of Energy's Savannah River (GA) Site in Georgia. Emission operating and monitoring data was examined for boilers and emergency generators, and estimated vapor phase chemical transport for research laboratories and batch chemical facilities using chemical properties and EPA-approved emission models. The emission inventory proved the facility's claim that total annual air emissions had been reduced by an order of magnitude in recent years.
- **Odor Training for Maine Regulators,** Tech Environmental developed and presented a two-day course on odor science and response to regulators with the Maine DEP. The first day focused on an in-depth exploration of odor, which is not a thing unto itself, but a complex, individualized human reaction to sensing an odorous compound in the air. The second day of the course took place at two offsite locations - solid waste facilities under the jurisdiction of Maine DEP. This odor training session gave Maine regulators the ability to differentiate between the various odors they will encounter in the field, which will enable them to react quickly and effectively.



# APPENDIX

TEAM RESUMES

LETTERS OF RECOMMENDATION



# Northern Tilth

## RESUME

**NAME:** ANDREW F. CARPENTER, Soil Scientist, Owner - Northern Tilth

**ADDRESS:** Northern Tilth  
P.O. Box 361  
Belfast, ME 04915  
(207) 338-5500  
e-mail: [andrew@northerntilth.com](mailto:andrew@northerntilth.com)  
website: [www.northerntilth.com](http://www.northerntilth.com)

### EDUCATION

- BA in Environmental Science, 1987, Wesleyan University
- MS in Plant, Soil & Environmental Science, 1998, University of Maine

### CERTIFICATIONS

- Certified Crop Advisor, American Society of Agronomy
- State of Maine Certified Soil Scientist
- Certified Nutrient Management Planning Specialist
- University of Maine Certified Compost Specialist

### PROFESSIONAL MEMBERSHIPS

- New England Biosolids & Residuals Association (current Treasurer and a member of the Board of Directors)
- Maine Wastewater Control Association (former chair of the Residuals Mgt. Committee)
- United States Composting Council

### PROFESSIONAL EXPERIENCE

- 2003 - Present**     **Soil Scientist/Owner Northern Tilth.** Provide technical services for organic waste recycling programs, including planning, development, permitting, implementation and compliance work.
- 1995 - 2003**     **Program Manager, Resource Management, Inc.** Managed biosolids, paper mill residuals and wood ash recycling projects throughout northern New England. Responsibilities also included new business development and compliance oversight.
- 1992 - 1995**     **Project Manager, BFI Organics.** Responsibility for permitting, compliance and management of biosolids and short paper fiber land application projects in NH and VT, including developing the first short paper fiber recycling program in VT.

## SELECT PUBLICATIONS

- Connelly, S and Carpenter A. 2011. *Farmland Restoration: Combining Residuals to Manufactured Topsoil*. BioCycle, May 2011.
- Brown, S., Beecher, N., Carpenter A. 2010. *Calculator tool for determining greenhouse gas emissions for biosolids processing and end use*. Environmental Science & Technology, 44 (24), 9509-9515
- Beecher, N., Carpenter A., and Willis, J. 2010. *Estimating Greenhouse Gas Emissions from Biosolids Management*. The New England Water Environment Association Journal, 44 (2), 22-29.
- Kester, G.B., Brobst, R.B, Carpenter, A.F, Chaney, R.L., Rubin, A.B, Schoof, R.L., and Taylor, D.S. 2005. *Risk Characterization, Assessment, and Management of Organic Pollutants in Beneficially Used Residual Products*. Journal of Environmental Quality
- Carpenter, Andrew. 2000. *A look at the risks related to dioxin in land-applied biosolids*. Water Environment & Technology
- Carpenter, Andrew and Fernandez, Ivan. 2000. *Pulp sludge as a component in manufactured topsoil*. Journal of Environmental Quality
- Carpenter, Andrew and Beecher, Ned. 1997. *Wood ash finds niche in biosolids composting*. BioCycle

## RECENT PRESENTATIONS

- 2012, May. NCASI Northern Regional Meeting, Portland, ME. *From Barren to Bounty: Converting Disturbed Land to Agricultural Fields using Paper Mill Residuals*
- 2011, May. WEF Biosolids and Residuals Specialty Conference, Sacramento, CA. *Hot and Cold: Potential Impacts from Biosolids Management Options on Carbon Footprints*
- 2010, June. Keynote Speaker for the Water Environment Association of Ontario Biosolids Specialty Conference, Burlington, Ontario CANADA. *Maximizing Resource Recovery from Biosolids: Notes from an Unapologetic Scavenger*.
- 2010, March. WEF Air and Odor Conference, Charlotte, NC. *Biosolids Management and Greenhouse Gas Emissions: Accounting for Credits and Debits*.
- 2009, Nov. 2009 North East Residuals & Biosolids & Energy Conference, New Haven, CT *Fuzzy Math: Biosolids Carbon Accounting in the Face of Uncertainty*
- 2009, Sept. Northwest Biosolids Management Association's Biofest, Blair, Washington *Biosolids and Manures as Nutrient Sources: A cursory Comparison of Risks and Benefits*
- 2007, Oct. WEAO Managing Biosolids and Residuals Beyond 2010 Seminar, Burlington, Ontario CANADA. *Use of Biosolids and Short Paper Fiber for Gravel Pit Reclamation in New England*





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## EXPERIENCE:

**2005- present.** *Coker Composting and Consulting, Vinton, VA.* **Principal.** Provides technical and managerial support to private and public organics recycling and composting facilities in planning, permitting, design, construction, and operations and in product marketing and sales.

**2003- 2006.** *McGill Environmental Systems of NC, Inc., Harrells, NC.* **Chief Engineer.** Provided composting technical support to two 80,000 ton-per-year (tpy) multi-feedstock enclosed aerated static pile solid waste/biosolids composting facilities. Managed planning, permitting, and design of new 130,000 tpy aerated static pile solid waste composting facility in Waverly, VA.

**2001- 2003.** *Mountain Organic Materials, LLC, Asheville, NC.* **Vice President & Operations Manager.** Construction and operation of 8,000 tpy aerated bin dairy manure composting operation at 650-head dairy farm. Directed product sales for compost and compost-amended topsoil. Management of wood waste recycling center, including retail and wholesale sales. Development of proprietary aerated composting bin technology.

**1998-2001.** *NC Dept. of Environment & Natural Resources, Div. Of Pollution Prevention & Env. Assistance, Raleigh, NC.* **Composting Specialist.** Provided technical assistance to solid and animal waste composting industry (source-separated organics collection/transport, facility planning and siting, compost process control and product marketing).

**1995-1997.** *Front Royal Environmental Services, Inc., Raleigh, NC.* **President.** Directed projects in industrial environmental assessments and compliance; and implementation of industrial air and water pollution control systems and soil and groundwater remediation systems. Licensed North Carolina General Contractor (1996-1997).

**1988-1995.** *Parsons Engineering Science, Inc., Fairfax, VA.* **Senior Associate.** Managed projects in facilities planning, engineering, construction and operation of wastewater treatment and biosolids management facilities (composting, incineration, drying). Managed industrial air quality permitting, air emissions testing, and water quality analysis activities. Participated in development of 40 CFR Part 503 sludge management regulations.

**1983-1988.** *Custom Carpentry & Design, Arlington, VA.* **President.** Founded and developed a 15-person residential and commercial construction company. Licensed General Contractor in Maryland, DC, and Virginia.

**1980-1983.** *Montgomery County, Maryland Department of Environmental Protection, Rockville, MD.* **Senior Environmental Planner.** Worked on two projects in biosolids composting planning, design, construction and operation (Dickerson Interim Composting Facility, WSSC Composting Facility in Calverton, MD); wastewater treatment plant siting (Rock Run AWT); and solid waste management planning (Dickerson Quarry Balefill).

**1976-1980.** *Planning Research Corporation, Rockville, MD.* **Project Manager.** Managed projects in biosolids composting (siting, facility planning) and environmental assessments/impact statements.

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## LICENSES, CERTIFICATIONS, & EDUCATION

2009. Virginia Nutrient Management Planner Certificate # 587
2007. Virginia Waste Management Facility Operator License # 4605 002846
2004. *Solid Waste Association of North America*. Certified Compost Systems Manager. Certificate No. 57591
2001. *University of Maine Cooperative Extension*. Certificate of Technical Competence in Composting.
2000. *University of Georgia*. Completion of Compost Operator Training Course
- 1975-1980. *George Washington University, Washington, DC*, Master of Science in Civil and Environmental Engineering.
- 1971-1975. *University of Virginia, Charlottesville, Virginia*. Bachelor of Arts Degree in Environmental Science.

## PROFESSIONAL AFFILIATIONS

- U.S. Composting Council, Ronkonkoma, NY –  
Board of Directors (2005-2008, 2009 - present)  
Treasurer (2007 – 2008, 2010-2011)  
Chairman, Finance Committee (2007 – 2008, 2009 - 2011)  
Chairman, Professional Credentials Committee (2007 – 2010)
- Virginia Composting Council, Vinton VA  
Chairman, Board of Directors (2011-present)
- Bedford County (VA) Economic Development Authority  
Board of Directors (2009 – present)
- Virginia Recycling Association, Midlothian, VA -  
Chairman, Organics Recycling Committee (2007 – present)
- North Carolina Composting Council, Raleigh, NC –  
Member, Board of Directors (1997-2005, 2006-2011)  
President (2003-2005)
- American Biogas Council – member
- Solid Waste Association of North America – member
- Water Environment Federation, Alexandria, VA –  
Member, Biosolids Management Committee (2003-2007, 1989-1994)

## ARTICLES AND PUBLICATIONS

- “Causes of Eutrophication in the Rivanna River Watershed, Albemarle County, Virginia”, University of Virginia Senior Research Thesis, May 1975
- “Bulking Agent Selection in Compost Plant Design”, *Compost Science*, November 1979 (co-authors: T.G. Shea, J.W. Braswell)
- “Effect of Advanced Wastewater Treatment Effluent on Golf Course Irrigation Needs and Turfgrass Response”, George Washington University Master’s Thesis, Dec., 1980
- “Multiple Hearth ReHeat-Oxidation Process”, 19<sup>th</sup> National Conference on Municipal Sewage Treatment Plant Sludge Management, June 1989 (co-authors: T.G. Shea, A. Baturay, and M.J. Brinker). Also published in conference proceedings.

- “Dewatering Municipal Sewage Sludge for Incineration”, 62<sup>nd</sup> Annual Water Pollution Control Federation Conference, October, 1989; also published in *Water Environment and Technology*, Vol. 3, No. 3, March 1991 (co-authors: R.L. Walden, T.G. Shea, and M.J. Brinker)
- “Impact of the Ocean Dumping Ban Act”, WPCF Specialty Conference on Residuals Management, August 1991. Also published in conference proceedings.
- “Alkaline Stabilization Processes”, WPCF Specialty Conference on Residuals Management, August 1991 (co-authors: L.A. Stone, D.W. Oerke, S.M. Rogowski). Also published in conference proceedings.
- “Evaluation of In-Vessel Composting Technologies”, 64<sup>th</sup> Annual WPCF Conference, October 1991 (co-authors: F. Quinn, L.A. Stone, T.G. Shea). Also published in conference proceedings.
- “Co-composting municipal sewage sludge with leaves, yard wastes and other recyclables a case study”, Air & Waste Management Association. 85<sup>th</sup> Annual Meeting and Exhibition, Kansas City, Missouri, 21-26 June 1992 (co-author: C.A. Howe). Also published in conference proceedings.
- “Pathogen Inactivation Using Thermal and Digestion Processes”, 65<sup>th</sup> Annual Water Environment Federation Conference, October 1992. Also published in conference proceedings.
- Water Environment Federation, Beneficial Use Programs for Biosolids Management, 1994 (contributing author)
- “Special Events: The Role of Recycling and Composting”, *Resource Recycling*, September, 1999, p. 26 (co-author: S. Childs)
- “North Carolina Builds Organics Recycling Infrastructure”, *Biocycle*, Vol. 41, No. 1, January 2000, p. 48
- “Food Wastes Composting at the 1999 Special Olympics World Summer Games”, proceedings of the Y2K Composting in the Southeast Conference, October 2000, (co-author: C. Salter)
- “Turning Food Scraps Into Feedstock”, *Resource Recycling*, November 2000
- “Characterizing the Composting Industry”, *Biocycle*, Vol. 45, No. 12, December 2004, p. 20 (co-author: N. Goldstein)
- “Emissions and Air Quality Compliance”, *Biocycle*, Vol. 47, No. 1, January 2006, p. 37
- “Composting Grease Trap Wastes”, *Biocycle*, Vol. 47, No. 8, August 2006, p. 27
- “Environmental Remediation By Composting”, *Biocycle*, Vol. 47, No. 12, December 2006, p. 18
- “What’s New in Grinders”, *Biocycle*, Vol. 48, No. 1, January 2007, p. 24
- “Smart Financing”, *Biocycle*, Vol. 48, No. 2, February 2007, p. 23
- “Smart Equipment Purchasing and Leasing”, *Biocycle*, Vol. 48, No. 3, March 2007, p. 18
- “What’s New in Live Bottom Trailers”, *Biocycle*, Vol. 48, No. 4, April 2007, p. 20
- “Turning Waste Into Black Gold”, *2007 Public Works Manual*, May 2007
- “Composting Site Remediation Success”, *Biocycle*, Vol. 48, No. 5, May 2007, p. 35
- “Smart Operator Training”, *Biocycle*, Vol. 48, No. 6, June 2007, p. 22
- “Compost Data Tracking and Analysis”, *Biocycle*, Vol. 48, No. 7, July 2007, p. 26
- “What’s New in Baggers & Blenders”, *Biocycle*, Vol. 48, No. 8, August 2007, p. 45
- “Smart Equipment Maintenance”, *Biocycle*, Vol. 48, No. 10, November 2007, p. 29
- “What’s New in Windrow Turners”, *Biocycle*, Vol. 48, No. 10, November 2007, p. 19
- “Compost Storm Water: Is It A Problem?” (Parts 1 – 3), *Biocycle*, Vol. 49, No. 2-4, Feb – May 2008
- “Collecting Source-Separated Organic Material”, *Biocycle*, Vol. 50, No. 1, January 2009, p. 23
- “Compost Economics”, *On-Farm Composting Handbook, 2<sup>nd</sup> Edition*, NRAES, in press
- “Uncle Sam Buys Green”, *Biocycle*, Vol. 50, No. 3, March 2009, p. 25
- “Composting Integrated Into Family Business”, *Biocycle*, Vol. 50, No. 10, October 2009
- “GIS Tools to Streamline Organics Diversion”, *Biocycle*, Vol. 51, Nos. 3 & 4, March & April, 2010
- “Selecting A Slow-Speed Shredder”, *Biocycle*, Vol. 51, No. 7, July 2010
- “Developing Composting Recipes for Process Control”, *Biocycle*, Vol. 52, No. 12, December 2011, p. 22
- “Composting Process Optimization”, *Biocycle*, Vol. 53, No. 1, January 2012, p. 42
- “Managing Odors in Organics Recycling”, *Biocycle*, Vol. 53, No. 4, April 2012, p. 25
- “Odor Defense Strategy”, *Biocycle*, Vol. 53, No. 5, May 2012, p. 35
- “Going on Offense Against Odors”, *Biocycle*, Vol. 53, No. 6, June 2012, p. 25
- “Odor Treatment At Composting Facilities”, *Biocycle*, Vol. 53, No. 8, August 2012, p. 21

## RESUME

Matthew Cotton has over twenty-five years of experience in solid waste management planning; permitting, environmental, and regulatory compliance; and composting. His company, Integrated Waste Management Consulting, LLC, has provided technical consulting services to public and private clients in California for over seventeen years. In over 25 years of work he has completed hundreds of significant solid waste projects, including permitting and assisting in the development of some of the major composting facilities in California.

## PROFESSIONAL EXPERIENCE

- 1995 – Present      **Principal, Integrated Waste Management Consulting**, Sole proprietor of consulting firm, specializing in solid waste management planning; permitting, environmental, and regulatory compliance; and composting for public and private clients. Representative projects and clients listed on the associated qualifications document.
- 1990 – 1995      **Associate, Brown, Vence & Associates**. Conducted numerous solid waste projects for public and private clients. Served as firm-wide resource on composting and organics recovery projects.
- 1986 – 1990      **Research Associate, Genereux Research**. Conducted solid waste and environmental research for this St. Paul, Minnesota based socio-economic research firm. Completed first yard trimmings composting pilot project in Minnesota in 1986.

## EDUCATION

B. A., Geography and Cultural Anthropology, Macalester College, St. Paul, Minnesota, 1986.

## AFFILIATIONS

Board of Directors, U.S. Composting Council 1999-present, President of the Board 2006 to 2008, Immediate Past-President 2009, 2010.

Board of Directors, Californian's Against Waste (2010 – Present)

Founding Member, California Organics Recycling Council

Solid Waste Association of America

**Michael T. Lannan, P.E.**  
**Vice President**

**Education**

B.S. Chemical Engineering  
Northeastern University,  
1991

M.S. Environmental  
Engineering  
Northeastern University,  
1993

**Certification**

Professional Engineer:  
Massachusetts  
New Hampshire  
Vermont  
New York  
Maine

National Council of  
Examiners for Engineering  
and Surveying:

Model Law Engineer

**Affiliations**

SWANA Air Quality  
Committee

New England  
Environmental Business  
Council  
Solid Waste Committee  
C&D Subcommittee

New England  
Environmental Business  
Council,  
Air Quality Committee  
Past Chair

Air and Waste Management  
EE-6 Odors Committee,  
Past Chair

New England Water  
Environment Association  
Residuals Management  
Committee

Fiberglass Reinforced  
Plastics Institute,  
Board of Advisors Chair

Water Environment  
Federation, Air Quality and  
Odor Control Committee

Air and Waste Management  
AE-2 Odors, Solvents, and  
Gases Committee

Mr. Lannan is a chemical engineer who has solved air quality, odor, noise and dust problems at solid waste facilities for over two decades. He has expertise in all aspects of air quality management, including air permitting, compliance assessments, control technology evaluations and air pollution control designs, dispersion modeling and air monitoring. Mr. Lannan has completed a wide variety of solid waste air quality related projects.

In addition to tradition solid waste landfill and waste-to-energy experience, he has been intimately involved in the diversion of food waste and food waste processes facilities for the last few years. He serves on the MassDEP food waste disposal ban stakeholder's committee.

Recently, Mr. Lannan completed a comprehensive food waste and organics management plan for a proposed facility in Pepperell, Massachusetts. As part of this plan, he completed an energy balance that examined biogas production potential, electrical production and usage requirements. He also explored potential digester feed streams and final compost end users.

Mr. Lannan is currently working directly for a town Board of Health agency as their technical air quality reviewer. His task is to identify potential air quality and nuisance concerns. He was the air quality expert for a proposed food waste to energy project in Waterbury, CT, and was available to testify at the Connecticut state house to explain both the potential benefits of food waste to energy as well as how the neighbor's potential concerns would be addressed.

He is currently working with MASCO, a consortium of 20 of the largest hospitals and universities in the Boston area, to help them develop food waste diversion plans as part of the pending food waste disposal ban set to begin in Massachusetts in 2014

Mr. Lannan has been involved in solid waste master planning in Massachusetts, Maine, Connecticut, New Hampshire and New York. He has also provided odor training to regulators in a number of northeastern states, and has taught several SWANA-certified air quality emissions seminars to solid waste operators. He recently the Maine DEP officials on the proper detention of gas and other odor concerns at composting and other solid waste facilities

Also, Mr. Lannan was responsible for estimating the air quality emissions, biogas production, and permitting for the first cow manure and foodwaste energy plant in the country.

## Employment History

2004 to present	Tech Environmental, Inc., Waltham, Massachusetts Vice President, Air Quality and Odor Control Services
2002 to 2004	Tech Environmental, Inc., Waltham, Massachusetts Associate, Air Quality and Odor Control Services
1991-2002	Camp Dresser and McKee, Cambridge, Massachusetts Air Quality and Odor Control Engineer, Air Quality Group Services

## Selected Publications and Presentations

Lannan, M. T. Cloudy with a Chance of Meatball Odors: Odor Control for Food Waste. WASTECON 2010 presented by the Solid Waste Association of North America, August 2010, Boston, MA.

Lannan, M. T., Riegert, M. R. Fundamentals of Odor Workshop. Training session presented to the Allegheny County Health Department (ACHD) Environmental Compliance May 2010, Pittsburgh, PA.

Buske, D. C.; Lannan, M. T.; Wallace, M. C.; Beaton, A. J. "Demystifying Landfill Gas Capture Efficiency." Solid Waste Association of North American 2009 Landfill Symposium and Planning & Management Conference, June 2009, Savannah, Georgia., and Federation of New York Solid Waste Associations Conference and Trade Show, May 2009, Bolton's Landing, New York.

Beaton, A. J.; Buske, D. C.; Lannan, M. T. "Part 363: Solid Waste Disposal Facilities – Odor, Public Health and LFG Safety Revisions." Federation of New York Solid Waste Associations Conference and Trade Show, May 2008, Bolton's Landing, New York.

Lannan, M. T., Riegert, M. R. March 2008. Fundamentals of Odor Workshop. Training session presented at SWANA's 31st Annual Landfill Gas Symposium in Houston, Texas.

Lannan, M. T.; Spieler, R. J.; Buske, D. C.; Riegert, M. L.; Roland, A. R. "When is it Necessary to Remove Hydrogen Sulfide from Landfill Gas before Combustion." Federation of New York Solid Waste Associations Conference and Trade Show, May 2007, Bolton's Landing, New York.

Lannan, M. T., Arthur, G.L., "Fiberglass Reinforced Plastic Institute: FRP 101 and Laminate Certification" Water Environment Federation / Air and Waste Management Association 2006 Specialty Conference "Odors and Air Emissions", April 2006, Hartford, Connecticut.

Buske, D. C.; Laurila, J. R.; Riegert, M. L.; Lannan, M. T. "Odor Impacts from Using C&D as Cover." Federation of New York Solid Waste Associations Conference and Trade Show, May 2005, Bolton's Landing, New York.

Buske, D.C., M.T. Lannan and J.R. Laurila, March 2005. The Difference Between Health and Welfare concerns from Landfill Gas Emissions. Presented at the 2005 Solid Waste Association of North America's Annual Landfill Gas Symposium, San Diego, CA .

Rezendez, A., J. Occhialini and M. Lannan, April 2004. GOT SULFUR? Analytic Methods in the Odor Detection Range. Proceedings for the Specialty Conference titled "Odors and Air Emissions" of the Water Environment Federation and Air and Waste Management Association, Seattle, WA.

Buske, D.C., J.R. Laurila, M.R. Riegert and M.T. Lannan, April 2004. Landfill Cover Materials, Odor, and Human Health. Proceedings for the Specialty Conference titled "Odors and Air Emissions" of the Water Environment Federation and Air and Waste Management Association, Seattle, WA.

Lannan, M.T. June 2003. Construction and Demolition (C&D) Waste and Odor Potential. Presented at the Summer Meeting of the Construction Material Recyclers Association, Westford, MA.

Lannan, M.T. and R.J. Gaudes, April 1997. Odor Scrubber Oxidant Comparison—Sodium Hypochlorite and Hydrogen Peroxide. Proceedings for the Specialty Conference "Control of Odors and VOC Emissions" of the Water Environment Federation, Houston, TX.

Wallace, M.C. and R.J. Gaudes, June 1996. A Guide to Odor Emissions Sampling Methods. Presented at the 89th Annual Meeting of the Air & Waste Management Association, Nashville, TN.

Lannan, M.T. and E.T. Serjak, June 1994. The Sulfur Dioxide Emissions Trading Policy: Can This Market Based Approach Work for Other Pollutants? Paper 94-MP11.04 in Proceedings of the 87th Annual Meeting of the Air & Waste Management Association, Cincinnati, OH.

***Dana C. Buske, Ph.D.***  
***Environmental Scientist***

***Education***

A.B. Chemistry  
Cornell University, 1995  
House

Ph.D. Chemistry  
Massachusetts Institute of  
Technology, 2000

Dr. Buske has extensive experience performing air emission and energy estimates for solid waste facilities. Prior to joining the staff at Tech Environmental, Dr. Buske conducted research in organic chemistry at the Massachusetts Institute of Technology Department of Chemistry and the Cornell University Department of Chemistry.

***Affiliations***

Solid Waste Association of  
North America

Society of Women  
Environmental Professionals

American Chemical Society

Society of Women Engineers

Sigma Xi, Scientific Research  
Society

Phi Beta Kappa, Honor  
Society

Dr. Buske is currently working directly for two town Board of Health agencies as their technical air quality reviewer and analyst. Her work is part of a multi-year monitoring plan for a 1,500 ton per day municipal solid waste incineration facility located in each Town. As part of the comprehensive monitoring plan, she suggested conditions to the Town for monitoring the operations of the facility. The monitoring plan execution has included witnessing stack testing, reviewing test reports and emissions information, and preparing an annual report for presentation to town officials and the community.

***Employment History***

2000 to present      Tech Environmental, Inc., Waltham, Massachusetts  
Environmental Scientist, Air Quality Services

***Selected Publications and Presentations***

Buske, D. C. January 2012. "Air Quality Best Management Practices". Presented at the New England Environmental Business Council's Sixth Annual Construction and Demolition Materials Regional Summit, Framingham, Massachusetts.

Buske, D. C.; Lannan, M. T.; Guldborg, P. H. "The Biofilter Effect on Landfill Gas Capture." Solid Waste Association of North American 2010 Landfill Gas Symposium, March 2010, San Diego, California.

Buske, D. C.; Lannan, M. T.; Wallace, M. C.; Beaton, A. J. "Demystifying Landfill Gas Capture Efficiency." Solid Waste Association of North American 2009 Landfill Symposium and Planning & Management Conference, June 2009, Savannah, Georgia.

Lannan, M. T.; Wallace, M. C.; Buske, D. C.; Beaton, A. J. "Demystifying Landfill Gas Capture Efficiency: Landfill Gas Fugitive Emission Factors." Federation of New York Solid Waste Associations Conference and Trade Show, May 2009, Bolton's Landing, New York.



Beaton, A. J.; Buske, D. C.; Lannan, M. T. "Part 363: Solid Waste Disposal Facilities – Odor, Public Health and LFG Safety Revisions." Federation of New York Solid Waste Associations Conference and Trade Show, May 2008, Bolton's Landing, New York.

Buske, D. C.; Riegert, M. L.; Lannan, M. T. "The Scale of Smell: Making Sense of Hydrogen Sulfide Limits." Water Environment Federation: Water Environment & Technology's Operations Forum, 2007, 19, 72-75.

Lannan, M. T.; Spieler, R. J.; Buske, D. C.; Riegert, M. L.; Roland, A. R. "When is it Necessary to Remove Hydrogen Sulfide from Landfill Gas before Combustion." Federation of New York Solid Waste Associations Conference and Trade Show, May 2007, Bolton's Landing, New York.

Buske, D. C.; Riegert, M. L.; Lannan, M. T. "Hydrogen Sulfide Limits: Health, Odor, or Welfare Based?" Water Environment Federation / Air and Waste Management Association 2006 Specialty Conference "Odors and Air Emissions", April 2006, Hartford, Connecticut.

Buske, D. C.; Laurila, J. R.; Riegert, M. L.; Lannan, M. T. "Odor Impacts from Using C&D as Cover." Federation of New York Solid Waste Associations Conference and Trade Show, May 2005, Bolton's Landing, New York.

Buske, D. C.; Lannan, M. T.; Laurila, J. R. "The Difference Between Health and Welfare Concerns from Landfill Gas Emissions." Solid Waste Association of North American 2005 Landfill Gas Symposium, March 2005, San Diego, California.

Buske, D. C.; Laurila, J. R.; Riegert, M. L.; Lannan, M. T. "Landfill Cover Materials, Odor, and Human Health." Water Environment Federation / Air and Waste Management Association 2004 Specialty Conference "Odors and Air Emissions", April 2004, Bellevue, Washington.

Inoue, T.; Liu, J. - F.; Buske, D. C.; Abiko, A. "Boron-Mediated Aldol Reaction of Carboxylic Esters: Complementary Anti- and Syn-Selective Asymmetric Aldol Reactions", *J. Org. Chem.* 2002, 67, 5250-5256.

Abiko, A.; Liu, J. - F.; Buske, D. C.; Moriyama, S.; Masamune, S. "The Boron-Mediated Double Aldol Reaction of Carboxylic Esters", *J. Am. Chem. Soc.* 1999, 121, 7168-7169.

Abiko, A.; Liu, J. - F.; Buske, D. C.; Moriyama, S.; Masamune, S. "The Boron-Mediated Double Aldol Reaction of Carboxylic Esters" 1999 American Chemical Society National meeting, New Orleans, Louisiana.

Liu, J. - F.; Abiko, A.; Pei, Z.; Buske, D. C.; Masamune, S. "Attainment of Syn-Selectivity for Boron-Mediated Asymmetric Aldol Reactions of Carboxylic Esters" *Tetrahedron Lett.* 1998, 39, 1873-1876.



FMC BioPolymer  
1735 Market Street  
Philadelphia, PA 19103

Phone: 215 299 6000  
Fax: 215 299 6821

September 12, 2012

Kevin Roche  
General Manager  
ecomaine

**Re:** Andrew Carpenter Letter of Recommendation

Dear: Mr. Roche,

We have known Andrew Carpenter of Northern Tilth for over 12 years and he has been a tremendous asset to our division. Andrew was our primary consultant who developed a cost-effective recycling program for 100% of the 23,000 tons of seaweed processing by-product that FMC BioPolymer generates at its Rockland, Maine carrageenan facility. When Andrew started working with FMC, all of the by-product from the plant was going into the City of Rockland's landfill/quarry. The disposal at the landfill was increasing in price, becoming a political issue in the City and was not in line with our corporate long term goals. After completing initial agricultural field trials, Andrew developed an operational-scale pilot project and finally a full scale land application program for FMC's seaweed by-product. In the process Andrew worked through numerous regulatory challenges related to recycling a material with no recycling track record in Maine. He also permitted and helped to design a year-round storage facility for the material, complete with a surface water treatment system and a groundwater monitoring program. The recycling program that Andrew developed has been a big success for FMC and Andrew has always made himself available to refine the program as needed over the years since it was first developed.

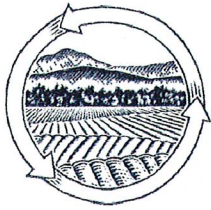
In all his work, Andrew has displayed good follow through and a commitment to environmental quality and satisfying a wide array of stakeholders including our plant technical representatives and site management, internal and external lawyers and Maine DEP regulators. Based on our experience in working with Andrew in Maine, FMC has hired Northern Tilth to consult on waste recycling projects at some of our other facilities including in Delaware and in the Philippines. I would strongly recommend Andrew for any work related to the planning and implementation of organic waste recycling programs.

If you need additional information, please don't hesitate to call me at (215) 299-6750

Sincerely,

A handwritten signature in blue ink that reads "Joseph P. Lala".

Joseph P. Lala - FMC BioPolymer, Global Environmental Manager



# Resource Management, Inc.

September 17, 2012

**Kevin Roche**  
General Manager  
ecomaine

**Re: Reference Letter for Northern Tilth**

Dear Mr. Roche:

I have had the pleasure of working with Andrew Carpenter for the past twenty years in his capacity as both an employee and a consultant. I first hired Andrew in 1992 where he worked in project management for a residuals recycling firm in New England. He then went on to start his own company in 2003, Northern Tilth, in Maine and our company retains his consulting services on a regular basis.

Andrew is extremely knowledgeable in the field of organic residuals management. He is well versed in characterizing the materials, assessing their properties, and evaluating options for managing these by-products. He has extensive experience in working through the complex regulatory arenas that govern these by-products, both for the characterization of the materials and the permitting required for the end-use.

Andrew has been involved with a wide array of by-products from food processing facilities, industrial by-products from pulp and paper operations, water and wastewater treatment plants, wood ash from power plants and manures and other agricultural by-products. His role has been to develop practical, cost-effective solutions for managing organic wastes, often working through complex permitting issues.

Andrew is able to communicate complex issues to a diverse group of stakeholders (plant operators, regulators, concerned neighbors, media, etc.). His involvement as an adjunct professor of soil science, as well as serving on several boards and on local community committees has led to many invitations to speak at conferences. Andrew is recognized throughout the northeast as the person to talk to for technical information on dioxin and other compounds found in residuals, especially on emerging issues of concern.

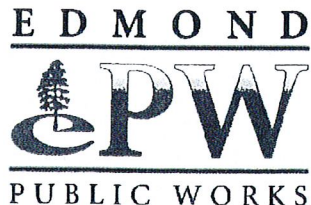
Andrew is focused and capable of methodically discerning the feasibility of workable waste management strategies and assessing existing and new technologies. He researches issues thoroughly and considers the multi-faceted impacts of choosing any option.

In closing, I would add, that is refreshing to work with someone who meets the expectations of the assignment, including meeting deadlines. And finally, Andrew also has a fine sense of humor which makes for great collaboration and team work. I know that Andrew would be a valuable consultant in ecomaine's future efforts to successfully recycle organic wastes.

If you would like information about specific assignments or projects Northern Tilth has completed for RMI, please do not hesitate to contact me by phone or email: [shelagh.connelly@RMRecycles.com](mailto:shelagh.connelly@RMRecycles.com)

Respectfully submitted,

Shelagh Connelly  
President



Herb Blomquist  
2004 Old Timbers Drive  
Edmond, OK, 73083  
herb.blomquist@edmondok.com  
Office Phone 216-7779 • Office Fax 216-7619

September 11, 2012

Kevin Roche, General Manager  
**ecomaine**  
64 Blueberry Road  
Portland, ME 04102


**Letter of Recommendation – Coker Composting & Consulting**

Dear Kevin:

It is my pleasure to recommend Mr. Craig S. Coker and his firm Coker Composting & Consulting to conduct a composting feasibility study for any municipality requesting his services. His professional knowledge and technical skills in the area of organic recycling is unsurpassed.

Mr. Coker conducted a composting feasibility study and a follow-up implementation plan for the City of Edmond, Oklahoma. We have found the information and recommendations Mr. Coker provided for the City of Edmond to be very useful as we continue to move forward with our goal to implement a composting program.

Sincerely Yours,

  
Herbert W. Blomquist  
Director of Public Works

w w w . e d m o n d o k . c o m

A GREAT PLACE TO GROW





September 12, 2012

Kevin Roche  
ecomaine  
64 Blueberry Road  
Portland, ME 04102

Dear Mr. Roche,

I am writing to provide a letter of reference for the services of Craig Coker of Coker Composting & Consulting.

I have been working with Craig since May 2010 when I initially decided to start a composting facility focused on collecting and composting food scraps. The decision to retain Craig's services was one of the best decisions I have made. While my enthusiasm was high, I had no composting experience other than my backyard compost pile. Craig provided invaluable guidance and knowledge that saved me lots of missteps, which could easily be restated as time and money. He provided great guidance with my business plan, actively managed the permitting process, and oversaw the facility design and construction.

Since I opened my gates for business last year, Craig has continued to be an invaluable resource. He has worked with my staff and I to shape our daily operations and best practices. He continues to serve as a liaison between my company and my state regulators. Most importantly, Craig continues to make himself available as questions and challenges arise.

Overall, Craig's vast knowledge and experience with the composting industry combined with his accessibility and responsiveness make his services invaluable. Retaining Craig's services continues to be a smart move. Please don't hesitate to contact me if you would like to discuss further.

Sincerely,

Eric Walter  
Black Bear Composting



September 11, 2012

Mr. Kevin Roche, General Manager  
Ecomaine  
64 Blueberry Road  
Portland, ME 04102

Re: Craig Coker Letter of Recommendation

Dear Mr. Roche:

I am writing to recommend the services of Coker Composting & Consulting. Craig Coker has worked with Blue Hen Organics since 2008 in all aspects of planning, permitting, training, and operations of our compost facility. His composting knowledge and understanding of our specific location, feedstocks, state permitting process, and operational issues have helped our company continue to produce excellent compost products that are in demand Delaware and Maryland.

Initially, Craig Coker helped us design and permit a windrow composting facility focusing on yard waste and poultry manure. When our facility opened in 2010, Craig helped us with operator training and site startup. Since 2010, Craig has helped us permit additional feedstocks such as food waste and hatchery waste. In addition, Craig worked with us to change our composting method from open windrows to a system of aerated static pile composting and curing in windrows. Craig's knowledge of many different composting methods and operational issues associated with food waste and hatchery waste has allowed us to compost these very difficult feedstocks with minimal operational issues. I feel confident in recommending Coker Compost & Consulting.

If you have any further questions, please feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert W. Tunnell III".

Robert W. Tunnell III  
Vice-President

BOARD OF DIRECTORS

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CHAIR

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WILLIAM MERRY, P.E., BCEE  
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DISTRICT ENGINEER

TIMOTHY S. FLANAGAN  
ASST. GENERAL MANAGER

RICHARD SHEDDEN, P.E.  
SENIOR ENGINEER

ROBERT WELLINGTON  
COUNSEL

# MONTEREY REGIONAL WASTE MANAGEMENT DISTRICT

*Home of the Last Chance Mercantile*

September 14, 2012

Mr. Kevin Roche  
ecomaine  
64 Blueberry Road  
Portland, ME 04102

RE: Letter of Recommendation - Matthew Cotton, Integrated Waste Management Consulting (IWMC)

Dear Mr. Roche:

The Monterey Regional Waste Management District (MRWMD) provides integrated waste management services to the cities and unincorporated jurisdictions in the greater Monterey Peninsula. The MRWMD operates a regional landfill, a Materials Recovery Facility, the Last Chance Mercantile reuse store, Household Hazardous Waste Collection Facility, Public Drop-off Recycling Center, Landfill Gas Renewable Energy Power Plant, Small Planet School Education Garden, and in cooperation with its private partner, two composting facilities.

I have known Matthew Cotton, principal of IWMC, for over 15 years. We got to know and work with Mr. Cotton during the time he provided consulting services to our original contract compost operator (Sun-Land Garden Products). Over the years, the MRWMD has had the opportunity to consult with and to retain Mr. Cotton and his company IWMC on a number of occasions, primarily for issues related to organics diversion at the facility. I have been in the solid waste business for 30 years in California, and in my opinion, Mr. Cotton is the "go-to guy" when questions arise related to the complexities of composting, whether those questions are legislative, regulatory, policy or operational.

I have no doubt that Mr. Cotton would be an asset to ecomaine as you move forward with your Organics Recycling Feasibility Study, and I recommend him highly.

Sincerely,

William M. Merry, P.E., BCEE  
General Manager

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**DEPARTMENT OF RESOURCES RECYCLING AND RECOVERY**

1001 I STREET, SACRAMENTO, CALIFORNIA 95814 • WWW.CALRECYCLE.CA.GOV • (916) 322-4027

P.O. BOX 4025, SACRAMENTO, CALIFORNIA 95812

September 13, 2012

Kevin Roche  
**ecomaine**  
64 Blueberry Road  
Portland, ME 04102

RE: Letter of Recommendation for Matthew Cotton, IWMC

Dear Mr. Roche:

I have known Matthew Cotton, principal of Integrated Waste Management Consulting, for over 15 years. CalRecycle has hired Mr. Cotton as a contractor for a number of important studies over the years including:

- Three Statewide Assessments of California's Compost and Mulch-Producing Infrastructure
- Comprehensive Compost Odor Response Project
- Programmatic EIR for Anaerobic Digestion
- LifeCycle Assessment of Organic Diversion Alternatives

Mr. Cotton is a valued stakeholder and, as a source of credible information on the organics recycling industry in California, he provides important input to our public meetings and policy setting discussions. Mr. Cotton is deeply engaged with composters, municipalities, and regulators here in California and we have often benefitted from that experience.

Mr. Cotton would be a great asset to **ecomaine** as you move forward with your Organics Recycling Feasibility Study.

Sincerely,

A handwritten signature in blue ink that reads "Brenda K. Smyth". The signature is written in a cursive style and is positioned above the typed name.

Brenda K. Smyth, Branch Chief  
Statewide Technical and Analytical Resources Branch  
CalRecycle







**PUBLIC HEALTH DEPARTMENT**  
Community Development Division

July 27, 2009

Re: Tech Environmental

To whom it may concern,

This correspondence pertains to the continued service provided to the North Andover Health Department and the North Andover Planning Department by the firm Tech Environmental. Since 2001 until the present, Tech Environmental has been contracted for the monitoring of a 1500 ton per day municipal, solid waste incineration facility known as Wheelabrator North Andover Inc. located on Holt Road, North Andover.

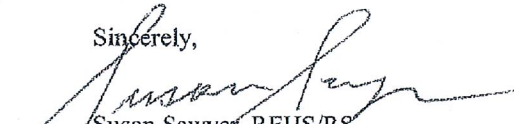
Tech developed the initial monitoring plan for this facility as their first task and subsequently implemented the plan. As part of the comprehensive monitoring plan:

- Tech witness quarterly stack testing, review test reports and emissions information, and prepare an annual report for presentation to town officials and the community.
- Tech has worked independently to provide facility oversight with monthly progress reports to the Board of Health. We have experienced responsive and reliable service as required and in addition they provided free technical expertise to the Board of Health and other Town officials to work on other projects.
- Tech presented a summary of the facility at a town meeting and answered questions from the Planning Board regarding emissions of dioxins/furans. Tech tracks the emission trends to verify that the dioxin levels are below the Town's limit and safely in compliance with both Town and MassDEP limits.
- They evaluate various aspects of the Wheelabrator North Andover Inc. (WNA) facility and its operations and prepare an annual report to describe the results and conclusions of the program to Town officials and the general public. They thoroughly achieve their goal to assist the town in making information about the incinerator more accessible and understandable to the general public and interested officials.

In addition to the incinerator, North Andover also hosts a regional wastewater treatment facility, the Greater Lawrence Sanitary District (GLSD). In an effort to provide information regarding odor, as it relates to possible health related concerns raised by the neighborhood, Tech successfully completed a contract to compile evidence and create educational materials for the Health Department to disseminate to the public.

In conclusion, the service provided by Tech Environmental's staff has always exceeded expectations and we look forward towards continuing the Town's relationship.

Sincerely,



Susan Sawyer, REHS/RS  
Public Health Director



COMMONWEALTH OF MASSACHUSETTS  
EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

DEVAL L. PATRICK  
Governor

IAN A. BOWLES  
Secretary

TIMOTHY P. MURRAY  
Lieutenant Governor

LAURIE BURT  
Commissioner

27 July 2009

RE: Reference for Tech Environmental

To Whom It May Concern:

Tech Environmental provided critical program technical support to the on-line Source Registration program from 2006-2008 under my direction. This work included developing and executing automated quality assurance measures on the data reported by facilities through the program, technical support to facilities via phone and e-mail, review and updating of emission factors, review and updating program instructions, and training the program's staff in how to run the newly developed quality assurance tools. Dana Buske was the primary Tech Environmental staff person performing or overseeing this work. The work was performed primarily at MassDEP.

In my experience with them I found Tech Environmental to be reliable and flexible, able to expand and contract support to meet our varying needs over time and work within our schedules. I found them to be technically able to handle the wide range of support that I needed, providing staff and a subcontractor with a high level of relevant experience and skills that came up to speed quickly on my projects.

Tech Environmental was a pleasure for me to work with, being able to understand my objectives and carry out the work with minimal oversight on my part. I found their work and their presentation to be professional and I was able to rely upon their expertise and understanding of the program.

Therefore, I am pleased to provide this reference for Tech Environmental.

A handwritten signature in black ink, appearing to read "Mark Wert", written over a horizontal line.

Mark Wert  
Project Manager / Branch Chief  
Massachusetts Dept. of Environmental Protection -- BWP  
One Winter Street, 7th floor, Boston, MA 02108  
617-292-5598 / 617-292-5858 (fax)