

## Recycling Incentives

### Overview

The reason individuals and businesses decide to recycle may be based on economic or other factors. Various factors can influence those decisions; some may be incentives and some disincentives. From the perspective of increasing the overall magnitude of diversion of materials from disposal, through recycling, there are several incentives/disincentive options. This paper discusses some of the additional incentives that may be available. In general incentives refer to items that would motivate or induce positive actions. Disincentives are things that might also motivate or induce actions, but likely more out of a concern or fear of consequences. Incentives may create many types of rewards (e.g., waste diversion, financial, moral, or personal). This paper does not address moral and personal incentives options other than those that may result from behavioral change through education. However, it is acknowledged that peer pressure and group dynamics can also be contributing and motivating factors.

It is important to note that many of the changes required to significantly increase recycling will require changes in law, regulation or ordinances; these changes are also forms of incentives/disincentives. Many of the options presented below may be more applicable to increases in residential recycling but also include incentive options to increase recycling from commercial/business and construction and demolition waste generation sources.

Incentives tend to change management options and possibly disposal practices, but do not always reduce the quantity of materials generated (requiring management).

### Current Programs

The Lincoln and Lancaster County programs provide incentives to current recycling efforts through a variety of mechanisms including:

- Educational brochures, web-sites, speaker outreach to schools, videos, as well as promotion of public and private waste diversion programs
- Waste Audits to commercial business (via WasteCap Nebraska)
- Material Reuse (via not-for-profits)
- Subsidies to various programs (via Occupation Tax and Grants), such as:
  - Transfer Station
  - Compost Site
  - Recycling Drop-off sites
  - Appliance De-manufacturing
  - Household Hazardous Waste
  - Construction and Demolition Waste Landfill
- Recycling Drop-off Centers (No charge drop-off sites)
- Toxics Reduction through household hazardous waste (HHW) (no charge) and Conditionally Exempt Small Quantity Generator (CESQG) programs (limited charges), and others.

Private and not-for-profits organizations provide a wide variety of recycling incentives including such programs as:

- Waste exchanges and reuse options for a wide array of materials (most at little or no charge). This includes various source reduction options.
- Keep Lincoln & Lancaster County Beautiful (assistance with cleanup and mini-grants)
- Take back programs by businesses
- Recycling rewards programs
- Product stewardship/extended producer responsibility initiatives

More detailed information on various system, facilities and programs can be found on City's recycling website <http://lincoln.ne.gov/city/pworks/waste/sldwaste/recycle/> and in the *Lincoln-Lancaster County's Official 2012 Waste Reduction & Recycling Guide*, which is also available through the City's Solid Waste Operation's website.

Source separated residential, commercial and construction and demolition recyclables, (separated at the source) are not regulated under Lincoln Municipal Code (LMC) (e.g., source separated recycling are excluded from the definition of "refuse", and as such vehicles and containers used to provide those services are not subject to the regulations associated with licensing, inspection and other refuse management provision of LMC 8.32 - Solid Waste), including the Occupation Tax.

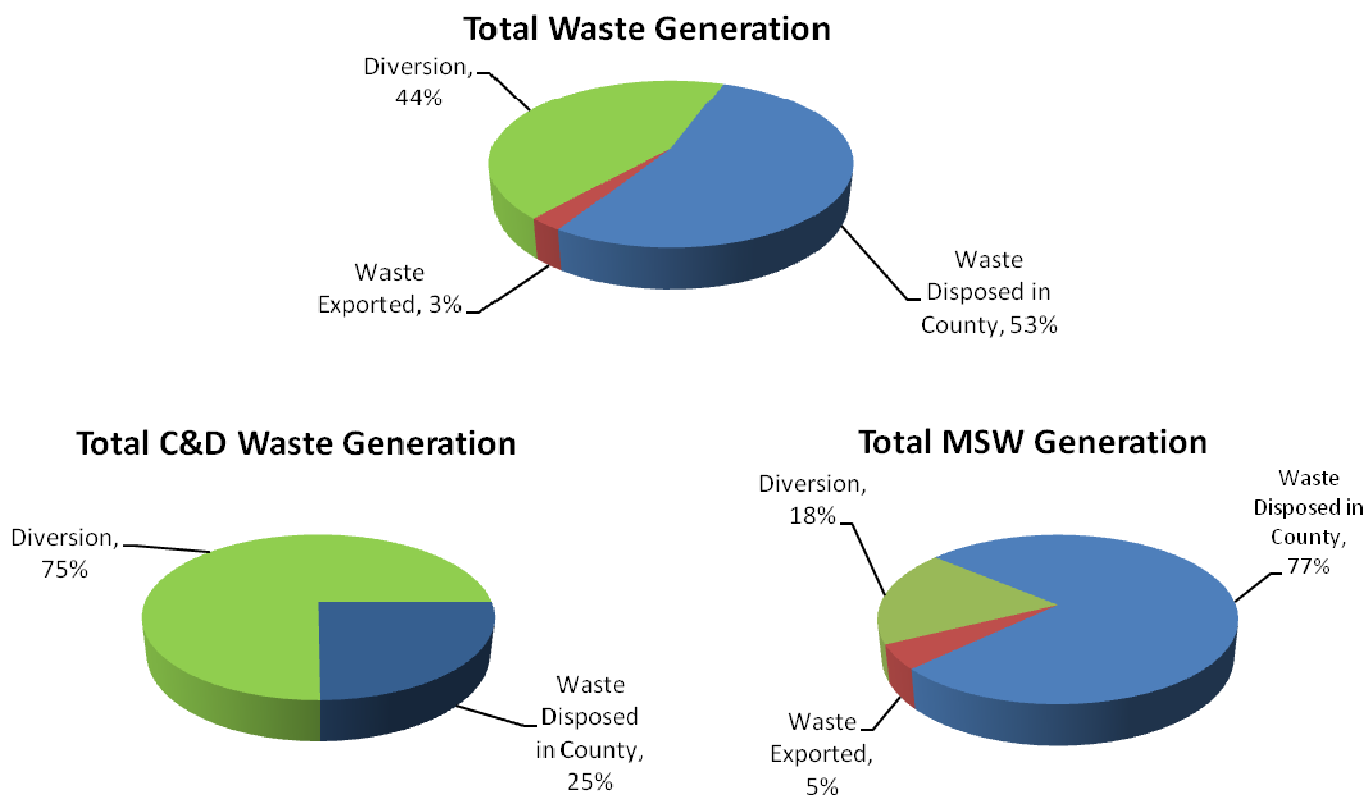
### **Generation and Diversion**

Topical papers on or related to source reduction, as well as residential and commercial recycling and diversion, provide additional detailed information on current quantities of waste generation and diversion rates. Additional information is also provided in the Needs Assessment, which looks at current generation and diversion rates and projects disposal capacity requirements into the future. This information is not repeated in this paper. This paper focuses on options that might be utilized as incentives or methods to increase existing diversion rates and practices through various future systems, facilities and programs. Key considerations (existing conditions) to be addressed in evaluating incentives include the following:

- Currently, it is estimated that only 24 percent of the occupied households in the Planning Area have curbside recycling services. These are households that subscribe (are charged a fee) for these services.
- LMC 5.41 establishes regulation for: recycling processing centers; recycling centers (buy-back centers); and recycling drop-off centers. Source separated recyclables are specifically excluded from current regulations related to vehicle licensing, minimum service levels, and reporting requirements.
- The quantities of recyclables diverted through the Planning Area wide drop-off centers, compost and wood waste area, appliance demanufacturing, and curbside recycling in FY 2010/2011 is equivalent to approximately 9 percent of the total municipal solid waste (MSW) stream.
- The Nebraska Department of Environmental Quality's (NDEQ) composition study reports that the three main components of Bluff Road Landfill's MSW waste (combined residential and commercial waste) stream (by weight) are paper fibers (44 percent), plastics (19 percent) and food (16 percent).
- In FY 2010-2011 the Bluff Road Landfill was used to dispose of approximately 287,210 tons of MSW and the N.48<sup>th</sup> Street Landfill was used to dispose of approximately 76,337 tons of construction and demolition waste, with an estimated 17,709 tons of refuse reported as exported from Lancaster County.

Calculated diversion rates for the Planning Area are portrayed in Figure 1.

**Figure 1 – 2011 Waste Disposal and Diversion, by Percentage**



### **Program (Facility/System) Options**

Incentive options can take many forms; some are very program specific, most are based in some measure on economic incentives/disincentives and will involve changes in laws, regulations, or ordinances to implement. Examples of incentive programs are also discussed in the technical paper on Source Reduction. General options discussed in this paper fall within the following categories:

- Status Quo
- Education
- Availability/Access/Convenience
- Fees/Rates
- Bans, Restrictions and Mandates
- Grants or Subsidies

As noted above the status quo consists of current educational efforts, waste audits, subsidies, drop-off centers, toxics reduction programs, waste exchanges and other initiatives. A portion of these programs are also a part of the current source reduction efforts. Many of the aspects of these programs are also applicable to additional incentive options, which in many cases may be enhancements of current programs. Also, many of the publicly provided programs receive some form of economic subsidy. The status quo also includes privately provided voluntary, subscription type residential recycling programs, existing processing and buy-back centers, not-

for-profit/charitable material drop-off and reuse programs, and special materials management programs (e.g., product stewardship and extended producer responsibility). These may also be subsidized by private businesses or other funding sources.

## **Education**

Education/behavioral change is considered an essential element in maintaining current levels of recycling and in increasing the quantity and percentage of materials recycled. While education is important to encourage, promote and sustain recycling, if the overall planning goal is to significantly increase the quantities of materials recycled then additional or expanded systems, facilities and programs are anticipated to be necessary. An educational effort will be important in implementing any (change to) selected systems, facilities or programs, especially programs that involve large scale increases in recycling, changing existing system alternatives, fees and rates, and bans or mandate

## **Availability/Access/Convenience**

A significant incentive to increase recycling is improving ease and convenience of systems, facilities and programs. For this reason mandated or universally available curbside residential recyclables collection programs have higher diversion rates than drop-off centers. Studies used to locate various services (groceries, fuel, shopping), show that access and convenience (as well as cost) are significant variables in deciding to locate and use a service. Access, in terms of the ability to obtain or make use of recycling programs is also important; this is one benefit that 24/7 access to existing City drop-off facilities provides. Limited access is also often cited as disincentive to recycling, e.g., it is not accessible, convenient or available, when it is needed.

## **Fees/Rates**

Fees and rates can be among the largest incentives and disincentives to recycling. Where added fees apply to recycling, above and beyond what is deemed necessary for disposal, it can be a disincentive to recycling. The amount of the fee and the added cost is likely one reason only 24 percent of the households and many businesses do not subscribe to recycling. There are two basic options to remove this disincentive that would increase the quantities of materials recycled in the Planning Area: 1) single fee service requirement; and, 2) variable rate/variable fee or volume based service, also known as “pay-as-you-throw” (PAYT).

Single fee systems for waste services, including recycling, can take many forms but are usually tied to a defined minimum level of service. The examples of single fee systems cited in the Residential Recycling and Diversion paper include:

- Cities of Bellevue and Ralston, Nebraska, where residents pay a single price (\$12.50 and \$13.38 per month, respectively) for garbage, recyclables and yard waste collection. There are many similar examples of single fee system in communities across the US.
- Saint Louis County, Missouri, requires weekly trash service. For one and two family households that service includes a “minimum level of service” of once weekly trash pickup, once weekly recyclables pickup, and twice a year bulk items pick-up. The hauler cannot provide less than those three services for one base price.  
(Source: <http://www.co.st-louis.mo.us/HealthandWellness/RecyclingandSolidWaste/WasteDisposal/TrashandRecyclingService#recyclingservice>, retrieved August 21, 2012)

These types of minimum levels of service can also be extended (likely by ordinance or laws) to businesses, industries and institutions as an incentive to recycle. The economic implications to waste generators of such a requirement will be a function of the efficiency of the refuse

collection system and details associated with how such a system is implemented (e.g., what materials the hauler must collect for recycling).

PAYT systems provide an economic incentive to recycle (and to generate less waste) because it charges more for greater quantities of waste set-out without charging more for increased quantities of recyclables set out. Traditionally, residential solid waste collection system customers have a uniform fee for waste collection and disposal services regardless of how much—or how little—refuse is set out for disposal. Similar to minimum level of service programs these typically require ordinances/laws to implement and the economic implications to waste generators will be a function of the efficiency of the refuse collection system and details associated with how such a system is implemented. The PAYT programs are considered, in some respects, analogous to rate structures associated with other utilities, where consumers pay based on the amount of water, electricity or gas utilized. For PAYT systems to be an effective incentive to recycle (disincentive to generate waste) the rate structure differential between various levels of refuse and recyclables collection services need to be significant. There are numerous examples that could be explored if this type of option were to be considered as part of the Solid Waste Plan 2040. One example is the structure used in Boulder County, Colorado. For the unincorporated areas, by ordinance (*Boulder County Ordinance NO. 2007 – 01*), the County has established the following provisions as it relates to incentivizing recycling and use of volume based rate:

- Haulers that provide garbage collection services to residential customers shall also provide to these customers weekly or bi-weekly collection of recyclables and shall charge a single rate for garbage collection and collection of unlimited amounts of recyclable material.
- Each Hauler shall determine a single standardized garbage container volume of approximately thirty-three (33) gallons which is the typical volume of a garbage bag or garbage can used by a residential customer. The hauler shall establish a single standardized price to be charged for the collection of this base volume. The hauler shall charge the same standardized price for each base volume unit of garbage subscribed regardless of the number of garbage containers, or standardized volume, placed for collection by the customer.

By establishing a base volume and requiring a doubling of fees for each doubling of volume (along with unlimited recycling (at no added cost)), the ordinance is intended to provide substantial incentive for recycling and volume reduction.

Skumatz Economic Research Associates (SERA), a leading authority on PAYT, indicated that in 2006 7,100 communities in the US used some form of volume based or PAYT system (*Resource Recycling, October 2006*). SERA research suggests that “PAYT reduces the total of residential trash disposed by about 17 percentage points. About one-third of this impact is an increase in recycling, about one-third is an increase in organics diversion [yard waste] and about one-third is source reduction/waste prevention.” (*Recycling Incentives, Part 1, Lisa Skumatz, et. al., Resource Recycling, February, 2011*).

In a recent magazine article a representative of the Solid Waste Association of North America (SWANA) commented that if PAYT is done only on the trash part [as opposed to total volume], that cost is inflated to pay for recycling. “It perhaps sends a false impression that curbside recyclables collection is free.” (*Waste Age, March 2012*).

Many businesses (commercial, industrial, institutions) as well as construction and demolition operations already rely on a form of volume based or PAYT system, in that they often pay fees based largely on a container size, weight of waste, and the frequency with which it is collected. In these instances, unless recycling is mandated or the refuse hauling company provides a

discount for containers of recyclable materials there may not be significant incentives to increase recycling. This concept is also in use for the management of yard waste (see separate technical paper) in the current Planning Area, via subscription collection system (e.g., if you choose to have collected yard waste removed from your residence or business you typically pay an added fee (pay as you throw)). The extent to which this is volume based in the Planning Area has not been determined.

On the USEPA's website it states "EPA supports this new approach to solid waste management, because it encompasses three interrelated components that are key to successful community programs:

- Environmental Sustainability...
- Economic Sustainability...
- Equity"

(<http://www.epa.gov/epawaste/consERVE/tools/payt/index.htm>, retrieved August 21, 2012)

In the area of residential recycling there are also programs utilizing recycling credit programs to provide households with financial or other incentives for taking part in recycling. Many of the early programs that provide flat dollar rebates as incentives to recycle have been discontinued. Programs that has been receiving significant national attention include "RecycleBank" and "Think Green Rewards", which involve "recycling credit" programs that "pay" points for recycling that can be redeemed on the program's website for coupons for dollars off purchases, or for gift cards from national and local sponsors. These are generally subscription/fee based programs and are currently available from at least one source in Lincoln.

While relatively new across the U.S., some cities are helping to off-set the cost of collecting recyclables and/or organics by reducing trash collection to every-other-week (Portland, OR; Renton, WA; Toronto, ON) or monthly/on-call (Boulder, CO; Arcata, CA). Reducing the frequency of trash collection can be viewed as an incentive encouraging greater diversion or disincentive to waste generation.

As discussed in the paper under Product Stewardship, extended producer responsibility laws may also use fees/rates to increase recycling. Under the extended producer responsibility laws the cost of such take back or end of life cost are included in the initial purchase price of the product.

### **Bans, Restrictions and Mandates**

As discussed under the technical paper on Source Reduction, where educational initiative generally focuses on voluntary participation, legislation can also be used to mandate changes. Federal, state and some local legislation/ordinances can be used to accelerate the implementation of source reduction and recycling programs. Legislation/ordinance can also have unforeseen side effects and will need to be considered carefully.

Bans and restriction are an indirect means of providing recycling incentives (disincentives targeting behavioral change). They do not necessarily reduce waste but rather use legislation to change management options. In Nebraska certain materials are banned from landfill disposal (e.g., tires, waste oils, lead acid batteries, appliances, and yard waste). In addition, Lincoln businesses are not allowed to dispose of hazardous wastes in the landfill. These do not necessarily reduce waste generation but create the need for alternate management approaches, which often include recycling and reuse. Bans on tires, batteries and appliances do not serve to decrease the quantity of materials purchased or the need for end-of life management.

Mandates are often viewed as disincentives. To be effective they also need to be supported by penalties, fines or other consequences (e.g., loss of landfill privileges, loss of hauler licenses, higher tipping fees).

Minimum levels of service regulation/ordinances are discussed above under Fees/Rates. They create both restrictions and mandates but can be effective in behavior change and in increasing recycling, especially as it relates to residential MSW. Applying minimum level of service regulations to business, with the intention of increasing recycling, can create added challenges and potential complications for certain business. While apartment (multiplex) facilities are considered under the technical paper on Commercial Recycling and Diversion the concept of minimum levels of service could be used with these facilities to significantly increase recycling; this may not be without challenges to older facilities or where space and infrastructure are viewed as impediments to implementation.

Recently a select group of communities in the US have developed policies and programs (mandates) that require residential waste recycling and include penalties (e.g., fines and lack of garbage pick-up) for those who do not recycle or who include recyclable materials in their waste. Mandated recycling/diversion can also include recovery and diversion requirements associated with demolition or construction projects, especially projects that utilize public funds. Where mandated recycling is required for construction demolition projects they generally require submission of a waste management plan, as part of the permitting process.

Mandates can also be used in new construction, and in the construction and demolition industries to increase recycling. A wide array of strategies that have been used to increase recycling; some examples of such mandate, as it relates to these industries include:

- **Building Specification:** where new construction is required to provide infrastructure (in businesses) to accommodate and facilitate recycling; the determination of compliance is done as part of the building permit review process. Building specification system can also be used in new construction to dictate or provide priority to use of recycled materials, thus helping to support markets and create market demand for certain materials. This concept is a significant cornerstone of the Green Building Council and their Leadership in Energy and Environmental Design (LEED) certification program.
- **Demolition and Deconstruction:** where demolition or reconstruction projects establish or are mandated to prepare a demolition materials management plan and document compliance. Again, such mandated programs require administrative oversight. These are considered hard to enforce on private sector projects where lowest achievable costs can be a significant consideration in project development.
- **Utilization of Recycled Materials:** where minimum content of recycled materials are specified in new construction; again, this is a cornerstone of the LEED certification program. Another key concept, which is focused on creating market incentives for use of recycled products through mandates on the inclusion of “buy-recycled” provision in purchasing policies and government construction specification. As a simple example, the City and County standard specification could be modified to include provisions to use materials such as local compost in construction projects. This would create added markets for the City’s LinGro compost. There are numerous other options for incorporating buy-recycled preference mandate provisions into local purchasing and construction practices. These could also include providing pricing advantages to projects that meet certain recycled product utilization levels.

It is important to note that mandates can be used to increase waste recycling and diversion, but may result in added costs to building construction and demolition projects.

## Grants or Subsidies

For grants and subsidies a source of money is necessary to provide the payouts and competition often exists for limited amounts of available funding. These may be one-time funding or more sustained funding sources. Nebraska's Integrated Solid Waste Management Act imposes a fee, to be paid to NDEQ, of \$1.25 per ton for each ton of waste landfill.

Fifty percent of the \$1.25 per ton fee is placed in the Waste Reduction and Recycling Incentive Fund; this fund is used to make grants to counties, municipalities, and agencies for the purposes of planning and implementing facilities and systems to further the goals of the Integrated Solid Waste Management Act. The grant proceeds can not be used to fund landfill closure site assessments, closure, monitoring, or investigative or corrective action costs.

The Nebraska Legislature has also established a Landfill Disposal Fee Rebate which sets aside a portion of the Waste Reduction and Recycling Fund to provide a rebate to political subdivisions that have developed and are implementing a written purchasing policy requiring a preference for purchasing products, materials or supplies that are manufactured or produced from recycled material. The City of Lincoln does participate and has received rebates from this fund.

The Waste Reduction and Recycling Act imposes a fee of \$1 per tire fee on the retail sale of new tires in Nebraska. A portion of the grants is also obligated to fund scrap tire recycling or reduction projects, the remainder can be used for other grants, as provided for in the Waste Reduction and Recycling Act.

Nebraska also has a Litter Reduction and Recycling Grant Program, which provides funds for:

1. Public education, motivation and participation,
2. Cleanup of public areas within the State.
3. New or improved community recycling and source separation programs

The Nebraska Environmental Trust (NET) derives revenue nearly 50 percent of its income from Nebraska Lottery proceeds. The Trust sets funding category areas for five-year periods, in a process involving members of the Nebraska public and conservation communities. Until July 2015, the Trust will consider funding proposals in the following priority areas:

- Habitat
- Surface and Ground Water
- Waste Management
- Air Quality
- Soil Management

The City of Lincoln, through its Occupation Tax, raises money to support/subsidize (incentivize) various existing solid waste systems, and recycling and waste diversion facilities and programs, excluding solid waste disposal at the Bluff Road landfill. The City also provides economic and technical support (e.g., waste audits, through WasteCap of Nebraska), to encourage recycling and source reduction.

New grant or subsidy programs could be developed by the City or in conjunction with specific funding sources to further encourage/promote the development of markets or new products for recycled materials, or to help businesses (e.g., through economic development grants or subsidies) implement systems, facilities and programs targeting source reduction, recycling and additional waste diversion. Again, the key will be identification of funding sources and mechanisms for grants and subsidies.



Appendix 1 is a state-by-state summary of State Recycling Tax Incentives, provided by the USEPA. This is intended to illustrate examples of what is being done at a state level in locations outside Nebraska.

### **Options Evaluation**

There are a wide array of issue and options associated with programs that provide incentives for recycling. It is not always possible to compare them to each other. Consistent with the guiding evaluation criteria developed for use in the Solid Waste Plan 2040, the recycling incentives have been further evaluated based on the considerations shown in Table 2. Options related to the status quo and education are discussed in numerous technical papers and are not further evaluated in this table. To significantly increase diversion through recycling, a combination of incentives and disincentives, including financial inducements and laws/ordinances/regulations will likely be necessary. Implementing such measure will almost certainly involve stakeholder and community participation.

Table 2 – Options Evaluation

| Evaluation Criteria               | Availability/Access/Convenience   | Fees/Rates  | Bans, Restrictions and Mandates   | Grants or Subsidies   |
|-----------------------------------|---|---|---|---|
| <b>Waste Reduction/ Diversion</b> | <p>Recycling is expected to increase with increased access and convenience to recycling opportunities.</p> <p>City wide curbside recycling is anticipated to produce the greatest levels of residential recycling.</p>  | <p>Fees and Rates are specific mechanisms used to increase recycling and source reduction.</p> <p>Fees and rates need to be carefully considered as they can also tend to drive exports of waste containing recoverable recyclables.</p> <p>Fees and rates can attempt to reduce landfilling, but may not in and of themselves reduce the quantity of material generated.</p> | <p>Bans and restrictions do not in and of themselves reduce the quantity of waste generation, but can be effective in directing materials away from local landfills and toward recycling programs.</p> <p>Bans, restriction and mandates can help create markets for diverted materials.</p> <p>Bans and mandates can lead to greater waste exports if only implemented at a local level.</p>   | <p>Grants and subsidies can be used to help establish and maintain certain programs or encourage new markets. Long-term they may or may not represent sustainable funding approaches for all programs.</p> <p>Non-sustainable funding represents a risk to programs success and public acceptance.</p>  |
| <b>Technical Requirements</b>     | <p>The capacity of existing processing facilities to handle increased quantities of recyclables may need to be evaluated. Programs to incentivized recycling may not benefit all existing recycling programs.</p> <p>Program options to increase availability, access and convenience of recycling options is considered compatible with other waste management options and can be structured to be effective and flexible.</p> | <p>The current Occupation Tax provides revenue to help subsidize recycling.</p> <p>Establishing new rates/fees will need to be carefully considered to ensure they effectively achieve the desired level of recycling.</p> <p>There are many examples across the US where rates and fees have been used to increase waste recycling.</p>                                      | <p>The capacity of existing processing facilities to a handle increased quantities of recyclables may need to be evaluated. Programs to incentivized recycling may not benefit all existing recycling programs.</p> <p>Some level of risk results from bans, restriction and mandates, unless solutions are available to deal with the affected material and enforcement is provided.</p> <p>It can be difficult to construct bans and mandates that are flexible and compatible with all other programs.</p> | <p>Grants and subsidies can help with establishing initial infrastructure and new programs.</p> <p>Grants and subsidies represent a level of risk because they are subject to changes that may be beyond the control of the program they are used to support.</p>   |
| <b>Environmental Impact</b>       | <p>Not applicable.</p> <p>Health and safety will be a concern with all programs, not limited to those with increased convenience.</p>   | <p>Incentives that increase recycling are viewed as helping to conserve resources (material and energy).</p> <p>Fees and rate structures can also be used as an incentive/disincentive to help reduce the toxicity of waste generated.</p>  | <p>Many of the current bans in Nebraska were intended to provide for increased environmental protection and landfill capacity.</p> <p>Many of the current regulations (restrictions and mandates) related to solid waste management are intended to reduce waste toxicity and be protective of human health and the environment (air, water, land).</p> <p>Extending regulations to recycling is generally understood to target increase conservation of resources and reduction in emissions.</p>            | <p>Some grant programs are based on environmental impact and reduced emissions considerations or health and safety.</p> <p>The City and County currently rely upon grants and subsidies to fund the toxics reduction program, composting operation, construction and demolition landfill, transfer station, education programs and other solid waste activities that include goals for recycling, waste reduction and environmental protection.</p> |
| <b>Economics</b>                  | <p>Option/incentives to increase availability/access/convenience will need to be evaluated in the future as specific programs are considered.</p>   | <p>Fees and rates can have a direct or indirect affect on residents and businesses.</p> <p>To minimize cost impacts to residents and businesses, incentives to increase recycling</p>   | <p>Bans, restriction and mandates need to consider the costs and benefits they will produce. In general these will increase the cost of service to residents and businesses.</p>  | <p>Grants and subsidies can be used to help fund certain programs or fund new facilities.</p> <p>Grants and certain low interest or tax deferred subsidies can be used as an</p>  |

| Evaluation Criteria             | Availability/Access/Convenience  | Fees/Rates  | Bans, Restrictions and Mandates   | Grants or Subsidies  |
|---------------------------------|--|---|---|--|
|                                 | <p>Funding sources will be specific to the program options selected. Improvements in efficiency may help defray overall program costs.</p> <p>Certain programs attempt to directly assign program costs to system users, such as PAYT.</p>   | <p>would need to also be implemented in an efficient manner.</p>  | <p>Funding new programs will be a major consideration; it will be important to examine new programs in the context of providing incentives without generating significant cost increase.</p> <p>Restriction and mandates can be used to create funding mechanisms as well as new markets.</p>   | <p>economic development mechanism.</p> <p>Long-term they may or may not represent sustainable funding approaches for all programs.</p> <p>Reliance on grants and subsidies can create certain economic risk for sponsors, residents and business.</p>  |
| <b>Implementation Viability</b> | <p>Most programs involving incentives will require laws/regulations/ordinance changes to implement.</p> <p>Social/political acceptability will be a factor in any options that attempts to change the current system.</p> <p>Universally accessible residential curbside recycling could reduce the number of drop-off centers currently in use.</p> <p>Permitting systems could be used as part of the incentives/disincentives to facilitate implementation of new programs.</p> | <p>Most programs involving incentives will require laws/regulations/ordinance changes to implement, including those that use rates and fees as incentives.</p> <p>Social/political acceptability will be a factor in any options that attempts to change the current system using rates and fees.</p> <p>Rates and fees to incentivize recycling may need to be implemented, in part through the permitting process to facilitate implementation of new programs.</p> | <p>Bans, restriction and mandates all require legislative or regulatory changes.</p> <p>The social/political acceptability will be a function of cost and benefit and are generally program/product specific.</p> <p>Bans, restriction and mandates can in many cases be used to shift funding responsibility to responsible parties and provide significant diversion/recycling rates.</p> <p>Changes to purchasing practices and specifications used by units of government may be easier to accomplish than large scale disposal bans on select materials.</p> | <p>There is generally significant competition for limited grant funds and so they may not always represent viable funding strategies (short- and long-term) for program implementation.</p> <p>These mechanisms are designed to provide incentives, but are subject to a variety of legislative/regulatory commitments for longevity.</p> <p>They are generally socially/politically acceptable incentives.</p> <p>They do not always provide a link between waste generators and recycling.</p> |

## Relationship to Guiding Principles and Goals

The current recycling programs rely upon a range of incentives to help encourage participation. Additional incentives could significantly increase levels of recycling. As it relates to the Guiding Principles and Goals of the Solid Waste Plan 2040, the recycling incentives can be directly applicable, as further noted below.

- **Emphasize the waste management hierarchy:** Recycling is one of the most preferred waste management methods in the hierarchy (immediately after reduce and reuse) in that it places maximum emphasis on options to recover materials and recycle them into new products. Current programs provide incentives to recycle and are compatible with this hierarchy. To increase recycling above the status quo, additional programs, with added incentives, convenience and possibly mandates would result in significantly higher level of residential recyclables diversion.
- **Encourage public/private partnerships:** A challenge in significantly increasing recycling will be changing the status quo. The current recycling system is built around public and private management system as well as a limited set of public and private incentives for recycling and source reduction. Incentives are a mechanism to change both the behavior of residents and business, which are also public-private partners. The largest current incentives are the City provided drop-off sites, City provided education and promotional outreach, and private take-back/buy-back centers. Implementation of larger volume recycling programs will require changes in many of the waste management programs currently managed by private entities, specifically waste collection and hauling (residential, commercial and C&D). It is assumed that changes recommended in the Solid Waste Plan 2040 would be developed with private parties providing collection and processing services and incentives/disincentives to encourage the expansion and participation in those programs.
- **Ensure sufficient system capacity:** Incentives for recycling do not necessarily ensure sufficient system capacity, but can be used to encourage or support expanded capacity and markets for diverted materials. Available processing capacity may need to be evaluated as part of any program that provides incentives to significantly expand recycling diversion rates.
- **Engage the community:** Incentives are intended to motivate or induce positive actions. As such they need to involve and engage the community. Any expanded recycling and diversion program would need to engage the residents and businesses to encourage them to divert more recyclables from disposal and possibly increase their knowledge of conservation, source reduction and reuse alternatives. To optimize success of an expanded curbside recycling program will also requires educating (behavior change) to encouraging participation and sustained participation.
- **Embrace sustainable principles:** Maximizing recovery of materials through recycling into new products recognizes that waste is not inevitable and discarded materials are potentially valuable resources. Incentives are one means of reinforcing these principles.

## Summary

There are many types of incentive program options available, most of which are consistent with the Solid Waste Plan 2040 guiding principles and the waste management hierarchy. From the perspective of significantly increasing the overall magnitude of diversion of materials from disposal, through recycling, there are various incentives/disincentive options. In general incentives refer to items that would motivate or induce positive actions. Many of the changes

required to significantly increase recycling will require changes in law, regulation or ordinances; these changes are also forms of incentives/disincentives. Lincoln and Lancaster County provides incentives to current recycling efforts through a variety of mechanisms, including subsidies. Private and not-for-profits organizations also provide a wide variety of recycling incentives. Two of the most significant incentives that can be used to increase recycling are: 1) improving ease and convenience of systems, facilities and programs; and, 2) providing minimum level of service mandates. Where added fees apply to recycling, above and beyond what is deemed necessary for disposal, it can be a disincentive to recycling. Bans and restriction are an indirect means of providing recycling incentives (disincentives targeting behavioral change); they do not necessarily reduce the overall quantity of materials generated but rather use legislation to change to management options. Incentive options can take many forms; some are very program specific, most are based in some measure on economic incentives/disincentives and will involve changes in laws, regulations or ordinances to implement.

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## Appendix





# APPENDIX 1



## Wastes - Resource Conservation - Reduce, Reuse, Recycle

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## State Recycling Tax Incentives

Note: EPA no longer updates this information, but it may be useful as a reference or resource.

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| State     | Description  | Eligible App  |
|-----------|--|---|
| <b>AZ</b> | Recycling equipment income tax credit for individuals and corporations equaling 10 percent of the installed cost of the equipment. Equipment must process postconsumer recyclables or produce finished products composed of at least 25 percent postconsumer recycled materials. | Individuals and corp  |
| <b>AR</b> | Recycling equipment income tax credit equaling 30 percent of the equipment costs. Equipment must handle at least 10 percent postconsumer solid waste.  | Recycling businesse   |
| <b>DE</b> | Recycling investment tax credit totaling \$500 for each \$100,000 invested.<br><br>Recycling employment income tax credit of \$500 for each new employee added as a result of incorporating recycled products into the process.  | Recycling businesse<br>least 25 percent (by recycled materials o<br>removed from the s<br>waste stream. /p> |
| <b>FL</b> | Recycling investment tax credit totaling \$500 for each \$100,000 invested.<br><br>Recycling employment income tax credit of \$500 for each new employee added as a result of incorporating recycled products into the process.  |   |
| <b>GA</b> | Personal income tax credit for investment in recycling facilities, machinery, or equipment. Amount   | Manufacturing indus   |

of credit is equal to 3, 5, or 8 percent (based on tiers) of the qualified investment.

|           |  |   |
|-----------|--|---|
| <b>HI</b> | Recycling equipment sales tax reduction of between 0.5 and 4 percent.  | Solid waste processi                            |
| <b>IA</b> | <p>Personal and real property tax exemptions for machinery and equipment used for recycling or reprocessing of paper, cardboard, or plastic products.</p> <p>100 percent sales tax exemption for purchases of industrial machinery, equipment, computers, and replacement parts used in the recycling or reprocessing of waste products.</p>   | Recycling businesse in description.             |
| <b>ID</b> | Recycling equipment income tax credit of up to 20 percent of equipment costs but not exceeding \$30,000 per year. Requires that 90 percent of the equipment's product be made from recyclables.  | Recycling businesse postconsumer paper plastic. |
| <b>KY</b> | <p>Recycling equipment personal income tax credit of up to 50 percent of the equipment costs.</p> <p>Recycling equipment sales and use tax exemption. Includes equipment used to collect, separate, compress, bale, shred, or handle waste materials for recycling.</p>  | Recycling businesse                             |
| <b>LA</b> | <p>Recycling equipment income tax credit for 20 percent of recycling equipment costs, less any other credits that are claimed. Equipment must process 100 percent postconsumer or recovered materials or make a product that contains 50 percent postconsumer or recovered materials.</p> <p>State, parish, and local property tax exemptions for recycling machinery and equipment for up to 10 years. Applies only to recycling manufacturing companies.</p> | Recycling businesse in description.             |
| <b>MD</b> | Personal property tax exemption on tools, implements, machinery, and manufacturing apparatus or engines. The exemption does not apply in certain counties.   | Recycling businesse                             |

|           |   |   |
|-----------|---|---|
| <b>MN</b> | <p>Sales tax exemption for construction costs for resource recovery facilities.</p> <p>Recycling processing equipment tax exemption for recycling processors only. Rebate of 6.5 or 7 percent of the equipment costs depending on whether the business is located in Minnesota.</p> <p>Equipment sales tax exemption for paper recycling companies.</p> | Recycling businesses in description.  |
| <b>MT</b> | <p>Recycling equipment income tax credit of 25 percent for the first \$250,000 invested, 15 percent for the next \$250,000, and 5 percent on the next \$500,000.</p> <p>Reclaimable material income tax credit for taxpayers who purchase a product made from reclaimed materials. Tax credit is equal to 5 percent of the cost of the product.</p>     | See description.  |
| <b>NC</b> | Real and personal property tax, corporate state income tax, and franchise tax deductions for recycling plants, facilities, and/or equipment.  | Businesses that purchase and construct facilities or equipment for recycling or resource recovery in North Carolina.            |
| <b>ND</b> | Recycling equipment sales and use tax exemption for recycling machinery and equipment in new or expanding recycling facilities.   | Recycling businesses.   |
| <b>NJ</b> | Sales tax exemption for the purchase of recycling equipment.  | Recycling businesses.   |
| <b>NM</b> | Recycling equipment income tax credit equal to 5 percent of equipment costs. Tax credit is limited to recycling equipment that creates jobs, rather than reducing the workforce.  | Recycling and manufacturing businesses.   |
| <b>NV</b> | Personal property tax exemption of 75 percent for 10 years. Real property tax exemption of 25 percent for 20 years.   | Manufacturing and recycling companies that meet job creation and development goals and use raw materials from within the state. |

|           |   |  |
|-----------|---|--|
| <b>OK</b> | Recycling facility income tax credit of up to 15 percent for machinery and equipment, construction and renovation, and expansion financing.   | Recycling business manufacturers.                          |
| <b>OR</b> | <p>Three separate recycling tax credit programs with the credit taken against Oregon income tax. Credit can be taken from only one program.</p> <p>Reclaimed plastic tax credit of 50 percent of the plastic recycling capital investment taken at a rate of 10 percent per year for 5 years.</p> <p>Pollution control facility tax credit of 50 percent of the recycling equipment and facility capital cost taken at a rate of 5 percent per year for 10 years.</p> <p>Business energy tax credit of 35 percent of the recycling equipment capital investment taken over 5 years.</p> | <p><a href="#">See description</a> <small>EXIT</small></p> |
| <b>SC</b> | Recycling equipment sales and use tax exemption for machines used in the collection, separation, processing, or reuse of materials that would otherwise become solid waste.   | Recycling and manufacturing businesses.                    |
| <b>TX</b> | Any equipment used for pollution control can receive a use determination from TCEQ that can be turned in to the appraisal district to get a property tax exemption. However, equipment used partially for pollution control and partly for production is eligible only for a partial use determination (i.e., you can only get the pollution control portion of the value). Since recycling is generally for pollution control and production, the equipment may not be eligible for a 100% use determination.  | <a href="#">See description</a> <small>EXIT</small>        |
| <b>UT</b> | <p>Recycling income tax credits of 5 percent on equipment and machinery costs and 20 percent on operating costs (maximum \$2,000). Only available for recycling collectors, processors, and manufacturers located in state Recycling Market Development Zones.</p> <p>Sales tax exemption for manufacturers purchasing and leasing machinery and equipment. Sales tax exemptions range from 30 to 100 percent depending on what year the machinery is purchased. Available for all manufacturers, including recyclers.</p>  | See description.   |

**VA**

Recycling equipment income tax credit equal to 10 percent of the equipment purchase price. Machinery and equipment must be used to manufacture, process, compound, or produce items from recyclable materials.

Recycling business [Share](#)

Retail sales and use tax exemption for machinery, equipment, and power used by industrial recyclers.

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**WI**

Recycling property tax exemption for machinery and equipment, including parts, used exclusively and directly in waste reduction or recycling.

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## Commercial Recycling and Diversion

### Overview

Recycling turns materials that would otherwise become waste into valuable resources. Recycling includes: 1) collecting materials that would otherwise be considered waste; 2) sorting and processing recyclables into raw materials that can be used to produce new products; and, 3) purchasing recycled product. As illustrated by the traditional recycling logo, using the collected material, in whole or in part, in new products is necessary to complete the “recycling” cycle.



The “commercial recycling” options discussed in this paper will generally focus on systems, facilities and programs serving businesses, industry, institutions, and residential multi-family units (three-plexes and greater; apartments), to coincide with LMC 8.32.205, which differentiates the frequency of solid waste collection requirements based on number of dwelling units. For purposes of this paper these will all be referred to as “commercial” recycling, unless examples are applicable to only a limited subset of this group (e.g., multi-family residential recycling).

Multi-family residential units, and business, industry and institutions in the Lincoln and Lancaster County Planning Area (Planning Area) have access to voluntary recycling opportunities but systems, facilities and programs may not always be convenient or may have extra costs, which serve as disincentives.

Opportunities in commercial recycling have the potential to dramatically increase diversion, through increased recycling in the Planning Area. Commercial recycling programs are often associated with old corrugated containers (OCC or cardboard) and office paper because they are easy to collect and have readily identified markets; however, a wide variety of high quality, recyclables (papers, metals, plastics and other materials) can be obtained from commercial, industrial and institutional businesses. The types and quantities of materials that can be diverted from businesses are generally specific to the type of business. The types of materials that could be diverted from multi-family dwelling are similar to those described in the paper on Residential Recycling and Diversion. Food waste is one example of a material that can be collected from a specific businesses type (i.e. restaurants and institutions) and diverted from disposal.. Properly planned and implemented, commercial recycling also has the potential to have a lower cost per ton diverted than a residential collection program. Separate technical papers address materials such as yard waste and food waste composting as well as markets for recyclable materials.

It is important to also note that under the definition of “refuse” in LMC 8.32.010 refuse, specifically excludes recyclables (as defined in LMC 5.41.010) that have been separated out at the source. This distinction is important because it does not subject vehicles involved in collecting source separate recyclables to licensing requirements under LMC 8.32.

As presented in the Residential Recycling and Diversion paper, the USEPA has stated “Recycling materials reduces greenhouse gas emissions.” EPA estimates for example, “by recycling all of its office paper waste for one year, an office building of 7,000 workers could reduce greenhouse gas emissions by 546 MTCE [million metric ton carbon equivalent], when compared to landfilling. This is the equivalent to taking nearly 400 cars off the road that year.”

(Source: <http://www.epa.gov/climatechange/waste/measureghg.html>, retrieved August 17, 2012)

## Current Programs

The Lincoln Recycling Office provides education and outreach for commercial recycling. The City supports and promotes public and private recycling efforts through its website <http://lincoln.ne.gov/city/pworks/waste/sldwaste/> and by providing a wide array of services. The primary public and private services for the commercial sector include but are not limited to:

- Commercial recyclables collection (voluntary/subscription service)
- Buyback and processing centers
- Waste audits (supported through WasteCap of Nebraska)
- Drop-off centers, for residential recycling
- Education
- Partnerships

Commercial recycling occurring in the Planning Area also includes internal corporate recycling and materials exchange. Additional, more specific information on various system, facilities and programs can be found on the City's recycling website <http://lincoln.ne.gov/city/pworks/waste/sldwaste/recycle/> and in the *Lincoln-Lancaster County's Official 2012 Waste Reduction & Recycling Guide*. While these source place emphasis on household diversion opportunities (including multi-family households - apartment complexes), they also include a wide variety of options that are available to business, industry and institutions waste generators. Also, included within these sources is information on a wide array of private and not-for-profit recycling service providers, as well as source reduction opportunities.

The City provided facilities (residential recyclables drop-off centers), education, waste audit and support programs, and yard waste composting, are funded through the Occupation Tax, user fees, material revenues and grants.

Historically, commercial recycling services for source separated office paper, OCC, and other traditional recyclables has been provided by private recyclers in Lincoln or Omaha. Some larger commercial refuse haulers have provided separate cardboard recycling containers at selected retail locations. Recently, some refuse haulers have expanded their waste collection business to include recycling services for both residential and commercial customers. This has resulted in more recycling services available for commercial recycling. Some refuse haulers may also subcontract with recycling firms to provide recycling services to their customers.

Firms providing source separated recyclables collection services are not required to license their (source separated recyclables) collection vehicles and report any information regarding their service areas, type of services provided, type and quantity of material diverted/recycled, or the number of customers they service. As a result, the number of waste haulers providing commercial recycling services and participation levels are not known. Private recycling processing centers operate in the City and collect/accept recyclables from business customers and sort and process them to meet market specifications. These facilities process a wide variety of paper, plastics and metals for shipment to various markets and some offer confidential document shredding and recycling. The capacity to process significantly larger volumes of materials would need to be evaluated if a significant increase of recyclables resulted from an expanded commercial recycling program. Commercial recycling programs are funded by program users through, subscription fees and revenue derived from the collected materials.

There are eight buyback center locations in the City for metal cans and scrap metal; two of the centers only accept metal cans. Two firms have facilities located in the Planning Area, and handle large volumes of scrap from the Planning Area, including automobile and demolition scrap metals. Their local facilities also accepts and recycles materials from other recyclers in

the region. Material quantities recycled through buyback centers or diverted as a result of waste audits are unknown.

The City recently completed a pilot study in four apartment complexes, to evaluate recycling education alternatives specific to multi-family/apartment residents. A summary of information from that pilot study is included in Appendix 1. Some of the key observations and findings from the pilot study are:

1. Residents feel recycling is important, but do not recycle because they do not have space or it is not convenient.
2. Very few residents currently use City drop-off sites.
3. Education alone may not be enough to spur recycling rates; convenience is needed.
4. Residents think they would use on-site recycling services.
5. Residents who don't think recycling is important will still participate if it is highly convenient. Maximize the convenience of the recycling system by mimicking the system currently in place for trash removal.
6. The educational material should be diverse in its content, format and distribution.
7. The use of reusable bags to encourage recycling may be an effective tool.
8. There were multiple examples of enthusiasm from residents who previously recycled. Such enthusiasm could be directed by property managers into "recycling green teams" or "environmental captains" for the apartment complexes to assist with recycling education and monitoring.

The main recommendations resulting from the study that can help guide options for future multi-family recycling programs are:

1. Facilitate discussion and recycling training for property managers as opposed to the individual tenant.
2. Utilize the existing educational materials from the pilot project to create education packets for apartment managers to provide to new residents as a "welcome packet".
3. Examine the issues and opportunities with on-site collection containers. Participation rates would increase with the convenience of on-site containers. Apartment managers may be willing to add recycling to their current waste collection if it is cost effective.

Some of the same observations and recommendations described above could also apply to property managers and owners of business, industry and institutions buildings.

While education is important to encourage, promote and sustain commercial recycling, if an overall recommendation of the Solid Waste Plan 2040 is to significantly increase the quantities of materials recycled from these "commercial" waste generators, then additional or expanded programs will be necessary. As discussed below, these programs may require some form of market regulation or mandated programs; this presumes such services would be provided by private firms, as opposed to municipally operated systems.

### **Generation and Diversion**

An annual City survey of recyclers provides some data on commercial recycling activities and the quantity of recyclables handled by these private-sector efforts. Table 1 summarizes the reported data since 2000 for various recycled materials. The quantities originally reported include metals associated with auto scrap, as well as salvage and demolition activities; quantities of metals in Table 1 were adjusted in an effort to reflect only metals from commercial recycling operations. These quantities exclude materials such as tires, oil, wood pallets, electronics and other miscellaneous materials, because these materials have been inconsistently reported. The



totals in Table 1 also exclude recycled concrete and asphalt materials (construction and demolition waste recycling, which is addressed in a separate technical paper).

**Table 1 – Tons of Materials Recycled Tons<sup>(1)</sup>  
(Reported by Private-Sector)**

| Calendar Year | Metals (tons) <sup>(2)</sup> | Paper (tons) | Cardboard (tons) | Glass (tons) | Plastic (tons) | Total Tons |
|---------------|------------------------------|--------------|------------------|--------------|----------------|------------|
| 2000          | 5,967                        | 10,095       | 12,412           | 1,899        | 92             | 30,465     |
| 2001          | 3,205                        | 9,891        | 11,260           | 2,931        | 74             | 27,361     |
| 2002          | 5,623                        | 11,343       | 13,690           | 2,665        | 281            | 33,602     |
| 2003          | 5,188                        | 18,937       | 11,495           | 1,633        | 513            | 37,766     |
| 2004          | 7,962                        | 14,108       | 14,464           | 1,702        | 276            | 38,512     |
| 2005          | 9,505                        | 20,277       | 13,098           | 1,183        | 342            | 44,405     |
| 2006          | 7,434                        | 12,262       | 20,931           | 1,696        | 461            | 42,784     |
| 2007          | 7,777                        | 16,962       | 21,673           | 1,542        | 399            | 48,353     |
| 2008          | 9,716                        | 9,227        | 14,317           | 316          | 449            | 34,025     |
| 2009          | 7,247                        | 9,638        | 16,017           | 327          | 618            | 33,847     |
| 2010          | 9,618                        | 11,071       | 15,721           | 1,004        | 923            | 38,337     |
| 2011          | 9,437                        | 8,703        | 14,801           | 71           | 649            | 33,661     |

Notes:

- (1) Data prior to 2010 includes recyclables collected through residential curbside recycling collection programs.
- (2) Actual quantities of reported ferrous metals have been adjusted to reflect 3 percent of the waste stream to correspond to the percentages of metals in NDEQ statewide waste composition study. Adjustments were made because the values reported to the City include items such as scrap automobiles and metals from salvage and demolition operations.

The average amount of commercial materials reported to be recycled since 2000 has been approximately 37,000 tons per year. These quantities have not been verified and it is not known what amounts come from subscription recycling service, buybacks, or other internal corporate recycling programs. Quantities of recyclables imported and exported are also unknown.

Data collected on waste composition, at the Bluff Road Landfill, does not allow a clear distinction between residential and commercial municipal solid waste (MSW); however, the City estimates that approximately one-half of the waste disposed at the Bluff Road Landfill comes from “commercial” sources. Comparing the 33,661 tons in FY2010/2011 with the estimated commercial waste tonnage received at the Bluff Road Landfill in FY 2010/2011 and commercial tonnage exported from county, in FY 2010/2011, would result in a commercial waste recycling/diversion rate of 18 percent.

The NDEQ conducted a series of waste composition studies in 2007 and 2008. The main objectives of these studies were to determine the characteristics of Nebraska’s solid waste stream and to establish a baseline of waste characterization data for the state. NDEQ’s composition study included four seasonal sampling events at the City’s Bluff Road Landfill and separate characterization for commercial and residential waste streams. The figure and tables in Appendix 2 shows the NDEQ composition study results for commercial waste. The NDEQ study reports that the three main components of Bluff Road Landfill’s commercial waste stream (by weight) are paper fibers (49 percent), plastics (19 percent) and food (16 percent).

Based on NDEQ's table comparing the composition of commercial and residential waste, it is reasonable to assume that the majority of the cardboard comes from commercial sources and represent initial materials that would be targeted in an expanded commercial recycling program. Food waste (16 percent of total MSW) is another component of the disposed waste stream that may be more easily captured from select generators of commercial waste (restaurants and institutions) than from residential waste. While estimates of detailed waste composition may be useful in evaluating future waste management systems (including increased diversion opportunities), it is equally important to recognize that waste received at the landfill is a heterogeneous mix and that most of these materials are not currently collected or managed in a form conducive to large volume recovery (e.g., they are all mixed together and cross-contaminated by other waste products). For this reason evaluation of recycling alternatives are principally focused on pre-disposal recovery/recycling options. A processing facility is one option that may provide post-disposal recovery opportunities for loads of waste that include high percentages of relatively clean recyclables.

### **Program (Facility/System) Options**

Commercial recycling program options can take many forms and will need to be tailored to the specific opportunities and needs of a given commercial waste generator. This is one factor that makes the concept of commercial recycling potentially more complex than residential recycling. Commercial recycling programs will need to adapt to the differences in types of business, business infrastructures, participants, program/services, and available/targeted materials.

A key consideration in evaluating options may be how such commercial waste generators currently provide garbage management within their existing facilities. Mimicking such infrastructure may provide the most convenient and cost effective means of consolidating materials for collection and shipping to recycling facilities.

While this infrastructure is vital to a successful diversion program, the focus of this paper is generally on options to collect and manage the recyclable materials from existing facilities. Where new facilities are being constructed there are also options to facilitate efficient infrastructure. New construction recycling space requirements is a topic receiving significant emphasis in many locations in the US. This topic is presented below, along with other program options. A short discussion is also provided on waste audits; while not a major recycling diversion program they can be an effective component in planning or evaluating existing and new program options.

Among the most common approaches for commercial recycling, utilized across the US, are the following:

- New construction (infrastructure) requirements
- Refuse hauler recycling service
- Owner/Operator commercial recycling service
- Processing facility
- Buy-back centers/targeted materials programs
- Waste audits

These methods are typically complimented by education and promotional programs. While increased education (behavior change) may produce some increase in commercial recycling (above the status quo), if major increases in commercial recycling is a goal of the Solid Waste Plan 2040, then some form of market regulation or mandated programs will likely be required.

Product Stewardship and extended producer responsibility, discussed in more detail in a separate paper, can also compliment a comprehensive commercial recycling program.

Expanded commercial recycling programs may need to involve more than one of the options presented below to maximize diversion and address inherent limitations with any one program type.

**New Construction (Infrastructure) Requirements.** One of the challenges with commercial recycling is the lack of space and infrastructure available to accommodate recycling in existing facilities. Many existing commercial establishments and multi-family complexes have limited or no additional space for recycling containers/bins. One approach (emerging policy in some locations) is to require new commercial and multi-family building projects, or major renovations, to include infrastructure (not limited to space) for collection, storage and handling of recyclable materials as part of the design and construction. The owner would need to obtain approval of the recycling infrastructure when submitting their building permit application.

One such concept would dictate that the amount of space to be provided for the storage and collection of recyclable materials must be as large as the amount of space provided for trash, is adequate for the maintenance and servicing of recycling containers, and is designed to accommodate collection and storage containers, consistent with the recyclable materials generated. The recycling area(s) must also be as accessible and convenient to tenants/multi-family residents and collection vehicles as the trash storage and collection area(s). A second concept is to establish minimum space requirement based on building size categories.

Some examples of recycling infrastructure requirements in new and remodeled commercial buildings include:

- City of Broomfield, Colorado requires “all new and significantly remodeled structures where refuse is generated...shall provide adequate space for the collection and storage of refuse and recyclable materials.” Significantly remodeled is defined as 50 percent or greater of structure market value prior to remodel. (Source: [http://www.colocode.com/broomfield/title17.htm#chapter17\\_34](http://www.colocode.com/broomfield/title17.htm#chapter17_34), retrieved on 8/21/2012)
- Municipal code in SeaTac, Washington requires that new construction incorporates the space required for on-site storage of recyclables prior to collection. The recycling space requirements applies to both residential (including multi-family) and non-residential buildings. (Source: <http://www.codepublishing.com/wa/seatac/html/Seatac13/Seatac13250.html>, retrieved on 08/21/2012)
- The state of California requires new commercial and multi-family developments of 5 units or more, or remodels that add 30 percent or more to the existing floor area to include adequate, accessible, and convenient areas for collecting and loading recyclables. Requirements have been incorporated into the California Building Code.

**Refuse Hauler Recycling Service.** This approach is based on market regulation (mandates established by law, regulations or ordinances). Market regulation is described in the technical paper of Residential Recycling and Diversion. Reference should be made to the discussions under the paper on Residential Recycling and Diversion for more detailed discussion on options such as: free market (with minimum level of service); franchising (exclusive or non-exclusive); and contract. The following discussion is generally based on continuing the free market approach to providing refuse collection services. The current commercial recycling system in the Planning Area is totally voluntary and commercial refuse collection is done on a free market basis.

There are two sub-options to this approach:

- The service is offered, but the refuse generator can choose to use the program.
- The service must be provided to all refuse generators.

Under the first sub-option approach all licensed refuse haulers are required to provide (or offer) all commercial customers (businesses, industry, institutions, and multi-family units) a convenient opportunity (minimum level of service) to recycle. A licensing program for source separated recyclables haulers may also be necessary to effectively implement and enforce such an option. Under the continued free market approach to refuse collection, it would be the responsibility of the refuse hauling services to determine how to organize and structure the recyclables collection program (under guidelines provided through ordinance and hauler license requirements). Commercial recycling ordinance(s) can be more complicated than residential ordinances, but would typically define such aspects as materials to be collected and frequency of collection. Refuse haulers could be allowed to subcontract the recycling service to other licensed haulers if they do not wish to provide the service themselves. Haulers would target a minimum number of materials specified in the ordinance and/or based on business classifications. Ordinances can also be established to determine how compensation to the refuse hauler might be structured (see discussion in the paper on Recycling Incentives for discussion on single fee systems and pay-as-you-throw concepts to incentivize recycling).

Commercial collection is often presented to businesses as a two-dumpster concept – one for waste and one for select recyclables; in certain applications food waste collection could be the second cart/dumpster or the third. Under the voluntary participation approach all businesses, industry, institutions, and multi-family units are offered recycling services, along with recycling information, but the residents and business would determine whether or not and to what extent they would participate.

With a hauler required service ordinance (second sub-option), all licensed haulers are required to provide minimum recycling services. This concept is more closely aligned with single service fee provisions (see Recycling Incentives) where refuse haulers would be free to set their own rates. Similar to the existing free market system, businesses, industries, institutions and multi-family residences could choose their service provider, knowing that the fee being set includes a minimum level of recycling service

This option places the burden of recycling services on the private haulers rather than on the businesses; thus a limited number of private haulers are regulated instead of the multitude of businesses, industries, institutions and multi-family residences generating commercial waste.

Some examples of hauler required commercial recycling service and ordinances include:

- Starting in January 1, 2012, the City of Urbana, Illinois required all haulers operating in Urbana to offer recycling services to their business and commercial customers. Haulers must target specified list of recyclables per the ordinance and set their own recycling collection rates. (Source: <http://urbanaininois.us/residents/recycling-program-ucycle/commercial-recycling>, retrieved on 08/21/2012)
- In Kane County, Illinois, hauler licensing requirements for material separation plans are combined with the commercial establishments' recyclable materials separation requirements for complete generator and hauler participation. (Source: <http://www.countyofkane.org/Documents/Recycling/licenseOrdinance95-157.pdf>, retrieved on 08/21/2012)
- As part of its hauler permitting requirements, all waste haulers in City of Boston must offer recycling collection service to commercial solid waste customers. This includes providing all commercial customers informational and educational materials detailing recycling service. (Source : [http://www.cityofboston.gov/Images/Documents/Commercial%20Trash%20Hauler%20Ordinance\\_tcm3-10117.pdf](http://www.cityofboston.gov/Images/Documents/Commercial%20Trash%20Hauler%20Ordinance_tcm3-10117.pdf), retrieved on 08/21/2012)

**Owner/Operator Commercial Recycling Service.** Under an owner/operator commercial recycling service ordinances, all building owners/operators would be required (mandated by law(s)) to provide a minimum level of recycling services for their tenants or residents (multi-family). Owners or operators (property managers) of commercial and multi-family buildings would sign up with licensed refuse or recyclables hauler for recycling services. Participation by the tenants and residents would be voluntary (see discussion under Recycling Incentives on mandatory recycling). Much like the refuse hauler provided recycling option, regulations would typically define such aspects minimum program standards, materials to be collected and frequency of collection.

As the findings from the City's apartment recycling study discovered, multi-family units have unique issues related to commercial recycling. Among the issues are that individual housing units, within multi-family complexes, also have limited space within the apartment unit, which may deter a resident from sorting and storing their recyclables prior to taking it to a recycling storage area.

Waste diversion from institutions can be another area of special focus. Some institutions are characterized as having high percentages of paper and food within their waste streams.

Some examples of voluntary and mandated commercial building recycling plans/programs include:

- In Pittsburg, Pennsylvania, "The operator of every business establishment [and apartment over 6 units] located within the City of Pittsburgh must establish a program to recycle high grade office paper, plastic bottles, corrugated cardboard, aluminum cans and leaf waste, where applicable." (Source: Pittsburgh Public Works, "Recycling," <http://www.city.pittsburgh.pa.us/pw/html/recycling.html> retrieved on 09/10/2009)
- Minneapolis commercial and business property owners are required to offer regular recycling collection (at least twice per month) for targeted recyclable materials, including a written recycling plan (submitted to City) and written information/instructions for tenants and/or employees (Source: City of Minneapolis, Commercial recycling ordinance, <http://www.minneapolismn.gov/regservices/fire/WCMS1P-082517>, retrieved on 08/21/2012)
- Lee County, Florida requires "that all businesses and multi-family properties in unincorporated Lee County must provide sufficient on-site recycling services." Recycling guidelines in the ordinance identify the standards for commercial and multi-family recycling collection, in addition to C&D recycling. (Source: [http://www3.leeqov.com/solidwaste/Autopage\\_T1\\_R89.htm](http://www3.leeqov.com/solidwaste/Autopage_T1_R89.htm), retrieved 08/21/2012)
- Peoria County, Illinois requires all businesses in the county to recycle two of their most quantified recyclables. The ordinance also includes quarterly reporting requirements. (Source: <http://www.peoriacounty.org/recycle/cro/>, retrieved on 08/21/2012)

**Processing Facility.** Post-disposal processing of the entire commercial waste stream has many of the same extensive costs and limitations as processing mixed residential waste. However, by targeting waste loads with concentrated volumes of select recyclable materials, it is possible to more cost effectively process (select loads of) commercial waste. This requires special facilities (material recovery facility(s) or transfer station(s)) which are equipped to handle this type of task; currently no such facilities have obtained a permit to operate in the Planning Area, however a permit application from a local processor has been submitted to NDEQ. Processing could be as simple as sorting on the tipping floor or more mechanized with conveyors, sort stations, and magnets. Such facilities would also need to be sized to process and store the recovered source-separated recyclables and have the ability to ship them to market. Because such facilities would target post-disposal recovery of materials their diversion

rates might not be as high as an efficient source separated program. Convenient location and discounted tip fees and/or buy-back (revenue shares) could be used to encourage waste generators and haulers to use these facilities.

**Buy-Back Centers/Targeted Materials Programs.** Buy-back centers typically pay users for materials brought to the center, based on weight and percentage of commodity market prices. By themselves, these do not achieve high levels of commercial diversion but do provide a financial motivation to divert select materials. Buy-back centers are commonly a retail business that target select materials, such as scrap yard that buys metals by type (e.g., aluminum, brass, ferrous). Buy-back centers have also been reviewed under discussion of Source Reduction, as a means of preventing materials from entering the waste management system.

Waste exchanges and targeted materials diversion programs generally focus on non-traditional materials that are more difficult to collect and/or recycle. Keep Nebraska Beautiful currently operates the Nebraska Materials Exchange Program, which focuses on schools and businesses. Expanding material reuse centers and waste exchanges (public/private partnerships) have generally been discussed in technical paper related to Source Reduction. Targeted commercial programs could include specific materials such as OCC, plastics (bags, film, and manufacturing scrap), wood pallets, foods, and select paper fibers. Targeting greater diversion of foods and fibers (i.e., organics) is further described and evaluated in the Organics Waste Diversion (Composting) paper.

Buy-back centers, material reuse/waste exchanges, and targeted materials programs are not further evaluated in this paper.

**Waste Audits.** The waste audit is often one of the first steps in effectively starting a commercial recycling program within a business. A waste audit is a formal, structured process used to help quantify the amount and types of waste being generated by an organization. There are a number of different ways to conduct a waste audit, such as visual waste audits, waste characterization (actual waste sorts), desktop audits and combinations (i.e. visual and desktop analysis). Information from audits can help businesses (and institutions) identify current waste generation practices and opportunities/strategies for improving their waste management and diversion system; waste audits typically focus on waste (source) reduction, increasing recycling, and reducing quantity of wastes disposed through process changes.

Waste audits can be provided by contract service, non-profits (such as currently provided by WasteCap of Nebraska), public-sponsored programs, or internal self-audits. There have been many resources and guidance documents developed for businesses and institutions on how to conduct their own waste audits.

Waste audits are not further evaluated in this paper.

## **Options Evaluation**

The general issues associated with commercial recycling programs are:

- convenience
- participation and diversion levels
- costs of services and funding
- available processing capacity (affect on existing service providers)
- implementation considerations
- policy and ordinance changes
- enforcement

The policy/ordinance changes, enforcement, and other implementation considerations are of particular relevance for a universal available commercial recycling collection (either, refuse

hauler required or building owner/operator provided), given the current voluntary subscription recycling system and free market refuse collection. The commercial recycling system options vary significantly between businesses, industries, institutions and multi-family residences. Any programs implemented will need to be flexible, recognize the differences between these generators, and obtain business community and institutional support to be successful.

Commercial recycling collection can provide the following benefits:

- Divert large quantities of recyclable materials for relatively low cost per ton.
- Potentially generate positive cash flow for some businesses with large volumes of select recyclables (papers, plastics, metals).

Implementation of commercial recycling programs can face the following challenges:

- Limited space (e.g., for additional dumpsters or carts) and infrastructure to accommodate recycling.
- Initial investment costs are needed to provide the necessary infrastructure.
- Certain commercial waste generators and private haulers may be resistant to change, especially if they have the potential to result in a net increased cost (internal collection, storage, recyclables collection).

Costs of recycling services to commercial, industrial, institutional, and multi-family (apartments) customers are highly variable and a function of the program and materials handled. Cost will need to be a consideration in any recommendation that might include additional commercial recycling programs in the Solid Waste Plan 2040.

Consistent with the guiding evaluation criteria developed for use in the Solid Waste Plan 2040, the commercial recycling options have been further evaluated based on the considerations shown in Table 3. To significantly increase diversion of waste from businesses, industries, institutions and multi-family residences, through recycling, some form of expanded, City-wide, universally available, recycling program would likely be necessary. Such a program(s) would need to be structured to maximize participation, diversion quantities and program effectiveness.

**Table 3 – Options Evaluation**

| <b>Evaluation Criteria</b>        | <b>Refuse Hauler Recycling Service</b>  | <b>Owner/Operator Commercial Recycling Service</b>  | <b>Processing Facility</b>  |
|-----------------------------------|---|---|---|
| <b>Waste Reduction/ Diversion</b> | <p>Opportunities are believed to exist for large volume diversion with significant increases in commercial recycling.</p> <p>Materials diverted can vary by business; traditional material markets (paper fiber and metals) are well established.</p> <p>Participation rates and diversion would increase substantially with convenient, universally-available recyclables collection program.</p>  | <p>Opportunities are believed to exist for large volume diversion with significant increases in commercial recycling.</p> <p>Materials diverted can vary by business; traditional material markets (paper fiber and metals) are well established.</p> <p>Participation rates and diversion would increase substantially with convenient, universally-available recyclables collection program.</p>  | <p>Can be effective in capturing materials from post-disposal waste stream; however, recovery rates diminish and cost increase as the percentages of available recyclables in the waste decrease.</p> <p>When implemented as a part of a transfer station it could be used to both reduce quantities sent to landfills and reduce exports.</p> <p>As a stand-alone option it would not be anticipated to achieve the same degree of diversion as pre-disposal source separated recycling options.</p> |
| <b>Technical Requirements</b>     | <p>May provide added business opportunities for existing waste and recycling service providers. Under a free market collection system structure haulers would continue to compete for added service opportunities.</p> <p>This will require significant infrastructure at certain businesses, industries, institutions and multi-family residences to provide for added drop-off storage and handling.</p> <p>Ordinance will need to be carefully</p> | <p>May provide added business opportunities for existing waste and recycling service providers. Under a free market collection system structure haulers would continue to compete for added service opportunities.</p> <p>This will require significant infrastructure at certain businesses, industries, institutions and multi-family residences to provide for added drop-off storage and handling.</p> <p>Ordinance will need to be carefully</p> | <p>This may require new construction. Post-disposal processing may not be compatible with existing processing centers and existing transfer station is not designed, equipped or permitted to provide this type of sorting.</p> <p>Can be designed to be compatible with the other program options and flexible in handling select mixed commercial loads.</p> <p>Risk that private haulers will not utilize such a facility(s) unless conveniently located and provides</p>                          |



| Evaluation Criteria         | Refuse Hauler Recycling Service  | Owner/Operator Commercial Recycling Service  | Processing Facility   |
|-----------------------------|--|--|---|
|                             | <p>constructed to be flexible, optimize performance and be compatible with the diversity of businesses, industries, institutions and multi-family residences (minimize risk of program failure).</p> <p>Existing recycling processing capacity will need to be evaluated for ability to process greater quantities.</p> <p>Expanded recycling is viewed as compatible with existing operations.</p> <p>Risks may exist with added costs, resistance to change, and compatibility with existing infrastructure.</p> | <p>constructed to be flexible, optimize performance and be compatible with the diversity of businesses, industries, institutions and multi-family residences (minimize risk of program failure).</p> <p>Existing recycling processing capacity will need to be evaluated for ability to process greater quantities.</p> <p>Expanded recycling is viewed as compatible with existing operations.</p> <p>Risks may exist with added costs, resistance to change, and compatibility with existing infrastructure.</p> <p>New construction standards will increase building construction costs which could meet with resistance for some project developers.</p> | <p>financial incentive (i.e. tip fee competitive with alternate drop-off facilities - landfill).</p>  |
| <b>Environmental Impact</b> | <p>Provides opportunity to significantly divert recyclable materials which conserves resources and reduces greenhouse gas emissions.</p> <p>Would be compatible with other programs targeting environmental protection and reduction in waste toxicity.</p>  | <p>Provides opportunity to significantly divert recyclable materials which conserves resources and reduces greenhouse gas emissions.</p> <p>Would be compatible with other programs targeting environmental protection and reduction in waste toxicity.</p> <p>Developing structured recycling plans and designing recycling bin</p>   | <p>Provides opportunity to divert recyclable materials which conserves resources and reduces greenhouse gas emissions.</p> <p>Would be compatible with other programs targeting environmental protection and reduction in waste toxicity.</p> <p>Depending upon location, may reduce collection vehicle emissions</p> |

| Evaluation Criteria | Refuse Hauler Recycling Service   | Owner/Operator Commercial Recycling Service   | Processing Facility   |
|---------------------|---|---|---|
|                     |   | space would need to address impacts to water quality, health and safety.  | by reducing distance than the drop-off/disposal site.<br><br>Does not require significantly more collection vehicles on the streets which can have a health and safety benefit.   |
| <b>Economics</b>    | <p>The costs of added commercial recycling would be borne by program participants.</p> <p>Reduction in refuse collection (frequency and/or bin size) may help offset recycling costs.</p> <p>Will require added infrastructure at participating commercial establishments and operating costs to implement and maintain.</p> <p>Increases in material recycling and processing may create some economic development opportunities.</p> <p>Assuming a continuation of existing free market collection systems, it does not rely upon government funding to implement or sustain a program.</p> | <p>The costs of added recycling service would be borne by building tenants/ program participants.</p> <p>Reduction in refuse collection (frequency and/or bin size) may help offset recycling costs.</p> <p>Will require added infrastructure in commercial establishments and operating costs to implement and maintain.</p> <p>Increases in material recycling and processing may create some economic development opportunities.</p> <p>Designing recycling space (bin areas) into new construction has the potential to increase construction costs.</p> <p>Will require more governmental costs than refuse hauler provided systems to review plans, and monitor and enforce.</p> <p>Assuming a continuation of existing</p> | <p>Requires capital investment and funding for land purchase, design, and construction costs. Requires commitment to operating and maintenance costs; processing facility alone is not considered a net revenue generator.</p> <p>Tip fee would need to be competitive with competing options (e.g., haul to and disposal at a landfill).</p> <p>Combing select load processing/recovery with a transfer station may be cost effective, but as a stand-alone option would not optimize diversion.</p> <p>NDEQ grants may be possible funding source for a portion of the capital project associated with recycling.</p> |

| Evaluation Criteria             | Refuse Hauler Recycling Service   | Owner/Operator Commercial Recycling Service   | Processing Facility   |
|---------------------------------|---|---|---|
|                                 |   | free market collection systems, it does not rely upon government funding to implement or sustain.   |   |
| <b>Implementation Viability</b> | <p>Requires ordinance and changes to LMC, including haulers licensing requirements.</p> <p>Some businesses, industries, institutions and multi-family residences as well as refuse haulers may resist change.</p> <p>Minimum service levels would need to reflect differences in various businesses, industries, institutions and multi-family residences.</p> <p>Will require cooperation of commercial waste generators and refuse haulers to establish a system that is socially/politically acceptable.</p> <p>Policy changes will require time for development and approval. Parties affected will need reasonable time frame for compliance.</p> <p>Land and siting may be a consideration if additional processing capacity is required.</p> <p>Not a new technology and examples of successful implementation are available.</p> <p>Single services fees may need to be</p> | <p>Requires ordinances and change to LMC to mandate owner/operator provided program.</p> <p>Some businesses, industries, institutions and multi-family residences as well as building developers and refuse haulers may resist change.</p> <p>Minimum service levels would need to reflect differences in various businesses, industries, institutions and multi-family residences.</p> <p>Will require cooperation of commercial waste generators and refuse haulers to establish a system that is socially/politically acceptable.</p> <p>Land and siting may be a consideration if additional processing capacity is required.</p> <p>Not all existing buildings may be able to comply, depending upon space and infrastructure available. Exemptions may need to be defined.</p> <p>Policy changes will require time for development and approval. Parties affected will need reasonable time</p> | <p>Suitable and permitable site(s) is required. One option may be co-located near other City facilities. Siting new solid waste facilities can be challenging and sometimes controversial.</p> <p>May require modification to LMC and legal/ financial incentive to direct collected recyclables to new facility.</p> <p>Anticipated to require NDEQ permit.</p> <p>Not a new technology and examples of successful implementation are available.</p> |

| Evaluation Criteria | Refuse Hauler Recycling Service             | Owner/Operator Commercial Recycling Service  | Processing Facility |
|---------------------|---|--|---------------------|
|                     | considered to ensure maximum participation. | frame for compliance.<br>Governmental assistance and enforcement will be necessary to assure successful program. |                     |

## Relationship to Guiding Principles and Goals

The current commercial recycling programs of voluntary subscription recyclables collection, public (residential) drop-off facilities, buyback centers, corporate internal recycling, waste audits and education outreach involves public/private partnerships and provides opportunities to engage the commercial waste generators in diverting materials to recycling. However, the limited extent of such programs suggests that there are greater diversion opportunities available. Businesses, industries, institutions and multi-family residences likely provide the greatest opportunity for diversion of recyclables. As it relates to the Guiding Principles and Goals of the Solid Waste Plan 2040, the possibility of expanding commercial recycling is directly applicable, as further noted below.

- **Emphasize the waste management hierarchy:** Recycling is one of the most preferred waste management methods in the hierarchy (immediately after reduce and reuse) in that it places maximum emphasis on options to recover materials and recycle them into new products. Current programs are compatible with this hierarchy. To increase recycling above the status quo, the convenience and mandate of a City-wide, universally-provided recycling collection program (through refuse hauler or building owner/operators) should result in significantly higher level of commercial recyclables diversion.
- **Encourage public/private partnerships:** The current system of recycling involves both public and private efforts, including subscription recyclables collection provided by private firms, private recycling processing centers, City provided drop-off centers (for residential recyclables), City provided education and promotional outreach, and private buy-back centers. If City-wide (universally available) commercial recycling collection programs are selected for implementation it is expected that they will be developed with private parties providing collection and processing services. Services by non-profits, privates, and public/private partnership such as strategic multi-material drop-off facilities, buyback centers, special materials take-backs, and waste audits are expected to continue and complement any decision to implement an expanded commercial recycling program.
- **Ensure sufficient system capacity:** System capacity for commercial recycling involves space (infrastructure) at the waste generator facility to accommodate recyclables collection and storage. Some existing apartment complexes, commercial buildings/businesses, and institutions may have limited or insufficient space for expanded recycling bins. New building construction, through ordinances, could be required to provide the space for recycling infrastructure. Available processing capacity may need to be evaluated as part of any program that significantly expands recycling diversion rates (residential or commercial) to determine the need for additional processing capacity and facilities.
- **Engage the community:** Any expanded commercial recyclables collection program would need to engage the residents and businesses to encourage them to divert more recyclables from disposal. Within the Planning Area 21 percent of residents are estimated to live in multi-family dwellings in 2010. The City's recently completed pilot study to evaluate recycling education alternatives, specific to multi-family/apartment residents, suggests residents feel recycling is important, but do not recycle because they do not have space or it is not convenient. Commercial recycling opportunities in the work place and in schools engage the community within all aspects of their life. The City is also home to a large university student population; engaging the student body in

recycling not only increases diversion, but may provide longer lasting behavior changes that can extend beyond the borders of the Planning Area. Development of a commercial recycling program and related ordinances will need to engage the business community and private haulers to develop a viable and enforceable program. To optimize success of an expanded commercial recycling program will also require education (behavior change) to encourage and sustain participation.

- **Embrace sustainable principles:** Maximizing recovery of materials and recycling into new products recognizes that waste is not inevitable and discarded materials are potentially valuable resources.

## Summary

Recycling turns materials that would otherwise become waste into valuable resources. It also reduces greenhouse gas emissions and conserves space in landfills. The City supports and promotes public and private recycling efforts through its website and by providing a wide array of services. Commercial recycling is a largely unregulated business. The number of waste haulers providing commercial recycling services and participation levels are not known; while data is limited on commercial recycling rates, using information voluntarily provided to the City it was estimated that the current level of commercial recycling may be approximately 18 percent.

To significantly increase diversion of commercial waste, through recycling, will likely require some form of market regulation or mandated program (e.g., minimum levels of service through refuse hauler or building owner/operators). Market regulation refers to the establishment of requirements for services or that programs operate under a set of rules (regulations) established by the community.

Focusing on the commercial waste stream for the collection of recyclables can dramatically increase diversion. High quality, source separated recyclables (papers, metals and plastics) can often be obtained from commercial waste generation sources.

Commercial recycling program options can take many forms and will need to be tailored to the specific opportunities and needs of a given commercial waste generator. This is one factor that makes the concept of commercial recycling potentially more complex than residential recycling. Commercial recycling programs will need to adapt to the differences in types of business, business infrastructures, participants, program/services, and available/targeted materials. The preferred method for any given community will be a function of community desires, costs, diversion goals, public and institutional support, and implementation processes. The most significant impediments include the lack of convenience, lack of necessary infrastructure (space) and anticipated higher costs for services.

Among the most common approaches for increasing commercial recycling/diversion rates, utilized by various communities across the U.S., are the following:

- New construction (infrastructure) requirements
- Refuse hauler recycling service
- Owner/Operator commercial recycling service
- Processing facility

These methods are typically complimented by education and promotional programs.

There are many program options available, all of which are essentially consistent with the Solid Waste Plan 2040 guiding principles and the waste management hierarchy. Of the expanded program options available, City-wide (universally available – refuse hauler or building owner/operator provide) programs appear to provide the greatest opportunity to maximize

commercial recycling (rates and quantities) and minimize landfill disposal of solid waste. If the Solid Waste Plan 2040 incorporates universally available, City-wide commercial recycling, the City will need to evaluate minimum levels of service, and how to fund, implement and enforce such services.

## Appendices





## Appendix 1

# Final Report: Apartment Recycling Pilot Project

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June 2012

## Executive Summary

Between mid-March and early June of 2012, The City of Lincoln Recycling Office underwent a pilot study to evaluate recycling education alternatives. The goal of the project was to determine which methods for education improve resident recycling rates and general knowledge about recycling. Letters, posters, brochures, flyers, and postcards were sent to residents detailing the location of drop off sites, what items can be recycled, how to set up a simple and convenient recycling system in an apartment, and the local benefits of recycling.

Four apartment complexes participated in three education and outreach alternatives. As part of Alternative A, residents of Lexington Ridge and Sunridge Apartments received educational material through either emails or hard copies. For Alternative B, residents at The Lodge Apartments were given hard copies of the same educational material as well as re-usable laminate bags. Accompanied by instructions, the bags could be used to sort, store, and transport recycling to the nearest drop-off site. Alternative C examined Holmes Lake Apartments, an apartment building with a recycling room on each floor of the building. Hard copies of educational material were distributed to these residents. To analyze the outcomes of our education effort, pre and post project surveys were distributed to all residents in the study. The post survey had drastically lower participation at all locations and was a major limitation in our study.

The pilot project resulted in many useful observations and recommendations for further analysis. First, educational materials are successful for improving the knowledge of those who already recycle with existing infrastructure. Improving the convenience of recycling services will have a much greater effect than providing educational material alone. The main body of this report also elaborates on observations that 1) residents feel recycling is important 2) few residents use the City drop-off sites, 3) residents would value on-site recycling containers, 4) residents who do not think recycling is important will still recycle if it is sufficiently convenient.

The main recommendations resulting from this project is that there should be an ongoing effort to increase the recycling rate of apartment dwellers. A survey of apartment managers and the Solid Waste Management Plan update planning process are two potential tools. Specific actions are to 1) facilitate discussion and recycling training for property managers as opposed to the individual tenant 2) utilize the existing educational materials from the pilot project to create education packets 3) examine the issues and opportunities with on-site collection containers.

## Appendix 1

### I. Purpose of the Project

Residents of multi family dwelling units typically underuse recycling services. The trend for lower recycling rates occurs in many communities around the US due to a variety of challenges. First, curbside collection is generally not feasible due to the building and site characteristics of multifamily dwelling units. Second, due to space restrictions and inconvenience, very few apartment dwellers will store and transport their recycling to a local drop off site. In Lincoln, apartment dwellers represent a substantial portion of the population. The 2010 Census indicates that renter occupied housing units account for 41.4% of Lincoln's population, or approximately 90,173 people<sup>1</sup>. Educational programs which improve the recycling rates within this population can significantly impact overall waste diversion for the City. As such, long range planning of recycling programs will need to address the needs of apartment dwellers. With grant funding from the Nebraska Department of Environmental Quality, the Recycling Office implemented a pilot program to study a variety of education and outreach alternatives for multi-family dwelling units.

### II. Goals

The overall goal of the project was to evaluate alternative approaches for multi family dwelling unit recycling education.

- 1) Determine which method/s of public education and outreach are most successful for improving recycling rates among apartment dwellers.
- 2) Determine which method/s of public education and outreach improve knowledge of recycling services in community.
- 3) Discover and document any new factors, strengths, or barriers to apartment recycling that can guide future studies or programs pertaining to apartment recycling.

### III. Project Design

The first phase of the project was to review previous research and case studies of multifamily recycling projects. An important source of information came from EPA funded studies including "Multifamily Recycling: A National Study" (2001) and "Complex Recycling Issues: Strategies for Record-Setting Waste Reduction in Multi-Family Dwellings (1999).

Next, a variety of apartment management companies were contacted to gauge their interest in participating in education outreach for their tenants. These initial inquiries resulted in overall positive feedback and a list of possible apartment complexes to include. Four apartment complexes were chosen to participate in the education and outreach study. These apartments were chosen based on the interest of management in participating, proximity to a recycling drop-off site, and number of residents. Others were chosen for their unique qualities such as a database of residents' email addresses, and on-site recycling.

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<sup>1</sup> Apartment units that are duplex, tri-plex and four-plex may have access to recycling services. As such, this figure may be somewhat over-estimated.

## Appendix 1

The educational materials were designed to communicate a variety of important issues for apartment dwellers:

- What items can be recycled
- How to set up a simple and convenient recycling system in an apartment
- Directions to the nearest drop-off site
- The importance of recycling to support the local environment and economy

These messages were distributed through the use of letters, flyers, brochures and postcards<sup>2</sup>. The recycling office worked with a graphic designer at the Citizen Information Center to design interesting and visually appealing products.

Three alternative for recycling education and outreach were implemented.

**Alternative A: Lexington Ridge and Sunridge Apartments.** Distribute the series of educational material to residents of two different apartment complexes. One group will receive the information through e-mail, the other will receive hard copies delivered to their door.

**Alternative B: The Lodge Apartments.** Distribute the same educational materials with the added incentive of re-usable laminate bags. The bags are ideal for storing recyclables conveniently with limited space and can also be used to transport the material to the nearest drop-off site. Each unit will receive three bags labeled “Plastic Containers #1-#5,” “Cans and Glass Bottles,” and “Cardboard & Newspaper.” In addition to the bags, residents were given instructions and tips on how to use the bags.

**Alternative C: Holmes Lake Apartments.** Preliminary research indicated that some apartment buildings in Lincoln already have an established on-site recycling system. At Holmes Lake Apartments, each floor of the building has a designated garbage/recycling room with a separate chute for trash, paper, plastic, and cans. This type of building was included in the study to see how education and outreach affects residents with highly convenient recycling options. The apartment building with an existing recycling infrastructure will receive similar educational materials as those in Alternative A&B; however, will put a stronger emphasis on the items that their system collects, and less of an emphasis on the community drop off locations.

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<sup>2</sup> An example of the educational materials used in this project can be found at the end of this document.

## Appendix 1

Figure 1. Pilot Study Participants

| Apartment                  | Address                                       | # of Units | Alternative   |
|----------------------------|---|------------|---|
| Lexington Ridge Apartments | 8600 Lexington Ave<br>Lincoln, NE 68505       | 216        | A) Education- Emails  |
| Sun Ridge Apartments       | 8311 Sunridge Road<br>Lincoln, NE 68505       | 156        | A) Education- Door to Door (City Staff)                                 |
| The Lodge Apartment        | 4600 Briarpark Drive<br>Lincoln, NE 68516     | 304        | B) Education and Bags Door to Door<br>(Apartment Managers)              |
| Holmes Lake Apartments     | 7100 Holmes Park<br>Road Lincoln, NE<br>68506 | 144        | C) Education/Existing Recycling<br>Door to Door<br>(Apartment Managers) |

### IV. Methods to Analyze Outcomes

#### Pre and Post Surveys

Pre and post surveys attached to informational letters were used to obtain information about apartment recycling demographics and the effectiveness of the various elements of our education projects. There were some limitations with this approach recognized from the onset. First, that a lack of participation would make analysis difficult. Second, residents who are already recycling may be more likely to respond which may skew the results of the sample.

It was important to provide a return process that was simple and easy for residents, depending on the apartment characteristics. At Lexington Ridge Apartments, surveys were delivered by email using Survey Monkey ®. At Sunridge Apartments, residents were instructed to return the completed survey to an envelope hanging on a bulletin in the foyer of their building. At the Lodge Apartments and Holmes Lake Apartments residents were instructed to return surveys to the main office or the afterhours drop box.

#### Visual Observations of Waste Stream

As a supplement to the surveys, attempts were made to track changes in the waste streams at each of the apartment buildings. Verbal agreements were made with each of the waste haulers at the different apartments to record the amount of waste in each of the containers intermittently throughout the project. One week worth of samples would be collected before the project, during the project, and after the project. Waste haulers were given worksheets which listed container numbers on the route and the extent to which they were full (quarter, half, three quarter, or full). We anticipated that this effort may be ineffective due to waste hauler participation, length of

## Appendix 1

study, and number of samples taken. However, this method was attempted to not only observe potential changes in the waste stream but to establish some data that may be useful for the apartment managers in the future.

### Results

#### Survey

The table below represents the overall themes and observations from the pre and post surveys. The pre-survey provided an acceptable response rate at three of the four apartment complexes. However, due to a collection of surveys that were lost in the mail at The Lodge, there were an insufficient number of returned surveys. In addition, the collected responses from the post survey were drastically reduced at all apartment complexes. For this reason the outcomes and recommendations are not based on statistically significant data but general observations. Original data from the pre and post surveys can be found at the end of this document.

Figure 2. Overview of Pre Survey Results

| Sunridge  | Lexington Ridge   | The Lodge   | Holmes Lake  |
|---|---|---|--|
| <ul style="list-style-type: none"> <li>• 25% response rate</li> <li>• Most think recycling is important</li> <li>• 56% do not recycle, mostly because they do not have space or it isn't convenient</li> <li>• 80% of respondents between ages 18-35</li> </ul> | <ul style="list-style-type: none"> <li>• 17 % response rate</li> <li>• More than half think recycling is very important</li> <li>• 58% do not recycle, mostly because it isn't convenient or they do not have space</li> <li>• 83% of respondents are ages 18-35</li> </ul> | <ul style="list-style-type: none"> <li>• Due to lost surveys, results may not be relevant</li> <li>• Majority thinks recycling is very important</li> <li>• 73 % do not recycle mostly because of lack of space or it isn't convenient</li> <li>• Ages are equally distributed across the sample</li> </ul> | <ul style="list-style-type: none"> <li>• 42% response rate</li> <li>• Majority thinks recycling is very important</li> <li>• Those who do not think it is important are recyclers</li> <li>• 98% recycle on site</li> <li>• 85% of respondents are ages 50+</li> </ul> |

## Appendix 1

Figure 3. Overview of Post Survey Results

| Sunridge  | Lexinton Ridge  | The Lodge  | Holmes Lake   |
|---|---|--|---|
| <ul style="list-style-type: none"> <li>• 2.5% response rate, drastic reduction from the pre-survey</li> <li>• 3 of the 4 respondents recycled prior to the project, knowledge was only somewhat improved</li> <li>• 3 out of 4 feels our project demonstrated that recycling is simple/convenient</li> <li>• All indicated they would recycle if there were containers on site</li> <li>• All respondents were female.</li> </ul> | <ul style="list-style-type: none"> <li>• 2% response rate</li> <li>• Respondents think recycling is important</li> <li>• The most useful types of information was the location of drop off sites</li> <li>• Most felt the project demonstrated that recycling is simple/convenient</li> <li>• Two respondents will recycle using the drop-off sites who did not recycle prior to the project</li> <li>• All would recycle if there were containers located on site</li> </ul> | <ul style="list-style-type: none"> <li>• 2.6 % response rate</li> <li>• Most think recycling is important</li> <li>• Half did not have better knowledge of recycling</li> <li>• Most thought the project demonstrated recycling is simple convenient</li> <li>• 75% will use the on-site container, many of which were previous recyclers</li> <li>• Most would not recycle if it were not available on-site</li> <li>• 63% used the three bag system</li> </ul> | <ul style="list-style-type: none"> <li>• 19% response rate, drastically reduced from the pre-survey</li> <li>• Majority still thinks recycling is very important</li> <li>• 70% now have a better knowledge of recycling</li> <li>• Most useful information was “what items are recyclable” and “how recycling affects our local environment and economy.”</li> <li>• 98% recycle on site</li> <li>• 41% would be highly unlikely to recycle if it were not available on-site</li> <li>• 93% of respondents are ages 50+</li> </ul> |

### Waste Stream Assessments

We were unable to make substantial observations about changes in waste stream.<sup>3</sup> First, it was difficult to get the waste haulers to provide the data. In addition, as explained by one waste hauler, apartment dwellers represent a “migratory” population of people meaning that they create

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<sup>3</sup> The waste hauler at Lexington Ridge and Sunridge Apartments failed to provide any samples. At Holmes Lake the hauler claimed to have taken samples but they have not been received. In any case, with an incredible high recycling rate among residents at the start of the project, we expect that there were little to no changes in the waste stream to be observed. The hauler at The Lodge provided consistent tracking of waste containers; however, it is difficult to see any clear patterns over such short time duration of the project.

## Appendix 1

high amounts of waste during their transitions in and out of apartments. This is especially true during the months of April, May, and June.

### V. Observations

One of the most useful outcomes of this project is that it created a baseline set of educational materials including brochures, flyers, postcards, posters, and letters that can be reused in the future with slight alteration. There were approximately 820 apartment units who were each contacted on five occasions with educational materials about recycling.

1. **Residents feel recycling is important.** Though some of the respondents previously recycled, many did not even though they thought it was important. This may suggest baseline attentiveness to recycling issues that can be further developed to increase the recycling rate of apartment dwellers. The key factor to accomplish this will be through making recycling more convenient.
2. **Very few residents currently use City drop-off sites.** At the apartment complexes that don't have on-site containers, recycling participation of the sample was between 27% and 42%. It is not likely that this is indicative of the entire population. More likely than not, those who already recycle were more likely to take the survey than those who don't. If our surveys captured a high number of those who already recycle, then true participation rates are likely lower.
3. **Education alone may not be enough to spur recycling rates.** Our study showed that most residents don't recycle because they think it is inconvenient. Many residents felt that our educational material communicated the convenience and ease of recycling but many others disagreed. This suggests that educational material can improve recycling habits and knowledge; however, education alone is not enough to spur new recycling. Educational materials may be more effective to supplement a recycling program that is viewed as convenient.
4. **Residents think they would use on-site recycling services.** There was a strong feeling among the pre survey comments that on-site containers would be valuable. Residents that returned the post survey all indicated that they would use on-site recycling containers. These containers address the convenience and space issue because recyclables can be conveniently deposited daily. During the course of the project, the Lodge Apartments installed a centrally located recycling container. According to the waste hauler, it has been mostly full on collection days.
5. **Residents who don't think recycling is important will still participate if it is highly convenient.** This was the case at Holmes Lake apartments, where residents have access to a trash/recycling room on each floor of the building. For these residents, the same amount of effort is required to remove trash as to remove recyclables. Apartment buildings can maximize the convenience of the recycling system by mimicking the system currently in place for trash removal.



## Appendix 1

6. **The educational material should be diverse in its content, format, and distribution.** The educational material addressed a wide range of topics. There lacked a consensus among the surveys as to which information was the most useful. As such, educational materials should be broad in the types of information they convey. Apartment buildings lacking access to on-site containers found the locations to be useful information; however, they also marked that how to sort and store, the local effects of recycling, and information from the web were also useful. This project tried two different approaches for distribution. The use of emails over hard copies returned similar survey response rates but it is unclear if one method over the other was a more successful campaign tool. Using different layouts for educational materials may have been effective for reaching a broader audience. For residents who will not take the time to read a brochure cover to cover a small postcard can be a more effective tool. Distribution was an important component of the education aspect. Our project functioned as a campaign to broadcast the recycling message. It is possible that the number of materials sent in the time frame became bothersome to residents. A long term education project should aim to accommodate resident turnover without overwhelming the inboxes/doorways of residents.
7. **The use of bags to encourage recycling may be an effective tool.** Due to a small sample it is difficult to determine the effect that the use of bags had to increase recycling rates. The survey response rate was comparable to those complexes that did not receive reusable bags. The apartment complex that received reusable bags for recycling did contract with a their waste hauler to provide an on-site recycling station for their tenants. Property managers who offer on-site recycling may have some incentive to provide bags and instructions as part of move-in packets. The use of bags could help to keep units more organized and clean, and increase the volume of recyclables collected on site.
8. **There were multiple examples of enthusiasm from residents who previously recycled.** We received positive feedback about the need for recycling education from those residents who already recycled. There were also comments about the possibility of residents talking with their neighbors about how to recycle. This suggests that apartment managers may have some success with “recycling green teams” or “environmental captains” at their apartment complexes to assist with recycling education and monitoring on site.

## VI. Recommendations

There should be an ongoing effort to increase the recycling rate of apartment dwellers. The current planning effort to update the Solid Waste Management Plan represents an opportunity to assess a variety of issues, opportunities, and alternatives for apartment recycling. The pilot project has provided some data and background that may inform future progress towards apartment project recycling.

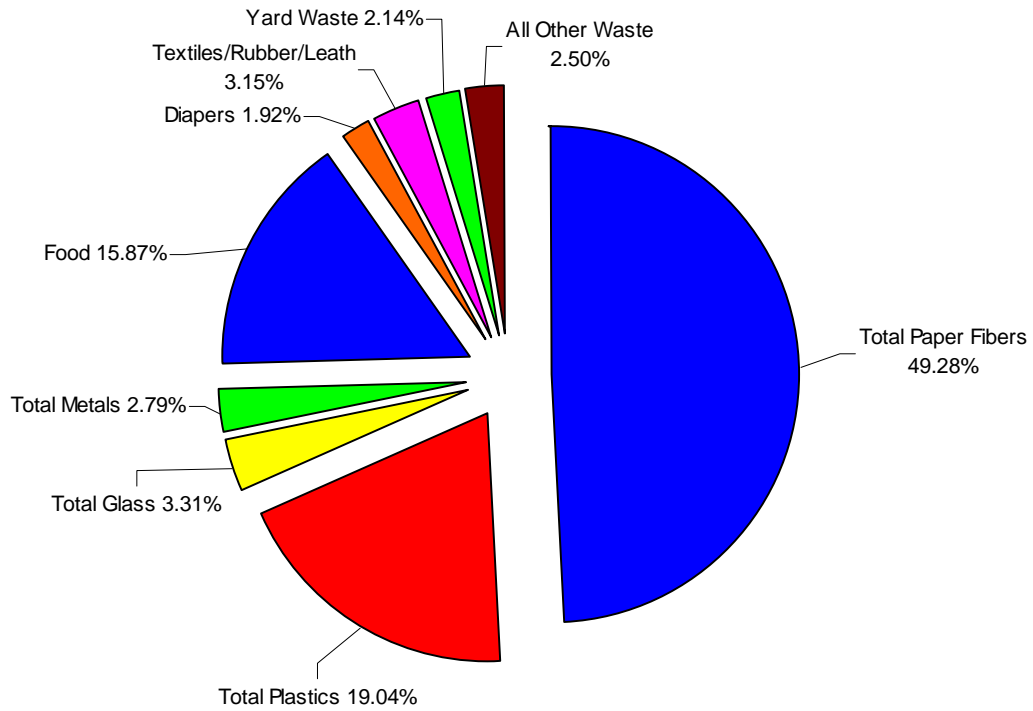
## Appendix 1

- 1. Facilitate discussion and recycling training for property managers as opposed to the individual tenant.** A survey that identifies the thoughts and concerns of property managers regarding recycling would be a useful tool. For example: Do they know if their current waste hauler offers recycling pick up? Is recycling a cost effective waste management option for them? Would the geographic layout of their buildings be conducive to an efficient drop/off pick up routine for recycling? Do their residents view access to recycling as an important amenity?
- 2. Utilize the existing educational materials from the pilot project to create education packets.** For example, a template “resident welcome packet” could be provided to apartment managers. It would include a map of the recycling sites, lists of recyclable material, instructions on how to recycle in an apartment, and tips on why recycling benefits the community. These materials would be customized, printed, and distributed by apartment managers at their discretion.
- 3. Examine the issues and opportunities with on-site collection containers.** A central observation from the project is that residents would like to use on-site containers. This approach improves convenience for residents without the large costs and renovation required to establish a recycling chute in the building. Apartment managers, such as those at the Lodge Apartments, may be willing to add recycling to their current waste collection if it is cost effective. Many communities have established ordinances which require apartment complexes over a certain number of units to provide recycling services to tenants. Further analysis should consider the feasibility of education and/or policy which results in on-site recycling containers at apartments.

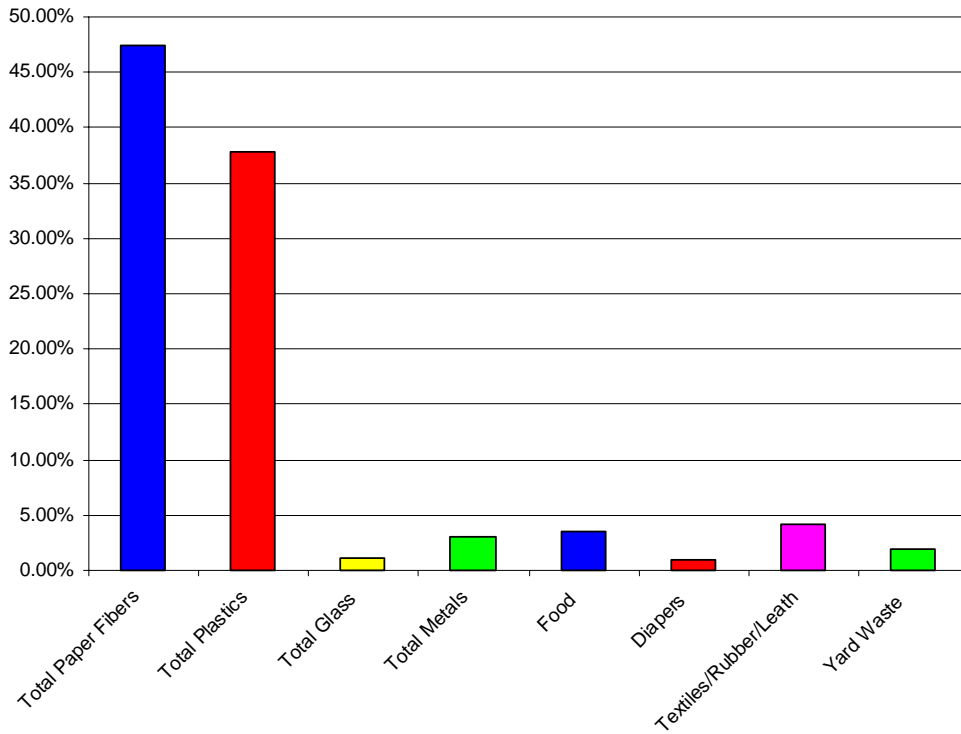
# APPENDIX 2

TABLE B.21  
COMMERCIAL WEIGHT DATA SUMMARY FOR THE BLUFF ROAD LANDFILL

| Material Category/Component          | Net Weight<br>(pounds) | % of Material<br>Category | % of Sorted<br>Sample |
|--------------------------------------|------------------------|---------------------------|-----------------------|
| Cardboard                            | 3,407.96               | 31.91%                    | 15.73%                |
| Office Paper                         | 1,188.83               | 11.13%                    | 5.49%                 |
| Newsprint                            | 839.80                 | 7.86%                     | 3.88%                 |
| Magazines                            | 614.69                 | 5.76%                     | 2.84%                 |
| Paperboard/Liner Board               | 871.27                 | 8.16%                     | 4.02%                 |
| Mixed Paper                          | 3,756.33               | 35.18%                    | 17.34%                |
| <b>TOTAL PAPER FIBERS</b>            | <b>10,678.88</b>       |                           | <b>49.28%</b>         |
| PET #1                               | 656.19                 | 15.90%                    | 3.03%                 |
| HDPE #2                              | 268.50                 | 6.51%                     | 1.24%                 |
| Other Numbered Containers            | 707.82                 | 17.15%                    | 3.27%                 |
| Plastic Film/Wrap/Bags               | 1,664.85               | 40.35%                    | 7.68%                 |
| Other Plastics                       | 828.81                 | 20.09%                    | 3.83%                 |
| <b>TOTAL PLASTICS</b>                | <b>4,126.17</b>        |                           | <b>19.04%</b>         |
| Clear Glass Containers               | 373.54                 | 52.08%                    | 1.72%                 |
| Brown Glass Containers               | 238.89                 | 33.31%                    | 1.10%                 |
| Green Glass Containers               | 73.83                  | 10.29%                    | 0.34%                 |
| Blue Glass Containers                | 4.24                   | 0.59%                     | 0.02%                 |
| Other Glass                          | 26.74                  | 3.73%                     | 0.12%                 |
| <b>TOTAL GLASS</b>                   | <b>717.24</b>          |                           | <b>3.31%</b>          |
| Aluminum Cans                        | 192.38                 | 31.81%                    | 0.89%                 |
| Tin Cans                             | 283.09                 | 46.80%                    | 1.31%                 |
| Other Aluminum                       | 60.30                  | 9.97%                     | 0.28%                 |
| Other Tin                            | 31.10                  | 5.14%                     | 0.14%                 |
| Other Mixed Metals                   | 37.96                  | 6.28%                     | 0.18%                 |
| <b>TOTAL METALS</b>                  | <b>604.83</b>          |                           | <b>2.79%</b>          |
| Food                                 | 3,437.95               |                           | 15.87%                |
| Diapers                              | 415.67                 |                           | 1.92%                 |
| Textiles/Rubber/Leather              | 681.78                 |                           | 3.15%                 |
| Yard Waste                           | 464.60                 |                           | 2.14%                 |
| Household Hazardous Waste            | 2.63                   |                           | 0.01%                 |
| Electronic Waste                     | 78.40                  |                           | 0.36%                 |
| Dry-Cell Batteries                   | 11.05                  |                           | 0.05%                 |
| Misc. C/D Waste                      | 62.81                  |                           | 0.29%                 |
| Wood                                 | 53.54                  |                           | 0.25%                 |
| Empty Aerosol Cans                   | 32.77                  |                           | 0.15%                 |
| Non-Distinct Waste                   | 160.06                 |                           | 0.74%                 |
| Other Misc. Wastes                   | 139.58                 |                           | 0.64%                 |
| <b>TOTAL WEIGHT OF SORTED SAMPLE</b> | <b>21,667.96</b>       |                           | <b>100.00%</b>        |



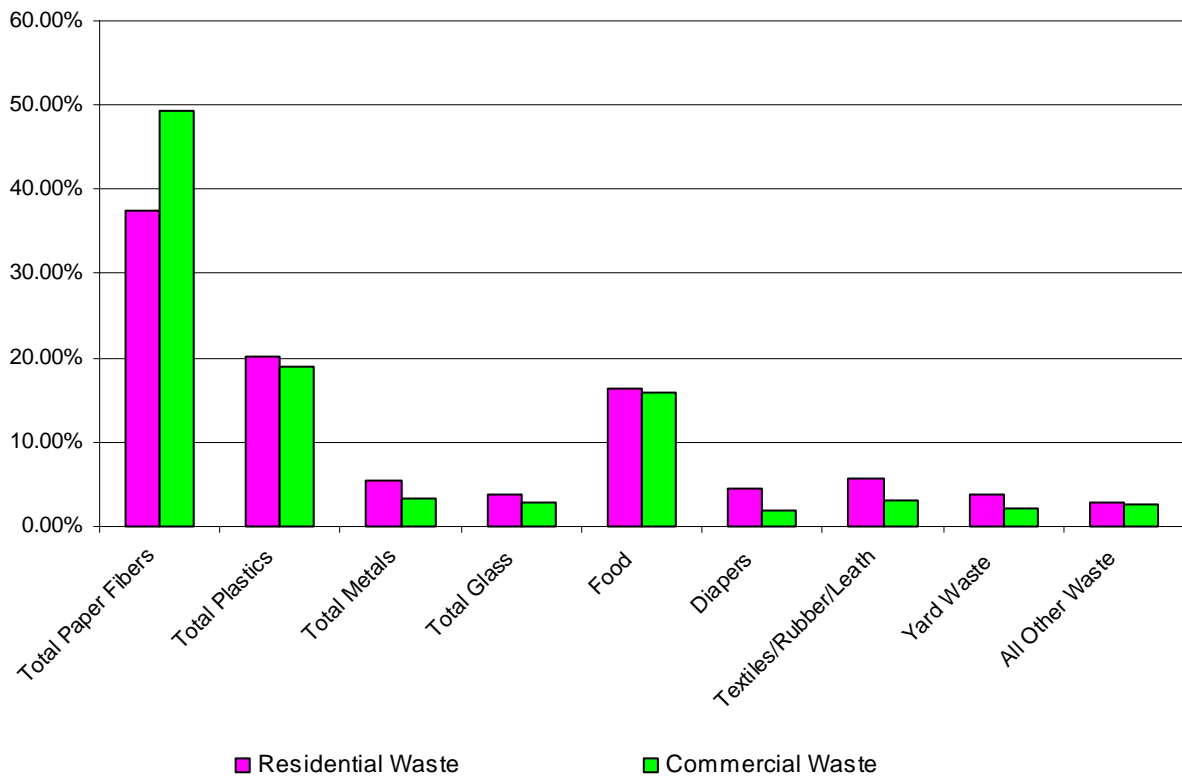
**CHART B.5**  
**DISTRIBUTION OF THE CONSOLIDATED COMMERCIAL**  
**WEIGHT DATA FOR BLUFF ROAD LANDFILL**



**CHART B.6**  
**DISTRIBUTION OF THE CONSOLIDATED COMMERCIAL**  
**VOLUME DATA FOR BLUFF ROAD LANDFILL**

**TABLE B.23  
COMPARISON OF THE CONSOLIDATED WEIGHT DATA FOR  
RESIDENTIAL AND COMMERCIAL SAMPLES AT THE BLUFF ROAD LANDFILL**

| <b>CONSOLIDATED FIELD SORTING EVENTS (FALL 2007, WINTER 2008, SPRING 2008, AND SUMMER 2008)</b> |   |                                    |
|---|---|------------------------------------|
| <b>Material Category/Component</b>  | <b>Percentage of the Net Weight of the Sorted Samples</b> |                                    |
|   | <b>Residential<br/>Waste Stream</b>                       | <b>Commercial<br/>Waste Stream</b> |
| Cardboard   | 1.50%   | 15.73%                             |
| Office Paper  | 3.99%   | 5.49%                              |
| Newsprint   | 6.72%   | 3.88%                              |
| Magazines   | 5.17%   | 2.84%                              |
| Paperboard/Liner Board  | 5.83%   | 4.02%                              |
| Mixed Paper   | 14.19%  | 17.34%                             |
| <b>TOTAL PAPER FIBERS</b>   | <b>37.39%</b>   | <b>49.28%</b>                      |
| PET #1  | 2.85%   | 3.03%                              |
| HDPE #2   | 1.88%   | 1.24%                              |
| Other Numbered Containers   | 3.00%   | 3.27%                              |
| Plastic Film/Wrap/Bags  | 7.71%   | 7.68%                              |
| Other Plastics  | 4.62%   | 3.83%                              |
| <b>TOTAL PLASTICS</b>   | <b>20.06%</b>   | <b>19.04%</b>                      |
| Clear Glass Containers  | 3.13%   | 1.72%                              |
| Brown Glass Containers  | 1.33%   | 1.10%                              |
| Green Glass Containers  | 0.68%   | 0.34%                              |
| Blue Glass Containers   | 0.01%   | 0.02%                              |
| Other Glass   | 0.20%   | 0.12%                              |
| <b>TOTAL GLASS</b>  | <b>5.34%</b>  | <b>3.31%</b>                       |
| Aluminum Cans   | 1.15%   | 0.89%                              |
| Tin Cans  | 1.85%   | 1.31%                              |
| Other Aluminum  | 0.31%   | 0.28%                              |
| Other Tin   | 0.15%   | 0.14%                              |
| Other Mixed Metals  | 0.28%   | 0.18%                              |
| <b>TOTAL METALS</b>   | <b>3.74%</b>  | <b>2.79%</b>                       |
| Food  | 16.38%  | 15.87%                             |
| Diapers   | 4.56%   | 1.92%                              |
| Textiles/Rubber/Leather   | 5.74%   | 3.15%                              |
| Yard Waste  | 3.85%   | 2.14%                              |
| Household Hazardous Waste   | 0.02%   | 0.01%                              |
| Electronic Waste  | 0.47%   | 0.36%                              |
| Dry-Cell Batteries  | 0.12%   | 0.05%                              |
| Misc. C/D Waste   | 0.01%   | 0.29%                              |
| Wood  | 0.39%   | 0.25%                              |
| Empty Aerosol Cans  | 0.20%   | 0.15%                              |
| Non-Distinct Waste  | 1.67%   | 0.74%                              |
| Other Misc. Wastes  | 0.03%   | 0.64%                              |



**CHART B.7  
DISTRIBUTION OF CONSOLIDATED WEIGHT DATA FOR  
RESIDENTIAL AND COMMERCIAL SAMPLES AT THE BLUFF ROADLANDFILL**

## Organic Waste Diversion (Composting)

### Overview

Organic (waste) refer to a broad range of materials, often derived from plants and living things. In traditional, municipal solid waste (MSW) management and for purposes of this paper the term organic waste will refer to the following materials: yard trimmings, food scraps, wood waste, and paper/fibers, including paperboard products. Organic wastes biologically decompose (resulting in air emissions) and as a category of waste, organic waste is typically the largest component of the solid waste stream. For these reasons, it is also a major target for diversion in solid waste management planning efforts. Lincoln Municipal Code (LMC) 5.41.010 defines organic materials as any biodegradable material: “lawn clippings and leaves; raw sewage or treated sewage sludge; animal or paunch manure; any other plant or food residue; or a mixture of any of the above.”

Much of the current recycling efforts in the Lincoln and Lancaster County planning area (Planning Area) have focused on recovery and recycling paper/fiber, aerobically composting yard waste, and chipping wood waste for re-use. Most of the readily putrescible (organic) waste, with the exception of yard waste, is disposed of at the Bluff Road Landfill or exported. Food waste, which represents approximately 16 percent of the MSW stream, is disposed of by landfilling (principally at the Bluff Road Landfill). Separate technical papers address yard waste and dry paper/fibers recycling (residential and commercial). The primary focus of this paper will be food waste, managed alone or with other organic materials.

Food waste is part of the definition of garbage in LMC 8.32.010; “garbage” includes “all animal, fruit, or vegetable wastes resulting from the handling, preparation, cooking, or consumption of food.” Garbage is a subset of “refuse” in the LMC definitions. Refuse haulers that collect, haul, or convey garbage are required to be licensed (as required by LMC 8.32.110) and follow the conditions of LMC 8.32.

Commercial composting operations in the City, or within three miles, are also required to obtain a permit to operate in accordance with the requirements of LMC 5.41.150. Commercial composting operations include composting of yard waste and any other organic materials as defined in the LMC that originate from off the premises.

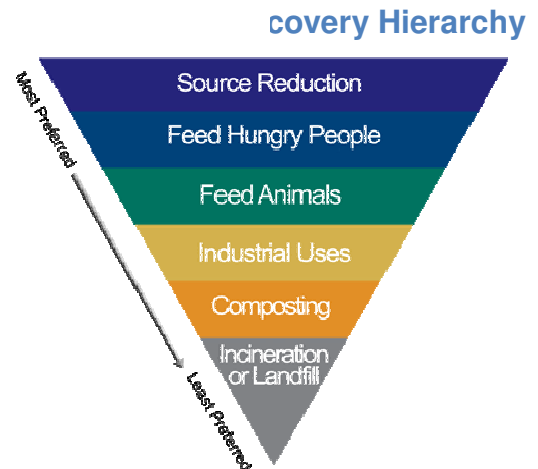
Food waste is generated from many sources including but not limited to:

- households
- restaurants and eating establishments
- food manufacturing and processing facilities
- supermarkets
- institutions such as schools, prisons and hospitals

Food waste can further be categorized as either pre-consumer (i.e., food prep waste) or post-consumer waste (e.g., leftover food or plate scrapings). Food service providers (e.g., restaurants, supermarkets, institutions) produce a significant amount of food waste that needs to be managed each day. Individuals, households and other small scale generators can also generate a significant amount of food waste but in a more dispersed setting and may only require weekly management. According to a 2006 study “Food Loss and the American Household”, households threw away 14 percent of the food they purchase. A more recent study “Wasted: How America is Losing Up to 40 Percent of its Food from Farm to Fork to Landfill”, estimates that food waste comprises about 40 percent of all food generated in the United States.

In managing food waste, both the United States Environmental Protection Agency (USEPA) and United States Department of Agriculture (USDA) recommend following the “food recovery hierarchy”, as shown in Figure 1. This mimics USEPA’s hierarchy for integrated solid waste management (Source: <http://www.epa.gov/osw/consERVE/materials/organics/food/>, retrieved on 08/23/2012)

- **Source Reduction** – Reduce the amount of food waste being generated;
- **Feed People** – Donate excess food to food banks, soup kitchens and shelters;
- **Feed Animals** – Provide food scraps to farmers;
- **Industrial Uses** – Provide fats for rendering; oil for fuel; food discards for animal feed production; or anaerobic digestion combined with soil amendment production or composting of the residuals;
- **Composting** – Recycle food scraps into a nutrient rich soil amendment.



### Current Programs

Current programs for organic waste diversion in the Planning Area generally focus on dry papers/fiber recycling, yard waste composting, and wood waste chipping. Food waste diversion (source reduction) in the Planning Area includes non-profit food distribution programs and possible on-site management of food scraps by some generators. Within the City of Lincoln, the Food Bank of Lincoln and numerous non-profit food pantries accept donations of food from residents and businesses for distribution for those in need. (Source: <http://www.foodpantries.org/ci/ne-lincoln>, retrieved on 08/24/2012). Other villages in the Planning Area may also operate food pantries.

There are also two private livestock composting operations and a private yard waste composting facility near Lincoln. One of the livestock waste composting operations is reported to accept a small amount of lawn waste and other organic wastes. Permit requirements for these facilities do not allow them to accept more than 1,000 cubic yards of other organic wastes. Livestock waste is not a waste type addressed in the Solid Waste Plan 2040 and as such is not discussed further in this paper.

The City supports and promotes paper/fiber recycling and yard and wood waste management, through its website <http://lincoln.ne.gov/city/pworks/waste/sldwaste/> and in the *Lincoln-Lancaster County's Official 2012 Waste Reduction & Recycling Guide*. See separate papers on Yard Waste, Residential Recycling and Diversion and Commercial Recycling and Diversion for more information on programs to manage yard waste and paper/fibers. The City also provides Christmas tree grinding and mulching for approximately 3 weeks following the Christmas holiday.

NDEQ Title 132 – Integrated Solid Waste Management Regulations define solid waste processing facilities to “mean any facility where solid wastes are processed, and shall include, but not be limited to solid waste compost sites, materials recovery facilities, recycling centers and solid waste transfer stations.” The regulations require that “No person shall construct or operate a solid waste management facility without a permit issued by the Department [NDEQ] pursuant to this Section unless otherwise provided in these regulations.”



Partial exemptions from permit requirements exist for solid waste processing facilities when:

- a solid waste compost site receives between 20,000 and 100,000 cubic yards per year of lawn wastes only (this currently applies to the City's Bluff Road site);
- a solid waste compost sites receives less than 1000 cubic yards per year of material; or
- a solid waste compost sites receives between 20,000 and 100,000 cubic yards per year of material that consists of lawn waste in combination with less than 1000 cubic yards of other materials.

Organic wastes not diverted through source reduction or recycling are generally disposed of at a landfill.

While the focus of this paper is on options for diversion of organic waste it is noted that the Bluff Road Landfill and possibly one of the landfills accepting exported wastes are equipped with landfill gas recovery systems. These systems attempt to capture the methane emissions resulting from anaerobic digestion of organic materials that occur within the landfill. The City has entered into an agreement with Lincoln Electric System (LES) to buy the majority of landfill gas collected and convert it to electrical energy. Collected gas, which is not used by LES will be combusted in a flare system (to destroy the methane gas) located at the Bluff Road Landfill. This is considered the status quo; as the landfill grows the gas collection system will be expanded and LES has agreed to expand its electrical generation system when enough landfill gas is available to support an additional electrical generation unit.

### **Generation and Diversion**

The NDEQ's 2008 Nebraska Waste Characterization Study included a waste sort and characterization at the Bluff Road Landfill. This study estimated that approximately 63.3 percent of the MSW disposed was organic materials (includes all papers (44.1 percent), food (16.0 percent), yard waste (2.9 percent), and wood (0.3 percent)). Based on fiscal year 2011 disposal tonnages (Bluff Road and exported), the food waste component (16 percent) is equivalent to 49,000 tons per year. The study did not characterize the quantity of the paper/fibers or the extent to which they were contaminated and might limit post-disposal recovery for recycling. Soiled papers (as well as clean papers not recycled) are also a candidate for composting, provided they can be cost effectively segregated from the waste stream.

### **Program (Facility/System) Options**

Organics diversion programs vary from community to community across the U.S. Recycling is used to target paper/fibers (organics); composting of source separated yard waste and processing of wood waste are also key organics diversion programs. Source reduction targets reducing the quantities of these and other materials that require diversion and post-generation management programs. Although many communities already have some level of food waste diversion through source reduction (education and food donations/food pantries), more recent efforts have focused on collection and composting of food waste in order to significantly increase landfill diversion. These food waste composting programs often look to combine food with yard waste and other organic materials as part of the composting operations. In examining food/organics waste composting there are three distinct but related elements that need to be addressed:

- Marketing
- Collection and recovery
- Composting or digestion

This paper deals with large scale organics management. While “backyard” composting is a viable option for certain vegetative wastes it is considered a source reduction option (composted and used at the generation site) and is not addressed further in this paper.

## **Markets**

While a separate paper deals with markets for recovered/recycled materials, it is important to note that absent a use for the material resulting from composting operation, the costs increase significantly; lack of markets has been one of the major contributors to failed organics composting programs in the US. A major factor in marketing is product purity, which includes aesthetic considerations as well as physical and chemical contaminants. These matters all need to be carefully understood and addressed to ensure a marketable product. Because of the potential threat for contamination, a program of careful monitoring and testing will be required. Composted products that do not meet market criteria will need to be managed by an alternate strategy or disposed. In concept, organic waste compost, derived from MSW would be subject to criteria similar to what is currently required for materials derived from biosolids. A synopsis of the criteria is summarized in Appendix 1.

For compost produced from food or other organic waste it should be anticipated that testing for similar pathogens, vector attraction reduction (VAR) and chemical composition will be necessary. Without markets, the composting process may result in a more expensive method of volume reduction and stabilization prior to landfill disposal.

These factors impact market demand for the finished compost. Over the last five fiscal years the City has distributed an average of about 6,200 cubic yards of LinGro compost per year. As mentioned in the paper on Recycling Incentives it will be essential to establish viable and sustainable markets before undertaking a large-scale organics composting program; additional research and market development may be necessary to ensure the long-term availability of such markets.

## **Collection and Recovery**

Assuming adequate markets and processing facilities are (or will be available) to support organic waste composting, the next key elements is implementation of the collection infrastructure. Collection and recovery methods may vary significantly depending upon the targeted source of the organic material. In general, options include pre-and post disposal and sanitary sewer disposal systems; there are also differing options that might be applied to residential sources versus commercial, industrial and institutional sources. In all instances extensive education may be a key component in establishing and implementing the program. Education will be needed to address simply what can and can not go into a composting operation, and how to prepare and manage the material prior to collection.

There have been several MSW composting operations attempted in the US; these largely take post-disposal, mixed municipal waste (organic and non-organic) and compost them all together. While some success has been demonstrated with these methods, many of these projects have shut-down and operational facilities (e.g., Rapid City, South Dakota) have had difficulty with marketing the materials. Operational problems and lack of markets has significantly increased the cost of such mixed waste composting operations. As such, this paper focuses principally on source separated organic material options.

**Wet/Dry Systems.** Collection operations can generally be separated into: 1) residential; and 2) business (commercial, industrial, institutional) options. Common among both options is what is described as “wet/dry” collection. Wet/dry collection systems involve the source separation (prior to collection) of organics into: 1) “wet” wastes (food, yard waste, and soiled papers); and,

2) other “dry” municipal solid waste (MSW). The “dry” fraction can be further separated into “dry” recyclables (paper/fibers, plastics, metals) and refuse for disposal.

For many communities looking to implement organics diversion the first step is to determine whether to target residential or commercial sources. Another important factor to consider is frequency of collection due to odors and vector attraction in hot summer months.

For residential wet/dry collection systems the first step is to implement or optimize residential (single-stream) curbside recycling then later add another cart for targeted organics (yard waste, food scraps and food-soiled papers). Also, pilot programs are often developed through public/private partnerships to evaluate and incorporate food waste and food-soiled paper into the residential organics collection system. Some programs provide small pails or buckets to the residents for use in the kitchen which can then be used to fill larger containers. See discussion in the paper on Residential Recycling and Diversion for additional information on collection of recyclables. Collection of residential food waste has been widespread in parts of Canada for many years; however, programs in the United States are more limited. Some examples of residential organics collection in the U.S. include:

- Since August 2008, the City of Boulder, Colorado has required haulers to offer organics collection to single-family residences, bundled at one rate with trash and recyclables collection. Organics are collected every other week, alternating with recyclables. The programs estimate diversion of over 50 percent from the residential waste stream (Source: “U.S. Residential Food Waste Collection and Composting”, *BioCycle*, December 2009, Vol. 50, No. 12, p. 35). Some haulers also offer organics/food waste collection services to businesses and multi-family units.
- The City of Dubuque, Iowa currently provides curbside organics collection to approximately 300 subscribers (households, businesses and institutions). The City provides 12-gallon wheeled containers with snap-locking lids, plus 2-gallon kitchen pails/buckets to residents. Subscription cost is \$0.60 per month for residents; larger 48-gallon and 64-gallon carts for businesses are \$5.50 and \$8.50 per month, respectively. A summary of Dubuque’s food scrap recycling program is in Appendix 2 of this paper. Food waste is collected weekly, commingled with yard waste in the packer truck. Dubuque’s compost facility is limited to processing a maximum 2 tons per week of food waste under Iowa rules. Expanding food waste collection would require a MSW composting facility permit and facility capital improvements to meet those requirements. (Source: <http://www.cityofdubuque.org/index.aspx?NID=483>, retrieved 08/27/2012)
- City of Seattle, Washington provides weekly food and yard waste collection to residential households. In early 2009, the mandatory food waste participation program went into effect for single-family households; households must participate in the curbside organics collection or backyard composting. This requirement expands to all households up to four-plexes by September 15, 2012. Current organic collection rates vary from \$4.65 to \$8.95 per month based on can/cart size. (Source: [http://www.seattle.gov/util/Services/Yard/Yard\\_Waste\\_Collection/index.asp](http://www.seattle.gov/util/Services/Yard/Yard_Waste_Collection/index.asp), retrieved on 08/27/2012)

For programs targeting commercial food waste generators and food service providers (e.g. supermarkets, institutions/cafeterias, and restaurants) consideration needs to be given to the following:

- Types of organic waste (produced)
- Convenience

- Participation and diversion levels
- Costs of services and funding

Similar to residential wet/dry collection, the legal considerations and collection infrastructure will need to be investigated and developed in order to encourage or require businesses and institutions to recycle food waste and food-soiled paper and for private haulers to establish the needed infrastructure to properly manage those materials. See the technical paper on Commercial Recycling and Diversion for additional discussion on collection infrastructure. By initially focusing on large volume generators it may be easier to implement a two or three container separation system (organics, dry recyclables and waste). Collection of food waste (organics) may present additional challenges for the commercial sector. Key issues that will need to be addressed with generators and haulers are expected to include:

- Containers
- Container maintenance
- Collection frequency

An organics waste diversions program will need to be implemented in conjunction with a compost facility permitted (at state and local levels) to accept food and other organic wastes. Once a food waste composting facility(s) is available, pilot programs are typically used to begin the collection and processing of the material. Properly structured, the source separation of organic wastes will minimize residuals and rejects from the composting process.

**Sanitary Sewer Collection Systems.** Another food waste processing alternative gaining support over the past few years is the use of in-sink food waste disposals or other pre-processing prior to direct piping or trucking to anaerobic digester, typically part of the local wastewater treatment plant. Food waste grinders or pulpers have been around for many decades and in the early years for garbage disposal they were promoted as a tool for clean and effective management of household food waste. Based on certain prerequisites, this approach can be implemented on-site for kitchen facilities at targeted establishments (institutions, cafeterias/food services, and restaurants) or at a centralized center. The processed food waste would then be piped to sanitary sewer system or trucked to the digester facility. Considerations for implementing this method include:

- On-site equipment requirements at residential and commercial establishments.
- Adequate piping system to handle quantity and/or modifications required for direct sewer routing.
- Increased water consumption to properly flush solids and keep pipes clean.
- Added costs to industries for increased organic loading in their waste water. Large businesses or industries are typically charged based on such factors as volume and organic loading placed in the sanitary sewer.
- Wastewater treatment plant must have the capacity to handle the increased volumes, solid, and organics loading.

The University of Nebraska at Lincoln (UNL) recently commissioned a study to investigate diverting food waste from the UNL cafeterias to the City of Lincoln's anaerobic digestion facilities at the Theresa Street Wastewater Treatment Facilities (WWTF). The study evaluated on-site pre-processing modifications along with re-piping to sanitary sewer system or trucking food waste from centralized slurry tank to the treatment plant. The study concluded that the least cost alternative was the direct sanitary sewer disposal option, provided that UNL could resolve pipe plugging problems through re-plumbing the grinder units. Otherwise a centralized slurry tank with sanitary sewer discharge was the next cost-effective alternative. The study indicated that the Theresa Street WWTF would have to be upgraded to include additional

screening and storage capacity, if this approach resulted in significant increases in volume of materials disposed in this manner. UNL has decided not to pursue this option at the present time. (Bio-Waste Anaerobic Digestion Study for UNL, Draft February 2012, HDR).

### **Composting or Digestion**

Once organic waste is collected it would be delivered to a processing and composting facility. In developing such a facility the primary questions will be the type of wastes to be handled and the type of composting process to be used. There are two primary means of decomposing the organic material – aerobically or anaerobically. Aerobic processes refer to decomposition in the presence of oxygen and anaerobic processes refers to decomposition in the absence of oxygen.

**Aerobic Organic Waste Composting.** Aerobic composting of organic waste collected in commercial and residential programs can occur through one or more of the following methods:

- Windrow composting – organic materials (i.e. yard waste, wood waste, and vegetative food/paper waste) mixed into turned windrows or aerated static piles at a permitted composting facility. If an enclosed facility were used, with frequent turning and good temperature control, this could also incorporate meat and greases.
- In-vessel composting – uses an enclosed reactor with temperature and moisture-control to contain and expedite composting; especially suited for processing food wastes, biosolids and sludges. Initial reactor holding time would be 7 to 10 days, followed by secondary digestion.
- Vermicomposting – uses red worms to break down organic materials into compost; not suited for animal products or grease and best used for small-scale on-site composting systems.

All anaerobic digestion processes produce a digestate (compost) material, carbon dioxide (CO<sub>2</sub>) and water vapor.

The City's current yard waste composting facility, adjacent to the Bluff Road Landfill, is operated using windrows. Yard waste compost is periodically turned and the final product is screened prior to use or marketing as LinGro Compost. This facility is currently close to capacity; expanded City composting operations to include food waste would likely require not only expansion of the composting area, but also modification to the current facility and operations including pre-grinding incoming materials, construction of forced aeration system, increasing operation staff and other features. Operated as a large scale organic waste composting operation would require a permit to comply with NDEQ Title 132 permitting requirements. Alternatively, other sites could be identified for organics composting in the County.

Issues with outdoor composting of food waste include vectors, odors and storage of waste. Wet food waste has less air voids than yard waste alone, which can result in anaerobic conditions and produce odors. To help minimize anaerobic conditions a forced aeration system is usually necessary for composting wet organic waste, with yard waste, in windrows. Grinding and mixing with yard waste along with frequent monitoring and turning would aid in effective aerobic decomposition. Storage can be a significant issue since standard operations of the existing facility does not provide a steady stream of yard waste (grass in summer; leaves in fall) and as such the City often needs to store yard wastes for extended periods of time before mixing and composting can begin (yard waste often stored through the winter, with composting beginning when grass supply increases and warm temperatures are available). Storage of large volumes of food waste is problematic and could lead to anaerobic conditions (odors) and vector issues with this technology.

In-vessel composters come in a variety of sizes and retention times, but generally have some type of mechanical mixing or aeration system. In-vessel composting can process larger quantities in a relatively small area more quickly than windrow composting and can better accommodate animal waste products (i.e. full range of readily digestible food waste). This technology is capital-intensive, but is well-adapted for processes that are likely to require odor control and reduced buffer space requirements to be acceptable to neighbors. There are three basic configurations with several subcategories in each configuration:

- Vertical flow reactors (anaerobic digesters) - agitated bed (multiple hearths or multiple floors), packed bed or silo
- Horizontal or inclined flow reactors - rotating drums or kilns, agitated beds (channels or bins, circular or rectangular shape) or static beds (tunnel reactors, ram or conveyor type)
- Batch reactors – enclosures, bags or boxes

In-vessel systems have a relatively high cost of construction and operation as compared to windrow systems, with a distinct advantage on digestion time and space requirements. The resulting compost is typically only partially digested and a secondary “curing” time, under aerobic conditions is necessary. This can be done with static piles or windrow systems. Aeration is often necessary for secondary curing to prevent undigested materials from becoming anaerobic; enclosed curing facilities may also be necessary to control odors. A thorough assessment of these in-vessel systems is beyond the scope of this paper. Ultimate selection of a composting technology will be dependent on the final feedstock mix, market, regulatory restrictions and adjacent land uses. Typical in-vessel requirements can include:

- Processing equipment - include aerated bins, bags, channels or agitated beds
- Buildings - needed to house in-vessel technology and windrow curing (typically aerated)
- Bunkers - covered and paved units to store cured compost prior to distribution
- Mobile equipment - front-end loaders, trucks and conveyance systems required to move materials between buildings
- Trommel screen - to remove oversized objects from end-product and prepare for market.

**Anaerobic Organic Waste Digestion/Composting.** Anaerobic digestion can be used to digest food and green waste, agricultural waste, wastewater treatment plant sludge or other similar waste streams. The anaerobic digestion process may either be a wet or semi-dry process depending on the total liquids and solids content of the waste being digested in the reaction vessel. Both types of anaerobic digestion processes involve an enclosed vessel where biological processes are used to decompose the organic waste to produce a semi-solid digestate (compost) material and a biogas. The biogas typically consists of methane, CO<sub>2</sub> and water vapor. The resulting methane gas can be used as a fuel for boilers or an internal combustion engine or, in sufficient quantities, in a gas turbine to produce electricity. In many cases the volume of digester gas is insufficient, by itself to justify an energy recovery project and is therefore burned in a flare. If there is a market for the use of the gas, it may have to be treated to remove moisture or other contaminants. Odor is one characteristic of anaerobic digestion. As such, site location can be a major factor in siting a facility and odor control would be a necessary component of the selected implementation technology.

The remaining digestate (compost) material is typically between 10-30% (by weight) of the waste input depending on the type of anaerobic digestion process used. Anaerobic digestion is a less energy intensive process and typically results in a more thorough breakdown of readily digestible solid than is achieved by aerobic composting means. The digestate can be treated further (e.g. dried and cured aerobically) to produce a compost that can be marketed as a soil amendment (see discussion above on marketing).

This anaerobic digestion approach can be used to stabilize organic waste in the waste stream through one of the following methods:

- Anaerobic composting – stand-alone facility for food and other source separated organic wastes from the MSW stream.
- Co-composted – mixed with sewage sludge and digested at the City's wastewater treatment plant. This approach, would apply to a strategy that used garbage disposals (grinders) at the generation source and sanitary sewer system for conveyance of sink/food waste to the wastewater treatment facility. This approach might also be applicable if the City were to construct a pre-processing facility at the wastewater plant – the feasibility of this option on a large scale would require further evaluation.

Anaerobic digestion is widely used on a commercial-scale for industrial and agricultural wastes, as well as wastewater sludge. Anaerobic digestion technology has been applied on a larger scale in Europe on mixed MSW and source separated organics, but there is only limited commercial-scale experience in North America. The Greater Toronto Area is home to two of the only commercial-scale plants in North America that are designed specifically for processing source separated organic wastes.

### **Options Evaluation**

The general issues that will need to be addressed in implementing an organic waste diversion/composting programs are:

- types of organic waste (produced and to be managed)
- markets for compost, digestate and biogas
- implementation considerations, especially the collection program
  - convenience
- participation and diversion levels
- costs of services and funding
- available processing capacity (new facility requirements)
- odors and emissions
- policy and ordinance changes
  - enforcement

Organics waste collection and management programs will vary depending upon the targeted waste generators (residential, commercial, both). Any programs implemented will need to be flexible, recognize the differences between generators, and obtain hauler, residents, business community and institutional support to be successful.

Based on NDEQ Title 132 criteria for solid waste processing facilities, current yard waste and commercial compost operations in the Planning Area may be able to take up to 1000 cubic yards per year of other materials (such as food waste) and still maintain partial exemption status. However, significant diversion of non-yard waste organics (food waste and soiled papers) will likely require special permits.

When organic waste is disposed in a landfill it decomposes under anaerobic conditions and produces landfill gas (methane and CO<sub>2</sub>) which must be captured and destroyed to reduce emissions of methane. Methane and CO<sub>2</sub> are both greenhouse gases, but methane is considered 21 times more potent based a CO<sub>2</sub> equivalency.

To significantly increase diversion of organic waste, and more specifically food waste within the Planning Area, some form of targeted, source separated collection program will be necessary. Consistent with the guiding evaluation criteria developed for use in the Solid Waste Plan 2040,

the organic waste diversion options have been further evaluated based on the following considerations.

- **Waste Reduction/Diversion:** Removal of food and other organic waste from the MSW stream for management through composting would be considered a form of recycling, assuming markets are available for the compost/digestate. To be successful long-term financially sustainable markets will be necessary; sustainable local markets are not known to currently exist in the Planning Area and would need to be further researched or developed in conjunction with any program that added differing types of organics to the current yard waste composting operation or City biosolids production. Organics waste diversion would not necessarily reduce waste exports, but significant diversion efforts will extend the life of the landfill.
- **Technical Requirements:** New or expanded facilities would be required to undertake both collection and composting of additional organic waste streams. Changes will be required with the current MSW collection programs to implement organic or wet/dry collection programs. The most significant areas of risk may be associated with markets and as a result costs; related risks include contamination (product purity) and odor control. Markets for compost from a mixed stream of residentially and commercially generated food waste have not been established nationally. The techniques that produce compost (aerobic and anaerobic) from organic matter are well known and technically proven. Systems can be designed to effectively compost food and other organic matter and control odors, but the costs of these systems are higher than the cost of systems that compost only yard waste.
- **Environmental Impacts:** Both aerobic and anaerobic digestion produce CO<sub>2</sub>, which is a greenhouse gas; anaerobic digestion (which can also occur in uncontrolled aerobic processes) generates methane, which is a more potent greenhouse gas. Anaerobic operations are typically characterized by much more pronounced odors. Any system that relies on anaerobic processes will need to be contained (e.g., in a digester) and the methane captured. Captured methane can be a fuel source, if a market exists, or will need to be burned to reduce methane to CO<sub>2</sub> and water. Storage, handling, and management of food waste on a large scale will require additional health and safety practices, because as it reaches the management facility it is a biologically active waste (rotting and decaying). All composting and management processes will need to be designed to limit environmental emissions (air and water).
- **Economic Impacts:** Implementation of an expanded organics management program (beyond current voluntary yard waste collection and City provided receiving, processing and composting) will require added capital expenditures for the collection, storage and processing (composting), as well as post processing storage. Unless economically advantageous markets are identified, the cost to residents and businesses will be higher than the status quo. If an expanded organics collection and composting program were to be undertaken decisions would be required on the role of public and private entities in funding additional systems, facilities, and programs. The economic development potential associated with this management option may be limited to employment opportunities (haulers and composting facility), marketing and distribution of the compost/digestate product.
- **Implementation Viability:** Implementation will require legislative and regulatory changes. Because food waste is generally putrescible the changes required in collection, storage, and management at the source of generation (household or business) should be anticipated to result in some level of social/political discontent. Until



a more defined strategy is developed it can not be clearly determined how such a strategy will affect the parties responsible for generation of this waste type. Additional land and siting is generally anticipated to be necessary with a large scale program; some minimization of land and facilities may be possible if anaerobic digestion can be accommodated within the City's existing WWTF. Any facility handling more than 1000 tons per year of organic material (not yard waste) will require additional state and local permits.

### **Relationship to Guiding Principles and Goals**

As it relates to the Guiding Principles and Goals of the Solid Waste Plan 2040, organics waste diversion (composting) is directly applicable, as further noted below.

- **Emphasize the waste management hierarchy:** management of organic materials (yard waste, food waste, and (soiled) papers) is directly related to the waste management hierarchy in that it places maximum emphasis on reduce, reuse, and recycle (composting) to avoid or minimize disposal in the City's landfill. Current programs for diversion of collected yard waste from disposal are compatible with this hierarchy. To significantly increase diversion, above the status quo, food waste (and possibly other organics) from commercial and residential sectors will need to be actively targeted.
- **Encourage public/private partnerships:** current curbside collection of yard waste is voluntary (subscription based) through private haulers and relies significantly on City provided receiving, storage, composting and marketing of the end products. Expanding collection to include food waste (e.g., wet/dry collection programs) would likely be provided by private haulers but the structure of such programs and the party responsible for the additional composting facilities would require further evaluation, in conjunction with the implementation of this type of program.
- **Ensure sufficient system capacity:** increased source reduction programs for yard wastes could help delay the need for additional infrastructure during the planning period. The Planning Area currently does not have a compost facility permitted with NDEQ to accept large volumes of food waste or similar organic wastes. Development of an expanded organics collection and composting is anticipated to require added infrastructure for storage and collection at the generator's level, and additional facilities for composting. Additional system changes would also be anticipated with the hauler collection system to provide for handling of source separated, putrescible, organic materials. Many commercial establishments may not have sufficient space for separate food waste/organics bins in addition to existing containers and possible recyclables containers; each will need to evaluate their space requirements. Private haulers may need to procure additional collection equipment to specifically serve organics collection customers.
- **Engage the community:** increased source reduction of food waste (e.g., food pantry programs or onsite composting) will require an engaged community because it ultimately seeks to enhance the current practices. Development of an organic materials diversion program and related ordinances (for collection) will need to engage the residential and business community, private haulers, and potential processors to develop a viable and enforceable program. Some opposition to change can be anticipated. Public education to engage the community will be important to facilitate change, and to increase and sustain participation in any source reduction program and organics collection/composting program.

- **Embrace sustainable principles:** Reduction in the quantity of organic wastes generated (source reduction) and reuse of the products resulting from composting operations are consistent with sustainability principles. Composting emphasizes minimizing environmental and social impacts. Recovery of organic materials and recycling/composting, possibly with energy recovery (anaerobic digestion) will reduce the quantities of waste disposed and further recognizes that waste is not inevitable and discarded materials are potentially valuable resources.

## Summary

Organic (waste) refer to a broad range of materials, often derived from plants and living things. In traditional, municipal solid waste (MSW) management and for purposes of this paper the term organic waste will be used to refers to the following materials: yard trimmings, food scraps, wood waste, and paper/fibers, including paperboard products. Organic wastes biologically decompose (resulting in air emissions) and as a category of waste, organic waste is typically the largest component of the solid waste stream.

Current curbside collection of yard waste is voluntary, subscription based through private haulers and relies significantly on the City provided receiving, storage, composting and marketing of the end products. Implementation of expanded organics diversion programs (e.g., food waste composting) will likely require laws/ordinances to mandate a basic program and define levels of service. While the technologies to undertake composting are well known the most significant risk may lie in long-term, viable and economically sustainable markets for the compost/digestate. Large scale, source separated, organics (food and soiled papers) is an emerging strategy in the US, with a somewhat tainted history of unsuccessful (MSW composting projects/programs).

If increased organics diversion and composting are selected as part of the strategies for inclusion in the Solid Waste Plan 2040, it may be appropriate to begin with a pilot program and target select waste streams. In all instances markets for the resulting compost will likely be the key to economic viability and success of any such program.

## Appendices

### Appendix 1 – Biosolids Classifications

*To ensure that biosolids applied to the land do not threaten public health, the U.S. Environmental Protection Agency (USEPA) created the 40 CFR Part 503 Rule. It categorizes biosolids as Class A or B, depending on the level of pathogenic organisms in the material, and describes specific processes to reduce pathogens to these levels.*

*The rule also requires “vector attraction reduction” (VAR) – reducing the potential for spreading of infectious disease agents by vectors (i.e., flies, rodents and birds) – and spells out specific management practices, monitoring frequencies, record keeping and reporting requirements.*

*Class A Biosolids - contain minute levels of pathogens. To achieve Class A certification, biosolids must undergo heating, composting, digestion or increased pH that reduces pathogens to below detectable levels. Class A biosolids can be land applied without any pathogen-related restrictions at the site. Class A biosolids can be bagged and marketed to the public for application to lawns and gardens.*

*Class B biosolids have less stringent standards for treatment and contain small but compliant amounts of bacteria. Class B requirements ensure that pathogens in biosolids have been reduced to levels that protect public health and the environment and include certain restrictions for crop harvesting, grazing animals and public contact for all forms of Class B biosolids. Class B biosolids are treated in a wastewater treatment facility and undergo heating, composting, digestion or increased pH processes before leaving the plant. This semi-solid material can receive further treatment when exposed to the natural environment as a fertilizer, where heat, wind and soil microbes naturally stabilize the biosolids.*

## APPENDIX 2

### Dubuque's GreenCart Program – Food Scrap and Organics Recycling 7-1-10

Dubuque is the **first city in Iowa** to offer a curbside food scrap recycling program. Currently up to 300 households, businesses and institutions are encouraged to subscribe to this fee-based program. Subscribers will be provided a **2-gallon KitchenCatcher and a 12-gallon, wheeled, GreenCart**. The subscription for each GreenCart is only **\$0.60 per month**. It is billed on the City Utility Bill. Larger container options are available to our business and institutional customers: 48 gal carts @ \$5.50 per month, and 64 gallon carts @ \$8.50 per month.

The food scrap recycling program has helped us 1.) Extend our landfill life, 2.) Reduce pollution (especially methane - a powerful greenhouse gas), 3.) Maintain Dubuque County's recycling rate above 25 percent, and 4.) Create a beneficial compost product for gardens and landscaping. According to the 2005 IDNR Waste analysis, more than 25% of the current refuse materials set out from the average Dubuque household could be processed into compost.

#### ***Weekly Curbside Set out***

The GreenCart is **co-collected every week** with yard waste on your regularly scheduled collection day from the first full week in April through the last full week in November. Weekly setouts are recommended to reduce neighborhood sanitation concerns. Place your GreenCart at the curb or alley setout point by 6 a.m. The GreenCart has a weight limit of 40 pounds. Do not set out the smaller indoor container (your KitchenCatcher) – it might get blown away if placed at the curb.

#### ***Feed your GreenCart over the Holidays***

Use your GreenCart to reduce the compostables that you or your neighbours might have thrown out during the holidays. Instead, feed your GreenCart. Watermelon rinds, bones and all food leftovers from entertaining can be disposed of in your GreenCart. If you have too much material to fit in your larger GreenCart, your extra compostables, weighing less than 40 pounds, could be placed in a paper yard waste bag for collection with an attached single-use yard waste sticker.

#### ***Compostable Paper and Landscape Materials***

Add paper! Non-recyclable paper, tissues, paper towels, paper cups, paper plates, paper take-out containers and messy pizza boxes are great additions to the GreenCart. Not only are they compostable, but they reduce pests by decreasing the moisture content in the cart. The drier the material, the easier it is to handle. Discarded potted plants (pots removed) and other plant material are also great additions.

#### ***GreenCart Storage***

Store your 12-gallon GreenCart where you currently store your regular trash container (in the garage or at the side of your home.). Keep out of direct sunlight.

#### ***Kitchen Catcher***

Store your Kitchen Catcher in a convenient location (on the counter, under the sink or mounted to the inside of a cupboard door). We recommend emptying the contents every two days or so.



#### ***More Tips***

- **PLASTIC BAGS ARE NEVER ALLOWED IN THE GREENCART.** Plastic does not degrade and results in an undesirable compost product.
- Wash your GreenCart and Kitchen Catcher (dishwasher safe) with mild detergent as required. It helps reduce odors.
- To reduce odor and minimize mess, you can line your bins or wrap / cover loose scraps in newspaper or a paper bag. Placing compostable paper in the bottom of the cart helps absorb liquids.
- If you have a bad odor forming, you can sprinkle a small amount of baking soda onto the materials in the GreenCart to absorb liquids and help reduce odor.
- The smell from a little concentrated household cleaner applied to the outside of the GreenCart has worked as a deterrent to critters trying to investigate the contents of your GreenCart.

***For further information or to subscribe, call the Public Works Department at 589-4250.***

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# Food Scrap Recycling - What can go into the GreenCart?

**Total weight of contents not to exceed 40 pounds**

## Acceptable Items

Baked goods & dough  
Bread, toast  
Butter & margarine  
Cake, cookies & candy  
Cereal & oatmeal  
Cheese & dairy products  
Coffee filters & grounds  
Corncobs & husks  
Eggs & eggshells  
Fish & fish parts, shellfish  
Fruits & vegetables  
Flour, grains & rice  
Gravy & sauces  
Grease, lards & fats  
Herbs & spices  
Jams & jelly  
Mustard & mayonnaise  
Meat, bones & meat products  
Muffins & muffin papers  
Nuts & nutshells  
Pasta & pizza  
Peanut butter  
Plate scrapings  
Popcorn  
Salads & salad dressing  
Sour cream & yogurt  
Sugar & syrup  
Tea bags

Greasy pizza boxes  
Microwave popcorn bags  
Paper napkins, plates & cups  
Paper take-out trays  
Paper towels & facial tissues  
Popsicle sticks & toothpicks

Cut flowers

Houseplants (soil ok but no pots)

Yard Waste: grass, leaves, trimmings, small prunings, culled garden produce, weeds, sod

## Unacceptable Items

Animal waste & bedding, including droppings and litter  
Cigarette butts and ashes  
Dead animals  
Diapers  
Disposable mop sheets  
Feminine hygiene products  
Hair/pet fur, feathers  
Hazardous waste  
Medical waste  
Plastic films, straws and bags, tubs & lids  
Textiles, clothing, shoes, etc.  
Wood & treated wood  
Vacuum bags/dust  
Waxed paper & waxed cardboard  
Wood ashes (cold)  
Wood chips & sawdust  
Wine corks



## Into your yellow recycling bin

Paper: clean cardboard, newspapers, magazines, catalogs, junk mail, cereal boxes, egg cartons, paper towel rolls, toilet paper rolls, paper bags, etc.

Metal: cans, foil

Glass: jars, beverage containers

Plastics: #1 thru #5

Question about something that is not on the list? Contact us at 589-4250

## Construction and Demolition Materials Recycling

### Overview

Waste material resulting from new construction, remodeling or the demolition of existing structures is for purpose of this paper referred to as construction and demolition (C&D) waste. The term C&D waste includes “building rubbish”, “demolition debris” and “construction and demolition” wastes as further defined below.

There are many definitions and material types that are considered C&D waste. Lincoln Municipal Code (LMC) 8.32 defined “**Building rubbish**” as “all discarded or unwanted material or waste material from the construction, remodeling, and repair operations on houses, commercial buildings, and other structures including, but not limited to, excavated earth, stones, brick, plaster, lumber, concrete, and waste parts occasioned by installations and repairs” and “**Demolition debris**” as “all combustible and noncombustible waste material resulting from the demolition of structures, roadways, or other paved surfaces”. Both definitions exclude “garbage, asbestos products, asphaltic products and other hazardous wastes or hazardous materials”. In the LMC these building rubbish and demolition debris materials are a subset of “refuse” and are thus subject to refuse hauler licensing and related regulations, but are exempt from the Occupation Tax provided they are “lawfully being deposited in the 48<sup>th</sup> Street public sanitary landfill”.

Nebraska Department of Environmental Quality, Title 132 regulations, define “**Construction and Demolition**” waste as “waste which results from land clearing, the demolition of buildings, roads or other structures, including, but not limited to, fill materials, wood (including painted and treated wood), land clearing debris other than lawn waste, wall coverings (including wall paper, paneling and tile), drywall, plaster, non-asbestos insulation, roofing shingles and other roof coverings, plumbing fixtures, glass, plastic, carpeting, electrical wiring, pipe and metals. Such waste shall also include the above listed types of waste that result from construction projects.” NDEQ’s definition of construction and demolition waste does not include “friable asbestos waste, special waste, liquid waste, hazardous waste and waste that contains polychlorinated biphenyl (PCB), putrescible waste, household waste, industrial solid waste, corrugated cardboard, appliances, tires, drums, and fuel tanks.”

Based on Title 132 regulation, “**Fill**” means solid waste that consists only of one or more of the following: sand, gravel, stone, soil, rock, brick, concrete rubble, asphalt rubble or similar material. C&D material used as “fill” for erosion control, erosion repair, channel stabilization, landscaping, roadbed preparation or other land improvement are exempt from NDEQ regulation and do not require regulatory reporting or disposal in a licensed facility.

Disposal sites in Nebraska that accept C&D material are required to report disposal quantities to NDEQ. C&D processing facilities in Nebraska are required to have a permit from the NDEQ, but are only required to report quantities of processed material sent to disposal (not total quantities processed or quantities diverted).

LMC defines a “Limited Landfill” as “a type of [landfill] operation approved by the Health Director in which only building rubbish and demolition debris are disposed of by plan on a specified parcel of land and operated and maintained in such a manner as to present no danger to the health and safety and welfare of human beings.” There are currently no Limited Landfills in operation in Lancaster County. LMC classifies the City’s North 48<sup>th</sup> Street Construction and Demolition Waste Landfill as a “sanitary landfill”. The site is permitted by the NDEQ as a Construction & Demolition Waste Disposal Area.

C&D wastes may be managed in wide variety of manners. It may be landfilled at either a sanitary landfill or C&D landfill [Limited Landfill]; portions of this may be used as “Fill” for the above stated purposes. Certain C&D waste may also be processed (often by grinding) to form materials suitable for replacement of sands and gravels (recycled). A portion of the material from C&D projects may also be recycled or recovered for reuse such as metals, woods and certain building materials.

The Cleaner Greener Lincoln Initiative has formed an advisory committee to discuss sustainable building standards.

### **Current Programs**

The City provides limited education and support for C&D recycling options; the *Lincoln-Lancaster County's Official 2012 Waste Reduction & Recycling Guide* identifies limited options for managing wood waste and building materials. The City does not provide recycling or diversion facilities for C&D waste; all such facilities are provided by private and not-for-profit organizations.

The N. 48th Street Construction and Demolition Waste Landfill, 5101 North 48th Street, is located on City owned land. The North 48th Street site is approximately 450 acres in size of which 102 acres are currently permitted as a C&D waste disposal area. The City's North 48th Street Construction and Demolition Waste Landfill is located above an area where municipal solid wastes (MSW) from Lincoln and Lancaster County were disposed, starting in approximately 1956; in 1990 this site discontinued taking all wastes with the exception of demolition debris and building rubbish. These materials are used to correct grading and drainage above the historic MSW landfill area. The North 48th Street Construction and Demolition Waste Landfill has accepted an average of 70,700 tons per year of C&D waste over the last five (5) years. Lincoln's C & D Landfill operating permit has historically been more restrictive than traditional C & D Landfill operations. The City has limited the acceptance of large quantities of certain C&D and beneficial fill materials such as paper, gypsum board, rubber, plastics, shingles and asphalt. The City has also prohibited painted and treated wood. The amount of acceptable wood debris has generally been restricted to approximately 50 percent per each load. This limitation on what is accepted at Lincoln's C & D Landfill results in more construction and demolition waste being deposited at the Bluff Road Landfill.

There are specialty firms, trucking companies (that provide containers and container handling services), small businesses and residents that handle C&D waste. These entities typically make decisions on how to handle waste materials based on cost, convenience, storage and handling options, regulatory requirements, material composition, and management options (recycle, fill, disposal). When materials are hauled to C&D recycling and processing facilities these materials are considered source separated and trucking operations are exempt from both licensing requirements and the Occupation Tax; they are further exempt from reporting any information regarding the type of services provided and type and quantity of material diverted/recycled. As a result, the number of firms participating or providing C&D recycling services is not known.

Some building construction contractor in the community participate in Nebraska's green building program and offer C&D material recycling and diversion as part of their services. The number of contractors or projects that have recycled C&D waste from building projects have not been tracked.

As discussed in greater detail below, the City attempts to track the recycling and diversion of C&D materials but reporting is strictly voluntary and information reported cannot be validated.

## Generation and Diversion

Table 1 provides a summary of historical C&D tonnages disposed at the N. 48<sup>th</sup> Street Landfill. Quantities of C & D waste disposed will vary from year to based on economic and construction activity as well as the amount being diverted to recycling facilities. The C&D waste management business has evolved significantly since the City's 1994 solid waste plan was developed, with much greater volumes being diverted from disposal; this can be seen in the decrease in tonnages delivered to the N. 48<sup>th</sup> Street Construction and Demolition Waste Landfill. If C&D does not meet the acceptance criteria at the City's N. 48<sup>th</sup> Street Landfill it can be disposed of at the City's Bluff Road Landfill. The City does not specifically track (by waste type) the C&D waste going into the Bluff Road Landfill; this material may also arrive at the Bluff Road Landfill mixed with other waste types or via the N.48<sup>th</sup> Street small vehicle transfer station (citizen self haul of C&D materials).

**Table 1 - Historical Quantities Disposed at the North 48<sup>th</sup> Street Construction and Demolition Waste Landfill (Tons)**

| FY    | C&D Waste |
|-------|-----------|
| 00-01 | 61,305    |
| 01-02 | 88,227    |
| 02-03 | 78,649    |
| 03-04 | 98,174    |
| 04-05 | 76,746    |
| 05-06 | 86,159    |
| 06-07 | 75,491    |
| 07-08 | 89,446    |
| 08-09 | 53,185    |
| 09-10 | 59,119    |
| 10-11 | 76,337    |

A portion of the C&D waste stream generated in the Lincoln and Lancaster County may also be exported to other disposal sites in the region; the quantities exported are required to be reported (under the Occupation Tax) but are not distinguished from other waste types. C&D waste generators and demolition contractors can also haul certain waste (e.g., metals, asphalt roofing shingles, wood, concrete, and asphalt) from their project sites to various processing sites in the region that recover materials. Materials sent to these facilities are are not required to be reported to the City.

Based on processing rate information obtained by the City (shown in Table 2), it is apparent that significant quantities of potential C&D waste (e.g., concrete and asphalt) are being diverted from disposal and reused/recycled rather than landfilled. Visual observations at the City's North 48<sup>th</sup> Street Landfill suggest that opportunities remain for further recycling/diversion of C&D waste. Table 2 shows the quantities of Planning Area concrete and asphalt that have been reported as diverted from disposal since 2000.

Separate data on diverted metals from construction sources is not available, but is likely included in the reported commercial recycling tonnages. The concrete and asphalt diversion data has been relatively consistent year to year tonnage. Based on the data in Table 2, the private-sector recycling operations have diverted an average of approximately 352,000 tons per year of these materials, since 2000. Using FY 2010/2011 C&D disposal data and 2011 C&D diversion rates, the current C&D diversion rate is 75 percent.



There is at least one private firm that accepts wood waste and grinds it into landscape mulch. There are also local asphalt firms that accept asphalt roofing shingles for recycling. Both operations have disposal fees less than the Bluff Road Landfill. There are also non-profit organizations that accept donations of reusable building materials.

The composition of C&D waste can also vary significantly from project to project. While Appendix 1 provides some broad guidelines, developed by WasteCap Resource Solutions, for estimating C&D waste generation/diversion; each project will need to be evaluated individually to target project specific recyclable materials (or source reduction options).

**Table 2 –Recycled Tons of Concrete and Asphalt  
(Reported by Private-Sector Processing Firms)**

| <b>Calendar Year</b> | <b>Clean Concrete</b> | <b>Asphalt</b> | <b>Total Tons</b> |
|----------------------|-----------------------|----------------|-------------------|
| 2000                 | 174,524               | 82,876         | 257,400           |
| 2001                 | 228,628               | 101,920        | 330,548           |
| 2002                 | 272,194               | 100,813        | 373,007           |
| 2003                 | 275,029               | 92,881         | 367,910           |
| 2004                 | 198,732               | 116,020        | 314,752           |
| 2005                 | 215,784               | 152,807        | 368,591           |
| 2006                 | 315,557               | 101,258        | 416,815           |
| 2007                 | 283,385               | 77,249         | 360,634           |
| 2008                 | 291,514               | 80,863         | 372,377           |
| 2009                 | 291,506               | 70,122         | 361,628           |
| 2010                 | 263,946               | 77,962         | 341,908           |
| 2011                 | 146,995               | 83,752         | 230,747           |

**Program (Facility/System) Options**

There are several options that the City could consider to increase C&D recycling.

- Education/Voluntary Programs (status quo)
- Regulatory requirements
- Market and Diversion Incentives
- Construction Materials Recycling and Processing Centers

As with other recycling options (residential and commercial) there is a wide array of program options that could be considered in conjunction with C&D recycling from new construction, remodeling or the demolition projects.

Increased education/behavior change will be important for any program that attempts to significantly increase the quantities of materials over what is being accomplished with existing programs.

**Regulatory Requirements.** These can take several forms; the most common examples may include:

- Mandatory recycling plans
- Minimum diversion requirements for demolition projects (permit condition)
- Incorporation into disaster response plans

Appendix 2 provides additional information on C&D regulations and requirements across the US. The concept of mandatory recycling plans can be used with demolition, as well as new construction or remodeling projects. Under this concept the permitting process is typically used to both obligate diversion efforts and as a means of enforcement. These are most easily used in conjunction with projects over a certain threshold of waste generation. This concept generally requires that, as part of a permit application and as a prerequisite to issuing a construction and demolition permit, a plan is submitted that identifies waste management and recycling/diversion practices that will be applicable to the project. Such projects require documentation of compliance and enforcement to be effective. Such a process will require policies to establish types of materials and degree of diversion required.

Minimum diversion requirements for demolition (or new construction) projects would typically be a part of a mandatory (permit required) construction waste management/recycling plan concept. Such plans would establish minimum diversion requirements specific to the project. Initially this concept could be implemented with projects involving public funds. One such example is Madison, Wisconsin's ordinance requiring C&D recycling from certain new construction, remodeling and demolition projects:

- Madison, Wisconsin requires, by ordinance, (starting January 2010) that:
  - New construction projects that use concrete and steel support must recycle 70% or their construction debris by weight.
  - Remodeling projects with a value in excess of \$20,000 must recycle a specific list of materials:
  - Persons seeking a demolition permit must file a reuse and recycling plan.

(Source: [http://www.cityofmadison.com/streets/recycling/demolition/construction Demolition.cfm](http://www.cityofmadison.com/streets/recycling/demolition/construction%20Demolition.cfm), retrieved on 09/01/2012)

As noted above, Appendix 1 provides an example of how C&D diversion quantities might be estimated. It is important to keep in mind that for such projects to be effective, especially in private development opportunities, cost effective diversion options (markets) need to be available. The challenge in recycling these materials is having contractors and their subcontractors separate the material at the job site and cost effectively transport it to recycling facilities.

Natural disasters can produce a large quantity of material that is similar in characteristics to C&D waste. Such disasters can significantly and negatively impact permitted C&D disposal sites (and MSW landfills). To avoid significant impacts, such plans should include provisions for recycling/diversion of materials such as wood, metals, asphalt shingles, vegetation, drywall (gypsum), plumbing fixtures, carpeting, electrical wiring, pipe, and other materials. This preparedness strategy would be a key asset in minimizing the quantity of waste requiring landfilling following a natural disaster.

**Market and Diversion Incentives.** As discussed in the paper under Recycling Incentives, there are a wide range of options that might be considered. From the standpoint of C&D recycling these options may include:

- Modify government procurement/purchasing specifications
- Require the use of recyclable materials
- Targeted programs
- Increased landfill fees
- Disposal bans

By incorporating “buy-recycled” provisions or mandatory use of recycled products in procurement and purchasing policies, it is possible to stimulate markets and create incentives to recycle. These programs are often most easily implemented in government programs and to a certain extent already exist in certain federal programs. While there are many programs in the private sector, these are typically voluntary.

As discussed in the paper on Recycling Incentives, the building specification system can also be used in new construction to dictate or provide priority to the use of recycled materials, thus helping to support markets and create market demand for certain materials. This concept is a significant cornerstone of the Green Building Council and their Leadership in Energy and Environmental Design (LEED) certification program. As a simple example, the City and County’s standard specification could be modified to include provisions to use materials such as locally produced compost in construction projects. This would create added markets for the City’s LinGro compost.

Targeted programs may involve specific facilities created by the City or private industry based on diversion policies. Examples of materials that are commonly targeted are wood (clean and pallets), aggregates (crushed concrete, asphalt, brick), or shingles. Programs that are in various states of evolution across the US also include, but are not limited to materials such as carpeting, durable goods, ceiling and floor tiles, plastics (clean film and rigid), and drywall. Most of the large volume existing programs, in or adjacent to the Planning Area, are private industry initiatives. As such, expanding diversion for these materials may involve measures (incentives) to enhance program effectiveness, participation or reduce costs. Where local or regional markets do not exist more research may be needed on how to develop, encourage or incentivize the creation of such markets. The extent of implementation details, associated with such program options, is beyond the scope of this paper. One example of such a diversion program is the carpet recycling program in Omaha, Nebraska (considered an existing market); while such a program does not currently exist in the Planning Area, it may be possible to create a program (new market) or identify options to piggyback on this existing program. Another example may be the development of a program to divert drywall (gypsum). To develop such a program would first involve establishment of markets and reasonable projection of market pricing. Gypsum (Calcium Sulfate Dihydrate) has a potential beneficial use in agriculture as a soil amendment, soil conditioner, and fertilizer. C&D derived gypsum would need to compete with other natural and readily available man-made sources (e.g., considered a waste product from air pollution control equipment from power plants). In the case of C&D derived gypsum it will be important in market development to consider that gypsum from power plants is likely already marketed for this same purpose, there is a readily available supply, and the sale price is relatively low cost.

An indirect incentive (disincentive) would be to increase landfill disposal rates to discourage disposal by making diversion options more cost effective. Raising the disposal rate may involve social and political considerations. This concept could make certain higher cost recycling options more competitive with disposal rates. One disadvantage of this concept is that the City is currently using C&D material at the N. 48<sup>th</sup> Street Landfill to correct grading and drainage above the historic MSW landfill area. By reducing the quantities of C&D material this site accepts it would have the benefit of prolonging the life of the site, but it may also require the City to purchase soil for grading and drainage purposes, as opposed to deriving revenue from accepting C&D materials and using it for the same purpose. A separate paper discusses construction and demolition site disposal capacity and capacity requirements.

Disposal bans are also discussed under the technical paper on Recycling Incentives. Appendix 3 is an example from Seattle, Washington, where they have begun a phased in series of disposal bans, related to C&D waste. Bans do not necessarily reduce waste generation, but

added incentives (disincentives) to encourage diversion of certain materials. Again, this presupposes the existence of processing and recovery outlets for these materials. As noted in the Appendix 3 document, effective January 2012 Seattle banned landfill disposal of concrete, brick and asphalt paving. By forecasting future bans, Seattle also provides opportunities for additional market development prior to the ban taking affect.

**Construction Materials Recycling and Processing Centers.** Recycling/reuse/processing centers are typically intended to give products a second life or repurpose. Examples of materials handled by recycle/reuse centers include, but are not limited to doors, windows, cabinets, electrical appliances, furniture, hardware, gently used building materials, household goods, etc. Recovery of these materials may in some instances require de-construction as opposed to demolition. Examples of such facilities include: Habitat for Humanity-ReStores and EcoStores in Lincoln. These are not-for-profits that accept and warehouse usable construction materials for resale or in program directed construction projects.

Processing facilities may be stand alone facilities or in combination with transfer stations. Some facilities only take limited types of materials (relatively clean concrete and asphalt), while others attempt to process mixed C&D wastes for recovery. Multi-material processing facilities have many challenges, including large capital costs (for buildings, material storage and processing equipment), high operating costs (for personnel and equipment), and limited markets, if they are not producing a pure enough product – all leading to tipping fees potentially higher than current C&D landfilling rates. Transfer station(s) will be examined in a separate technical paper: if transfer station(s) are considered a cost effective option for solid waste management then supplemental evaluations my be appropriate to determine the cost effectiveness of adding select materials processing capabilities, not limited to C&D wastes/recyclables.

As with other recycling programs, to be most effective a combination of the above options will likely produce the largest diversion rate.

### **Options Evaluation**

The general issues associated with C&D recycling programs are:

- Markets for recovered material
- Material storage and handling costs
- Competition with low disposal rates
- Lack of incentives, especially for small volume projects
- Funding and cost justification for new economic incentives
- Difficulty in implementing mandatory programs (e.g., bans for inert material)

Before new programs are implemented it may be necessary to undertake a market analysis to confirm that adequate markets are available for materials targeted for recovery, especially unique materials.

Consistent with the guiding evaluation criteria developed for use in the Solid Waste Plan 2040, the C&D recycling options have been further evaluated based on the considerations shown in Table 3. Education/Voluntary programs are not included in this options analysis.

Table 3 – Options Evaluation

| Evaluation Criteria               | Regulatory Requirements  | Market and Diversion Incentives   | Construction Materials Recycling and Processing Centers   |
|-----------------------------------|--|---|---|
| <b>Waste Reduction/ Diversion</b> | <p>Can contribute toward increased source reduction and recycling.</p> <p>May or may not increase market availability</p> <p>Can lead to waste exports if not done properly.</p> <p>Can preserve existing landfill space, especially as it relates to disaster response.</p>   | <p>Bans, mandates, fees, and restrictions do not in and of themselves reduce the quantity of waste generation, but can be effective in directing materials away from local landfills and toward recycling programs.</p> <p>Rates and incentives/disincentives (penalties) need to be carefully considered as they can also lead to greater waste exports.</p> <p>Availability of cost effective markets and reuse options will be a key to expanding the types of C&amp;D materials diverted.</p> <p>Bans, restriction and mandates can help create markets for diverted materials.</p> | <p>Availability of local, cost competitive recycling and processing facilities for materials not currently diverted should contribute to increased recycling, reduced exports and reduced quantities going to landfills.</p> <p>To increase facilities generally requires suitable markets. New or added facilities can not generally be implemented until viable/sustainable markets are established.</p>  |
| <b>Technical Requirements</b>     | <p>Existing processing facilities for concrete and asphalt diversion appear to have adequate capacity.</p> <p>The availability and stability of markets will need to be evaluated in conjunction with targeted materials.</p> <p>Can be reliable, but will require funding for mechanisms to monitor and enforce compliance, to ensure consistency.</p> <p>Programs can be constructed to be flexible, but are still based on varying forms of mandates.</p> | <p>Added processing capacity may be necessary if current local markets do not exist for diverted materials.</p> <p>Implementing preferred purchasing practices and buy-recycled can be done within the policies of local government.</p> <p>Some level of risk results from bans, restriction and mandates, unless solutions are available to deal with the affected material and enforcement is provided.</p>  | <p>Existing processing facilities for concrete and asphalt diversion appear to have adequate capacity.</p> <p>Added processing capacity may be necessary if current local markets do not exist for diverted materials.</p> <p>Added facilities, through government sponsorship, will need to be evaluated against compatibility with existing privately funded programs.</p> <p>If a transfer station(s) are deemed appropriate, then further evaluation of adding processing capacity should be undertaken (not limited to C&amp;D materials).</p> |
| <b>Environmental Impact</b>       | <p>Can target materials with goal of conservation of material and energy resources.</p>  | <p>Environmental benefits would need to be evaluated relative to specific option.</p> <p>A portion of the material currently disposed of is considered inert (non-toxic) and may not represent a risk to air or water resources.</p> <p>The City is using select C&amp;D (less than 50 percent combustible) to help improve drainage and fix grading above an existing MSW landfill.</p>  | <p>Can target materials with goal of conservation of material and energy resources.</p> <p>Environmental benefits would need to be evaluated relative to specific option.</p>   |
| <b>Economics</b>                  | <p>May result in increased cost to new projects and added cost for demolition and remodeling projects for both compliance and if cost of management of recovered materials exceed cost of disposal options.</p> <p>Funding sources will be specific to the program options selected, but generally place the burden on the generator of C&amp;D waste or new project developer.</p>  | <p>New and expanded facilities will require capital expenditures. If long-term cost effectiveness is not established, funding could be a major challenge.</p> <p>Incentives can help off-set diversion program costs, but will require a funding source if the business does not generate a profit.</p> <p>Costs to residents and businesses will be specific to the program options selected, but generally place the burden on the</p>  | <p>New and expanded facilities will require capital expenditures. If long-term cost effectiveness is not established, funding could be a major challenge.</p> <p>Costs to residents and businesses will be specific to the program options selected; large scale facilities may need to distribute cost to more than waste generators/users.</p> <p>All current facilities that divert C&amp;D are funded by private and not-for-profits. City funding would likely be associated with a</p>  |

| Evaluation Criteria             | Regulatory Requirements   | Market and Diversion Incentives  | Construction Materials Recycling and Processing Centers   |
|---------------------------------|---|--|---|
|                                 |   | <p>generator of C&amp;D waste or new project developer.</p> <p>New markets for target materials may represent an economic development opportunity.</p>   | <p>transfer station(s), which contained processing as a supplemental function. Transfer station(s) will be examined in a separate technical paper.</p> <p>Grants and subsidies can be used to help fund certain programs or fund new facilities, but long-term they may or may not ensure sustainable programs.</p> <p>Non-sustainable project economics represents a risk to programs success and public acceptance.</p>   |
| <b>Implementation Viability</b> | <p>Will require laws/regulations/ordinance changes to implement. Social/political acceptability will be a factor in any options that attempts to change the current system and results in added costs to projects.</p> <p>Storing C&amp;D for processing or pending distribution to markets can require relatively large area of land.</p> <p>Permitting programs would be used as part of the approval and enforcement mechanism to facilitate implementation of new programs.</p> | <p>Most programs involving incentives or bans will require laws/regulations/ordinance changes to implement, including those that use rates and fees and incentives.</p> <p>Establishing incentives/disincentives for new markets or increase diversion will need to be carefully considered to ensure they effectively achieve the desired level of recycling.</p> <p>Storing C&amp;D for processing or pending distribution to markets can require relatively large areas of land.</p> <p>Social/political acceptability will be a factor in any options that attempts to change the current system using rates and bans.</p> <p>Changes to purchasing practices and specifications used by units of government may be easier to accomplish than large scale disposal bans on select materials.</p> | <p>Siting and constructing new large scale waste processing facilities (not limited to C&amp;D waste) can have issues with social/political acceptance.</p> <p>Storing C&amp;D for processing or pending distribution to markets can require relatively large areas of land.</p> <p>Some amount of permitting will be required with the construction of any new facility. This should not impede construction unless the facility is controversial or fails to comply with applicable laws.</p> |

## Relationship to Guiding Principles and Goals

The current C&D recycling programs are voluntary private initiatives with minimal support or involvement by Lincoln and Lancaster County. These programs currently (2011) divert an estimated 75 percent of the C&D waste generated in the Planning Area. The principle materials known to be diverted are concrete, asphalt and metals. As it relates to the Guiding Principles and Goals of the Solid Waste Plan 2040, the possibility of expanding C&D recycling is directly applicable, as further noted below.

- **Emphasize the waste management hierarchy:** Recycling is one of the most preferred waste management methods in the hierarchy (immediately after reduce and reuse) in that it places maximum emphasis on options to recover materials and recycle them into new products. Current programs are compatible with this hierarchy. To increase recycling above the status quo, additional regulations, markets, incentives or possibly facilities will be necessary.
- **Encourage public/private partnerships:** The current system of recycling involves private efforts, including trucking and recycling processing facilities provided by private and not-for-profit firms. The City provides limited education and promotional outreach. If expanded C&D recycling programs are selected for implementation it is expected that they will likely be developed with private parties providing collection and processing services. Services by non-profits, privates, and public/private are expected to continue and complement any decision to implement an expanded C&D recycling program.
- **Ensure sufficient system capacity:** System capacity for C&D recycling is believed to be adequate for materials such as concrete, asphalt and metals. Construction of additional space (facilities) may be necessary to accommodate an expanded array of recyclables collection and storage. Establishment of viable markets will be essential to expanding the array of materials diverted.
- **Engage the community:** Any expanded C&D recycling program will be necessary to engage the businesses affected by this decision. To optimize success of an expanded C&D recycling program, it will also require education (behavior change) to encourage and sustain participation.
- **Embrace sustainable principles:** Maximizing recovery of C&D materials and recycling into new products recognizes that waste is not inevitable and discarded materials are potentially valuable resources.

## Summary

In FY 2010/2011 an estimated 75 percent of C&D materials were diverted, based upon the quantities of concrete and asphalt diversion (voluntarily) reported to the City. Diversion of metals from C&D waste is known to be occurring, but quantities are difficult to estimate and as such are not reflected in the C&D diversion estimates. When materials are hauled to C&D recycling and processing facilities, these materials are considered source separated and trucking operations are exempt from both licensing requirements and the Occupation Tax; they are further exempt from reporting any information regarding the type of services provided and type and quantity of material diverted/recycled. As a result, the number of firms participating or providing C&D recycling services is not known.

The City derives some benefit from the C&D materials currently disposed of at the N. 48<sup>th</sup> Street Construction and Demolition Waste Landfill because such materials are beneficially used to

correct grading and drainage above the historic MSW landfill area. By reducing the quantities of C&D material this site accepts it would have the benefit of prolonging the life of the site, but it may also require the City to purchase soil for grading and drainage purposes, as opposed to deriving revenue from accepting C&D materials and using it for the same purposes.

There are many program options available, all of which are essentially consistent with the Solid Waste Plan 2040 guiding principles and the waste management hierarchy. With any new or expanded program, markets for the recycled C&D materials will be a key factor in determining that such a diversion program is viable and sustainable. If the Solid Waste Plan 2040 incorporates expanded C&D waste recycling systems, facilities or programs, the City will need to evaluate minimum program requirements, and how to fund, implement and enforce such programs.



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## Appendices



# APPENDIX 1

## How to Estimate Quantities of Construction or Demolition Debris Your Project will Generate

### Calculating Quantities of C&D Debris

#### Step 1. Estimate Total Quantity of Debris

After you have determined what materials will be in your waste stream and produced a preliminary list of materials that may be targeted for reuse or recycling (see Construction Waste Management Plan Form ANALYSIS OF ESTIMATED CONSTRUCTION OR DEMOLITION WASTE TO BE GENERATED) it is time to estimate how much construction or demolition debris your project will produce.

If you have records of weights and volumes from past projects your company has done, these will be the most accurate. If not, here are some calculations to get you started. After you have documented a few projects, you will be able to get much closer estimates. However, these calculations should be useful in the beginning to determine appropriateness of recycling a variety of materials and to calculate projected hauling costs.

#### Method #1 (Construction only)

**Use Project Estimates.** Research quantities of materials ordered for your project. Determine a waste factor (typically between 5 – 10%) and calculate the waste from each material in that manner. Make sure to include packaging in estimates.

#### Method #2

#### **Utilize EPA Estimates.<sup>1</sup>**

Commercial (Non-residential) Construction Debris. Nonresidential building vary in C&D debris generated. US EPA uses an average generation of 3.89 pounds per square foot.

Commercial (Non-residential) Demolition Debris. Assuming an average building size of 13,300 square feet for buildings built between 1920 and 1969, EPA used 155 pounds per square foot for nonresidential buildings. A 13,300 square foot warehouse, for example, would produce 2,061,500 pounds of construction and demolition debris or 103,075 tons when demolished.

Residential Construction Debris. Types of houses, building practices and regulations vary widely. EPA used an average of 4.38 pounds per square foot of floor space for their estimates. Therefore, a 1,200 square foot house would result in 5,256 pounds of or 2.62 tons of construction debris.

Residential Demolition Debris. Assuming an average of 1,600 square feet for single-family houses and 1,000 square feet for multifamily houses, EPA used 61 pounds per square foot for single family and 115 pounds

<sup>1</sup> Franklin & Associates. "Characterization of Building-Related Construction and Demolition Debris in the United States" 6/15/1998. Order number EPA530-R-98-010

per square foot for multifamily houses. Consequently, a single-family house of 1,600 square feet, when brought down, would result in 97,600 pounds of demolition debris, or 4.88 tons.

**Utilize WasteCap Resource Solutions and National Association of Home Builders Estimates**

Commercial Construction Debris. Based on several WasteCap Resource Solutions projects, the average generation rate it has found is 5.44 pounds per square foot of commercial construction debris. These projects tend to be large buildings with large quantities of heavy materials -- concrete and metal in particular.

Residential Construction Debris. The National Association of Home Builders estimates four pounds per square foot of construction and the following waste from a 2,000 square foot home

**Step 2. Calculate the percentage, by weight, of different materials anticipated in the waste stream.** Use project estimates or the estimates below.

Commercial Construction Debris

| Material         | Estimated % (by weight) * |
|------------------|---------------------------|
| Trash            | 25%                       |
| Cans & Bottles   | .5%                       |
| Cardboard        | 10%                       |
| Concrete/masonry | 18%                       |
| Drywall          | 12%                       |
| Metal            | 11%                       |
| Wood             | 24%                       |
| Reuse/Other      | 0%                        |
| <b>Total</b>     | <b>100%</b>               |

\* Edit to suit your project. Estimates are from WasteCap's Commercial Construction projects.

Commercial Demolition Debris:

**Sample composition of demolition debris (19 nonresidential projects in the Pacific Northwest)<sup>2</sup>**

| Material     | % (by weight) |
|--------------|---------------|
| Trash        | 9%            |
| Asphalt      | 2%            |
| Brick        | 1%            |
| Concrete     | 66%           |
| Scrap Iron   | 5%            |
| Roofing      | 1%            |
| Wood         | 16%           |
| <b>Total</b> | <b>100%</b>   |

<sup>2</sup> Ibid. Figure 9. Page 2-18. Order number EPA 530-R-98-010.

Residential Construction Debris (from National Association of Home Builders):

| Material                         | Weight (Pounds) | Estimated % (by weight) | Volume (Cubic Yards) |
|----------------------------------|-----------------|-------------------------|----------------------|
| Solid Sawn Material              | 1,600           | 20%                     | 6                    |
| Engineered Wood                  | 1,400           | 18%                     | 5                    |
| Drywall                          | 2,000           | 25%                     | 5                    |
| Cardboard                        | 600             | 8%                      | 20                   |
| Metals                           | 150             | 2%                      | 1                    |
| Vinyl                            | 150             | 2%                      | 1                    |
| Masonry                          | 1,000           | 13%                     | .71                  |
| Containers – paint, caulks, etc. | 50              | 1%                      | -                    |
| Other                            | 1,050           | 13%                     | 11                   |
| <b>Total</b>                     | <b>8,000</b>    | <b>100%</b>             | <b>49.71</b>         |

Residential Demolition Debris (Note: numbers based on landfill data, not on data from demolition sites, so any material from residential demolition which was recycled (e.g. concrete) is not included) <sup>3</sup>

| Material         | % (by weight) |
|------------------|---------------|
| Trash            | 19%           |
| Asphalt shingles | 29%           |
| Brick            | 4%            |
| Cardboard        | 2%            |
| Drywall          | 6%            |
| Ferrous metals   | 3%            |
| Plastic          | 3%            |
| Wood             | 34%           |
| <b>Total</b>     | <b>100%</b>   |

**Step 3. Calculate projected weight and volume of the different materials.** Utilize project estimates or use the conversion numbers below. Haulers can be very helpful with these calculations. They may have conversion estimates of quantity to weight which may be more accurate to your project. Work with your hauler(s).

| Recycling Conversions         | Trash | Cans & Bottles | Cardboard | Concrete | Drywall | Metal | Wood  |
|-------------------------------|-------|----------------|-----------|----------|---------|-------|-------|
| Average pounds per cubic yard | 350   | 50             | 100       | 1400     | 500     | 1,000 | 300   |
| Average tons per cubic yard   | 0.175 | 0.025          | 0.050     | 0.700    | 0.25    | .50   | 0.150 |
| Average cubic yards per ton   | 5.71  | 40             | 20        | 1.43     | 4       | 2     | 6.66  |

<sup>3</sup> Camp Dresser & McKee Inc. "Quantity and Composition Study of Construction and Demolition Debris in Wisconsin" Prepared for the Wisconsin Recycling Market Development Board. February 1998. Table 3-3.

#### **Step 4. Use These Calculations:**

- To help you decide what to and not to recycle
- In Your Construction Waste Management Plan
- To provide to potential haulers for more accurate bids
- To compare hauling proposals (see “Hauling RFP”)
- To calculate the projected cost of recycling vs. not recycling (see “Hauling RFP”)

# APPENDIX 2

## **NERC** | Northeast Recycling Council

Celebrating 25 Years of Uniting the Ten Northeast States for Environmentally Sound Materials Management

### SUMMARY OF U.S. STATE AND MUNICIPAL C&D REGULATIONS AND REQUIREMENTS

In the U.S., the solid waste management hierarchy places source reduction, reuse, and recycling as the highest priorities. This is applicable to residential and business-generated materials. It is also applicable to construction and demolition materials (C&D). More and more state and municipal regulations and requirements are mandating the recycling of C&D.

C&D materials are generated in new construction, remodeling, deconstruction and demolition. Common components of new construction in the U.S. include: wood; concrete/masonry; wallboard; metal; corrugated cardboard; bottles and cans; and trash. Demolition debris includes: concrete; wood; trash; scrap iron; asphalt; brick; and roofing. Many of these materials can be recycled and made into new products— clean, untreated wood can be made into new wood products (i.e., furniture, and wood chips and mulch for landscaping purposes); gypsum wallboard can be ground into a gypsum powder that is then manufactured into new plasterboard or applied as a soil amendment; and asphalt shingles can be recycled into cold patch, new shingles, or hot mix asphalt.

In 2011, the Northeast Recycling Council (NERC) completed the [Disposal Bans & Mandatory Recycling in the United States](http://www.nerc.org/documents/disposal_bans_mandatory_recycling_united_states.pdf) ([http://www.nerc.org/documents/disposal\\_bans\\_mandatory\\_recycling\\_united\\_states.pdf](http://www.nerc.org/documents/disposal_bans_mandatory_recycling_united_states.pdf))—a summary of state recycling regulations and material disposal bans in the U.S. Of the 49 states and District of Columbia (DC) reported in this study, 13 (28%) have some form of C&D material disposal ban or recycling requirement. Following are some of the highlights:

- Sixteen C&D materials are either banned from disposal or are required to be recycled in the reporting states.
- Six states ban the disposal of friable asbestos, which is commonly found in acoustic ceilings and tiles, many types of plasters, wallboard, joint compound or "mud" and thermal insulation for water heaters and pipes made before 1978.
- Five states ban the disposal of wallboard.
- Ten states require corrugated cardboard to be recycled, and one state bans its disposal.
- Seven states ban the disposal of mercury containing devices found in thermostats and in other devices.
- Seven states require glass containers to be recycled, and four states ban its disposal.

Table 1 below provides a summary of the information provided by the states.

| C&D Material                | States |    |    |    |    |    |    |     |    |    |    |    |     |
|-----------------------------|--------|----|----|----|----|----|----|-----|----|----|----|----|-----|
|                             | CT     | DC | MA | ME | NH | NJ | ND | PA  | RI | SD | VA | WV | WI  |
| Asbestos (friable)          | B      | B  |    |    |    |    | B  | B   |    |    | B  | B  |     |
| Asphalt Shingles & Pavement |        | B  | B  |    |    |    |    |     |    |    |    | B  |     |
| Brick                       |        | B  | B  |    |    |    |    |     |    |    |    | B  |     |
| C&D Wood                    |        | B  | B  |    |    |    |    |     |    |    |    | B  |     |
| C&D Metal                   | R      | B  | B  |    | B  |    | R  | B   | R  |    |    | B  |     |
| Concrete                    |        | B  | B  |    |    |    |    |     |    |    |    | B  |     |
| Corrugated Cardboard        | R      | R  | R  | B  | R  | R  |    | R   | R  | R  | R  |    | R   |
| Glass (containers)          | R      | R  | B  | R  | R  | R  |    | B   | R  | B  | R  |    | B   |
| Land Clearing Debris        |        |    |    |    |    |    |    |     |    |    |    | B  | B   |
| Metal (containers)          | R      | R  | B  |    |    | R  |    | R   | R  |    | R  |    | B/R |
| Mercury Containing Devices  |        | B  | B  | B  |    |    | B  |     | B  |    |    | B  | B   |
| Paint                       | B      | B  |    |    |    |    |    |     |    |    |    | B  | B   |
| Plastic (containers)        |        | R  | B  |    |    | R  |    | B/R | R  | B  |    |    | B/R |
| Scrap Metal                 | R      |    |    |    |    | R  | R  | R   | R  |    |    |    |     |
| Wallboard                   |        | B  | B  |    | B  | B  |    |     |    |    |    | B  |     |
| Wood (clean)                | B      |    | B  |    |    |    |    |     | R  |    |    |    |     |

NOTE: Glass, plastic, and metal containers are part of the waste generated by workers at C&D job sites.



Further research into municipal C&D recycling ordinances revealed that many regional state and federal agencies, as well as municipalities, do not maintain records about how C&D is handled at the municipal level. Instead, they track the promotion of C&D diversion at the state level, the kinds of C&D data tracking the states conduct (whether it is through voluntary methods or required by rule), and the licensing and permitting process for solid waste facilities and activities relating to the handling of C&D.<sup>1</sup>

Iowa offers a [model C&D recycling ordinance](http://www.iowadnr.gov/portals/idnr/uploads/waste/cndord_demorecycling.pdf) ([www.iowadnr.gov/portals/idnr/uploads/waste/cndord\\_demorecycling.pdf](http://www.iowadnr.gov/portals/idnr/uploads/waste/cndord_demorecycling.pdf)).

NERC identified C&D recycling ordinances in 128 municipalities; 118 in California (25% of all municipalities in the state), 2 in Connecticut, 2 in Florida, 2 in Illinois, 1 in Missouri, 12 in North Carolina, and 1 in Washington. Tables 2 and 3 lists of communities per state. Table 4 lists the C&D materials commonly included in municipal recycling ordinances.

|               |                  |                      |                     |                  |
|---------------|------------------|----------------------|---------------------|------------------|
| Alameda       | Coachella        | Huntington           | Piedmont            | Santa Clara      |
| Albany        | Colma            | Indian Wells         | Pleasant Hill       | Santa Clarita    |
| Aliso Viejo   | Contra Costa     | La Canada Flintridge | Pleasanton          | Santa Fe Springs |
| Antioch       | Cotati           | La Mesa              | Pomona              | Santa Monica     |
| Apple Valley  | Dana Point       | Livermore            | Port Hueneme        | Santa Rosa       |
| Arroyo Grande | Duarte           | Lynwood              | Portola Valley      | Santee           |
| Artesia       | Dublin           | Manhattan Beach      | Rancho Cucamonga    | Sierra Madre     |
| Asheboro      | East Palo Alto   | Marin                | Rancho Mirage       | Signal Hill      |
| Atherton      | El Centro        | Menlo Park           | Rancho Santa        | South El Monte   |
| Baldwin Park  | El Dorado        | Mission Viejo        | Redlands            | South Gate       |
| Bellflower    | Emeryville       | Monrovia             | Redondo Beach       | South Lake Tahoe |
| Berkeley      | Fairfield        | Monterey Park        | Sacramento          | Stockton         |
| Brawley       | Forest City      | Moraga               | San Buenaventura    | Tulare           |
| Brea          | Foster City      | Morro Bay            | San Carlos          | Tustin           |
| Brentwood     | Freemont         | Needles              | San Clemente        | Union City       |
| Brisbane      | Fresno           | Newark               | San Diego           | Vallejo          |
| Burlingame    | Gardena          | Norwalk              | San Francisco       | Vista            |
| Butte         | Glendora         | Oakland              | San Gabriel         | Walnut Creek     |
| Calaveras     | Half Moon Bay    | Ontario              | San Jose            | Willits          |
| Calexico      | Hawaiian Gardens | Orinda               | San Juan Capistrano | Winters          |
| Camarillo     | Hawthorne        | Oro Loma             | San Leandro         | Woodland         |
| Castro Valley | Hayward          | Palo Alto            | San Louis Obispo    | Woodside         |
| Chula Vista   | Hidden Hills     | Pasadena             | San Marino          |                  |
| Clayton       | Highland         | Pico Rivera          | San Mateo           |                  |

<sup>1</sup> E.g., New Jersey regulates the facilities able to accept C&D. Municipalities' involvement with C&D is limited to the issuance of a building or demolition permit.

| <b>Table 3. Municipalities with C&amp;D Material Recycling Ordinances in Other States</b> |                |                 |                 |                       |                   |
|---|----------------|-----------------|-----------------|-----------------------|-------------------|
| <b>Connecticut</b>  | <b>Florida</b> | <b>Illinois</b> | <b>Missouri</b> | <b>North Carolina</b> | <b>Washington</b> |
| Bridgeport  | Lee            | Chicago         | Kansas City     | Asheboro              | Seattle           |
| New Haven   | Sarasota       | Northbrook      |                 | Chapel Hill           |                   |
|   |                |                 |                 | Cramerton             |                   |
|   |                |                 |                 | Efland                |                   |
|   |                |                 |                 | Four Oaks             |                   |
|   |                |                 |                 | Glen Lennox           |                   |
|   |                |                 |                 | Hillsborough          |                   |
|   |                |                 |                 | Mount Olive           |                   |
|   |                |                 |                 | Pinehurst             |                   |
|   |                |                 |                 | Randleman             |                   |
|   |                |                 |                 | Smithfield            |                   |
|   |                |                 |                 | Stanley               |                   |

| <b>Table 4. Common C&amp;D Materials Included in Municipal Recycling Ordinances</b> |           |
|---|-----------|
| Aluminum  | Pallets   |
| Asphalt   | Paper     |
| Brick   | Pipe      |
| Buckets   | Plastic   |
| Cardboard   | Roof Tile |
| Carpet & Carpet Padding   | Steel     |
| Concrete  | Shingles  |
| Land Clearing Debris  | Wallboard |
| Lumber  | Wood      |

# APPENDIX 3

## Seattle C&D

### Required Recycling of C&D Materials

Around 61% of construction and demolition (C&D) waste was recycled from Seattle projects in 2010. Seattle Public Utilities is proposing a goal of 70% recycling for construction waste by 2020. In order to reach that goal, SPU is proposing a series of landfill disposal bans on readily recyclable C&D materials and certifying processing facilities that meet the City's new recycling requirements.

Effective January 2012

**No Landfill Disposal of Concrete, Bricks and Asphalt Paving**

Ordinance #123553 prohibits the disposal of recyclable concrete, bricks and asphalt paving from landfill disposal effective **January 1, 2012**. Such material should not be put in garbage containers or dumpsters, intermodal boxes or delivered to transfer stations for disposal. These materials already have a very high recycling rate and facilities that accept them and other C&D materials for recycling can be found at the following link [Seattle-King County Construction Recycling Directory](#).

**Exceptions:** This disposal ban does not apply to these materials that are painted, have hazardous contents, are difficult to separate from other attached materials such as wood or are present in only very small quantities.

2012 will be a year of education regarding this new disposal ban. Enforcement actions with potential penalties will not take place until 2013.



### Other Proposed Disposal Bans on C&D Materials

SPU is proposing to ban the disposal of these additional C&D materials:

- **Metal** (2013)
- **Cardboard** (2013)
- **Carpet** (2013)
- **Plastic Film Wrap** (2013)
- **New Construction Gypsum Scrap** (2013)
- **Clean Wood** (2014)
- **Tear-Off Asphalt Shingles** (2014)

All disposal bans are applicable to:

- Construction, Demolition and Remodeling Contractors
- Self-Haul Customers to Private Transfer Stations
- Self-Haul Customers to Public Transfer Stations
- Third Party Haulers
- Processing Facilities

For more information on these proposed disposal bans, other new C&D programs which are being proposed and stakeholder involvement and input please visit the SPU webpage for the Solid Waste Plan at [www.seattle.gov/util/SolidWastePlan](http://www.seattle.gov/util/SolidWastePlan)

**This webpage will be updated with new recycling requirement information as it becomes available.**

## Residential Recycling and Diversion

### Overview

Recycling turns materials that would otherwise become waste into valuable resources. Recycling includes: 1) collecting materials that would otherwise be considered waste; 2) sorting and processing recyclables into raw materials that can be used to produce new products; and, 3) purchasing recycled product. As illustrated by the traditional recycling logo, using the collected material, in whole or in part, in new products is necessary to complete the “recycling” cycle.



When residents have materials that are no longer of value to them they make decisions on how to manage those materials. When the option of recycling is available a resident often considers several factors, including: location, convenience/opportunity, cost, environmental stewardship, and point in time options. The decision to choose recycling can be influenced by awareness, education, commitment, incentives, peer pressure and other factors. Residents in Lincoln and Lancaster County (Planning Area) have access to voluntary recycling opportunities but systems, facilities and programs may not always be convenient or may have what some consider extra costs, which serve as disincentives. Lincoln Municipal Code (LMC) 5.41.010 defines recyclables (for the purpose of recycling) as materials “separated or otherwise diverted from waste destined for disposal: wood, paper, glass, plastics, metals, automobile oil, tires, and batteries. Refuse derived fuels or other materials that are destroyed by incineration are not recyclables. Salvage material ... is not a recyclable.”

As a basis for this technical paper residential recycling is generally focused on recycling opportunities which include:

- Fiber or Papers:
  - Old newspaper (ONP)
  - Old corrugated containers (cardboard) (OCC) or corrugated and chip board
  - Mixed papers
- Glass (e.g., bottles and jars)
- Metals:
  - Ferrous metal (e.g., tin cans)
  - Nonferrous (e.g., aluminum cans)
- Plastics:
  - PET (#1 plastic)
  - HDPE (#2 plastic)
  - PVC (#3 plastic)
  - LDPE (#4 plastic)
  - PP (#5 plastic)
  - PS (#6 plastic)
  - Other (#7 plastic)

Separate technical papers address materials such as automobile oil, tires, batteries, yard waste and food waste composting as well as markets for recyclable materials. Other recyclable materials in the waste stream may also be discussed, but with less emphasis.

The “residential recycling” options discussed in this paper will generally focus on systems, facilities and programs serving single family and duplex dwelling units, to coincide with LMC 8.32.205, which differentiates the frequency of solid waste collection requirements based on the

number of dwelling units. However, concepts presented in this paper may be applicable to residential properties containing more than two dwellings. Multi-family recycling (three-plexes and apartments) is addressed under the technical paper on Commercial Recycling and Diversion. It is important to also note that under the definition of “refuse” in LMC 8.32.010, refuse specifically excludes recyclables (as defined in LMC 5.41.010) that have been separated out at the source. This distinction is also important because it does not subject vehicles involved in collecting source separate recyclables (as well as yard waste) to licensing requirements under LMC 8.32.

The USEPA has stated “Recycling materials reduces greenhouse gas emissions. EPA estimates that current national recycling efforts - 32 percent recycling in 2005 - yield annual greenhouse gas emission reductions of 49.9 MMTCE [million metric ton carbon equivalent], compared to landfilling/combusting the same material. This is equivalent to removing over 39.6 million cars from the road. Increasing the recycling rate to 35 percent would reduce greenhouse gas emissions by another 5.2 MMTCE, for a total reduction of over 55 MMTCE... If an average family of four were to recycle all of its mixed plastic waste, nearly 340 pounds of carbon equivalent emissions could be reduced each year.”

(Source: <http://www.epa.gov/climatechange/waste/measureghg.html>, retrieved August 17, 2012)

## Current Programs

The Lincoln Recycling Office was created in the fall of 1987. It was the first full-time municipal recycling coordinator position in the state of Nebraska. The creation of the position coincided with the development of the Bluff Road Landfill. The mission of the Recycling Office is to divert waste from the sanitary landfill in an economically and environmentally sound manner in full partnership with the private sector. The Recycling Office is a part of the City’s Solid Waste Operations within the Public Works and Utilities Department.

The City supports and promotes public and private recycling efforts through its website <http://lincoln.ne.gov/city/pworks/waste/sldwaste/> and by providing a wide array of services. The primary public and private services include, but are not limited to:

- Drop-off locations
- Residential recyclables collection and processing
- Education

Specific information on various system, facilities and programs can be found on the City’s recycling website <http://lincoln.ne.gov/city/pworks/waste/sldwaste/recycle/> and in the *Lincoln-Lancaster County’s Official 2012 Waste Reduction & Recycling Guide*, which is also available through the City’s Solid Waste Operations website. Also, included within these sources are information on a wide array of private and not-for-profit recycling service providers, as well as source reduction opportunities.

For the convenience of residents in the Planning Area the City operates a network of 29 multi-material recycling (drop-off) centers and 4 newspaper-only recycling (drop-off) centers in Lincoln and Lancaster County; most are open 24-hours per day. Two private recycling processing centers also operate multi-material recycling drop-off centers in the City. One village (Hallam), operates its own recycling drop-off center. All total there are 36 drop-off sites; 25 are located in the City and nine are in areas of the County outside of the City. The locations and map of these sites can be found in the *Lincoln-Lancaster County’s Official 2012 Waste Reduction & Recycling Guide*. These sites provide residents locations where they can self haul and drop off select recyclable materials. The City contracts with a private hauler to collect and deliver the deposited materials from these drop-off centers to a recycling processing center, under contract

with the City to process and market these materials. The City provided facilities are funded primarily through the Occupation Tax, revenue from the sale of recyclables and grant funds.

Several private hauling companies provide curbside collection of recyclables on a subscription basis. There are no reporting requirements for haulers, and as such the number of haulers providing curbside recycling is unknown. Most of the residential curbside recycling programs are “single stream” service, which means that all acceptable recyclable materials are placed in a common container(s) and sorted at a remote processing center. The frequency of collection and is generally once per week. The Baseline Assessment/Survey conducted as part of the Solid Waste Plan 2040 indicates that approximately 24 percent of the residents in the City have (subscribe to) curbside recycling services. Prior to the assessment/survey the City conducted limited hauler surveys which resulted in an estimate of 21 percent of the occupied single-unit to four-unit dwellings in Lancaster County subscribed to curbside recycling in 2011. The City’s data did not distinguish between household participation rates for curbside recycling inside or outside the City; however, available information suggests that there are only a small number of households that subscribe to curbside recycling outside the City. The City’s survey is within the confidence interval of the Baseline Assessment/Survey; as such the 24 percent value will be used for purposes of this paper. None of the municipalities in the County provide either public or franchise curbside collection service for recyclables. Curbside residential recyclables collection programs are funded by program users through subscription fees and revenue derived from the collected materials.

Recycling drop-off centers include for-profit and not-for-profit operations. Three private recycling processing centers operate in the City and accept recyclables from residential and business customers and sort and process them to meet market specifications. The capacity to process significantly larger volumes of materials would need to be evaluated if a significant increase of recyclables resulted from an expanded residential recycling program. Additionally, not all existing facilities may benefit from an expanded program.

The City has an extensive education effort to promote recycling. It is funded through the Occupation Tax, revenues from the sale of recyclables and grant funds. The City also provides a recycling hot-line that individuals may contact with recycling questions.

### **Generation and Diversion**

Based on hauler surveys conducted by the City, it was estimated that household subscription curbside recycling services in 2011 resulted in 9,450 tons of recyclables being collected and diverted from disposal.

Since FY1990-1991, the recycling drop-off facilities have collected 114,163 tons of recyclables. The diversion rate through these facilities peaked at 7,437 tons in FY2007-2008 (see Table 1) and has declined since that time. The decline in volumes collected at the recycling drop-off sites may be attributed to: 1) global recession; 2) reduced size of newspaper and reduced subscriptions; and, 3) increase in curbside recycling subscription. Table 1 shows the distribution of material types and overall tonnages of materials collected at drop-off sites over the past eleven years.

**Table 1 – Summary of Material Tonnages at Recycling Drop-off Sites**

| F.Y.  | Newsprint | Containers |         |       |        | Paperboard<br>& OCC | Mixed<br>Paper | Total<br>Tons |
|-------|-----------|------------|---------|-------|--------|---------------------|----------------|---------------|
|       |           | Aluminum   | Plastic | Glass | Metals |                     |                |               |
| 00-01 | 3,317     | 27         | 178     | 577   | 117    | 732                 | 1,239          | 6,187         |
| 01-02 | 3,222     | 25         | 176     | 569   | 118    | 696                 | 1,236          | 6,042         |
| 02-03 | 3,219     | 32         | 190     | 594   | 133    | 738                 | 1,349          | 6,255         |
| 03-04 | 3,154     | 35         | 200     | 613   | 123    | 739                 | 1,436          | 6,300         |
| 04-05 | 3,161     | 36         | 230     | 628   | 126    | 865                 | 1,511          | 6,557         |
| 05-06 | 3,162     | 39         | 228     | 675   | 129    | 875                 | 1,573          | 6,681         |
| 06-07 | 3,210     | 43         | 281     | 726   | 122    | 966                 | 1,727          | 7,075         |
| 07-08 | 3,101     | 51         | 336     | 853   | 127    | 1,138               | 1,831          | 7,437         |
| 08-09 | 2,474     | 64         | 396     | 928   | 125    | 1,180               | 1,641          | 6,808         |
| 09-10 | 2,155     | 68         | 413     | 978   | 128    | 1,210               | 1,449          | 6,401         |
| 10-11 | 1,932     | 59         | 392     | 940   | 120    | 1,209               | 1,370          | 6,022         |

OCC = Old Corrugated Containers (Cardboard)

While data collected at the Bluff Road Landfill does not allow a clear distinction between residential and commercial municipal solid waste (MSW), the City has utilized information on vehicle types over the past five years and concluded that approximately one-half of the waste delivered to the Bluff Road Landfill and exported to other disposal facilities represents residential waste (the other one-half would represent commercial waste). Using these City values, it was estimated that a total of 152,460 tons of residential waste was sent to disposal from Lancaster County in 2011. While it is not strictly possible to estimate recycling rates (both participation and diversion) from residential sources, if the 6,022 tons handled through the drop-off centers, and the 387 tons of metals from appliance recycling, and 19,493 tons handled through the compost and wood waste programs (FY 2010/2011) are combined with the 9,450 tons collected through residential curbside recycling service (2011 survey) (and assumed to be all from residential sources in the County) it would roughly equate to a 19 percent residential MSW diversion rate in FY 2010/2011 (or 9 percent of the total MSW generation rate). For the estimated 24 percent of residential dwellings having curbside recycling, the per dwelling recycling rate was estimated to be 28 percent. This was calculated based on the following:

- The US Census Bureau report that there were a total of 84,679 occupied housing units in single-unit to four-unit dwellings<sup>1</sup> in Lancaster County
- The US Census Bureau report of an average household size of 2.55 people
- A unit waste generation rate of 3.6 pounds per capita per day
- 24 percent of the single-unit to four-unit dwellings in the Planning Area have curbside recycling and that they diverted 9,450 tons of materials to recycling in FY2010/2011

Statistics from the City of Omaha, Nebraska’s residential waste collection program indicate a recyclables diversion rate of approximately 11 percent (31 percent including yard waste) is achieved by curbside recycling. In Omaha residential curbside recycling is universally available to all residents, but beyond convenience there are no significant economic incentives (residents do not directly pay a fee for waste, yard waste, or recyclables collection) or disincentives.

<sup>1</sup> Source: B25124: TENURE BY HOUSEHOLD SIZE BY UNITS IN STRUCTURE - Universe: Occupied housing units 2008-2010 American Community Survey 3-Year Estimates



Ranges of diversion through residential curbside recycling generally vary from 8 to 25 percent across the United States, with some locations reporting diversion rates of 50 percent.

The NDEQ conducted a series of waste composition studies in 2007 and 2008. The main objectives of these studies were to determine the characteristics of Nebraska's solid waste stream and to establish a baseline of waste characterization data for the state. NDEQ's composition study included four seasonal sampling events (2007 to 2008) at the City's Bluff Road Landfill and separate characterization for residential and commercial waste streams. The figure and tables in Appendix 1 shows the NDEQ composition study results for residential waste. The NDEQ study reports that the three main components (by weight) of the residential waste stream disposed of at the Bluff Road Landfill are paper fibers (37 percent), plastics (20 percent) and food (16 percent).

Select data from the 526 page NDEQ report, relative to the Bluff Road Landfill residential waste composition, are included in Appendix 1. Because of the extensive nature of the composition study and the fact that this landfill is the principal MSW disposal site in the Planning Area this composition information is considered accurate for planning additional diversion programs and has not been modified by national data.

Recyclables disposed of have a secondary market value if they can be diverted from disposal or recovered in a clean (uncontaminated) form. While estimates of detailed waste composition may be useful in evaluating future waste management systems (including increased diversion opportunities), it is equally important to recognize that waste received at the landfill is a heterogeneous mix and that most of these materials are not currently collected or managed in a form conducive to large volume recovery (e.g., they are all mixed together and cross-contaminated by other waste products). For this reason evaluation of recycling alternatives are principally focused on pre-disposal recovery/recycling options.

### **Program (Facility/System) Options**

Residential recycling program options can take many forms and involve differing levels of participants, program/services, and materials. Methods of collecting recyclables vary from community to community across the US, but there are generally four primary methods:

- Curbside collection,
- Drop-off centers,
- Buy-back centers, and
- Deposit/refund programs.

These methods are typically complimented by education and promotional programs. Program options also exist for recovery of waste following disposal, via processing, but these are less common and not discussed in this paper.

Effective residential recycling programs often use combinations of the above options to maximize diversion and address inherent limitations with any one program type. For example, drop-off facilities are commonly utilized in conjunction with community-wide residential curbside collection to provide recycling opportunities to multi-family residents, to provide just-in-time management opportunities (large volume of OCC), and/or to capture certain materials that may not be collected in a curbside program (i.e., glass). Drop-off facilities can also serve small businesses as well as residents from outside the community.

## Curbside Recycling

There are many different types and examples of residential curbside recycling programs across the US. Most utilize some form of bin or container into which residents place recyclable materials for subsequent collection. Materials targeted for recovery through residential curbside programs also vary widely based on markets, program compatibility, and management and handling considerations.

The two most distinct curbside recycling concepts are: 1) multi-stream source separated, and 2) single stream commingled. In the multi-stream concept the resident separates materials into categories such as paper, containers, or by most distinct categories (e.g., paper would be separated by ONP, mixed paper, OCC, etc.); the goal of such programs is to reduce post collection processing costs and reduce possible cross-contamination. In single stream programs all acceptable recyclable materials are placed in a common container(s) and sorted at a remote processing center; such programs are believed to generate higher participation rates and require less intense educational efforts. Single stream programs are often advocated because of the ease and efficiency of collection, but are questioned in terms of optimum diversion because of potential for cross-contamination. There does appear to be a national trend toward single stream programs.

The current subscription based system in the Planning Area is totally voluntary and estimated to serve 24 percent of the occupied households. While increased education (behavior change) may produce some increase in residential recycling, if major increases in the number of residents using curbside recycling is a goal of the Solid Waste Plan 2040, then some form of market regulation or mandated programs will likely be required; this presumes that such collection services would be provided by private service firms, as opposed to municipally operated systems. Market regulation refers to the establishment of requirements for services or that programs operate under a set of rules (regulations) established by the community. Primary types of market regulation include:

- Free market (with minimum service ordinances)
- Franchising (exclusive or non-exclusive)
- Contracts

This paper does not explore the specific legal aspects that would need to be addressed to implement any of the listed market regulation program options.

Free market - minimum service ordinances can take a variety of forms but, in the simplest sense, might obligate a refuse firm to provide (or offer) a certain minimum level of recycling service to refuse customers as part of a license to operate within the community. Ordinance(s) would typically define such aspects as: materials to be collected, frequency of collection, and possibly maximum charges. There are also examples across the United States where refuse collectors have been required to provide refuse collection and recycling at a combined monthly cost of service. One such example is Saint Louis County, Missouri; the Saint Louis County Solid Waste Management Code requires, for one and two family households that a "minimum level of service" of once weekly trash pickup, once weekly recyclables pickup, and twice a year bulky item pickup. The hauler cannot provide less than those three services for one base price. (Source: <http://www.co.st-louis.mo.us/HealthandWellness/RecyclingandSolidWaste/WasteDisposal/TrashandRecyclingService#recyclingservice>, retrieved August 21, 2012). This is viewed as a partial incentive to recycle because customers would be paying for the service, even if they did not use it. Current LMC defines minimum levels of service in terms of frequency of refuse collection, but provides this obligation to the home owner, and allows residents to select their hauling service on a free market basis.

Under a free market, residential-type subscription service, multiple haulers could be driving the same routes (multiple vehicles on same street) to collect materials from one or more households. Collection fees for voluntary/free market subscription curbside residential recycling in Lincoln are generally believed to range from \$5 to \$10 per household per month; the Baseline Assessment/Survey identified a mean value of \$10 per month. Lower numbers of household participants and longer driving distances between stops are viewed as increasing the costs of providing the service. Additionally, not all refuse haulers provide this service.

Curbside residential recycling costs per household decrease through organized collection systems, such as with franchises or contracts, due to inherent efficiencies. Franchising refers to granting the rights or privileges to provide a specific services or services in a specific area. Franchises can be exclusive (one provider) or non-exclusive (more than one provider). Contracts refer to an agreement entered into voluntarily by two or more parties to create a legal obligation (as opposed to a right or privilege). Examples of franchises and contracts that include curbside recycling in the Midwest region are:

- The Cities of Bellevue and Ralston, Nebraska provide once per week collection services for solid waste, recyclable materials and yard waste to all residences (single family and up to three-units or two-units, respectively) within city limits. The cities contract for these services through a private hauler on an exclusive basis. The combined collection, hauling, recycling, disposal and related services are billed to households on a monthly basis through their utility bills; current rates for these services are \$12.50 and \$13.38 per month for Bellevue and Ralston, respectively.
- Tulsa, Oklahoma had 50 or more independent private haulers as well as city collection crews, all operating under an “open territory” system, similar to Lincoln. Tulsa established four collection franchise districts/quadrants (one of which was serviced by the city). The private haulers formed an organization (TRI) to respond as a group to Tulsa’s request for franchise collection services and won the bid for the other three quadrants. TRI reorganized routes to provide a more efficient collection services and then split the routes among its members. Tulsa’s agreement with TRI specifically defined the services to be provided. Tulsa bills its customers for collection and disposal costs as part of its water and sewer bill and pays TRI on a household basis.
- In 2008, Metro Waste Authority (Des Moines, Iowa) solicited proposals and awarded a contract for single stream recyclables collection services for select member communities (cities surrounding but excluding Des Moines) to replace it’s “Curb-It” green bin curbside recycling system. The successful bidder’s price was \$2.39 per household per month for every other week collection service; an alternate bid from this same firm was \$3.60 per household per month for weekly collection services. The prices were based on an estimate that it would initially serve 72,765 households and excluded (from the above rates) the costs of new carts, cart distribution, and cart exchange/replacement.

Standardized collection also makes it easier to implement incentives to recycle (see Recycling Incentives paper). Universally available curbside collection programs have been reported to result in diversion rates of between 10 to 25 percent of the residential waste stream (based on approximately 50 percent participation), with higher rates in more aggressive programs.

The market regulated options described above presume that the availability of curbside collection services is mandated and provided universally to (all) residential dwellings, but residents’ participation is voluntary. For purposes of this paper the term “universal” recycling is used to refer to options where the availability of services is mandated but participation is voluntary.

The term “mandatory recycling” has recently taken on a different connotation across the United States; the concepts that are currently receiving significant attention are programs being implemented in locations such as Seattle, Washington; Pittsburg, Pennsylvania; and San Diego and San Francisco, California. These programs use ordinances, enforcement, and fines to ensure recycling. Two examples of such mandatory recycling programs are summarized as follows:

- In Seattle, Washington, recycling is required by law; a “City ordinance bans recyclable paper, cardboard, glass and plastic bottles, and aluminum and tin cans from garbage containers.” “Garbage containers that contain more than 10 percent of recyclables will not be emptied. Haulers will leave instructions to remove recyclables before the following week’s collection” (Source: Seattle Public Utilities, “Recycle at Your House,” [http://www.seattle.gov/util/Services/Recycling/Recycle\\_at\\_Your\\_House/index.asp](http://www.seattle.gov/util/Services/Recycling/Recycle_at_Your_House/index.asp), retrieved on 09/10/2009).
- In Pittsburg, Pennsylvania, “all residents of the City of Pittsburgh must separate recyclable items from household trash and package them for bi-weekly recycling curbside collection or take them to a City recycling drop-off center.” “The operator of every business establishment [and apartment over 6 units] located within the City of Pittsburgh must establish a program to recycle high grade office paper, plastic bottles, corrugated cardboard, aluminum cans and leaf waste, where applicable” (Source: Pittsburgh Public Works, “Recycling,” <http://www.city.pittsburgh.pa.us/pw/html/recycling.html> retrieved on 09/10/2009).

The extent of fines and degree of enforcement in these mandatory programs vary with the individual programs. In addition, the driving force for such programs may be a function of state law or other factors. Mandatory (statutorily required) recycling with imposed fines or penalties, as described above, is a social and culturally driven decision. Whereas universal programs look to expand services and provide motivation to voluntarily recycle.

While the USEPA no longer maintains its curbside collection website, it does continue to publish information that provides a relative measure of curbside residential recycling collection costs based on various frequencies of collection, set-out methods and diversion rates; this information is summarized in Table 2. This evaluation is based on a single provider within a given service area.

USEPA identifies the primary impacts on the per-ton or per-household costs of curbside collecting recyclables as being a function of the following:

- **“Costs increase with the number of separately segregated commodities collected.** Single-stream collection programs (all recyclables combined in a single bin/container) are the least costly to collect, followed by two-stream (two containers/separations), etc.
- **Costs increase with the frequency of collection.** Collecting half as frequently as waste pick-up (e.g., every other week instead of weekly) can reduce collection costs by approximately 25 percent, assuming traditional two-stream [excluding yard waste] set-outs.
- **Costs decrease as more materials are collected by the program.** If few households participate in the program and the program does not collect many commodities, the per-household cost soars, as it is costly to drive a recycling truck past household after household that has not set out recyclables.”

(Source: [www.epa.gov/waste/conserve/tools/localgov/economics/index.htm](http://www.epa.gov/waste/conserve/tools/localgov/economics/index.htm), retrieved on 09/10/2009).

**Table 2 – Collection Costs for Various Frequencies of Collection, Set Out Methods and Diversion Rates**

| Variable                           | Two-Sort Set Out               |                                     | Single-Stream Set Out          |                                 |                                     |
|------------------------------------|--------------------------------|-------------------------------------|--------------------------------|---------------------------------|-------------------------------------|
|                                    | Once a Week—<br>High Diversion | Every Other Week—<br>High Diversion | Once a Week—<br>High Diversion | Once a Week—<br>Lower Diversion | Every Other Week—<br>High Diversion |
| Solid waste/household (tons/year): |                                |                                     |                                |                                 |                                     |
| Disposed                           | 0.60                           | 0.60                                | 0.60                           | 0.80                            | 0.60                                |
| Recycled                           | 0.40                           | 0.40                                | 0.40                           | 0.20                            | 0.40                                |
| Percent diverted                   | 40%                            | 40%                                 | 40%                            | 20%                             | 40%                                 |
| Pounds/household/collection day    | 15.38                          | 30.77                               | 15.38                          | 7.69                            | 30.77                               |
| Cost/household/year                | \$58.67                        | \$45.76                             | \$54.40                        | \$52.15                         | \$32.86                             |
| Cost/ton                           | \$141                          | \$103                               | \$139                          | \$278                           | \$89.38                             |

Source: <http://www.epa.gov/wastes/consERVE/tools/localgov/economics/collection.htm>

### Drop-off Centers

The 36 facilities across the Planning Area provide an excellent example of residential recycling drop-off (convenience) centers. Again, the locations and map of these sites can be found in the *Lincoln-Lancaster County's Official 2012 Waste Reduction & Recycling Guide*. Drop-off centers were the predominant strategy used in many communities as they began recycling programs decades ago. They were considered easy to implement, low tech, and a cost effective way of meeting a community's demand for recycling. They require a site (possibly with some level of security), containers, service and maintenance (including contaminant removal), and a method of collection, processing and marketing materials. Multiple facilities are required in communities such as Lincoln to be truly convenient. Facilities can be staffed or un-staffed; however, staffing significantly increases costs – most drop-off centers in the US, including those in the Planning Area are un-staffed. A key issue with drop-off centers is the quality of materials deposited; the greater the failure to comply with establish program requirements the higher the cost, both in terms of contaminants and processing. Illegal dumping of household waste at un-staffed recycling drop-off centers can also be an issue.

The advantage of the drop-off center strategy for residential recycling is that it may be a low cost and low tech option. The City records indicate that over the past five fiscal years the recycling drop-off centers have operated at an average cost of \$75 per ton of material recycled (operating costs divided by tons; operating costs include amortized capital costs). Over the same five fiscal years the City received an average revenue of \$56 per ton of material recycled. As such, the average net cost per ton diverted has been approximately \$19 over past five fiscal years. The disadvantage is that drop-off centers rely heavily on public desire and commitment to participate (e.g., collect and transport materials to the remote site(s)), because it is less convenient than curbside recycling. Participation may also require an added level of commitment to store and transport the material to the collection site. As such, this approach is not considered as effective as curbside recycling in encouraging regular participation in recycling. However, because most drop-off sites in the Planning Area are accessible 24/7 they

make it easy for residents to use. Drop-off centers also provide one option for multifamily residential dwellings that cannot be effectively served by curbside programs.

Drop-off programs are generally not well suited for the disabled, elderly, or mobility restricted.

Waste exchanges and targeted materials programs are a form of drop-off centers that generally focus on non-traditional materials (e.g., materials that are more difficult to collect and/or recycle). Keep Nebraska Beautiful currently operates the Nebraska Materials Exchange Program, which focuses more on schools and businesses than residential services. Expanding material reuse centers/waste exchange (public/private partnerships) have generally been discussed in technical papers related to source reduction. Facilities that target and process hard-to-recycle items, such as books, textiles, shoes, cooking oil, etc., are an advanced component of diversion programs. These facilities are commonly operated by public or non-profit organizations and vary widely in service levels. An example of this type of facility is the EcoCycle/City of Boulder, Colorado's Center for Hard-to-Recycle Materials ([www.ecocycle.org/charm](http://www.ecocycle.org/charm)). Targeted programs can also include specific materials such as plastics (bags, film and single use containers), foods, and fibers. Targeting greater diversion of foods and fibers (i.e., organics) is further described and evaluated in the Organics Waste Diversion (Composting) paper.

Material reuse/waste exchanges and targeted materials programs are not further evaluated in this paper.

### **Buy-Back Centers**

Buy-back centers are similar to drop-off centers except they pay users for materials brought to the center. By themselves, these do not achieve high levels of residential diversion but do provide a financial incentive to divert select materials. These are more commonly a retail business that targets select materials, such as a scrap yard, that buys metals by type (e.g., aluminum, brass, ferrous). The most common material diverted, from the standpoint of residential buy-back recycling, is aluminum cans; a more common version may be automobile and bulk metals scrap yards. Buy-back centers have also been reviewed under the paper on Source Reduction as a means of preventing materials from entering the waste management system.

Typically buy-back centers pay for materials based weight and on a percentage of commodity market prices.

### **Deposit/Refund Programs**

From a residential recycling perspective, these programs typically target beverage cans or bottles. As such, deposit/refund programs only target a small percentage of the potentially recyclable materials generated at a residential level.

The deposit/refund is typically added to the initial sale price. When an empty bottle or can is returned to a redemption location or collection center the original deposit is refunded. Other examples applicable to residential recycling are discussed in papers under Zero Waste, Product Stewardship, and Source Reduction and include materials such as batteries.

Beverage container type recycling programs, also known as "bottle bills", are typically implemented at a state level due to management and enforcement considerations. Iowa is one near by example of a state that has a beverage container law. In California the Department of Conservation establishes a minimum per-pound repurchase rate for redeemed beverage container types: aluminum, glass, plastic and bi-metal.

## Options Evaluation

The general issues associated with residential recycling programs are:

- convenience
- participation and diversion goals
- costs of services and funding
- implementation considerations

Implementation considerations are of particular relevance for a universal curbside recyclables collection option, based on the Planning Area's current curbside recyclables subscription system and free market refuse collection. Residential recycling program options can be tailored to specific community's desires, goals and policies. The preferable method for any given community is a function of community desires, costs, diversion goals, public and institutional support, and implementation processes. Educating households and encouraging participation are considered requirements to optimize the success of any residential recycling program.

Consistent with the guiding evaluation criteria developed for use in the Solid Waste Plan 2040, the residential recycling options have been further evaluated based on the considerations shown in Table 3. To significantly increase diversion of residential waste through recycling a combination of City-wide, universal curbside recycling collection along with strategic drop-off centers and continuation of private and non-profit organizations collection sites would likely be necessary. Such a combination of programs would maximize community participation and program effectiveness. Because of the specialty nature of programs such as buy-back centers and deposit/refund programs, and the relatively low level of total diversion achieved through these programs alone, they are not further evaluated. It is generally assumed that in the final Solid Waste Plan 2040 development that continuation of existing buy-back centers would be encouraged, to the extent they are compatible with the final plan.

**Table 3 – Options Evaluation**

| <b>Evaluation Criteria</b>        | <b>Curbside Collection</b>  | <b>Drop-off centers</b>  |
|-----------------------------------|---|--|
| <b>Waste Reduction/ Diversion</b> | <p>Existing programs are considered effective for subscribers and provide diversion opportunities; Fees and lack of universal availability limit participation and diversion quantities.</p> <p>Current subscription curbside collection services divert approximately 2.5 percent of the Total MSW stream.</p> <p>Participation rates and diversion potential increase substantially with convenient, universally-provided curbside recyclables collection.</p> <p>Provides the highest level diversion option for residential recyclables when universally available. Higher levels of diversion can be achieved if use of such programs is mandatory.</p> <p>Properly implemented, single-stream collection systems have been shown to have greater participation and collect more materials per household than multi-stream, source separation systems.</p> | <p>Existing programs are considered effective and provide diversion opportunities; The lack of a direct fee and 24/7 access is an incentive to participated.</p> <p>By itself this approach will not maximize residential waste recycling.</p> <p>The relative convenience, compared to curbside collection, is a limiting factor in participation rates and quantities diverted.</p> <p>Current drop-off facilities divert approximately 1.6 percent of the Total MSW stream.</p> <p>Development of new drop-off center locations may not proportionally increase participation or diversion.</p> |
| <b>Technical Requirements</b>     | <p>Recyclables processing capacity will need to be evaluated for ability to process significantly greater quantities of recyclables; not all existing processing facilities may benefit from a City wide collection program. Expanded or new processing capacity may be required.</p> <p>Curbside collection is compatible with other program elements.</p> <p>Additional service opportunities would be created by a universally available collection program. Not all</p>   | <p>Existing processing centers are assumed to have adequate capacity for modest increase in diversion.</p> <p>Existing drop-off centers are compatible with other program elements.</p> <p>Continuing select drop-off centers in the Planning Area (in conjunction with City-wide curbside recycling) will provide convenience, accessibility and participation to residents and small businesses not served by a collection program.</p> <p>Drop-off programs are highly reliable due to 24/7</p>   |



| Evaluation Criteria         | Curbside Collection  | Drop-off centers   |
|-----------------------------|--|--|
|                             | <p>existing haulers (recyclables and waste) may benefit from a City wide collection program.</p> <p>Curbside collection and drop-off centers are compatible and together optimized residential recycling diversion opportunities.</p> <p>This approach is widely used across the US and is considered highly reliable/low risk. The primary risk is with market prices for collected materials. Under a voluntary system, residents may be provided curbside recycling opportunities but may choose not to participate.</p>  | <p>availability. This is considered a low risk approach. The primary risk is with market prices for collected materials.</p>   |
| <b>Environmental Impact</b> | <p>Provides greatest opportunity to divert recyclable materials from the residential waste stream disposed. Increased recycling helps further conserve resources and extends the life of Bluff Road Landfill.</p> <p>The USEPA has determined that recycling reduces greenhouse gas emissions and better protects the environment, as compared to disposal options.</p> <p>The greater the efficiency of a curbside recycling program the potentially greater net environmental benefit.</p> <p>Issues that would need to be addressed in a universally available curbside recycling program would include traffic (safety) and air emissions if multiple haulers were to be collecting recyclables in the same neighborhood.</p> <p>Similar to curbside collection of refuse, litter is a concern that needs to be addressed.</p> | <p>Provides for conservation of resources but does not optimized diversion.</p> <p>Residents may continue to dispose of recyclables with refuse due to lack of convenience.</p> <p>Air emissions also result from the residents traveling to the drop-off centers, although it is likely that residents combine trips to the drop-offs with other destinations.</p> <p>Illegally dumped refuse and litter can be issues at unattended drop-off centers.</p> <p>Health and safety can also be a concern at unattended drop-off centers.</p> |

| Evaluation Criteria                    | Curbside Collection   | Drop-off centers   |
|--|---|--|
| <p><b>Economics</b></p>                | <p>Service providers under an expanded program would need to expend capital to provide for increased collection and handling costs.</p> <p>The costs of added curbside recyclables collection would likely be borne directly by residents. Current program costs are borne by those who choose to subscribe/participate.</p> <p>Cost per ton of material diverted (and as a result cost per household) should decrease with more efficient collection programs and higher participation rates.</p> <p>Curbside recycling and refuse collection could be required as a combined monthly cost of service.</p> <p>Expanded collection services will likely represent business and employment opportunities for firms providing such service.</p> <p>Assuming continued private sector collection services, this does not rely upon government funding to implement or sustain program.</p> <p>Selective reduction of the number of drop-off centers can reduce City funded drop-off program operating costs.</p> | <p>The costs of current and possibly added drop-off centers represent a cost to the City, which will ultimately be borne indirectly by all residents and businesses through the Occupation Tax.</p> <p>Development of new drop-off centers is a capital investment and will require a budget appropriation. NDEQ grants may be a source for capital improvements.</p> <p>Requires a funding commitment by the City; is not considered a net revenue generator.</p> <p>Potential revenue loss with theft of higher value recyclables.</p> <p>Not considered to have economic development potential.</p> |
| <p><b>Implementation Viability</b></p> | <p>Not a new technology and has been proven viable.</p> <p>Will likely require modification to the LMC to implement a universally available system.</p> <p>Some opposition to change should be anticipated.</p> <p>Requires promotion and education to maximize and maintain participation.</p> <p>Assuming private haulers provide residential curbside</p>  | <p>Not a new technology and has been proven viable.</p> <p>No regulatory changes required for continuation of existing programs. Continued City funding and funding for expansion would be required to sustain the program.</p> <p>Requires promotion and education to maximize and maintain participation.</p> <p>Additional land/sites would be required for program</p>   |

| Evaluation Criteria | Curbside Collection  | Drop-off centers  |
|---------------------|--|---|
|                     | <p>recycling services they would likely have primary responsibility for expanded program implementation.</p> <p>City would likely need to work with existing haulers and/or processing facilities to implement an acceptable, expanded program.</p> <p>City may need to define minimum level of service; a totally voluntary program may not ensure consistency of approach.</p> <p>If universally available curbside program is implemented, the City will need to evaluate the network of existing drop-off centers to determine how to best serve rural areas, high density, multi-family residential units and small businesses.</p> <p>Implementation of an expanded curbside collection program can be implemented quickly (less than 1 year), if desired.</p> | <p>expansion.</p> <p>If the drop-off program is expanded, siting requirements for recycling drop-off centers may need to be investigated.</p> |

## Relationship to Guiding Principles and Goals

The current recycling program of voluntary, subscription curbside recyclables collection, public and private drop-off facilities, buyback centers, and education outreach involves public/private partnerships and provides opportunities to engage the community in diverting materials to recycling. However, the absence of a universally available city-wide curbside collection program (due to rates of subscription) limits the extent of recyclables diversion. As it relates to the Guiding Principles and Goals of the Solid Waste Plan 2040, the possibility of expanding residential recycling is directly applicable, as further noted below.

- **Emphasize the waste management hierarchy:** Recycling is one of the most preferred waste management methods in the hierarchy (immediately after reduce and reuse) in that it places maximum emphasis on options to recover materials and recycle them into new products. Current programs are compatible with this hierarchy. To increase recycling above the status quo, the convenience and mandate of a city-wide, universally-provided curbside collection should result in significantly higher level of residential recyclables diversion.
- **Encourage public/private partnerships:** The current system of recycling involves both public and private efforts including subscription curbside recyclables collection provided by private firms, private recycling processing centers, City provided drop-off sites, City provided education and promotional outreach, and private buy-back centers. If a city-wide (universally available) recycling curbside collection program is selected for implementation it is expected to be developed with private parties providing collection and processing services. Services by non-profits, privates, and public/private partnership, buyback centers, special materials take-backs, and thrift stores are expected to continue and complement any decision to implement an expanded residential curbside recycling program.
- **Ensure sufficient system capacity:** Three private recycling processing centers, serving residential and business customers, operate in the City and others are available in the region. Available processing capacity may need to be evaluated as part of any program that significantly expands recycling diversion rates to determine the need for additional processing capacity and facilities.
- **Engage the community:** Any expanded residential recycling and curbside collection program would need to engage the residents and businesses to encourage them to divert more recyclables from disposal and possibly increase their knowledge of conservation, source reduction and reuse alternatives. Optimizing the success of an expanded residential curbside recycling program will also require education (behavior change) to encourage participation and sustain participation.
- **Embrace sustainable principles:** Maximizing recovery of materials through recycling into new products recognizes that waste is not inevitable and discarded materials are potentially valuable resources.

## Summary

Recycling turns materials that would otherwise become waste into valuable resources. It also reduces greenhouse gas emissions and conserves space in landfills. The City supports and promotes public and private recycling efforts by providing a wide array of services. Currently an estimated 24 percent of the residential households voluntarily subscribe to curbside recycling services. It is estimated that approximately 19 percent of the residential MSW is currently recycled. It is likely that a major increase in the number of residents using curbside recycling

will required some form of market regulation or mandate. Market regulation refers to the establishment of requirements for services or that programs operate under a set of rules (regulations) established by the community. There are numerous examples across the United States of voluntary and mandatory recycling programs that achieve higher levels of residential waste diversion than are currently achieved in the Planning Area.

To significantly increase diversion of residential waste, through recycling, a combination of City-wide, universal curbside recycling collection along with strategic drop-off centers and continuation of private and non-profit organizations collection sites would likely be necessary. Drop-off centers are not as effective as curbside recycling in encouraging regular participation in recycling and are not viewed as a singular option to optimize diversion.

The general issues associated with the current Planning Area residential recycling programs are convenience, participation and diversion levels, costs of services, efficiencies, funding of new programs, service providers, processing capacity, and implementation considerations. Residential recycling program options can be tailored to specific community's desires, goals and policies. The preferable method for any given community is a function of community desires, costs, diversion goals, public and institutional support, and implementation processes.

There are many types of program options available, all of which are essentially consistent with the Solid Waste Plan 2040 guiding principles and the waste management hierarchy. Of the program options available, city-wide (universally-available) curbside recycling appears to provide the greatest opportunity to maximize residential recycling (rates and quantities) and minimize landfill disposal of solid waste. If the Solid Waste Plan 2040 incorporates universally available, city-wide curbside recycling, the City will need to evaluate the number and location for drop-off centers, to be used in conjunction with such a program. If the Solid Waste Plan 2040 incorporates universally available, city-wide curbside recycling the City would also need to evaluate minimum levels of service, how to fund such services, and how to most effectively/efficiently implement such a program.

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## Appendix

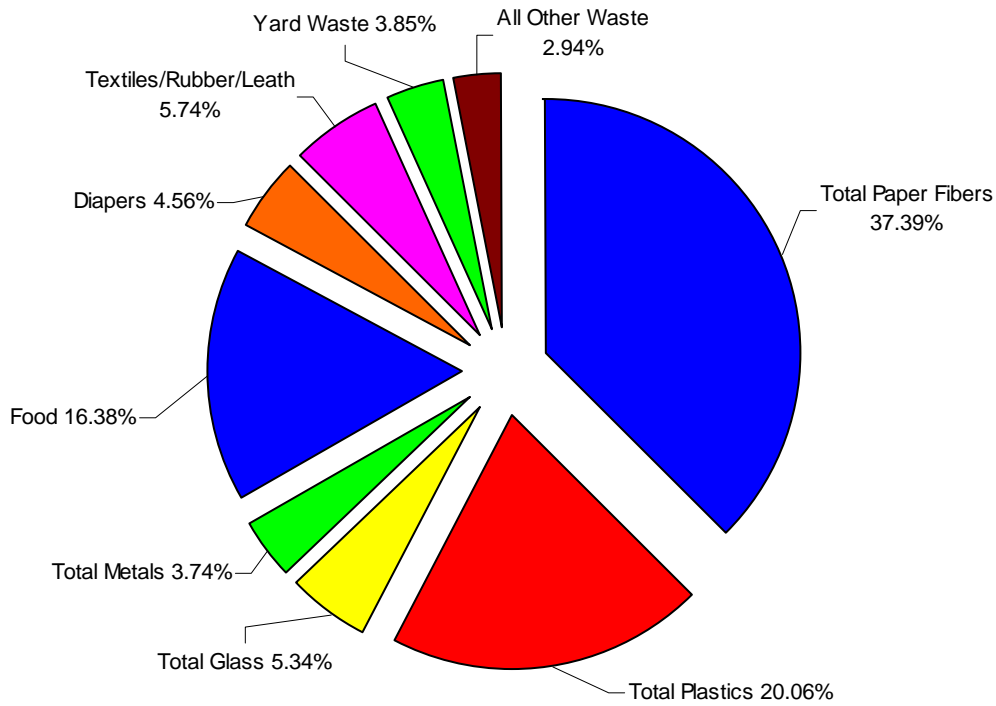




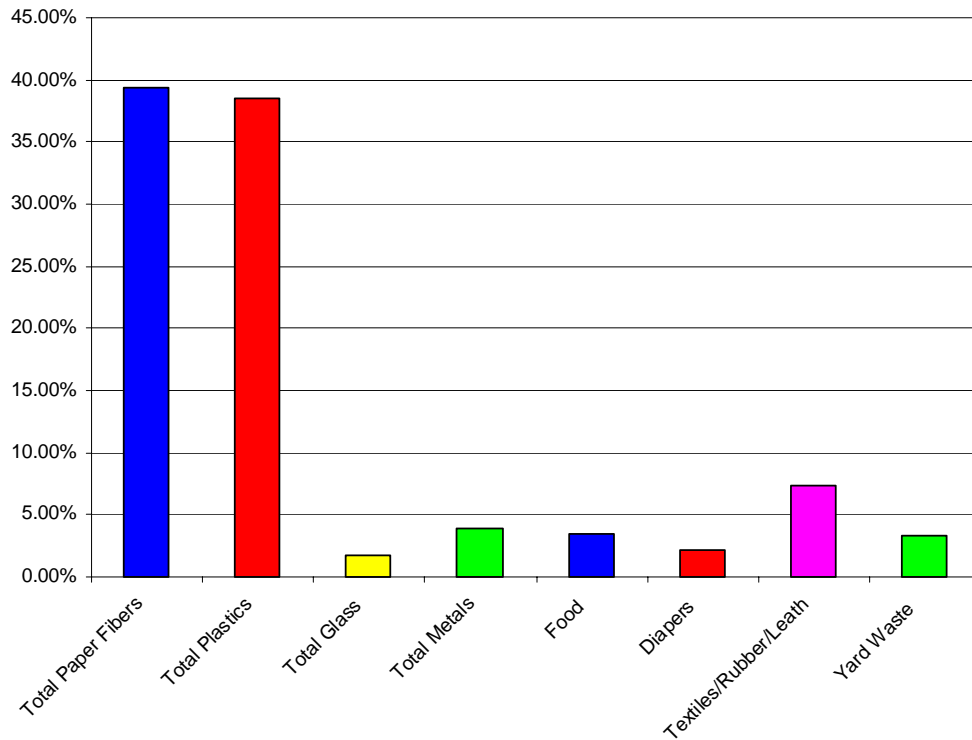
# APPENDIX 1

TABLE B.19  
RESIDENTIAL WEIGHT DATA SUMMARY FOR THE BLUFF ROAD LANDFILL

| Material Category/Component          | Net Weight<br>(pounds) | % of Material<br>Category | % of Sorted<br>Sample |
|--------------------------------------|------------------------|---------------------------|-----------------------|
| Cardboard                            | 257.85                 | 4.02%                     | 1.50%                 |
| Office Paper                         | 683.93                 | 10.67%                    | 3.99%                 |
| Newsprint                            | 1,151.88               | 17.97%                    | 6.72%                 |
| Magazines                            | 886.67                 | 13.83%                    | 5.17%                 |
| Paperboard/Liner Board               | 999.01                 | 15.58%                    | 5.83%                 |
| Mixed Paper                          | 2,432.27               | 37.94%                    | 14.19%                |
| <b>TOTAL PAPER FIBERS</b>            | <b>6,411.61</b>        |                           | <b>37.39%</b>         |
| PET #1                               | 488.16                 | 14.19%                    | 2.85%                 |
| HDPE #2                              | 322.39                 | 9.37%                     | 1.88%                 |
| Other Numbered Containers            | 514.16                 | 14.95%                    | 3.00%                 |
| Plastic Film/Wrap/Bags               | 1,322.42               | 38.45%                    | 7.71%                 |
| Other Plastics                       | 792.27                 | 23.04%                    | 4.62%                 |
| <b>TOTAL PLASTICS</b>                | <b>3,439.40</b>        |                           | <b>20.06%</b>         |
| Clear Glass Containers               | 536.42                 | 58.59%                    | 3.13%                 |
| Brown Glass Containers               | 227.41                 | 24.84%                    | 1.33%                 |
| Green Glass Containers               | 115.94                 | 12.66%                    | 0.68%                 |
| Blue Glass Containers                | 1.08                   | 0.12%                     | 0.01%                 |
| Other Glass                          | 34.71                  | 3.79%                     | 0.20%                 |
| <b>TOTAL GLASS</b>                   | <b>915.56</b>          |                           | <b>5.34%</b>          |
| Aluminum Cans                        | 197.10                 | 30.70%                    | 1.15%                 |
| Tin Cans                             | 317.17                 | 49.40%                    | 1.85%                 |
| Other Aluminum                       | 53.25                  | 8.29%                     | 0.31%                 |
| Other Tin                            | 26.22                  | 4.08%                     | 0.15%                 |
| Other Mixed Metals                   | 48.36                  | 7.53%                     | 0.28%                 |
| <b>TOTAL METALS</b>                  | <b>642.10</b>          |                           | <b>3.74%</b>          |
| Food                                 | 2,807.68               |                           | 16.38%                |
| Diapers                              | 782.43                 |                           | 4.56%                 |
| Textiles/Rubber/Leather              | 984.01                 |                           | 5.74%                 |
| Yard Waste                           | 660.64                 |                           | 3.85%                 |
| Household Hazardous Waste            | 3.85                   |                           | 0.02%                 |
| Electronic Waste                     | 80.88                  |                           | 0.47%                 |
| Dry-Cell Batteries                   | 21.35                  |                           | 0.12%                 |
| Misc. C/D Waste                      | 2.37                   |                           | 0.01%                 |
| Wood                                 | 67.65                  |                           | 0.39%                 |
| Empty Aerosol Cans                   | 34.87                  |                           | 0.20%                 |
| Non-Distinct Waste                   | 286.29                 |                           | 1.67%                 |
| Other Misc. Wastes                   | 5.38                   |                           | 0.03%                 |
| <b>TOTAL WEIGHT OF SORTED SAMPLE</b> | <b>17,146.07</b>       |                           | <b>100.00%</b>        |



**CHART B.3**  
**DISTRIBUTION OF THE CONSOLIDATED RESIDENTIAL**  
**WEIGHT DATA FOR THE BLUFF ROAD LANDFILL**



**CHART B.4**  
**DISTRIBUTION OF THE CONSOLIDATED RESIDENTIAL**  
**VOLUME DATA FOR THE BLUFF ROAD LANDFILL**