



Fairmount Park Recycling Center



Compost Facility Evaluation



Prepared for:

**The City of Philadelphia,
Pennsylvania**



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**SWANA RECYCLING
TECHNICAL ASSISTANCE STUDY
FINAL REPORT
CITY OF PHILADELPHIA
FAIRMOUNT PARK RECYCLING CENTER
COMPOST FACILITY EVALUATION**

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CITY OF PHILADELPHIA
FAIRMOUNT PARK RECYCLING CENTER
EXECUTIVE SUMMARY
COMPOST FACILITY EVALUATION

Gannett Fleming, Inc. (GF) conducted an evaluation of the City of Philadelphia (City) Fairmount Park Recycling Center and Compost Facility (Compost Facility) in September and October of 2008 to provide guidance and recommendations to the City for improving the operational efficiency and economic sustainability of the Compost Facility. The City is mandated by the **Municipal Waste Planning, Recycling and Waste Reduction Act of 1988 (Act 101)** to provide curbside leaf waste collection services and direct leaves to an approved processor, not to a landfill or other disposal facility. Consequently, the Compost Facility serves as a cost-effective processor for **4,000 – 6,000 tons** of leaves, trees, manure and other organic materials collected by City municipal crews each year. The Compost Facility reduces waste disposal costs, saves landfill space, helps the City to meet State leaf waste management requirements, and yields valuable finished compost products that are made available to City residents, used on City projects, and are used by other local organizations.

Based on GF's evaluation, the Compost Facility is well organized and properly designed and configured. The Compost Facility adequately composts leaves and manure provided that all processing equipment is functioning properly. However, the Compost Facility processing equipment is plagued with ongoing operational malfunctions that cause high annual maintenance costs along with increased operational costs, at the same time leading to facility shutdowns (as occurred in 2006). City organics that cannot be processed at the Compost Facility are diverted to the Tullytown Resource Recovery Facility (Tullytown) located 20 miles away in Bucks County. Tullytown charges **\$37.00 per ton** to process City organics and transportation and labor costs associated with hauling to this more distant facility are substantially higher when compared with using the local Compost Facility. Diverting the annual average of **3,500 tons** of City leaves to Tullytown will cost **\$130,000** in disposal fees plus associated transportation and labor costs.

Operating the Compost Facility using underperforming processing equipment, and outsourcing woody waste processing to a private processor has, and will, continue to place financial burdens on this facility unless new (possibly used) equipment is purchased. The City is also missing opportunities to market its valuable finished product for revenue to offset at least a portion of the **\$300,000 annual operating and wood waste processing costs** (all four district sites). Without establishing additional markets and demand for its compost products, the unprocessed and processed organics will continue to accumulate at the facility and hinder operations. Because the City is not optimizing the Compost Facility and its economic platform, the program incurs expenses that are absorbed by the City and ultimately passed on to residents. Because only a portion of residents utilize the Compost Facility, but all residents pay taxes, it is fair to generate

revenue for materials in order to minimize the tax burden and improve the economic sustainability of the program. Consequently, it is GF's baseline recommendation that the City make significant improvements and financial investments in the Compost Facility over the next 1-3 years to improve the economics and processing efficiency/capacity of this important Compost Facility. GF's recommendations, as summarized from the recommendations provided in this Report, are as follows:

- To improve the short and long term operational and economic sustainability of the Compost Operation, GF recommends the City procure a self-propelled windrow turner, a trommel screen, and a horizontal grinder over the next one 1-3 years (refer to Section 6.1 for equipment recommendations additional information to support this recommendation).
- It is recommended the City pursue Act 101, Section 902 Recycling Grant funds in 2009 for compost equipment. Other Pennsylvania municipalities utilize the Recycling Grant program to offset cost associated with their compost operations.
- If the City procures a new windrow turner and trommel screen, GF recommends the City retain the existing windrow turner and trommel screen for use as backup equipment and or to provide additional processing capacity as needed.
- GF recommends the City request equipment vendors to give demos prior to final procurement.
- GF recommends the City procure compost processing and handling equipment that is under the Department of General Services "State Contract" provided the equipment under the contract has been reviewed carefully and meets City needs/specification requirements.
- The City should fundamentally redesign its compost and mulch product marketing approach to generate revenues from mechanically loaded products, from bulk sales to commercial entities, and through tipping fees for spot loads of incoming organics. The facility should increase the rate of distribution of material offsite to improve operating efficiency and capacity and consider implementing the following:
 - Open the Compost Facility for at least four hours on Saturdays, continuing free self-load pickup for the general public; but add a program to sell compost products that are loaded into pick-up trucks and trailers using a front end loader.
 - Establish one or more self-load pick up areas in Fairmount Park or other designated areas and place piles of finished compost products at these locations for public use at no cost.
 - Execute sales contracts for bulk quantities of finished screened compost material. It may also be feasible to sell unscreened bulk materials, particularly if material accumulation hinders operating efficiency.
 - Develop a network of potential organic material markets.

- Increase the public and private market demand for finished compost products by promoting the benefits of compost and mulch to the public and private sector.
- Improve the City website (and other forms of media) to include information about the compost program, including the specific products available for free and for sale. The website information should include hours of operation and instruction to the general public concerning compost products and site procedures. A section of the website should be developed to inform commercial vendors on available materials, material quality and specifications (test data), and include contact information.
- GF recommends the City review the attached **Proposed Features** map as a guideline to implementing the following recommended changes to the compost site operation:
 - **Expand the self-load pick-up** area at the entrance of the facility.
 - **Woody waste processing** – It is recommended the City procure and operate a horizontal grinder to:
 - Significantly reduce annual woody waste processing costs
 - Increase material processing capabilities
 - Reduce/eliminate over-accumulation of bulky woody materials on site
 - Produce two saleable products: Mulch and wood shreds/chips
 - Accept and process trees, brush and similar materials from the private sector (e.g. local landscapers) for tipping fee to generate revenue.
 - **Finished Product Loading Area** – Incoming customers would pass through the gate to the loading area. A heavy equipment operator would load trucks and trailers with the requested amount of material. Upon exit, the customer would be charged based on weight, bucket load, or cubic yards.
 - **Proposed Pad Expansion** – GF recommends the pad be expanded to increase increasing overall processing capacity.
 - **Leaf Staging Area (windrows and premixing)** – Construct oversized windrows in the staging area of leaves mixed with horse manure to accelerate composting.
- The Compost Facility should increase the quantity of nitrogen in its windrows by increasing volumes of manure and/or adding other sources of nitrogen-bearing materials (e.g. grass).
- The City should test their compost product(s) at least once per year and post the data on the City website and provide the test data to markets/vendors. Compost samples can be sent to Penn State Agricultural Analytical Services Lab for analysis (www.aasl.psu.edu).
- The City should train at least one compost site operator in composting. Compost classes are available through the Professional Recyclers of PA (www.proprecycles.org).

CITY OF PHILADELPHIA
FAIRMOUNT PARK RECYCLING CENTER
FINAL REPORT
COMPOST FACILITY EVALUATION

1.0 INTRODUCTION

Curbside leaf waste collection is mandated in the City by the **Municipal Waste Planning, Recycling and Waste Reduction Act of 1988 (Act 101)**. The City of Philadelphia's (City) Fairmount Park Recycling Center and Composting Facility (Compost Facility) is an important resource to City residents and the City Streets Department. The ability to cost effectively divert nearly all City-collected leaves from the landfill or other processors to the Compost Facility, reduces waste disposal costs, saves landfill space, helps the City to meet State leaf waste management requirements, and yields valuable finished compost products. After processing, finished compost products are returned to City residents and are used by the City and other entities for a variety of landscaping projects and similar applications. Currently, the Facility is facing operational and financial difficulty. There have been ongoing processing equipment failures, resulting in expensive maintenance repairs, and extended periods when the compost operations are shut down. The primary processing equipment was purchased in 1992 and has been used extensively to process 4,000 to 6,000 tons of material each year.

In addition, the Facility does not own and operate a grinder to process woody wastes, hence, the City spends up to \$150,000 annually for woody waste processing using a private contractor. The City has requested this evaluation by Gannett Fleming, Inc. (GF) to provide guidance on improving existing composting operations. GF has experience in completing composting evaluations and facility design across Pennsylvania and other states. This study was funded by the SWANA Recycling Technical Assistance program; a program involving a partnership among the Solid Waste Authority of North America (SWANA), the Pennsylvania State Association of Township Supervisors, and the Pennsylvania Department of Environmental Protection (PADEP).

1.1 Scope

GF worked with the City to develop the following tasks for this project.

- Task #1** GF will gather and review background information provided by the City pertaining to the current compost operation including operating scheme, costs and marketing.
- Task #2** GF will conduct one (1) site visit of the compost facility to complete a site observation and to take photos and conduct a compost facility evaluation.
- Task #3** GF will prepare and provide a project report including findings and recommendations, placing emphasis on improving overall facility operating performance. This task includes a review of the report by the PADEP and response to PADEP comments. An electronic file of the final report will be submitted to PADEP and to the City. One bound and one unbound copy of the Final Report will be provided plus one electronic version.

2.0 BACKGROUND

The City of Philadelphia’s Fairmount Park Recycling Center and Compost Facility (Compost Facility) is located on **3850 Ford Road, Philadelphia, PA 19131**. The Facility was developed in 1981 to address the City’s need to manage an abundance of woody and vegetative material. The Compost Facility has grown to include the recycling of leaves collected from City streets plus horse manure collected from City stables and the Philadelphia Zoo. The compost site is approximately five acres including a 3.5 acre concrete pad for active windrow composting for leaves mixed with horse manure. The Compost Facility is run by District No. 1 - East and West Fairmount Park. District 1 redistributes its staffing resources, allocating one manager and one heavy equipment operator to manage and operate the composting operations.

The Compost Facility processes organic wastes using a Scarab windrow turner to mix leaf piles and a Royer trommel screen to produce clean compost. Several front end loaders are used to move and load materials. The incoming organic material comes from municipal crews; the facility does not currently accept truckloads of organic materials from the private/commercial sector. Although compost operations and maintenance costs are high, the Compost Facility rarely generates revenue from the sale of finished compost products.

3.0 FUNDAMENTAL COMPOSTING PARAMETERS

Prior to describing site specific details of the Compost Facility, GF has provided information in the following sections pertaining to fundamental composting parameters. A solid understanding and application of these parameters will help the City to make adjustments to feedstock mixtures and composting procedures to increase the rate of composting and to improve product quality. The following parameters work in concert and will influence the rate of decomposition and product quality:

Carbon (C) and nitrogen (N) balance - These essential nutrients are food for decomposer microbes. They must be provided in the organic materials being composted. Yard waste and leaves are low in nitrogen, which slows decomposition. **20-30:1 Carbon to Nitrogen** is optimal.

Moisture - Moisture is contained in yard waste materials or is added. Active composting of leaves is often a net user of water and dry periods will require watering of leaf and yard waste windrows.

Oxygen - Distribution of oxygen is governed by pile porosity and can be managed by including bulky materials like wood chips in active windrow piles. A very small amount of oxygen can be added by mixing or turning piles, but this oxygen is short-lived. As particle size decreases from the mechanical mixing process of windrows, oxygen (air flow) decreases as small particles fill voids.

Surface area - Reducing the particle size by grinding, chopping, shredding, and turning materials increases surface area. Added surface area exposes nutrients to microbes, but at the same time it can reduce air flow.

Volume/pile size - The volume, or size and shape of the compost pile should be sufficient to create and hold heat generated by biological activity, but not so large as to inhibit air flow. Leaf and yard waste piles 6-8’ high and 12-14’ wide generally sustain heat and biological activity.

Temperature and time - Effective composting should produce temperatures in a range of 130°F to 150°F. Sustaining temperatures of compost at 140°F for 3 days is a conservative measure to kill weed seeds and pathogens. Achieving high compost temperatures that do not result in anaerobic conditions accelerates composting and will improve compost quality.

Estimated Carbon-to-Nitrogen Ratios	
Browns = High Carbon	C:N
Ashes, wood	25:1
Cardboard, shredded	350:1
Corn stalks	75:1
Fruit waste	35:1
Leaves	60:1
Newspaper, shredded	175:1
Peanut shells	35:1
Pine needles	80:1
Sawdust	325:1
Straw	75:1
Wood chips	400:1
Greens = High Nitrogen	C:N
Alfalfa	12:1
Clover	23:1
Coffee grounds	20:1
Food waste	20:1
Garden waste	30:1
Grass clippings	20:1
Hay	25:1
Manures	15:1
Seaweed	19:1
Vegetable scraps	25:1
Weeds	30:1

Careful adherence to these parameters will improve the Compost Facility operations. For example, the City can improve the current carbon-rich leaf composting process by increasing the amount of nitrogen-bearing feedstock mixed in to the windrows. Leaf windrows should achieve and sustain temperatures from 130°F to 150°F. Increased nitrogen levels will accelerate the time required to reach and maintain the optimal compost temperature range. A stable, well-decomposed compost product is produced in two to four months depending on the frequency of pile turning. After the active composting phase is complete, compost should be cured for at least two months. The City also has access to horse manure which has higher nitrogen levels than leaves. Identifying other sources of nitrogen bearing materials (e.g. grass) and controlling the amount and delivery schedule of these materials may position the City to improve the compost process and meet target compost parameters.

4.0 EXISTING RECYCLING CENTER COMPOST OPERATIONS

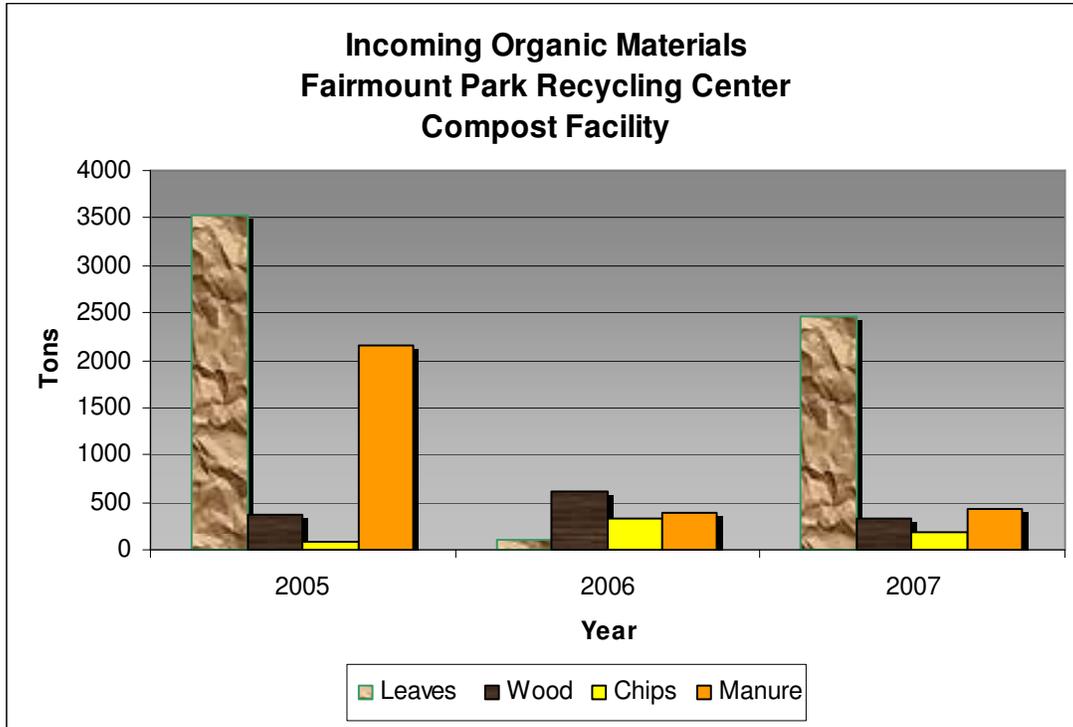
GF used GIS mapping to illustrate the current compost facility configuration. Site features are shown in the **Existing Features** map attached at the end of this Report. The map shows the self-load drop off area, recycling center building, compost pad, screening area, leaf stockpile area and other notable features. The following sections describe the existing compost operations, including the incoming and outgoing materials, processing methods, and equipment.

4.1 Incoming Organic Material/Feedstocks

Incoming organic materials are delivered by the City Streets Department and are separated into designated areas on site for handling and/or processing. Incoming materials primarily include:

- Leaves
- Large diameter woody wastes (tree trunks and stumps)
- Smaller diameter woody and green wastes (small tree trimmings and shrubbery)
- Woodchips or “chips” (produced by chippers used during park maintenance)
- Horse manure and other manure (from City horse stall cleanouts and the Zoo)

The quantities of incoming materials are shown in the Chart below. The quantity of small diameter woody trimmings and brush is incorporated into the wood category. Some of this material is contaminated with trash, which is hauled away for disposal. The clean brush and trimmings are stockpiled for grinding as space is available. As demonstrated by the Chart, leaves usually make up the largest portion of incoming organic materials; however, the 2006 leaf tonnage is extremely low because it was diverted to the Tullytown Resource and Recovery Facility (Tullytown). Equipment problems halted material processing at the Compost Facility during this year. Over the last 10 years, an average of **3,500 tons of leaves** were processed annually. In 2007, the Compost Facility received nearly **2,500 tons of leaves** from the curbside collection program and **335 tons of wood, 175 tons of chips, and 426 tons of horse manure.**



4.2 Material Handling and Processing

The Compost Facility is directed and supervised by one manager and material processing is accomplished by one laborer and one heavy equipment operator. The facility uses a front end loader, a backhoe, a Royer compost screener, and a Scarab windrow turner. An on-site truck scale accommodates the weighing of incoming and outgoing materials.

Leaves from City leaf collection: Leaves make up the bulk of material composted at the facility. Incoming truckloads are dropped directly on the compost pad in rows when space and traffic flow permits. In peak collection periods, trucks dump in the southeast corner of the site into large temporary staging piles (see **Existing Features** map). Each year, the operators completely fill the 3.5 acre compost pad four to five times with seven or eight windrows of leaves (mixed with manure). Windrows



measure approximately 440 feet long, 12 feet wide and 4 to 6 feet high. When leaves cannot be processed at the Compost Facility, they are taken to the Tullytown site in Bucks County for a processing cost/tipping fee of **\$37.00 per ton**. If leaves cannot be processed at the Compost

Facility (as occurred in 2006); the City may have to utilize the Tullytown site for leaf processing. Using the current fee of \$37.00 per ton, times the average of 3,500 tons per year, it may cost the City as much as **\$130,000** per year for processing leaves. Beyond the added tip fee expense, transporting leaves directly to Tullytown will have significant adverse impacts on the environment and City curbside leaf collection program. Impacts include increased difficulty in routing, additional scheduling and significant increases in costs due to the additional 20 miles of travel each way.

Large diameter woody wastes (tree trunks and stumps): These materials are stacked at the northern edge of the site and processed under contract with Bustleton Services, Inc. Bustleton Services brings in a grinder to four district sites in January or February, which includes the Recycling Center. In 2007, the contracted rate was \$7.90 per cubic yard. 18,797 cubic yards were processed totaling **\$148,496** for woody waste grinding services. The City retains the woodchips and gives them to residents or uses them in parks and other City projects. Residents can request permission to cut logs for firewood using their own chainsaw and labor.



Smaller diameter woody and green wastes (small tree trimmings and shrubbery): Large quantities of these materials are generated through park maintenance and other cleanups. Space permitting, the clean trimmings are stockpiled at the Compost Facility for processing with other woody waste. Much of this material is contaminated with trash and debris, which is removed and disposed. Additional brush could be stockpiled and processed if a grinder was available on site.





Woodchips or “chips”: Crews use wood chippers to consolidate brush at parks and other City properties. Chips brought to the Compost Facility are stockpiled, set out for distribution to the public, and given away to other entities.

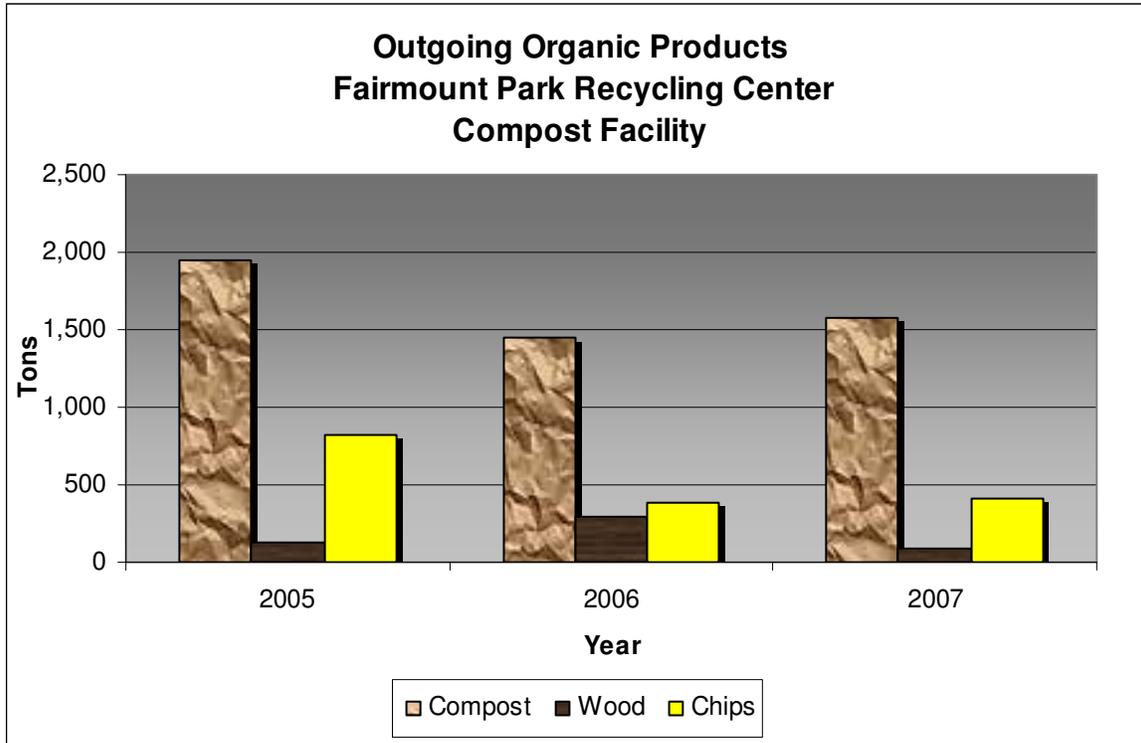
Horse manure (from City horse stall cleanouts): Manure is collected by municipal crews from working horse stables and the Philadelphia Zoo. In 2007, approximately 450 tons of manure were collected and mixed with leaves to produce finish compost. Manure is currently mixed with leaves at a volume ratio of 4 or 5 parts leaves to 1 part manure.



4.3 Outgoing Material, Finished Compost Products & Distribution

The Outgoing Organics Product Chart shows the primary finished compost products that are distributed from the facility. Over 1,500 tons of finished compost, from leaves mixed with horse manure, is distributed each year. Wood and processed wood chips are also distributed to a variety of end users for various applications. Finished products from the facility include:

- Wood chips
- Wood
- Mulch
- Leaf compost (includes some horse manure)
- Unprocessed horse manure
- 50:50 compost/soil blend (small quantities tried and used for municipal projects)



The public has access to a self-load, pick up area located to the left of the scale at the entrance of the facility (See **Existing Features** map). This area has piles of finished products that residents can load into their vehicles at no cost. The area is separated from the main compost operation by a fence and signage.

The following entities benefit from finished products produced by the Compost Facility:

- General public - home gardens and landscaping.
- Community gardens – amend and enhance gardens and plant growth.
- Civic associations – property beautification.
- Volunteer groups - beautify the City’s landscape.
- City Departments - empty lot and playground beautification, safety, erosion control, various landscape and construction project applications.

Currently, landscapers and similar contractors are not allowed to utilize the products.

4.4 Existing Compost Processing and Material Handling Equipment

Scarab Windrow Turner: This is used to turn and mix windrows of leaves and manure every seven days. It is a critical piece of the operation because frequent mixing accelerates pile reduction through mechanical breakage. Mixing increases the amount of exposed material surface to microbial activity. The mixing action creates uniform, evenly distributed particles. Turning also ensures that outer areas of the windrows (that are cooler and composting at a slower rate) are frequently mixed to allow for more efficient composting. Frequent turning of leaves on the compost pad aids active composting in approximately eight weeks. Without any mechanical turning, leaves may take a year or longer to fully compost.



Front-end Loaders: The City has a Case 721 front-end loader and two Fial loaders for moving and loading organic materials on the site. The front end loaders are used to feed the trommel screen with compost.

Royer Trommel Screen: The trommel screen is used to screen finished compost rendering it free of non-compostable debris. Nearly all leaf compost must be screened at this site since leaves are contaminated with trash and debris from the City collection program. Without the trommel screen to produce a clean finished product, the compost quality would be very poor and it would be difficult to find end users. Without a quality product and market demand, accumulated material at the site will decrease operating efficiency.



5.0 SITE VISIT AND COMPOST SITE EVALUATION

5.1 Compost Site Visit and Evaluation

GF conducted a site visit of the Compost Facility on September 10th, 2008. GF evaluated the existing site with consideration of current operation and composting methods. We examined the potential to improve the processing capacity, overall efficiency, and economic sustainability of

the operation. Some findings were not observed during the site visit, but discussed during the walk through or determined as part of this evaluation.

GF was impressed by the overall layout, organization and operation of the facility. However, the Scarab windrow turner was awaiting repair of the hydraulic wheel drive and material processing was at a near standstill.

GF noted the following favorable observations:

- **Site Organization** - The compost site was clean and organized.
- **Compost Pad** - The large concrete pad was in good condition. The compost pad is a good design that gradually slopes to the center to effectively manage stormwater and leachate. Excess water is directed from the compost piles to a detention basin enabling windrowed materials to drain. No water ponding was observed, even though the site visit was a day after significant rainfall.
- **Windrow Construction** - The windrows are properly formed and sized to maximize the use of the Scarab windrow turner.
- **Windrow Composting and Screening Methods** – Generally, the windrow techniques applied handle leaves effectively and the quality of the City’s compost was enhanced by turning manure into the leaves. The use of the Scarab windrow turner to mix windrows about every seven days produces market-grade finished leaf compost in about two months. It is clear that frequent pile turning is necessary to accelerate composting and getting finished piles removed so stockpiled leaves can be added to the pad.
- **Screening** – Screening the compost with the Royer trommel screen effectively removes unwanted debris, trash and other contaminants that are collected. After screening, the finished compost product appeared clean and market-grade quality.
- **Scale** - The site has a truck scale to weigh and accurately document incoming and outgoing materials. Although the facility is not generating revenue now, this scale will allow the accurate assessment of fees based on actual incoming and outgoing material weights in the future if the City restructures the system to generate revenue.
- **Traffic Flow and Safety** – The traffic flow and related safety precautions for compost customers are well maintained. There is adequate cueing for vehicles entering the facility and a scale house that is staffed to greet customers and weigh materials. Residential customers that enter the receiving area at the compost facility must sign in at the entrance.

- **Self-Load Finished Product Pick up Area** - The self-load pickup area for manure, compost, and wood chips is appropriately placed near the entrance of the facility and is separated from active compost operations by a fence. Signage is in place to prevent customers from entering processing areas.

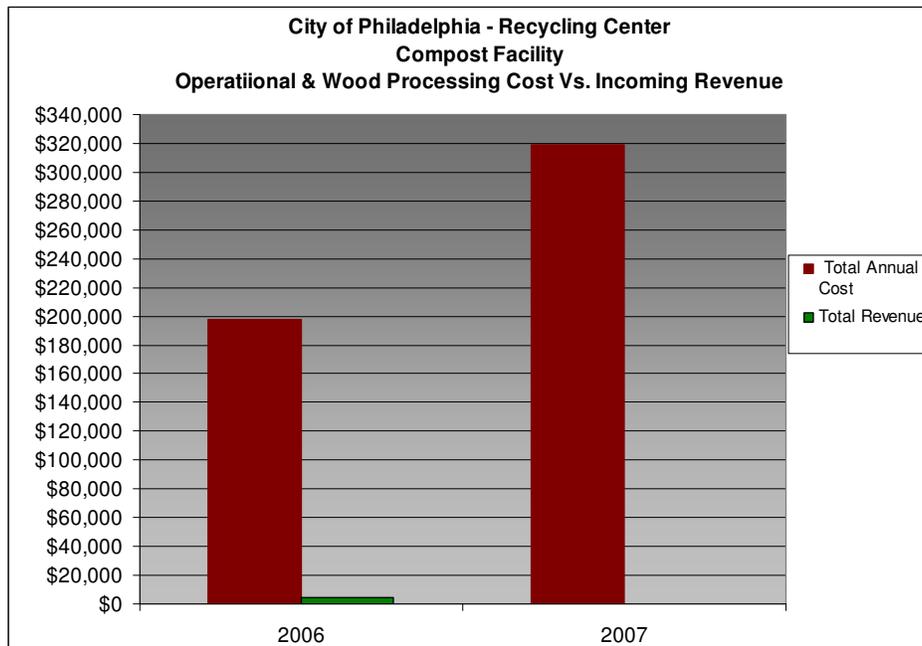
GF notes the following concerns and problems pertaining to the current compost operation:

- **Equipment** – This large-scale compost facility, which processes 4,000 to 6,000 tons of organic material annually and supports a City-wide public leaf waste management program, should have reliable equipment. Equipment and back-up equipment should be maintained to ensure cost effective processing throughout the year. Due to the poor condition of the City’s aging compost processing equipment, the operation is constantly at risk of shut down and overall economics of this facility and associated leaf waste management program cannot be optimized. Several key pieces of processing equipment are reviewed below:
 - **Scarab windrow turner** – This was not operational during GF’s site visit because it was awaiting hydraulic drive shaft repair. The Scarab windrow turner was purchased in 1992 and frequently has mechanical problems. Without frequent turning, the vast amount of incoming material that requires composting (4,000–6,000 tons per year) effectively overburdens the site and/or must be sent to another processor.
 - **Royer trommel screen** - Incoming yard waste material contains contamination and must be screened to produce a valuable and marketable finished compost product. The ability of the compost operation to market finished products is contingent on the efficient and continual operation of the trommel screen. The existing unit was purchased in 1992 and frequently requires repair.
 - **Woody waste grinder** - GF observed extensive quantities of stockpiled lumber and incoming loads of brush; however the facility does not operate woody waste grinding equipment. The annual costs paid to a private processor, as high as \$150,000 per year, is cost prohibitive and a City-owned grinder or other economically viable solution is needed.
- **Economics** – The Compost Facility incurs annual operational costs that can exceed \$200,000 plus approximately \$100,000 for woody waste reduction for four district sites in one year. The operation of this facility is a critical piece of the economical management of the City’s leaf waste program and parks maintenance program. The City is not fully utilizing of the Compost Facility as an economical processor and is not generating revenue from processed materials. Areas where economics can be improved are presented in the cost analysis in Section 6.0.

- **Compost Pad Area & Utilization** – The existing compost pad is 300’ x 500’ and is at or very near maximum capacity to process incoming loads of leaves, especially from fall leaf pickups. Depending on available space and the volume of incoming truckloads, large quantities of leaves must be piled at the southeast corner of the site prior to placement on the pad in windrows. When leaves cannot be added directly to the pad, it reduces operating efficiency because leaves must be re-handled to move them from the stockpile area. Since leaves that are stockpiled do not breakdown quickly, the amount of active composting is limited by the amount of material windrowed (and turned) on the pad. Some stockpiling occurs because of the large influx of trucks and there is not sufficient time for unloading in windrows. Generally, GF believes that the compost pad is used appropriately, but space limitations negatively impact the overall performance and processing capacity of the compost facility.
- **Feedstock Mixtures & Outgoing Material Quality** – The current compost quality is good. However, the compost operation can improve the natural compost process and quality of finished compost by increasing the nitrogen content in the windrows as feasible. Leaves are higher in carbon than is desired for composting and have a carbon to nitrogen ratio of 60:1. By achieving the recommended carbon to nitrogen ratio of **25-30:1**, the City can improve the compost process and finished product quality. The City accepts over 400 tons of horse manure annually and manure is a good source of nitrogen. Currently, horse manure is mixed into the leaf windrows at a 4-5:1 ratio by volume (leaves: horse manure). At these proportions, it is estimated that windrows yield about a 35-40:1 carbon to nitrogen ratio, which is still higher than the optimal C:N balance. Because the feedstock mixture is still high in carbon, the compost process and rate of natural decomposition by aerobic and anaerobic bacteria is not optimal. Note: samples from the piles should be tested by a lab for actual carbon to nitrogen ratios.
- **Limited End Users and Outlets for Material** – GF believes that finished products need to be moved off site quickly and additional end users identified. Seasonal demand, or accumulation of processed and unprocessed material from one year into the next takes up space at the compost facility and is a problem that should be addressed. Until a constant demand market is secured, it will be difficult to maximize processing capacity. Currently, finished compost products are mostly utilized by residents and municipal crews. Residents have limited access to the site during the Monday through Friday operating schedule. The amount of material used by municipal crews varies, and there is a sizeable product surplus from one year to the next.
- **Water** – The facility does not have a functioning water system to hydrate windrows.
- **Material Testing** – The City does not test its compost annually.

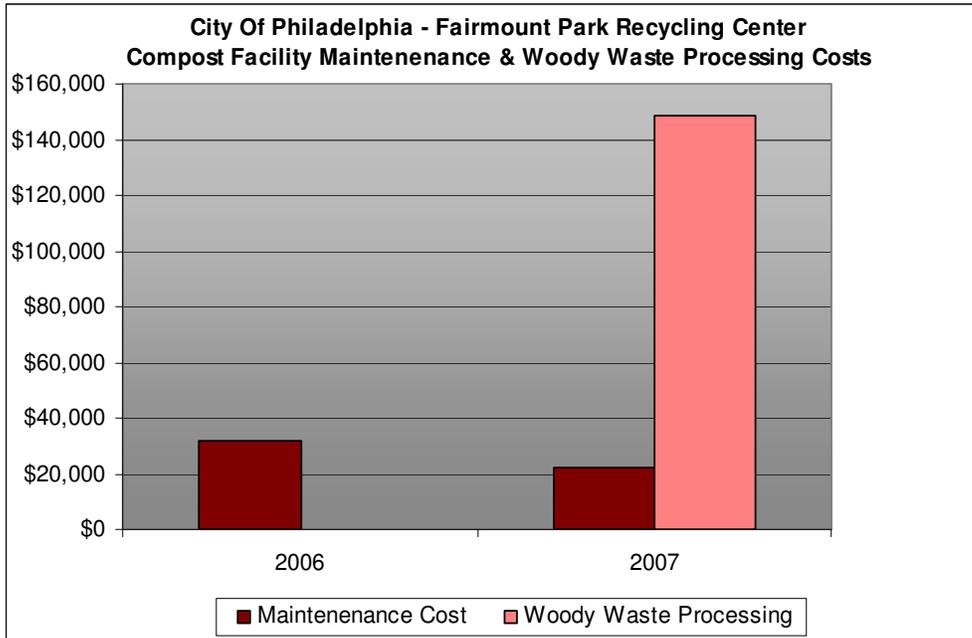
6.0 PRELIMINARY COST ANALYSIS

GF conducted a preliminary review of operating expenses and revenue. Note that figures are estimated values based on revenue and expense figures and draft budgets provided by the City. Our recommendation is that the City should operate its compost operation so that it generates revenue from finished compost products to offset operating costs and improve the overall economics of this facility. Many similar municipally operated compost facilities generate revenues to become economically sustainable operations. The additional revenue generated by sale of products, plus tipping fees assessed for incoming organics from the private sector, will improve overall economic and operational sustainability. Without these revenue offsets and/or funding from increased budget allocation, grant assistance or other sources, GF believes the facility is at risk of periodic or even permanent shut down. As seen in the Chart titled **Estimated Operational & Wood Processing Cost vs. Incoming Revenue**, the City may spend over \$300,000 in a given year to operate the facility, which includes the cost to outsource processing of woody material for all four district sites. In 2006, the City received less than \$5,000 from sale of compost when the material was put out for contract in order to create space from accumulated material.



As shown below in the **Maintenance and Woody Waste Processing Costs Chart**, the City spends between \$90,000 and \$150,000 per year for woody waste processing by a private contractor. The cost varies based on the volume. At these woody waste processing rates, the City could procure a new high-throughput horizontal grinder for approximately \$325,000, with a return on investment of two to four years. The cost of compost equipment maintenance also

varies but typically falls in the \$20,000 to \$25,000 range each year. These maintenance costs are higher than average due to the age and condition of the existing equipment.



There are clear opportunities to improve the economics of the Compost Facility over the short and longer term including:

- Bulk sales of mulch, compost, soil blends, wood chips and other products to commercial entities,
- Assessment of tip fees for controlled/spot market of incoming organic materials,
- Procurement of a horizontal grinder to process wood wastes,
- Avoiding facility shut downs and diverting leaves to another processor,
- Procuring new processing equipment to increase processing capacity while reducing annual maintenance costs,
- Sale of mechanically loaded compost products loaded at the facility by a heavy equipment operator onto residential trucks and trailers. Initially, it may be feasible to limit this program to four hours on a Saturday.

The typical price for finished compost products is highly variable and based on many factors: region; markets and demand; processing costs; material quality; volume (bulk versus small loads). GF has provided 2007 pricing for the Lehigh County compost operation in the **Appendices**. Millcreek Township in Erie County operates a large municipal compost operation where residential trucks and trailers are loaded using the bucket of a Case 721 front end loader. The site is set up to receive, load and invoice customers. 2008 rates are as follows:

Screened Mulch	\$20.00/yard
Unscreened Mulch	\$17.00/yard
Leaf Compost	\$10.00/yard (compost is turned only four times)

From spring through October 2008, Millcreek generated over \$45,000 of revenue through customer sales of mulch and compost.

6.1 Compost Processing Equipment

GF believes that the procurement of new compost processing equipment will be integral to improving the overall operational performance of the Compost Facility. Reliable processing equipment, including a grinder, will improve the longer-term economic sustainability of this facility. Unfortunately the initial capital costs for processing equipment are very high as demonstrated in the compost processing equipment table in this section. Even with these high initial capital costs, the longer term cost benefits and improved operational efficiency from the equipment must be considered in conjunction the existing equipment shortcomings:

Existing Windrow Turner – Incurs high annual maintenance cost and repeated breakdowns shut down the facility. This leads to accumulation of unprocessed leaves that hinder operations and result in high processing costs. When this equipment fails and leaves cannot be processed (like in 2006), they are taken to the Tullytown facility in Bucks County at a processing cost/tipping fee of \$37.00 per ton. Tullytown is over 20 miles one-way from central Philadelphia. Processing an average of 3,500 tons of leaves per year at \$37.00 per ton will cost the City approximately **\$130,000 per year**. Additionally, transporting leaves to the Tullytown facility using City leaf trucks requires a substantial financial investment for labor and fuel when compared to delivery to the facility. The compost operation is within five miles of most City locations allowing for efficient curbside collection system routing and material processing at a much lower cost.

Horizontal Grinder – The City does not own and operate a grinder to process woody wastes (e.g. trees and brush). Considering that annual woody waste processing costs by a private contractor can be as high **\$150,000**, and due to the high volume of woody wastes from the parks, a horizontal grinder is needed unless a more economic woody waste processing alternative is secured. A City-owned grinder will increase material processing capabilities and free the compost facility (and other sites) from over-accumulation of bulky woody materials. A grinder can increase overall material management and operations flexibility. Facility staff can then create different grades of saleable finished products including wood chips and mulch products. Unlike compost, mulch can be sold as a finished product immediately after processing.

GF also expects that the use of a grinder on site will reduce the total amount of brush that is delivered to the Tullytown facility, thus decreasing tipping fees for such. Currently, brush is forwarded to Tullytown when the material is contaminated with trash or when space is not available to stockpile the material at the Compost Facility.

Trommel Screen – The ability to market finished compost and generate revenue to help offset operating costs is contingent upon continual screening to remove non-compostable trash and debris from the finished product. The existing Royer trommel screen was purchased in 1992 and requires much routine maintenance. It is a priority to purchase a new trommel screen in order to increase screening capacity, to prevent likely facility shut down, and to reduce ongoing maintenance costs.

Compost Processing & Handling Equipment	Notable Pros	Notable Cons
<p>WINDROW TURNER</p> <p>Frontier (Self propelled – one-pass)</p> <p>\$350,000 plus \$20,000 (delivery and startup cost)</p>	<ul style="list-style-type: none"> - Simplified I-Beam Hydraulics (compared to similar models like Scarab that use scissor action) - Easy maintenance - Proven ability to mix compost thoroughly (compared with other similar models) - Less teeth; less cost for replacement 	<ul style="list-style-type: none"> - Higher initial capital cost than some similar models.
<p>TROMMEL SCREEN</p> <p>Wildcat 516 Cougar</p> <p>\$175,000 (includes delivery)</p>	<ul style="list-style-type: none"> - Easy set up and operation - 100 cubic yards per hour with ½ inch screen - Operable by remote - Low maintenance - trommel effectively screens even wet organics - Effectively removes unwanted debris - Low angle; lower & easy to load 	<ul style="list-style-type: none"> - Note: Other manufacturer models are available and may have features more familiar or user-friendly to City staff/operators.
<p>HORIZONTAL GRINDER</p> <p>Beast Bandit 3680</p> <p>\$385,000</p>	<ul style="list-style-type: none"> - 300 – 500 cubic yards per hour - Available on Pennsylvania State Contract (no bidding required) - Operable by remote; saves labor time - 45 day delivery - Reliable & can be moved easily. - Versatile processing: piled brush, whole trees, stumps, pallets, land clearing waste, green waste, palm fronds, logging slash, sawmill waste, construction waste, housing demolition, railroad ties, shingles/asphalt. 	<ul style="list-style-type: none"> - Large machinery requires operational space. - Must be located a safe distance from people while operating.
<p>FRONT END LOADER</p> <p>Case loader – 721E</p> <p>\$135,000</p>	<ul style="list-style-type: none"> - Electronically controlled Tier III emissions engine increases fuel efficiency. - Very versatile: range of motion/bucket height - High torque/HP decrease wear/tear - lifting. - Higher volume bucket (3.5 Cubic Yards) - Daily service checkpoints/ easy view/access - High Speed: efficient site movement. - Additional weight and HP. 	<ul style="list-style-type: none"> - This is a large vehicle that may be limited in some applications due to size.

Note: All equipment prices shown are 2008 estimates as provided by the equipment vendors.

Ideally, all three pieces of processing equipment will be utilized on the site and work in concert to promote the proper operation and management of this large-scale public facility. GF has provided a brief overview of recommended equipment options to meet the Compost Facility needs. GF contacted several municipalities and equipment vendors and recommend the following equipment. Equipment specifications provided by the vendors are included in the **Appendices**.

7.0 RECOMMENDEATIONS

The following section provides guidance and recommendations pertaining to improving the operational efficiency and economic sustainability of the City of Philadelphia (City) Fairmount Park Recycling Center and Compost Facility (Compost Facility). GF has based our recommendations on our September 10, 2008 compost facility site visit, background information provided by the City, and our experience with evaluating and designing municipal compost facilities.

The importance of implementing changes and upgrading the compost processing equipment at the Compost Facility should not be underestimated. This facility operates as a large-scale organics processor that manages nearly all of the City's leaves and organic materials from parks, stables and the Philadelphia Zoo. The City is required by Act 101 of 1988 to provide curbside leaf waste collection and insure it is processed by an approved facility and not landfilled. The ongoing and efficient operation and processing of organics at this public facility is critical because the cost of transportation and processing of this material at the Tullytown Resource and Recovery Facility or another processor will increase current costs dramatically. Using another processing location could negatively impact the City's ability to manage the residential curbside leaf waste collection program as mandated by Act 101 of 1988.

Operating the Compost Facility using aging processing equipment, plagued with mechanical failures, and outsourcing woody waste processing to a private processor has and will continue to be a financial burden unless new (possibly used) equipment is purchased. The City is missing opportunities to market its valuable finished product for revenue to offset at least a portion of the \$300,000 operational and woody waste processing costs. Without establishing additional markets and demand for its compost products, the unprocessed and processed organics will continue to accumulate at the facility and hinder operations. Because the City is not optimizing the Compost Facility and its economic platform, the program incurs expenses that are absorbed by the City and ultimately passed on to residents. Consequently, it is GF's baseline recommendation that the City make significant improvements and financial investments in the Compost Facility over the next 1-3 years to improve the economic sustainability of this important program.

GF's recommendations are broken down by category in the following sections.

EQUIPMENT

To improve the short and long term operational and economic sustainability of the Compost Operation, GF recommends the City procure a self-propelled windrow turner, a trommel screen, and a horizontal grinder over the next one 1-3 years. GF believes the procurement and operation of all three of these pieces of equipment will improve operation efficiency and flexibility, reduce annual maintenance costs, and create opportunities to reduce costs and generate revenue from finished products. GF has provided an equipment table in Section 6.1 including recommended equipment and 2008 equipment costs. The City should review its Compost Facility operating costs carefully along with our equipment recommendations and develop a purchasing strategy for procurement of processing equipment as soon as feasible. Although GF recommends new equipment, budgeting limitations may make the purchase of new equipment cost prohibitive.

It is recommended the City pursue Act 101, Section 902 Recycling Grant funds in 2009 for compost equipment, but the Recycling Grant Program has a limited amount of funds and funding is not guaranteed. As an example, it may be more economically feasible to lease a horizontal grinder or buy a used or refurbished grinder since woody waste processing costs are high and a new windrow turner and new trommel screen are high priority. It is recommended a portion of Act 101, Section 904 Grants should be invested in the Compost Facility equipment and infrastructure.

If the City procures a new windrow turner and trommel screen, GF recommends the City retain the existing windrow turner and trommel screen for use as backup equipment and or to provide additional processing capacity as needed unless maintenance costs prove cost-prohibitive compared with the operation cost and benefit.

GF recommends the City request equipment vendors to provide demos of processing equipment to verify the equipment is suitable for the City's processing needs prior to final procurement.

GF recommends the City procure compost processing and handling equipment that is under the Department of General Services "State Contract" provided the equipment under the contract has been reviewed carefully and meets City needs/specification requirements.

MARKETING AND REVENUE

The City should fundamentally redesign its compost and mulch product marketing approach. Currently the Compost Facility gives nearly all of its processed compost away at no charge and this should change. The City should implement a flexible marketing strategy that increases

material distribution off site to a variety of public and private markets. Consider implementing the following measures to move more finished product to end users:

- Open the Compost Facility for at least four hours on Saturdays, and consider expanding the hours of operation to be more convenient for the public after the new program has been tested. On Saturdays, continue free self-load pickup for the general public but add a program to sell compost products that are loaded into pick-up trucks and trailers using a front end loader (~3 cubic yards per bucket). A different fee can be charged for each finished product (e.g. mulch, compost, wood chips, soil blend). City residents that self-load their vehicles may not need to be charged for material as part of this new marketing approach.
- Establish one or more self-load pick up areas in Fairmount Park or other designated areas and place piles of finished compost products at these locations for public use at no cost.
- Execute sales contracts for bulk quantities of finished screened compost material and/or if feasible unscreened material. Research bulk pricing for compost products in the region so the City does not sell products at an unreasonably low price.
- Develop a network of potential organic material markets. The potential applications and markets for compost are expanding and the City should develop relationships with local and regional markets to maximize revenue potential for organic materials and to have outlets to move material offsite as needed.
- Increase the public and private market demand for finished compost products by promoting the benefits of compost and mulch to the public and private sector. Improve the City website (and other forms of media) to include information about the compost program, including the specific products available for free and for sale. The website information should include hours of operation and instruction to the general public concerning compost products and site procedures. A section of the website should be developed to inform commercial vendors on available materials, material quality and specifications (test data), and include contact information.

PROPOSED OPERATIONAL AND SITE CHANGES

GF recommends the City review the attached **Proposed Features** map as a guideline to implementing some changes to the compost site operation. As shown on the Proposed Features map, some site modifications include:

- **Expand the self-load pick-up area** at the entrance of the facility. This site modification is recommended because the compost facility may be opened in the future on Saturdays and thus could receive additional traffic/customers. Expanding the self-load pick-up area will help create buffer space for incoming traffic and loading and possibly allow for

additional materials to be placed out for pick up. The City could add a locked “donation” box in the self load pick up area for customers to offer donations for the materials they take. The money from donation box should be removed at the end of each business day.

- **Woody waste processing** – It is recommended the City procure and operate a horizontal grinder to:
 - Significantly reduce annual woody waste processing costs
 - Increase material processing capabilities
 - reduce/eliminate over-accumulation of bulky woody materials on site
 - Allow for segregation of smaller diameter tree trimmings, shrubbery, and similar leafy green brush from large diameter woody waste to produce two saleable products: Mulch and wood shreds/chips
 - Create the opportunity for the Compost Facility to accept and process trees, brush and similar materials from the private sector (e.g. local landscapers) for tipping fee to generate revenue. This is not recommended until the Compost Facility owns and operates a grinder and has ensured processing and stockpiling capacity along with increased demand by end users.
- **Finished Product Loading Area** – Incoming customers would pass through the gate to the loading area. A heavy equipment operator would load trucks and trailers with the requested amount of material. Upon exit, the customer would be charged based on weight, bucket load, or cubic yards.
- **Proposed Pad Expansion** – GF recommends the pad be expanded ensuring the additional pad area is sloped to center consistent with the existing stormwater design. The larger pad area will increase the amount of material that can be windrowed and composted at a given time, thus increasing overall processing capacity.
- **Leaf Staging Area (windrows and premixing)** – To the extent feasible, it may be beneficial to construct oversized windrows in the staging area of leaves mixed with horse manure to achieve some accelerated composting of this material that is normally heaped into large piles to await placement on the pad.
- **Proposed Equipment Storage Building** – In a future phase, after new processing equipment is procured, it may be feasible to build a pole building-type covered area to protect compost processing and handling equipment from the elements. Although compost processing equipment can withstand weathering, equipment life can be extended by proper storage in a covered area and the building can be an asset when performing repairs. Based on GF’s discussion with PADEP, pole buildings for equipment storage is not eligible under the Act 101, Section 902 Recycling Grant program, however, the use of Act 101 Section 904 Performance Grants is not restricted and could offset costs for a storage building.

FEED STOCK MIXTURES AND CARBON TO NITROGEN RATIOS

- As long as sufficient quantities of horse and other manures are available, it is recommended the City increase the quantity of manure that is added to leaf windrows. Horse manure is in the optimal carbon to nitrogen composting range without any other feedstocks. Consequently, the City could mix leaves to compost at a volume ratio as high as 1:2 (1 leaves to 2 manure) and still be near the **optimal 30:1 carbon to nitrogen ratio**. However, from an operational standpoint (e.g. space, windrow size limitations) and because there may be limited quantities of manure, the City should try to strike a balance where additional bucket loads of manure is mixed into the leaf windrows to add nitrogen, while not building oversized windrow or depleting all available manure.
- The feasibility of accepting and mixing other sources of nitrogen, including grass clippings, green shrubbery, green leaves and other feedstocks should be evaluated on an ongoing basis. For example, the Compost Facility staff could work with local golf courses to see if they require grass disposal. Golf courses may be paying for disposal of grass clippings or even using it on site. If the golf courses are paying for disposal, the facility may be able to charge a lower cost tipping fee and then mix the grass in with the leaves and horse manure to improve compost product quality.
- If the City begins to accept controlled loads of grass, the grass should be spread across leaf windrows (at an approximate depth of 6”s – 12”s) within 24 hours of arrival in order to minimize odors in accordance with Pennsylvania regulations for compost facilities. To estimate grass quantities grass quantities that could be accepted by the facility GF provided the following estimate:

Assumptions:

Windrow lengths - 440'

Depth of Grass - .5' - 1.0' (6"s to about 1 foot)

4' wide swath of grass across the top of each windrow

8 windrows

Volume Calculation

$(440 \times 8) \times 4 \times .5 = 7,040$ cubic ft / 27 = 260 cubic yards

$(440 \times 8) \times 4 \times 1 = 14,080$ cubic ft / 27 = 521 cubic yards

A range of 250 cubic yards to 520 cubic yards of grass could be added to windrows that cover the compost pad at one time; contingent upon the depth of the grass (.5 - 1 foot deep). The pad is covered four to five times each year. Grass would be more available in the spring and early summer.

Weight Conversion

Uncompacted Grass - 350 lbs to 450 lbs / cubic yard

Compacted Grass – 550 lbs to 1,500 lbs / cubic yard

MATERIAL TESTING

The City should test their compost product(s) at least once per year and post the data on the City website and provide the test data to markets/vendors. Compost samples can be sent to Penn State Agricultural Analytical Services Lab (www.aasl.psu.edu)

TRAINING

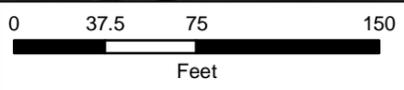
The City should train at least one compost site operator in composting. Compost classes are available through the Professional Recyclers of PA (www.proprecycles.org).

APPENDICES

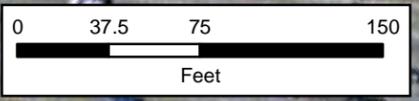
Equipment Specifications
Example Compost Product Pricing

Not included in on line Report

FIGURES



Fairmont Park Recycling Center City of Philadelphia, PA	
COMPOST FACILITY EXISTING FEATURES	
 Gannett Fleming	October 2008



Fairmont Park Recycling Center
City of Philadelphia, PA

COMPOST FACILITY
PROPOSED FEATURES

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