Report

Construction and Demolition Diversion Capacity Study

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Prepared for

Hennepin County

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Construction and Demolition (C&D) Diversion Capacity Study

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Executive Summary

The greater Twin Cities Metro Area is fortunate to have a competitive environment with multiple mixed C&D haulers, transfer stations and processors. There is ample capacity within the Metro Area construction and demolition (C&D) industry infrastructure to collect and process more materials. Collectively, the five C&D processors located in the Metro Area could handle more materials.

Individual end use commodity markets currently limit recovery and recycling, and each market has their own demand profile. There is significant potential for growth in the higher value or higher volume materials that remain in the mixed C&D waste stream which include: clean (unpainted/untreated) wood, concrete, cardboard, and metals. Commodities that have promise for additional recovery with moderate market development efforts include: asphalt shingles, sheetrock and vinyl siding. Commodities with end use applications that are challenged include: painted/treated wood, dirt/fines (e.g., for beneficial use as alternative daily cover), brick, various types of other plastics, textiles/carpet, and glass. Market development efforts can and should be conducted by both the public and private sectors.

Source separation at job sites, including reuse and direct haul to markets, provides a base for C&D diversion. This practice will continue especially for the higher volume and/or higher value commodities such as readily reusable construction materials (e.g., higher value cabinets and fixtures), old growth wood (e.g., Douglas fir), non-ferrous metals, and concrete. Depending on the demolition contractor and quality of recoverable materials, some salvage and recovery may occur from residential buildings scheduled before demolition. For example, metals, higher value fixtures, and other valuable commodities are sometimes removed for recycling or reuse before a building is torn down. The awareness and utilization of these diversion opportunities is generally not optimized even though the higher value commodities have relatively strong end use demand. A significant amount of these valuable materials is still being landfilled.

The price of C&D material landfilling is generally lower than the cost of recycling or other diversion. The relatively higher costs of labor and capital required to separate, recycle, or re-condition materials for reuse continues to be a barrier to increased diversion. C&D landfills serving the Metro Area charge around $40 per ton. (This is an average and some still charge on a cubic yard or volume basis, not weight.) Other studies have found that C&D landfill disposal needs to be at least $50 per ton in order for the C&D diversion rates to be more extensive. Nonetheless, the Metro Area has five (5) C&D processors (with elevated sorting conveyors and other processing equipment) that are able to sustain their businesses, in part because most are associated with C&D landfills. The conservation of C&D landfill airspace through recovery helps extend the life of their landfills. This landfill space conservation was mentioned by several of the vertically integrated companies interviewed for this study.

Many construction contractors and building owners want to recycle as much of their C&D waste as possible and are willing to pay a premium compared to simple disposal. Programs such as LEED and B3 have helped stimulate the visibility of the importance of recovery. Often it is the

building owner's customers who help shape the demand to "green construction" practices such as recycling. The Hennepin County cities interviewed for this study did not require a waste management plan (e.g., to identify reuse and recycling opportunities) as part of their construction and demolition permitting processes.

Recovery of some materials is not cost effective. However new and expanded markets continue to be found by C&D processors as they look to expand their outlets for their recycled materials. A requirement to expand use of recycled construction materials (e.g., concrete, shingles, asphalt, etc.) in building projects would assist market development.

The residential deconstruction (e.g., careful dismantling of reusable construction materials) market niche barely exists in the Metro Area. Intentional and planned diversion from the residential deconstruction sector is specialized. The organizations involved in contract deconstruction have specific criteria for selecting the buildings for deconstruction projects based on the quality of the construction materials. Deconstruction work is very labor intensive and currently not cost-competitive with simple demolition and disposal. Organizations that are active within the deconstruction niche rely on lower skilled, lower cost sources of labor. For example, one of the deconstruction organizations interviewed employs ex-offenders consistent with its non-profit mission. Another deconstruction firm uses laborers that are still in a prison. Further development of the deconstruction industry coupled with the environmental and tax benefits of reuse of these materials may help lower future costs of deconstruction.

There is a lack of awareness about retail construction materials outlets to support deconstruction. For example, the contractors interviewed for this study consistently reference closing of the ReUse Center in South Minneapolis several years ago as one reason for no longer saving and delivering reusable construction materials. Today, there are a several other used construction material stores in the Twin Cities area. These reuse stores play an important role, but have limited impact on the overall C&D industry.

The space needed to store and display for sale the wide variety of reusable construction materials is one of several barriers to growth of reuse retailers. Other barriers include: limited knowledge of homeowners and do-it-yourselfers of the availability of reused materials; limited knowledge of how to incorporate reused materials into projects; a lack of awareness of what reuse retail opportunities exist; and a lack of convenience of reuse retail outlets (hours and locations).

The most recent Minnesota Pollution Control Agency (MPCA) data from 22 permitted facilities located in the Metro Area indicates that about 810,800 tons in 2013 of mixed C&D was landfilled or recycled. MPCA calculates a Metro C&D diversion rate of 30 percent (242,400 tons recycled) based on permitted facility reports alone. This diversion rate is very low compared to earlier targets suggested in the Minnesota Construction, Demolition and Industrial (CD&I) Waste Study conducted for the MPCA and Solid Waste Management Coordinating Board (SWMCB) and published in 2007. Additional diversion takes place directly from large job sites to end markets and reuse opportunities, but these tons are not included in MPCA or county permit reports.

List of Abbreviations, Acronyms, and Definitions

AA	Architectural Antiques
ADC	Alternative daily cover
Btu	British thermal unit
C&D	Construction and demolition waste
CD&I	Construction, demolition & industrial waste
CDRA	Construction & Demolition Recycling Association
CMUs	Concrete masonry units
CORR	RCI's Protocol and Certification of Real Rates program to verify reuse and recycling rates of building materials.
Fines	Smaller particles sorted from mixed C&D waste for use as ADC and are typically 2-inch minus in size.
Foth	Foth Infrastructure & Environment, LLC
CCA	Chromated copper arsenate
HDPE	High-density polyethylene
HMA	Hot mix asphalt
LEED	Leadership in Energy and Environmental Design
LDPE	Low-density polyethylene
LLC	Limited liability corporation
MDF	Medium-density fiberboard
Mn/DOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MRF	Materials recovery facility
MSW	Mixed municipal solid waste
OCC	Old corrugated cardboard
Processing residual	C&D waste material remaining at the end of a processor's sort line containing items that do not have economic value.
PS	Polystyrene
PP	Polypropylene
PVC	Polyvinyl chloride – A type of plastic often used in construction materials (e.g., siding). Also referred more simply as "vinyl".
RAS	Recycled asphalt shingles
RCI	Recycling Certification Institute

USGBC	U.S. Green Building Council

1. Introduction

1.1. Purpose of This Study

The intent of this study is to determine the amount of C&D materials generated, the rate of diversion, and the capacity for additional diversion. C&D diversion and recycling can complement existing programs for reuse and recovery from traditional mixed municipal solid waste (MSW) as available estimates of tonnages generated indicate that C&D materials volumes can be nearly as large as MSW. Challenges such as a lack of accurate data about current generation and diversion rates for C&D materials exist and are explored.

This Hennepin County *C&D Diversion Capacity* study provides data about the current C&D reuse and recovery infrastructure as background information. This study helps identify key barriers and opportunities through direct interviews and other contacts with key city and industry representatives.

1.2. Data Limitations

This project does not include a field composition study where materials are actually sampled and sorted into categories. Therefore, C&D waste composition estimates used in this Hennepin County study are from previous 2006 field sort analysis conducted for the Solid Waste Management Coordinating Board (SWMCB) and MPCA.

Hennepin County does not issue building construction or demolition permits; this function is handled by cities. This project involves review of current practices for demolition permits by selected cities within the county. Current city barriers and opportunities to increase C&D diversion are explored from the perspective of city staff charged with administering construction and demolition permits.

The C&D recycling infrastructure in the Twin Cities metro area is entirely owned and operated by private companies, with the exception of limited MSW transfer and recovery facilities that may handle incidental C&D materials mixed into the MSW. Private companies often elect to hold data as confidential as a means to protect their individual proprietary interests. This Hennepin County study recognizes this need for confidential information to help stimulate competition and growth. The data gathering and reporting methods were designed explicitly to protect proprietary information.

There are few standardized definitions and data protocols within the industry other than common practice. MPCA and the counties require only a minimum of information in annual facility permit and license reports. Some C&D facilities do not report to Counties. Therefore, it is challenging to provide a detailed analysis of diversion capacity by specific commodity. Professional assumptions must be made to accommodate the lack of verifiable, standardized data.

2. Methods

2.1. Review of Past C&D Studies in Minnesota

A series of previous studies have been conducted in Minnesota that are directly relevant and serve as useful background for this Hennepin County *C&D Diversion Capacity Study*. For example, the Solid Waste Management Coordinating Board (SWMCB) commissioned Foth to conduct a study published in 2007 to evaluate the construction, demolition, and industrial wastes (CD&I) to determine what could potentially be recovered for reuse, recycling, or creation of energy or compost.[1] The CD&I Study project partners included the MPCA, SWMCB and the Minnesota Solid Waste Administrators Association.

Other notable studies include the MPCA 2013 Statewide Waste Characterization study of MSW composition and tonnage as disposed.[2] In this 2013 study, MPCA staff estimated about 2.9 million tons of MSW were disposed Statewide in 2012, including 1.6 million tons from the Metro Area.

In a recent MPCA in-house review of C&D waste generation and recovery[3], MPCA staff estimated that 1.3 million tons of C&D were disposed Statewide in 2013, including about 568,000 tons of C&D disposed in Metro Area C&D landfills.

A literature review was conducted of resources from Minnesota and in other parts of the country. A series of national trade associations web sites were reviewed including (but not limited to): Construction Demolition & Recycling Association (CDRA), Reclamation Administration, and Recycling Certification Institute (RCI). Appendix A contains a summary of selected results of this literature review from a wide variety of local and national sources.

2.2. Data Sources

2.2.1. Stakeholder Interviews and Site Visits

Together with Hennepin County staff, Foth compiled a list of selected stakeholders to interview and conduct on-site visits. Customized questionnaires were developed for each of the categories of stakeholders. Hennepin County staff reviewed, edited and approved these questionnaires. Foth then made arrangements for phone or in-person interviews. The interviews resulted in completed questionnaires. If site visits were conducted, photos were taken and logged if permission was granted by the interviewee. Draft questionnaire results were sent to selected interviewees to help build credibility with the C&D industry transfer station, processors and landfill representatives. The results of these interviews are compiled in Sections 3 – Results and Section 4 – Materials End Markets by Commodity.

2.2.2. MPCA and SWMCB Data

The 2007 SWMCB CD&I Study serves as a primary reference for this Hennepin County study. The detailed C&D composition by source type and commodity is contained in Appendix A.1.a.

In addition to individual facility reports, MPCA recently conducted an unpublished analysis of C&D waste disposal and recycling in Minnesota. The MPCA analysis is derived from data from the individual facility reports.

2.2.3. Minnesota County Data

Nearly all of the C&D facilities interviewed are permitted by the MPCA and licensed by the host county. Therefore, to gather additional background data, requests were made to obtain the facility reports from MPCA and the respective counties. This data is summarized in Table 3.1 in Section 3.1.2.

Ramsey County's "4R Program" (Reuse, Recycle, Renovate for Reinvestment) was established by the County Board in April 2010 to help divert construction materials from tax forfeiture properties[4]. The details of this Ramsey County 4R Program are included as Appendix A.1.c.

2.2.4. Other Data Sources

Several other data sources were used to gather and review facility-specific data including individual organization's web sites. Foth also has a national database of solid waste facilities which was used to help pre-populate the list of selected facilities to be interviewed, mostly for the contact data and permit numbers. Hennepin County staff also provided data on individual facilities, C&D reuse companies and ongoing building demolition and deconstruction contractors.

2.2.5. Literature Review

To supplement the data sources described above, Foth also refreshed its annotated bibliography of literature references on C&D recycling. The literature review was divided into Minnesota resources (Appendix A.1) and national resources (Appendix A.2). As part of the national literature review, two industry related organizations provide directly relevant data on this subject and are summarized in more detail:

- Reclamation Administration (see Appendix A.2.b); and
- Recycling Certification Institute (see Appendix A.2.c).

3. Results

3.1. Summary of C&D Waste Characterization – Metro Area

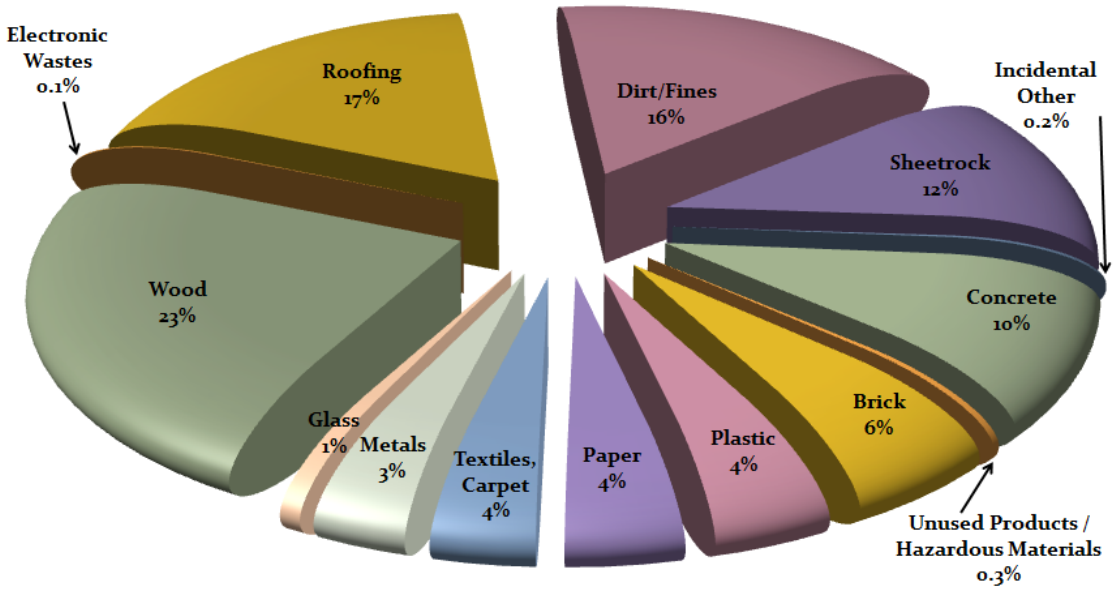
3.1.1. Composition

As part of the 2007 CD&I Study for SWMCB, Foth conducted a one-season C&D composition analysis at three (3) SKB landfill facilities that received C&D waste at the time. The construction and demolition waste sort composition data generated in the 2007 CD&I Study was consistent with C&D waste characterization data from other studies conducted in Minnesota and Iowa. The most prevalent materials were wood, roofing, dirt/fines, wallboard, and concrete/brick.

Figure 3.1 displays the composition of C&D waste from the Metro Area as disposed in Minnesota landfills in 2006.[5] Appendix A.1.a, Table A.1, contains the more detailed tabulation by source type and commodity. Figure 3.1 is for C&D data only (not including industrial waste). The data was derived from the 2007 CD&I Study waste sort composition analysis.

About 83 percent of the C&D materials as disposed are derived from six commodities: wood (23 percent), roofing (17 percent), dirt/fines (16 percent), sheetrock (12 percent), concrete (10 percent), and brick (6 percent). These higher volume commodities represent the greatest opportunity for increased diversion if adequate end-use markets can be developed.

Figure 3.1
Composition of C&D Waste as Disposed from the Metro Area



Source: Foth CD&I Study for SWMCB (2007)

3.1.2. Tonnage Disposed and Recycled

In 2015, MPCA staff conducted a preliminary analysis of C&D waste landfilling and recycling using permitted facilities' annual reports.[6] Figure 3.2 displays the results of this analysis for six years, 2008 through 2013. MPCA staff compiled landfill disposal data from the permitted landfills located within the Twin Cities Metro Area including:

- Burnsville Sanitary Landfill.
- Dawnway Demolition Landfill (South St. Paul).
- Dem-Con Landfill (Shakopee).
- SKB Rosemount.

The recycling data is derived from 22 different C&D processing facilities, transfer stations, recycling markets and landfills that submit annual reports to MPCA. Alternative daily cover (ADC) is not included in these recycling tonnage estimates. The percent recycling is calculated by dividing the amount of reported recycling tons each year by the total generated (landfilling plus recycling).

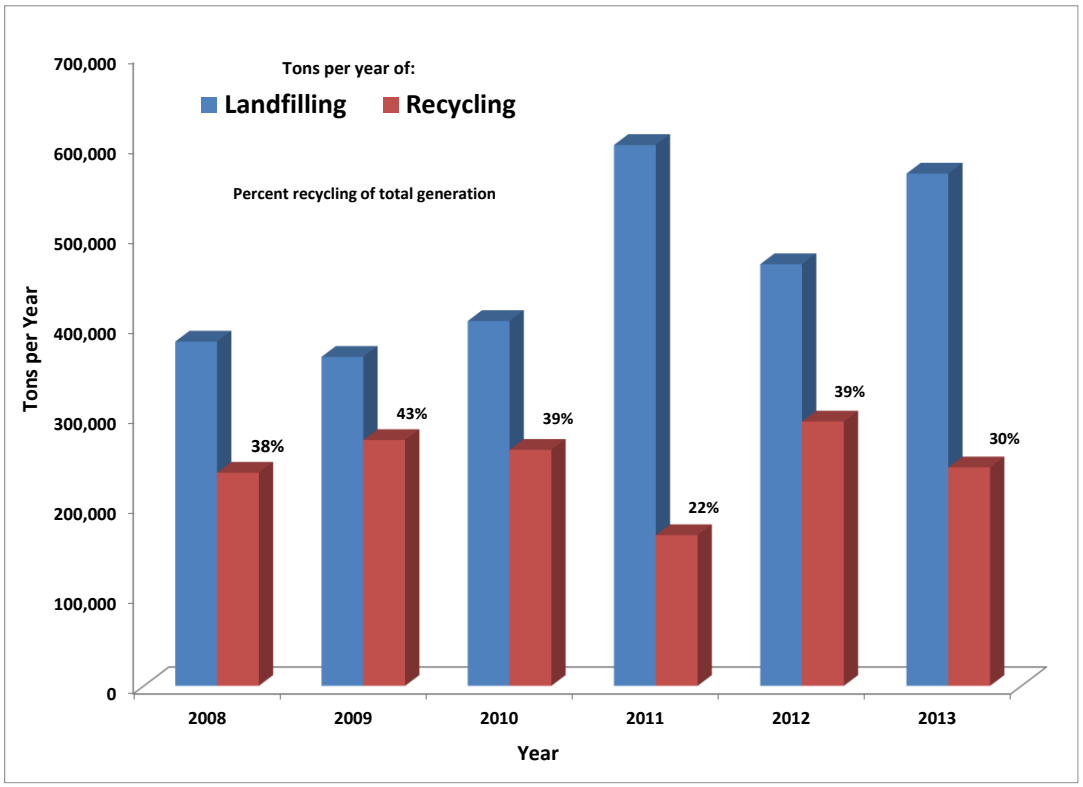
The recycling tonnage amounts and percent recycling should be considered approximations due to the following limitations:

- Inconsistencies in reporting.
- Conversions from cubic yards to tons, especially for different commodities.
- An unknown amount of C&D waste generated from within the Metro Area is disposed in landfills outside of the Metro Area. These exports of C&D waste may not be fully accounted in the MPCA staff analyses of percent recycling.
- Recycling data only reflects permitted facility reports. Materials are also recycled directly from the job site (e.g., concrete into aggregate; metals directly to scrap dealers) that is not recorded in MPCA facility reports.
- An unknown amount of reuse of construction materials occurs directly from the job site (e.g., reusable fixtures, cabinets, etc.) that is not recorded into MPCA permit reports.

Despite these data limitations, this MPCA data displayed in Figure 3.2 helps document the ebb and flow of C&D materials landfilling and recycling over this six year timeframe. Two variables that affect the C&D industry are:

- The general economy (e.g., the recession in 2007 through 2009) as it influences the overall number of construction and demolition projects.
- Natural disasters or other events that result in a large influx of demolition materials (e.g., the tornado that hit north Minneapolis in 2011).

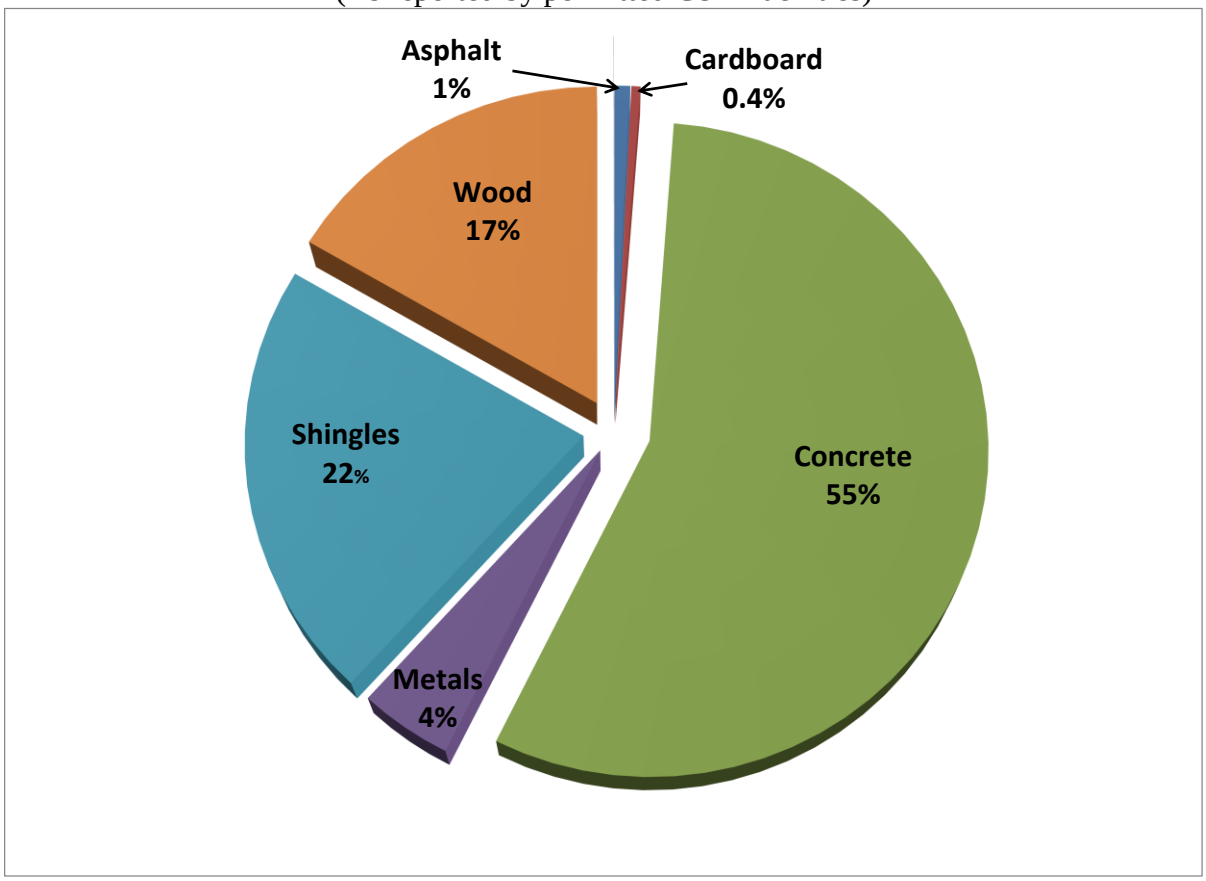
Figure 3.2
C&D Recycling and Disposal Trends
In the Metro Area, 2008 - 2013



Source: MPCA Staff - Annual Facility Permit Reports

Figure 3.3 displays the C&D "diversion" from the Metro Area in 2013 as reported by MPCA staff from annual permitted C&D facilities reports. The total tons of material diverted as reported were approximately 242,400 tons. The four largest commodities recovered were: concrete at 135,000 tons (55 percent), shingles at 52,000 tons (22 percent), wood at 40,000 tons (17 percent), and metals at 11,000 (4 percent). Not shown are miscellaneous materials with incidental recovery rates (0.02 percent) including brick and carpet. The percentages do not add up to 100.0% due to rounding.

Figure 3.3
C&D Diversion from the Metro Area, 2013
(As reported by permitted C&D facilities)



Source: MPCA Staff - Annual Facility Permit Reports

Table 3.1 displays the C&D tons as reported to MPCA from 24 permitted facilities. If facilities report their incoming materials by volume in terms of cubic yards of waste, MPCA staff converted to tons using a standard density assumption of 460 pounds per cubic yard. Foth re-categorized the data for further analysis by type of facility.

Table 3.1
Summary of MPCA Reports: Reported C&D Tons in 2013
(Tons in 2013 of Facilities in the Twin Cities Metro Area)

LANDFILLED, including:	**568,400**			
Landfills:		**568,400**	*	
Burnsville Landfill (Burnsville)			32,400	
Dawnway Landfill (South St. Paul)			25,800	
Dem-Con Landfill (Shakopee)			199,900	*
SKB Landfill (Rosemount)			310,300	*
** Landfilled material includes ADC/Residuals:*		*30,200*		
Dem-Con ADC			*24,300*	
SKB - C&D Recycling Residual			*5,900*	
RECYCLED, including:	**242,400**			
Landfills, recycling activities**:**		**62,600**		
Dawnway Landfill (South St. Paul)			57,700	
Dem-Con Landfill (Shakopee)			4,900	
Processors:		**169,000**		
Broadway Resource Recovery (Minneapolis)			83,500	
Dem-Con (Shakopee)			21,700	
Shamrock (Blaine)			7,100	
SKB (Rosemount)			22,100	
Veit - Como (Minneapolis)			34,600	
Transfer Stations:		**7,900**		
Alpha Container Services & Recycling (Coates)			400	
Commercial Container Recycling & Transfer (Minneapolis)			1,000	
Dan's Container Service (Newport)			100	
Gene's Transfer (Hugo)			200	
J&J Recycling (St. Paul)			2,200	
Keith Krupenny & Son (St. Paul)			500	
Lloyd's Construction Services (Savage)			1,900	
Ray Anderson & Sons (St. Paul)			200	
Twin City Refuse Recycling and Transfer (Blaine)			400	
Veit - Pierce Butler Transfer (St. Paul)			700	
Waste Management - Maple Grove Transfer			300	
MRFs & Recycling Centers:		**200**		
Republic (Allied) - Recyclery, Inver Grove Heights			200	
Markets:		**2,700**		
LPI - Savage (LDI Fibres)			300	
Misty Meadow Wood Products (Glenwood City, WI)			2,100	
National Recycling, Inc. (Hugo)			300	
TOTAL	**810,800**			

The four (4) landfills shown are in the Metro Area. Approximately 568,400 total tons were landfilled in 2013 in these four facilities. Two of the landfills reported ADC (Dem-Con at 24,300 tons) and C&D recycling residuals (SKB at 5,900 tons) which MPCA includes in the tons landfilled category.

Each facility may use slightly different terminology and definitions. Together with the data limitations mentioned above, these differences make exact comparisons between facilities challenging.

The recycling data indicates a total of about 242,400 tons were reported as recovered in 2013 from these Metro Area facilities. Two (2) of the landfills reported recycling activities. Dawnway Landfill reported 57,700 tons of concrete recycling for "beneficial use". This implies that the concrete C&D was crushed at this site for use as aggregate. Dem-Con reported 4,900 tons of recycling from the Dem-Con Landfill facility including 4,400 tons of shingles and 500 tons of wood. These tons from the Dem-Con Landfill are separate from the tons reported recycled from the adjacent Dem-Con C&D processing facility.

The five (5) C&D processors in the Twin Cities reported a total of 169,000 tons of material recovered in 2013. These five (5) processors each use elevated sort platforms, sorting conveyors, screens and magnets to separate the commodities from mixed C&D materials. MPCA does not include the 2-inch minus material used as ADC as recycling and therefore these ADC tons are not categorized as "recycled" in Table 3.1. These tons as reported to MPCA are approximate and for most of the processors recycling rates are not independently verified. But the amounts reported from year to year by each processor are similar and this MPCA data helps provide at least one means of quantifying the tons recycled from each facility.

Table 3.1 lists 11 transfer stations. The total amount of recycling from these 11 facilities was approximately 7,900 tons. Similar to the overall diversion composition shown in Figure 3.3, the predominant materials recycled from transfer stations are: asphalt shingles, concrete, metals and wood. Minor amounts of cardboard and brick are recycled. Each transfer station has slightly different sorting methods, but the most common approach is a simple "dump and pick" from the tipping floor using manual sorting and a skid-steer into separate roll-off boxes. Not all loads are sorted.

One (1) materials recovery facility (Republic's "Recyclery" in Inver Grove Heights) reports a small amount of C&D wood recovery, 200 tons in 2013.

Three (3) facilities were categorized by Foth as "markets" for purposes of this analysis of the MPCA reports. About 2,700 tons of wood from pallets and other, clean engineered lumber scrap were reported as reused and recycled. Many of the other types of C&D facilities also reported recycling into animal bedding or otherwise recovering wood for biomass fuel.

Table 3.1 is a means to quantify the amount of landfilling and diversion from facilities located in the Metro Area. The calculated C&D recycling rate for 2013 was approximately 30 percent of the total C&D waste discarded as reported. This is based on the MPCA reported amounts "recycled" (242,400 tons) compared to the total reported discards (810,800 tons) comprised of the sum recycled plus landfilled (568,400 tons) in 2013.

This method of calculating recycling rates based on MPCA facility reports is one indicator of total diversion. Not included in the MPCA facility reports are the amount of tons of C&D materials recycled directly. For example, the large concrete and asphalt recycling operations are not included

in Table 3.1. Wood scrap, if kept separated from large construction jobs, can also be transported directly to market for recycling or use as biomass fuel. Finally, the C&D metals that come from large jobs can be hauled direct to scrap dealers for recycling. The various wood and metal markets do not record such supplies of recyclables as coming from C&D operations. The markets for these commodities recycled directly are mature but do not report their tonnages to MPCA. If all of these "C&D tons" hauled direct to market were able to be estimated, the overall recycling and diversion rates would be much higher than reported to MPCA by the permitted facilities only.

3.1.3. County Facility Reports

Foth requested data from the host counties for selected C&D facilities for the past four (4) years. Additional data was also assembled from Ramsey County summaries. Table 3.2 represents a summary of the county tonnage reports by facility owner and facility name by year. Table 3.2 also displays the estimated percent that came from Hennepin County, if the data was available.

When reviewing the data within Table 3.2, several points should be kept in mind. The tonnage reports are for incoming C&D material only. Facilities are not required to report county of origin. Not all facilities ask the truck drivers for the source county or where the loads originated. Therefore, many of the county reports do not supply county of origin data.

If the facilities report in cubic yards; mixed C&D waste was converted to tons using the assumed density of 460 pounds per cubic yard. (Note that the RCI reports an average of 500 pounds per cubic yard.) This assumption is an approximate estimate of actual density used to provide a relative sense of scale of each facility.

All C&D facilities have business-to-business relationships and contracts for transfer, recycling, recovery and/or landfill disposal services. The Table 3.2 listing of the county of origin data includes some limited double counting of the same tons. For example, C&D waste is transported from county "A" to a transfer station in county "B" and then final landfill disposal in county "C". Each time the waste is transported to a new destination the county of origin changes and the same tons are again reported. The "Total of Facilities" is a simple sum of the tons handled as reported by each facility. This total sum should not be interpreted as the total of C&D tons in the Metro Area system because of double counting the same tons (e.g., via transfer station to landfill). These facilities were not included in this analysis as displayed in Table 3.2. Not all facilities reporting to the MPCA report to their respective County.

The percent estimates of C&D waste from Hennepin County shown in Table 3.2 are not complete for several reasons. First, not all counties require facilities to report county of origin (i.e., "ND = No data requested by form"). Even if the county reporting forms provide for county of origin, the facilities often do not provide the data (i.e., "NA = Data not provided" by facility).

Table 3.2
Summary of County Reports: Reported C&D Tons 2011 - 2014
(Tons per Year and "Percent from Hennepin County")

Year:	2011		2012		2013		2014	
Facility Name (City)	**Total C&D Received (Tons)**	**% from Hennepin County**	**Total C&D Received (Tons)**	**% from Hennepin County**	**Total C&D Received (Tons)**	**% from Hennepin County**	**Total C&D Received (Tons)**	**% from Hennepin County**
LANDFILLED:	**214,270**		**346,847**				**763,738**	
Burnsville C&D Landfill	ND	ND	ND	ND	ND	ND	26,255	NA
Elk River Landfill	31,695	ND	35,686	ND	24,185	ND	21,789	NA
SKB Rosemount Landfill	ND	ND	ND	ND	ND	ND	316,194	NA
Vonco II Landfill (Becker)	182,575	ND	311,161	ND	373,199	ND	399,500	ND
PROCESSORS:	**91,277**		**84,608**				**106,839**	
Broadway Resource Recovery (Minneapolis)	27,702	67%	31,014	66%	32,772	65%	ND	ND
Dem Con (Shakopee)	41,019	58%	38,175	59%	41,424	59%	48,461	63%
Shamrock Recycling (Blaine)	ND	ND	ND	ND	ND	ND	36,158	NA
Veit - Como (Minneapolis)*	22,556	ND	15,419	ND	29,263	ND	22,220	ND
TRANSFER STATIONS:	**95,395**		**66,586**				**101,787**	
Advanced Vasko - Como (St. Paul)	18,603	ND	21,373	ND	13,209	ND	11,373	ND
Commercial Container Recycling & Transfer (Minneapolis)	26,682	82%	ND	ND	ND	ND	ND	ND
J&J Recycling (St. Paul) *	1,712	ND	6,880	ND	2,075	ND	1,617	ND
Keith Krupenny (St. Paul) *	4,618	ND	1,582	ND	5,079	ND	3,747	ND
Lloyd's (Savage) *	9,434	51%	8,780	44%	9,528	49%	11,146	51%
Ray Anderson (St. Paul) *	3,652	ND	3,897	ND	2,465	ND	2,204	ND
Tubs (Golden Valley) *	2,332	74%	2,567	74%	2,623	74%	ND	ND
Twin Cities Refuse (Blaine) *	14,801	ND	7,822	ND	13,509	ND	14,112	ND
Walters (Blaine)	ND	ND	ND	ND	ND	ND	1,320	10%
SKB - Blaine	ND	ND	ND	ND	ND	ND	39,116	20%
SKB Malcolm (Minneapolis) *	10,960	56%	10,908	52%	10,637	61%	14,876	61%
WM Maple Grove *	2,601	99%	2,777	97%	2,010	88%	2,278	78%
TOTAL OF FACILITIES	**400,941**		**498,041**		**561,977**		**972,364**	

Source: County Reports as Submitted by Licensed Facilities

Codes: NA = Data not provided
ND = No data requested by form
* = Converted from yards to tons (@ 460 pounds per cubic yard)

These data limitations highlight the challenges of analyzing C&D waste information on a system-wide basis. There is limited ability to accurately estimate the fixed amount of C&D tons generated, disposed and diverted. For example, there is known double counting of the same tons represented in Table 3.2. Also, the Metro Area is not a closed system. C&D materials are being both transferred out and hauled into the region.

3.2. Construction and Demolition Activity

3.2.1. National Estimates of C&D Generation by Building Sector

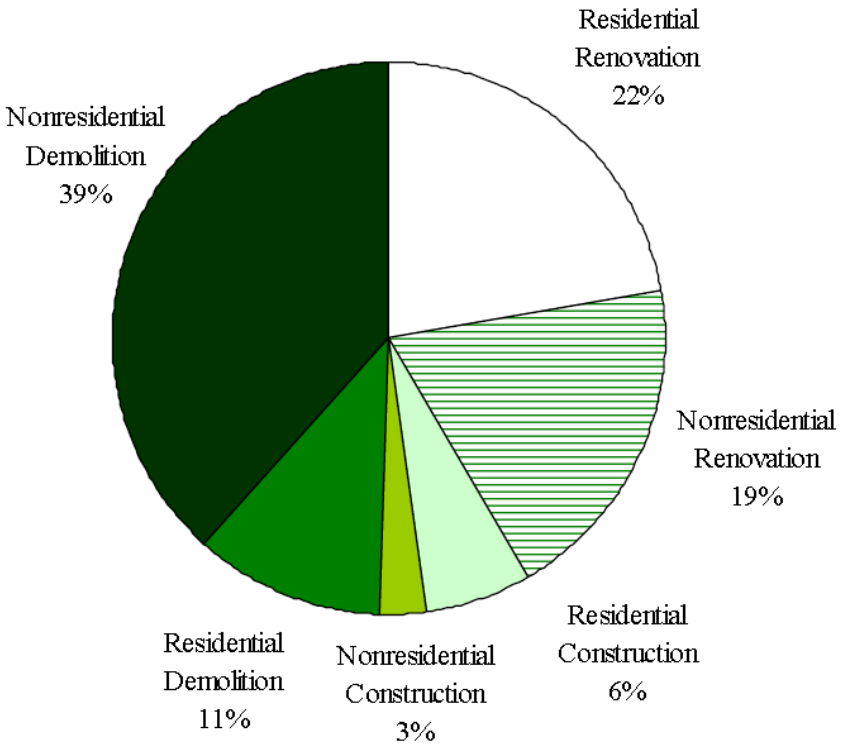
The relative amount and trends of construction and demolition activity can be an indirect indicator of C&D waste over time. National studies have attempted to correlate the amount of construction and demolition waste to the square feet of building construction or demolition. One such study was conducted by the U.S. Environmental Protection Agency (U.S. EPA) to estimate the building related construction and demolition waste amounts.[7] This U.S. EPA study states that "C&D materials are generated when new structures are built and when existing structures are renovated or demolished (including deconstruction activities)". This U.S. EPA study provides the following average estimates for six building sectors of construction and demolition activities:

- Residential construction job site = 4.4 pounds per square foot
- Non-residential construction = 4.3 pounds per square foot
- Residential demolition = 50 pounds per square foot
- Non-residential demolition = 158 pounds per square foot
- Residential Renovations:
  - Kitchen and bathroom = 22.7 to 24.1 pounds per square foot
  - Replace roof = 3.3 pounds per square foot
- Non-Residential Renovations:
  - Office Renovation = 11.8 pounds per square foot
  - Other Renovation = 10.8 pounds per square foot

These estimates are based on a series of job site waste assessment studies (i.e., waste sampling at construction, renovation, and demolition sites) conducted around the country by various agencies. These are weighted averages and the actual range of source data is quite broad in each category depending on many variables (e.g., contractor, location, job, sampling methodology, etc.).

The U.S. EPA study used United States Census Bureau construction activity data to estimate the relative contribution from each C&D building sector listed above. Figure 3.4 displays the U.S. EPA estimates of C&D waste by sector. This data indicates that residential C&D waste represents about 39 percent of the total and non-residential (i.e., commercial) C&D waste represents 61 percent of the total.

Figure 3.4
Relative Amount of C&D Waste by Generator Sector

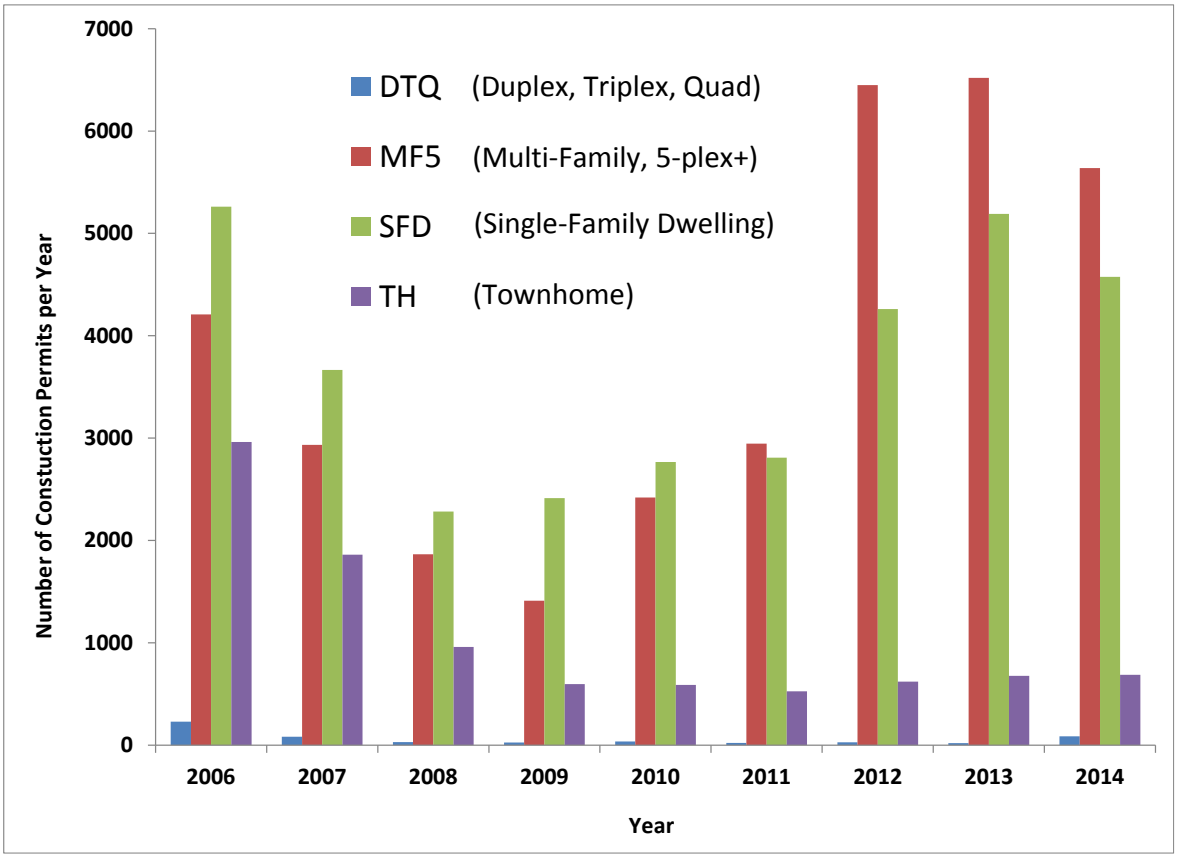


Source: U.S. EPA Study (2009)

3.2.2. Residential Construction and Demolition Activity in the Metro Area

The Metropolitan Council tracks residential construction permits throughout the seven (7) county Metro Area as one means to estimate annual housing counts. They also track construction activity in the non-residential sector for projects such as new or expanded commercial buildings. Figure 3.5 displays the residential construction permit data for the Twin Cities Metropolitan Area from 2006 through 2014 by housing type.

Figure 3.5
Residential Construction Permits
In the Twin Cities Metro Area, 2006 - 2014



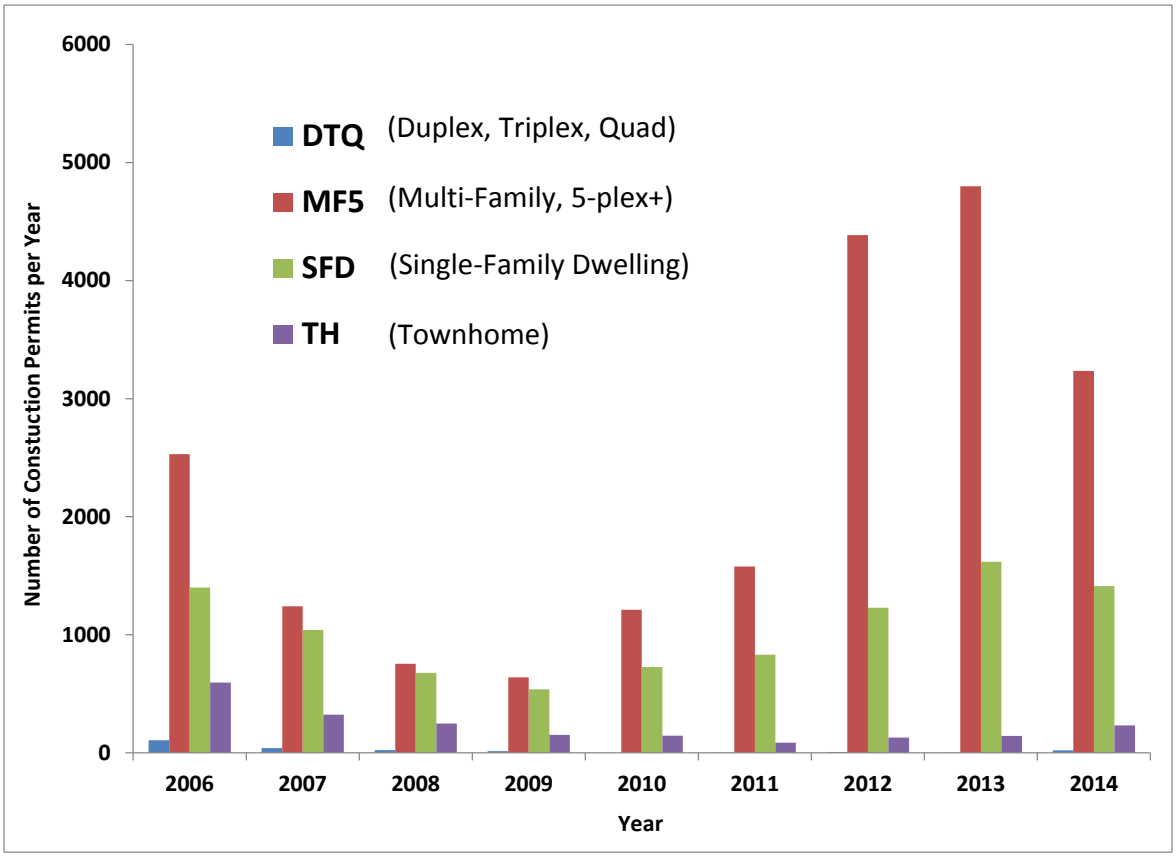
Source: Metropolitan Council

This graphic clearly shows the prolonged impact of the economic recession on housing construction from 2007 through 2011. It also shows the change from construction of more single unit homes from 2006 through 2010 to a predominance of multi-unit properties since 2011 (5-plex and above). This reflects the aging of baby-boomers and a shift in demand from single family to multi-family homes.

The Kansas City Federal Reserve Bank documented this[8], stating that "very strong" multi-family construction growth would begin in 2014 and continue through 2020 at a rate "nearly two thirds higher than its highest annual level during the 1990s and 2000s," while the level of single family construction would remain moderate. This affects the amount of construction-related debris that will be generated in future years as multi-unit buildings are constructed predominately of concrete while single unit homes are generally constructed of wood products. Construction waste from single unit homes is expected to be even lower due to low waste construction techniques (off-site, pre-construction, universal framing, etc.).

Figure 3.6 displays the residential construction permit data for Hennepin County from 2006 through 2014 by housing type. The Hennepin County trend parallels the Metro Area data shown in Figure 3.5; showing the prolonged impact of the economic recession on housing construction from 2007 through 2011. An interesting difference in the Hennepin County data is the relatively higher amount of multi-family (5-plex and above) construction activity in all years, but especially in the last three years 2012 through 2014. Also notable is the near absence of duplex, triplex, quad and significant reduction in town home construction permits.

Figure 3.6
Residential Construction Permits In Hennepin County, 2006 - 2014



Source: Metropolitan Council

The City of Minneapolis recognized an increase in the number of construction permits in the March 2015 "Green Building and Deconstruction" Report. In Potential Incentive Programs for Minneapolis, it was noted that density bonuses are the most desired incentive for developers. Minneapolis offers a variety of density bonuses; including up to a 20 percent increase in maximum permitted dwelling units. In the September 2014 "Deconstruction, Opportunities for the City of Minneapolis" report noted that of the dwellings constructed in 2000 to 2004, the vast majority were multi-unit properties.

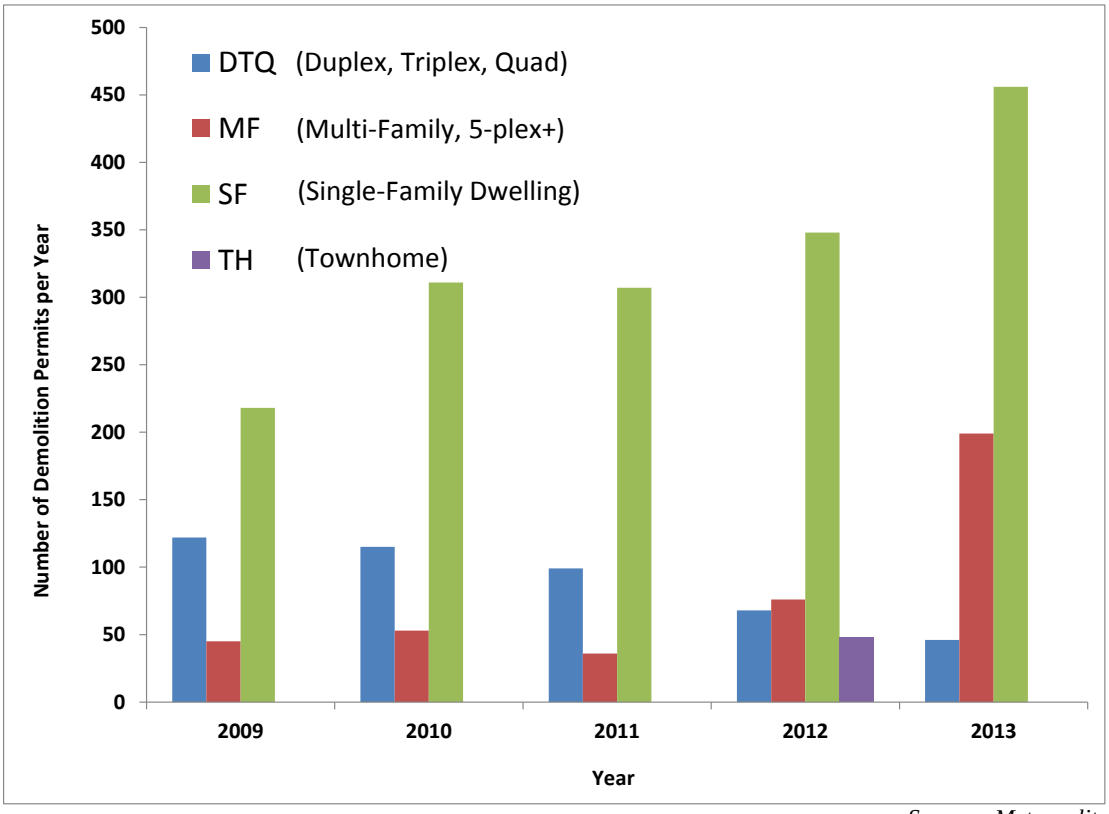
Figure 3.7 displays the residential demolition permit data for Hennepin County from 2009 through 2013 by housing type. The predominant housing type for demolitions in the county has traditionally been single-family dwellings. However, in 2013 the relative amount of multi-family (5-plex+) building demolitions increased significantly.

There are always many fewer demolition permits than construction permits. For example, in Hennepin County in 2013, there were 6,563 construction permits and only 701 demolition permits.

The Metropolitan Council has stated that the demolition permit data is not as reliable as the construction permit data. Cities voluntarily report their permit data and not all municipal staff track demolition permits in a consistent or standardized manner. Cities typically are more interested in construction that adds property value and cachet to the city's name rather than tear downs or demolitions.

The September 2014 Minneapolis report characterized demolitions and demolitions that result in re-build for 2013. There were 87 demolitions with re-builds and 83 demolition-only permits. The vast majority of the demolition with re-build was in affluent areas in Southwest Minneapolis, while demo-only permits were predominantly in northwest Minneapolis – the area affected by the 2011 tornado.

Figure 3.7
Residential Demolition Permits
In Hennepin County, 2009 - 2013

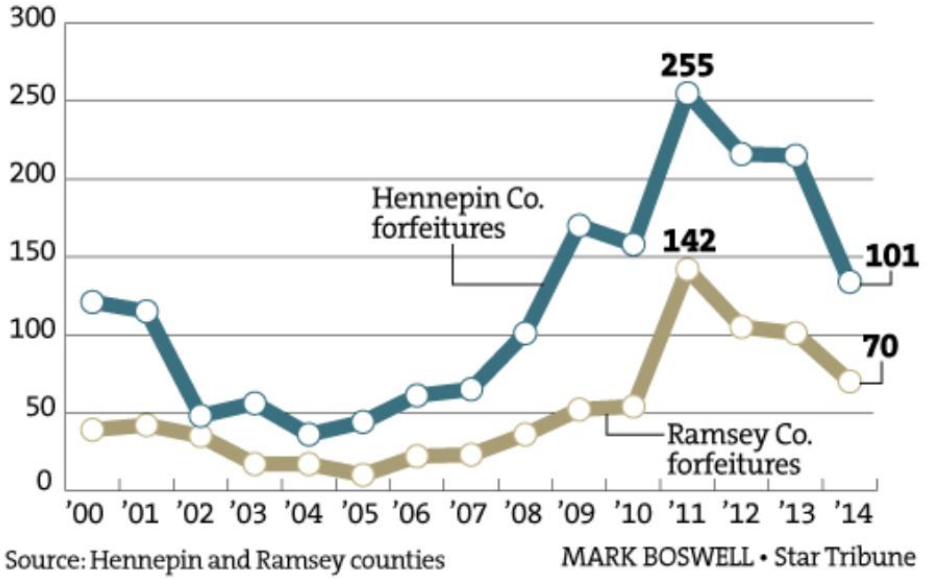


Source: Metropolitan Council

3.3. Tax Forfeiture Properties

Minnesota counties are authorized by State Statutes to take over properties if taxes are not paid. When land and buildings are forfeited, taxes are not collected on schedule. The Star Tribune of the Twin Cities recently published an article on tax-forfeited homes.[9] Properties fall into forfeiture only after an extensive and deliberately long process that begins with unpaid taxes, then a court judgment, and an extensive redemption period. Based on data from Hennepin and Ramsey Counties, Figure 3.8 displays the graphic from the Star Tribune article showing the number of tax-forfeiture properties from 2000 through 2014. Hennepin County hit a peak of 255 tax-forfeiture properties in 2011, which decreased to 101 in 2014. Note that while demolition permits have continued to increase (see Figure 3.7) over the past five years, tax-forfeiture properties have decreased since 2011. It is also important to note that not all tax-forfeiture properties are demolished. Some are rehabilitated, remodeled and put back into productive use.

Figure 3.8
Number of Tax-Forfeiture Properties
In Hennepin County and Ramsey County, 2000 – 2014



Source: Star Tribune

As a general rule, tax forfeited properties contribute relatively little to the overall generation of C&D waste. The number of tax forfeiture properties was less than one third of the total number of residential demolition permits in 2013. As shown in Figure 3.8, for the past three years, there has been a decreasing trend in tax forfeiture properties. This compares to an increase in residential construction and demolition permits over the same period of time (see Figures 3.6 and 3.7).

For a number of reasons, tax forfeiture properties are less attractive as potential sources of recoverable C&D materials compared to other building demolitions and remodeling jobs. The extended period of vacancy due to the lengthy foreclosure process often results in the more valuable scrap materials being scavenged (aka stolen) before a contracted deconstruction crew can get access to the building. In some cases, the health and safety hazards in foreclosed, vacant buildings will

discourage or prevent deconstruction or remodeling. Finally, the quality of the building materials and fixtures used in the original construction of tax forfeiture properties often does not encourage deconstruction.

3.4. Reuse Retailers

Interviews and/or site visits were conducted with eight reuse retailers:

- Architectural Antiques (see Appendix B.1 for details).
- Bauer Brothers (see Appendix B.2 for details).
- Better Futures Minnesota (see Appendix B.3 for details).
- Better Homes and Garbage (see Appendix B.4 for details).
- Natural Built Home (see Appendix B.5 for details).
- Northwest Architectural Salvage (see Appendix B.6 for details).
- Habitat for Humanity ReStore (see Appendix B.7 for details).
- All-State Salvage (not interviewed; Gone out of businesses).

The retailers fall into three broad market segments:

- Basic used building materials (e.g., standard fixtures, hardware, etc.);
- Businesses specializing in historically or architecturally significant items; and
- Businesses that have newer items, accept new or like-new building materials, but may also have historically or architecturally significant stock.

The businesses interviewed are very selective in the items that they accept for resale. The reuse retailers must be able to resell the materials. Architectural Antiques noted that they spend considerable time researching home interior furnishing trends, and have recently begun sourcing particular items from the 1950's. Very few items are purchased by the retailers. Exceptions include higher value historic or architecturally significant pieces.

The businesses interviewed typically take material that is brought to them or which they have made appointments to pick up at the curb. Only Architectural Antiques, which focuses on high-end materials, reported going into buildings to remove items in place. Architectural Antiques has their own crews for removal of items.

It is important to Architectural Antiques that they document the item in its original location; document the removal of the item; and then set-up of the item in the Architectural Antiques store. Architectural Antiques has their own operating specifications and protocols to help preserve the value of each item reused. Architectural Antiques is also the only retailer that reported going out of the Twin Cities to obtain items; they source nationally.

Most of the interviewed retailers reported that remodeling/deconstruction contractors or homeowners provided the items. No retailer reported that demolition companies provided them with items. The retailers have built relationships with specific contractors. Promotion is often through word-of-mouth referrals among neighborhoods or homeowner groups.

None of the retailers have tonnage data for amounts of intake, sales or disposal. Although most retailers reported that they have "very little" or less than one percent of their intake that is landfilled or otherwise disposed. This low disposal rate is likely due to their working relationships with individuals and their stringent material selection criteria. Only the ReStore reported a significant amount of disposal. ReStore uses a 30 cubic yard roll-off box pulled about once a week. ReStore sends the material to a C&D processor.

Very little processing of the items is done by most of the retailers. This is partially because they accept only reusable, salable items thus lowering their labor costs. Architectural Antiques is an exception; they put a great deal of effort into carefully removing items, setting up displays in the showroom, and maintaining the displays (dusting, polishing, etc.).

Most retailers interviewed are either comfortable with their present business size and scope or are planning for growth. All of these businesses except Natural Built Home have been in place for several years and have solid business niches.

One exception is Better Homes & Garbage who has downsized their business model citing three reasons for the change:

- Inability to sell recovered goods at a price at or above what it cost to obtain them;
- Lack of sufficient storage; and
- Inability to make a living wage solely through a reuse business.

Lack of sufficient storage and/or the high cost of storage are common challenges for all of the retailers, even Bauer Brothers. The ReStore is seeking an additional location, stating that their "donations are outpacing their sales throughput on occasion" requiring them to decline or find storage for goods. Bauer Brothers has very little heated or climate controlled storage; most of their items are either in cold storage areas or outside.

Less expensive storage allows them to accept items that are not immediately salable, to have much more stock on hand, to keep things for many years and to keep large numbers of the same item in their warehouse. Their clientele understands and accepts the inconveniences of cold retail space in return for the wide variety of goods they carry.

Retailers noted that potential buyers don't realize the costs that go into removing items from properties, repairing or refurbishing the items appropriately, storing them, marketing them and having a retail sales operation. It was noted that people believe that the items came out of properties "for free". For example, some customers do not understand why a vintage hand-forged hinge costs so much more than a standard screen door hinge from the local big-box hardware store.

All reuse retailers made comments similar to the following:

- C&D landfill disposal fees are very low when compared to the cost to recover materials to sell. It is hard to compete with such low disposal costs.
- Marketing is very difficult. Unless people are already inclined to reuse goods, or to seek out the craftsmanship of older goods, they don't understand the value of reuse and recycling. Home shows, magazines, etc. usually show new materials. When people find "cheap" goods

on Craigslist, not only are the legitimate retailers removed from consideration, but the lower quality of goods and lack of knowledge about proper installation reinforces the attitude that old stuff is just junk. There hasn't been widespread marketing or education about the greater good of reused home products similar to the education done on the value of standard recyclables. Finally, these are often small companies that do not have large advertising, public relations budgets or internet presence (e.g., web pages, social media) to promote their specific stores.

Additional comments from interviews in the September 2013 Minneapolis report are summarized as follows:

- The September 2013 Minneapolis report described the loyal and diverse following of the ReUse Center and the role it had in changing resident behaviors to favor purchase of reused materials over new. Although the business model was not successful over the long term, the convenience and community centric business practices could be a valuable model for any future effort.
- The September 2013 Minneapolis report also noted that the Better Future Warehouse, located in Golden Valley is only open Monday through Friday until 3:30 p.m. This excludes customers who work full time. The report suggests consideration of raising the awareness of the importance of C&D reuse among Minneapolis residents and providing means for C&D reuse to be a more convenient option.

Other ideas cited to encourage more reuse and recycling of building materials included:

- Support of C&D reuse could occur though leveraging storage space, cooperative marketing and advertising. The retailers on Minnehaha Avenue in Minneapolis that create a "destination" for building material reuse retailers, alternate energy providers, sustainable building products and antiques stores is becoming a successful model. This might look like a "sustainability park" or retail area that help attract like-minded customers.
- Many properties are demolished through a government process. There is usually a very long time period between when the property is no longer occupied until a retailer or knowledgeable contractor can get into the building to remove valuable items. During this time renegade scrappers remove artisan metal work and rodents, mold and water damage woodwork. Finding a way to allow removal of materials earlier in the process would be helpful. As noted earlier, properties demolished through a government process (e.g., tax forfeiture properties) is decreasing whereas overall residential demolition permits are increasing.

In conclusion, the reuse retailers serving the C&D industry are under-developed in the Twin Cities Metropolitan Area. However, there are important examples of enterprises, including non-profit organizations, which help provide deconstruction and materials reuse services. Many of these were interviewed and visited for this study. Further growth and promotions of these opportunities is needed for these practices to become more main stream among the C&D industry and to help increase C&D materials diversion. Helping to promote demand for reused building materials could be a valuable market development option.

3.5. C&D Contractors, Including Deconstruction Services

A series of seven construction, demolition and/or deconstruction contractors were interviewed:

- Better Futures (see Appendix C.1 for details).
- DMD Services (see Appendix C.2 for details).
- ESG Architects / Swenson's Workshop (see Appendix C.3 for details).
- Frattalone (see Appendix C.4 for details).
- Habitat for Humanity (see Appendix C.5 for details).
- River Birch Restoration (see Appendix C.6 for details).
- Wall Construction (see Appendix C.7 for details).

In addition to these formal interviews, additional field reconnaissance and personal communications with other contractors were conducted by the consultant team using a variety of personal and professional networks.

Better Futures Minnesota is a nonprofit jobs training and support services provider that recently started deconstructing homes in the Twin Cities.

When Better Futures deconstructs a home, the homeowner receives a tax credit for the value of the reclaimed material that is donated because Better Futures is a 501.c (3) non-profit corporation. Even with the tax credit, it is usually more expensive and time consuming to deconstruct than to landfill. Better Futures estimates that it takes approximately eight (8) hours to demolish a house for landfilling, as opposed to twelve (12) days or more using full deconstruction techniques. Their use of hard-to-employ persons teaches job skills and provides a living wage. They note that often time is critical on a project, and some property owners are not willing to delay construction.

Better Futures notes that landfill fees and taxes for C&D landfills are much less expensive in Minnesota than other states that have high percentages of deconstruction instead of landfilling. It is difficult for deconstruction to compete with demolition on the basis of cost. Better Futures estimates that it is technically possible to recycle or reuse up to 90 percent of certain residential buildings using advanced deconstruction techniques, but the low cost of landfilling makes it difficult for full deconstruction to be cost – competitive for most structures..

Marketing the reclaimed material from homes is Better Futures's greatest difficulty. Better Futures has found that old growth wood and higher value cabinetry is more marketable. Better Futures is testing the market for new wood, especially framing wood, and are looking for alternative uses. Better Futures reports they are working with the University of Minnesota – Duluth to develop furniture design and an education program for their workers that will allow them to build and market desks, bookcases and other wood products made from the deconstructed materials. See Appendix C.1 for more details on Better Futures.

Many homes built since 1945 to 1950 have low quality (i.e., not old growth) wood, particle board cabinets, laminate flooring, fiberglass or composite fixtures, etc. Reuse of the components of these

buildings is very limited. Higher quality items will always be easier to resell. Extensive reuse of such lower value components is not currently feasible.

Frattalone is a family of related companies involved with construction, demolition and materials recycling. The deconstruction and recycling of the Metrodome in 2013 – 2014 provides one case study example of a very large project led by Frattalone. A large team of demolition, recycling and related materials management companies (16 companies in total) completed the deconstruction and recycling of the Metrodome to make way for the new Vikings stadium. The Minnesota Sports Facilities Authority (MSFA) required the demolition plan to recycle or reuse at least 80 percent of the material from the old Metrodome facility.

Selected statistics about the diversion of C&D materials from this project include:

- 80,000 tons of concrete was recycled for use in other building projects.
- 2,500 tons of structural steel was reclaimed.
- 2,000 tons of other steel was recycled.
- 300 tons of roof cables were recycled.
- 120 tons of cast iron was recycled.
- 75 tons of high density polyethylene (HDPE) plastics were recycled.
- 25 tons of precious metals were recycled.

The total (gross) bid price for the demolition and salvage work was $4.9 million. The Frattalone team estimated $1.3 million for scrap and salvage value such that the net contract bid price was roughly $3.6 million. See Appendix C.4 for more details on this demolition project case study.

Habitat for Humanity reduces waste in two ways. The company does much of their framing construction off site, in their warehouse/shop. This allows them to maximize material efficiency, resulting in less waste. They also contract with a C&D processor, Broadway Resource Recovery through their on-site roll-off contractor, Atomic. They receive reports from Atomic that show an average diversion rate of materials in the roll-offs of seventy-five percent (75%), including use of ADC. See Appendix C.5 for more details.

The ReUse Center was a significant operation in the C&D reuse and deconstruction sectors. Launched in 1995 as program under the Green Institute (a non-profit development organization), the ReUse Center was the anchor business with a 26,000 square-foot resale store. The ReUse Center sold donated and salvaged building materials back to the public at a discounted price. Reportedly, customers generally received a 75% discount on products typically purchased from large-box retail home building supply stores. In 1997, the ReUse Center created their "DeConstruction Services" program to provide training and employment opportunities for community members. Deconstruction Services crews salvaged materials from buildings slated for demolition. The salvaged materials were most often sold back to the ReUse Center, which in turn sold them to the public. After about ten years of operation, over 35,000 tons of construction materials like wood flooring, kitchen cabinets, doors, windows, sinks, tubs, and hardware were placed back into service. In 2007, the ReUse Center received the 2006 Governor's Award for Excellence in Waste and

Pollution Prevention. Unfortunately, due to larger challenges of the Green Institute, the ReUse Center and its Deconstruction Services went out of business about five years ago.

Several traditional contractors were interviewed that provide more standard home remodeling and construction services. The selected contractors for interviews are smaller to mid-size companies, often structured as sole proprietors or limited liability corporations (LLCs). The detailed results of these interviews are reported in Appendix C. Each contractor approaches C&D diversion differently. All are aware of C&D waste recycling/processing services and all are very cost conscience. Source separation practices on the job site depend on the job, the material and the remodeling operation protocols of each contractor. One of the contractors said that more extensive on site recycling practices is too costly and that only limited types and amounts of materials are economically recyclable (e.g., non-ferrous metals). Other contractors will regularly separate cardboard, all metals and other recyclable C&D materials and drop-off the materials to various recyclers. All contractors mentioned the demise of the ReUse Center in south Minneapolis with the implication that this type of service was now lacking. When prompted about the Habitat For Humanity ReStore in New Brighton, they were aware of this outlet, but delivering source separated items was not a regular practice for most contractors. One of the contractors was keenly aware of other reuse retailers in the Twin Cities (e.g., Bauer Brothers, Architectural Antiques, etc.), but this company makes historic remodeling a custom service. All of the contractors mentioned the use of the online website craigslist as a common practice for items that are of known value.

In the construction industry, the practices of C&D materials reuse and recycling are well known but not universally implemented. For example, the high cost of skilled labor on smaller residential remodeling and construction jobs often makes it challenging for most contractors to conduct extensive on-site source separation beyond the most valuable items (e.g., non-ferrous metals). All contractors interviewed are aware of materials reuse opportunities, but these are not main stream diversion activities. All contractors implied they would welcome additional opportunities for materials reuse drop-off and retail services. Further development of the deconstruction industry coupled with the environmental and tax benefits of reuse of these materials may help lower future costs of deconstruction.

3.6. City Building and Demolition Programs

Various cities in the county were interviewed to determine the number of construction and demolition permits they were issued, if they have rules or preferences for reuse, recycling, deconstruction versus demolition, and if they have programs to encourage deconstruction or rehabilitation of buildings in lieu of demolition.

Interviews and/or web site reviews were conducted with the following cities:

- Bloomington (permit application only; No interview. See Appendix D.1 for details)
- Edina (see Appendix D.2 for details)
- Minneapolis (see Appendix D.3 for details)
- Plymouth (see Appendix D.4 for details)
- Richfield (see Appendix D.5 for details)

None of the reviewed cities have requirements for recycling or reuse of construction or demolition wastes in their building, demolition or wrecking permit programs. Most cities have combined building and demolitions permit processes. The City of Minneapolis is the only city interviewed that has a separate "Wrecking" permit and license program. The wrecking permit does not require recycling or reuse of materials, nor does it require that tonnage reports be provided to the City. The City of Minneapolis began a deconstruction pilot program with Better Futures but has had difficulty in selecting good candidate properties. Better Futures stated that many of the properties offered did not have enough retained value to be deconstructed due to storm damage from the tornado or tax forfeiture properties. (See Appendix D.3 – Minneapolis Interviews).

All cities, except Minneapolis, have construction permit fees that are on a sliding scale that varies with the value of the building. The construction permit fee includes the building value sliding scale, a plan review fee, and a state surcharge. Most cities have "add-on" fees, such as fees for inspections outside normal business hours, re-inspecting, etc.

The September 2014 "Deconstruction Opportunities for the City of Minneapolis" report noted that Minneapolis has a policy goal to become a Zero Waste City. For "Minneapolis to be a Zero Waste City, removing C&D materials from the waste stream is essential." The report promotes materials reuse and recycling specifically from demolition projects as a policy priority for the City. The report notes that "building trends over the last few decades have created a housing stock that is by and large neither reusable nor recyclable. Therefore, efforts to work towards a sustainable C&D waste stream through deconstruction are being hindered by modern building practices that are themselves unsustainable.

All cities reported that there is no immediate or mid-term intention to require recycling or reuse of construction and demolition wastes or the reporting of tonnages of those wastes to the cities. The city staff interviewed noted that such requirements are neither a priority for elected officials nor a priority for city building staff.

3.7. C&D Processors / Transfer Stations / Landfills

3.7.1. Overview of the Observed C&D Systems

Eight (8) companies and twelve (12) facilities that handle, manage, or dispose C&D wastes were selected by the county and Foth staff for interviews and site visits for this project. Table 3.3 lists the facilities in alphabetical order by name. Figure 3.9 displays a map of these facilities.

The C&D waste market is both price competitive and sensitive to travel distance. The location of the C&D processing facilities and landfills helps drive decisions about the destination of C&D loads. Per interviews with landfills and processors, most C&D that is hauled direct by contractors and haulers in the Twin Cities metro area typically comes from within 20 miles of the facility. For example, a 30 cubic yard roll-off box can weigh from three (3) to seven (7) tons making it expensive to transport low-value materials over longer distances. C&D is hauled both by contractors themselves as well as C&D waste haulers. Specific data on quantities of each was not reported. Landfills accepting from a larger geographic area typically rely on transfer stations and larger transfer trailer loads to reduce the costs of direct hauling. Figure 3.9 is a map that provides an illustration of the geography of the facilities interviewed for this study.

Like all commodities, mixed C&D waste and source-separated materials will be delivered to the most economical destination. The private companies generally do not consider city or county boundaries specifically in their decisions for recycling, processing, or disposal locations. Although prices were not disclosed it was clear that hauling companies that own their own landfills or processing facilities will hauler longer distances to ensure they handle their own materials. All of the facilities interviewed for this study have multiple business-to-business contractual relationships for transportation, processing, and landfill disposal services.

Figure 3.9
Map of C&D Processors, Transfer Stations and Landfills

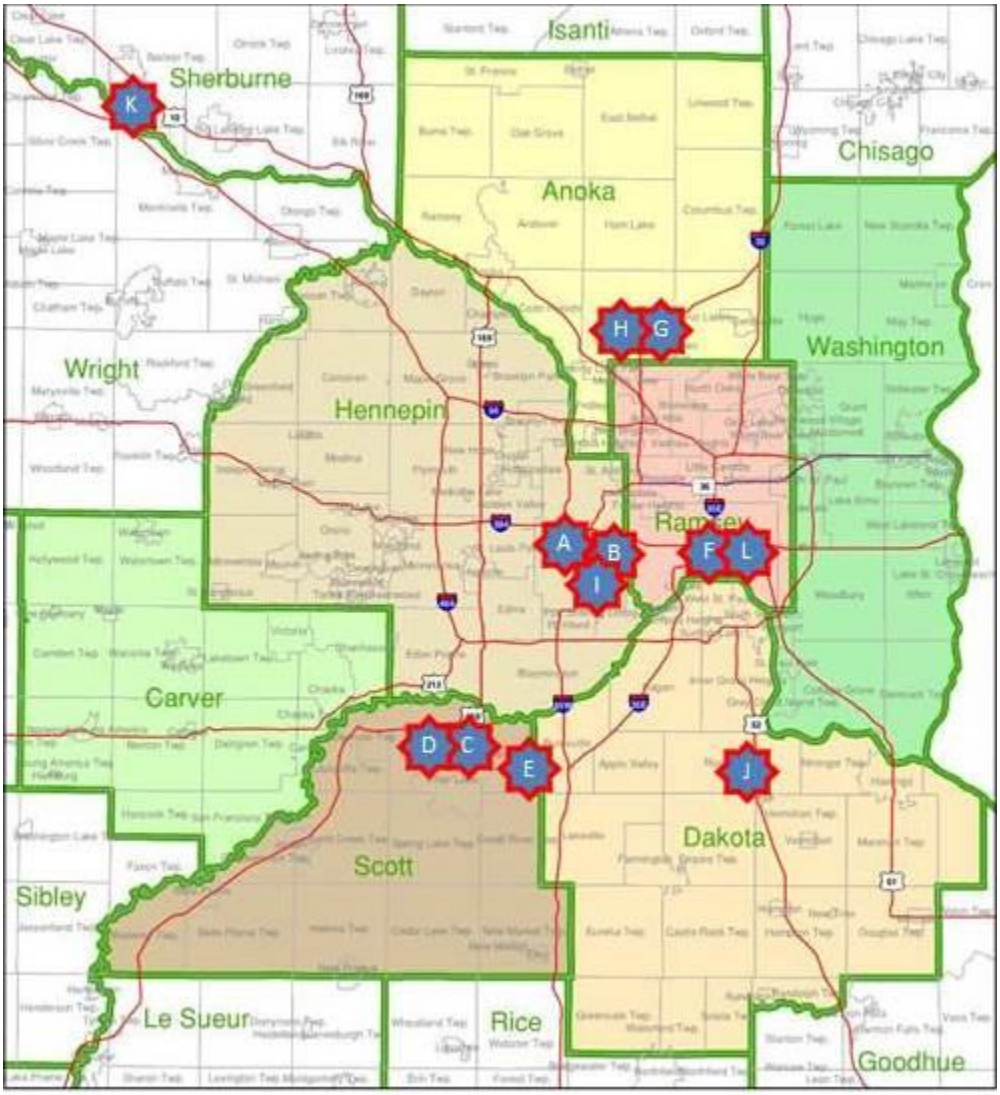


Table 3.3
List of C&D Companies Interviewed

Map Key Code	Facility Name	Owner	City
A	Broadway RR / Atomic Recycling	Broadway	Minneapolis
B	Como Recycling & Transfer Facility	Veit	Minneapolis
C	Dem-Con C&D Landfill	Dem-Con	Shakopee
D	Dem-Con Transfer Station/Processing	Dem-Con	Shakopee
E	Lloyd's	Lloyds'	Savage
F	Pierce - Butler Recycling & Transfer Facility	Veit	St. Paul
G	Shamrock Disposal & Shamrock Recycling & Transfer	Shamrock	Blaine
H	SKB Blaine Environmental Campus	Waste Connections / SKB	Blaine
I	SKB Malcolm Transfer Station	Waste Connections / SKB	Minneapolis
J	SKB Rosemount C&D Facility	Waste Connections / SKB	Rosemount
K	VONCO II Demolition Debris Landfill	Veit	Becker
L	Saint Paul Recycling Transfer Facility	Advanced Disposal	St. Paul

C&D waste management is typically an integrated business model consisting of several lines of service:

- Transportation (roll-off box company);
- Processing (e.g., sorting facility); and
- Landfilling.

Integrated C&D companies typically own two (2) or three (3) of the above service lines. Merchant haulers that are not a subsidiary or affiliated companies utilize transfer stations, processing facilities and landfills. These merchant haulers ensure a minimum, steady C&D waste supply to allow for a profitable business.

Table 3.4 is a summary of the amount received and recycling rate data from the C&D companies interviewed. Foth interviewed each company with a standard set of questions, but the data results shown in Table 3.4 indicate the wide variety of responses. Some companies carefully measure their C&D waste received via truck scales and report their amounts in tons. Other companies use volume estimates only and record their incoming loads in cubic yards. Each of the C&D landfills that offered information on remaining capacity have relatively long landfill life remaining given their current receiving rates. Each company was asked about their actual recycling rates. The C&D processors interviewed indicated a range of 60 percent to 75 percent recycling rates with alternative daily cover (ADC) included in the percentage. The Dem-Con recycling rate at their landfill is very low because most loads that have recoverable amounts of recyclables are diverted to their C&D processing facility for sorting and recovery. The Broadway Resource Recovery recycling rates are from the Atomic Recycling web page document *"Construction Waste Management & Recycling Plan"*.[10] Broadway's recycling rates were not disclosed in the Foth interview.

SKB – Rosemount data is not displayed on Table 3.4 because the tons of C&D materials disposed vs. recovered was not disclosed to Foth in the interview. SKB utilizes a portable C&D sorting

platform that is mobilized to different areas of the active C&D landfill. Also, the total tons managed as reported by SKB (1.5 million tons per year) include both C&D and industrial waste. Therefore, the SKB – Rosemount data was not included in Table 3.4 simply because it is not directly comparable to the other facilities.

Table 3.4 is an indicator of the heterogeneous nature of the C&D industry and the challenge of trying to compare different facilities with different types and sources of waste. C&D data management does not have uniform systems for analysis.

All of the landfills toured for this study have metal recovery near the face of the landfill where loads are tipped. Dem-Con, SKB-Rosemount, and VONCO II all use magnets attached to a grapple-boom arm to capture ferrous scrap at or near the working face of the landfill. Advanced Disposal and Lloyd's manually sort ferrous scrap on the transfer station tipping floor with a loader. All of the landfills reported recycling metal and clean wood. The landfills reported that cardboard recovery operations are done as markets allow.

Landfill disposal is an integral part of the overall C&D waste management system. Marketable recoverable materials can be removed from the C&D waste stream at several points within the system: by the construction or demolition contractors at the job site; at the transfer station; at the C&D processor; and at the landfill. But each entity has a share of material that cannot be reused, recycled or otherwise economically recovered. Even the C&D processors that are intentionally designed and operated to maximize recycling still have residuals that cannot be recovered.

The flow of materials to C&D facilities depends in part on the on ownership structure. For example, the VDS Como Transfer Station is owned by the same parent company (Veit USA) as the VONCO II landfill. Dem-Con Recovery & Recycling is owned by the same parent company that owns Dem-Con Landfill, Dem-Con Companies. Except for Dem-Con, the companies have hauling operations (e.g., roll-off businesses) associated with the processing and landfill businesses. Most C&D processors that own landfills stated they originally got into the processing business as a way to save air space in their landfills.

3.7.2. Description of C&D Transfer and Processing Operations

The five (5) existing Metro Area C&D processors have been in operation for many years. This diversity of C&D recycling plants is a unique private network compared to other metropolitan areas of our size. These processors help remove marketable commodities from mixed C&D waste and try to minimize the non-recyclable residuals that must be landfilled.

Transfer stations are typically sited at a central location as close as possible to the point of waste generation (in or near the urban core of the Metro Area). The intent is to transfer smaller loads into larger transfer trailers to enable more cost-effective transportation to landfill. Some transfer stations will sort out large ferrous metal scrap and other large recyclable items as they load materials into transfer trailers. However, unless a the facility is intentionally designed and operated to accommodate a sorting operation (e.g., with an elevated sorting platform and commodity storage bunkers), only a minimal amount of material is recycled out of mixed C&D transfer stations. In most cases transfer stations send material direct to landfills without the C&D waste being processed.

Table 3.4
Summary Data from C&D Companies Interviewed

Company	Type of Facility	Amount Received (From Interviews)	Estimated Tons per Year	Capacity Notes	Actual Recycling Rate	ADC Included?
TRANSFER STATIONS AND LANDFILLS:						
Advanced Disposal	Transfer Station	750 tons per day (TPD) (Includes MSW & C&D)	195,000	750 TPD maximum	Not disclosed	
Dem-Con	Landfill	900,000 cubic yards (CY) per year	750,000	Landfill has 65 million CY (30 years of capacity) of air space remaining	Less than 1%	No
Lloyd's	Transfer Station	65,816 cubic yards (CY)	15,100	62,000 TPY maximum	10% without ADC	No
VONCO II	Landfill	150,000 TPY (Mixed C&D; not processing residual or other special wastes)	150,000	Landfill has 40 million CY (75 years capacity) of air space remaining		
C&D PROCESSORS:						
Broadway	Processing Facility	155,000 to 160,000 TPY	157,500	187,600 Tons Per Year	74% with ADC 49% without ADC	Yes
Dem-Con	Processing Facility	250 to 300 TPD (C&D only)	71,500	700 TPD maximum includes processing and RRT Transfer Station for MSW	62.17% with ADC or 39.09% without ADC	Yes
VDS Como TS	Processing Facility	1,500 to 2,000 CY per day	104,700	3,000 Yards Per Day	60% to 75% with ADC	Yes
FACILITIES TOTAL			**1,443,800**			

Sources: Interviews and company web sites

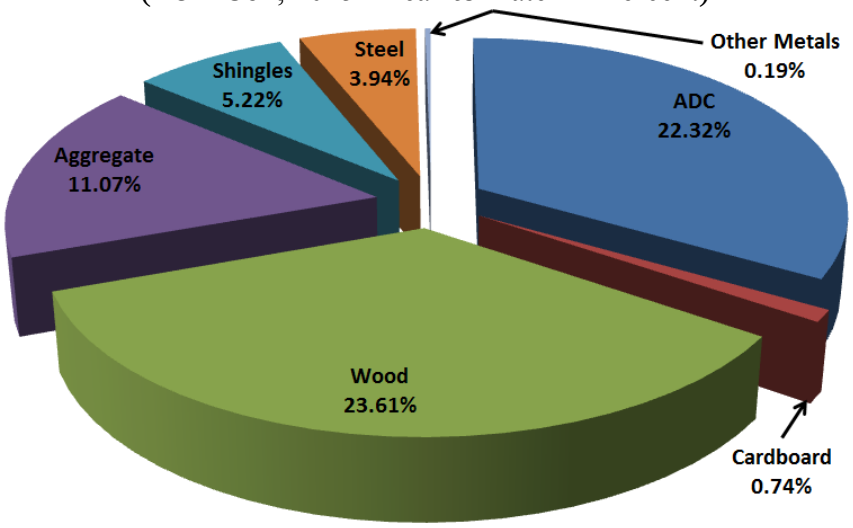
Most of the processors observed utilize elevated sort-line systems that include manual picking stations to remove marketable materials. Recyclables are pulled from the line either manually or using magnets. This "positive" sorting of recyclables helps assure the recovered materials are clean enough to meet market specifications.

At the processors, the most common items observed to be recycled from mixed C&D loads included: wood, ferrous and non-ferrous metal, cardboard, and aggregate from materials such as concrete, brick, and rock. Tear-off roofing shingles are being recovered by nearly all processors, at least to a minimum extent, but not on a year-round basis due to lack of steady end markets and seasonal supplies.

Figure 3.10 is an example of one processor's (Dem-Con) reported materials recovery composition.[11] These Dem-Con percentages are for this year-to-date (2015) and may not be "typical" of all months, years or other processors. Actual materials recovery composition will change by month, year, markets, processing system design and operations. The control and management of supply quality is one of the most critical variables and will vary by processor and hauler/supplier customer.

Figure 3.10
An Example of One Processor's Composition of Materials Diversion From Mixed C&D

(Dem-Con, 2015 "Year-to-Date" in Percent)



Source: Dem-Con

The smaller particles of "fines", either 2-inch or 3-inch minus are traditionally screened out at the beginning of the process and then used as alternative daily cover (ADC). Figure 3.11 displays a photograph of typical ADC material from a processor.

Figure 3.11
Photograph of Typical ADC

ADC includes dirt, wall board, masonry, small pieces of cardboard and paper, rocks, and plastic all in smaller pieces (either 2 inch or 3 inch minus). ADC generally has little to no BTU energy value as most of it is inert aggregate-like material. It can be economically sorted via mechanical screens from mixed C&D, but it has few other uses other than landfill ADC.

All material not screened or otherwise sorted off the line remains at the end of the conveyor belt and is described as "processing residual". It consists typically of carpet, laminate, composite materials, gypsum or wall board, buckets, vinyl siding, and plastic sheeting. Figure 3.12 displays a photograph of typical processing residual materials.

Figure 3.12
Photograph of Typical Processing Residuals

One of the more challenging materials for potential recovery is sheetrock. The C&D processors interviewed all consistently stated there are no viable markets for sheetrock or processed gypsum. There are no industrial users (e.g., wallboard manufacturers) in Minnesota. Land application is either prohibited or not needed due to the type and quality of local soils. One of the processors (Dem-Con) has been granted a Case Specific Beneficial Use Determination (CSBUD) for gypsum.

The problem with sheetrock is compounded because the gypsum can cause foul odors. Hydrogen sulfide gas is directly attributable to gypsum. Two landfills have gas recovery systems with gas flaring in part to help manage odor emissions. Another landfill interviewee mentioned that use of large amounts of ADC produced from C&D processors leads to higher levels of odor.

It was noted by all respondents that the amount of mixed C&D material able to be recovered depends on the type of job (construction vs. demolition) and the job-site sorting that occurs prior to the material being brought to the processor. Processors and others who sort C&D are dependent on end markets to determine what can economically be recovered and recycled.

Most markets for materials are local. Clean wood waste (without paint, preservatives or other forms of treatment) is used for combustion, animal bedding, and landscaping. Aggregate is often reused on site for road construction or fill. Ferrous, non-ferrous, and cardboard go to typical recyclable end markets. Recent declines in recyclable prices have significantly impacted market demand for traditional recyclables. (For more discussion on markets, see Section 4 – Materials End Markets by Commodity.)

According to several of the processors interviewed, the additional capital and operating costs to invest into a mixed C&D processing facility is a major barrier to increased materials recycling. Merchant haulers have tight margins and if C&D processing is more expensive, they will choose to landfill. Processors that also own landfills stated that they originally got into processing to save landfill space as a primary driver.

There is ample processing capacity in the greater Twin Cities area. Most of the processors currently operate only one shift. Under current operations, some of the C&D processing facilities are under-utilized. Plus, there is the possibility of adding additional shifts if supplies and commodity end markets warrant.

3.7.3. Source Separation on the Job Site

C&D materials are more frequently recovered or reused at larger commercial job sites. . This type of diversion does not occur as much at smaller commercial and single-family residential remodeling and construction jobs. Source separation is a common practice for the higher value, higher volume materials such as metals and concrete if the job is large enough and depending on the contractor and job. This type of recycling is typically not measured at the job site.

One of the barriers to source separation recycling and reduction at C&D job sites is lack of space. Space for multiple vendors and recyclables containers is very limited whether it's inside of the buildings where remodeling projects occur or at the building dock. For example, it is often difficult to manage recyclables separately at the job site compared to one roll-off box for all mixed C&D materials. Job site space is a significant barrier to increase diversion.

Source separation at the job site is much more likely to occur on larger commercial projects. Source separation occurs on smaller residential and commercial job sites if there are higher value materials such as ferrous and non-ferrous metals. Also, if the owner has any diversion requirements, these will increase source separation on the job site.

Another barrier to source separation at the job site is the potential for additional exposure hazardous materials such as asbestos or lead. Some contractors expressed unwillingness to take on the additional cost and risk of source separation (e.g., tiles, insulation, etc.).

3.7.4. Comments from the Processors

Not all processors agreed on the methods to increase C&D diversion. Most respondents did not want to see mandated recycling rates, but two did suggest this would help. The following general comments were expressed repeatedly as areas of concern for processors.

- Do not ban materials from the landfill or require they be recovered/recycled without first ensuring there are adequate end markets in place. Outright bans of materials do not work if there is no place to take the material. It is important for the end market infrastructure to be in place to use the materials.
- Counties and the State could significantly support increased C&D recovery/recycling through their own procurement of materials. For example, highway engineers could help promote the use of recycled materials derived from C&D waste when they specify aggregate base and hot mix asphalt for road construction projects.
- Mn/DOT and the counties could directly specify recycled materials for use in road construction projects. Some materials engineers specify virgin materials only even though recycled materials that meet the same quality and performance specifications can work just as well. Often, the recycled material alternatives are available at competitive pricing.

3.8. Other National Resources and Literature

Appendix A includes results of selected literature reviews Literature from Minnesota sources (Appendix A.1) and national sources (Appendix A.2). Appendix A.2.a contains a summary of the Chicago metro region and Madison, WI C&D mandatory policies and recycling programs based in part on the Reclamation Administration web site. Appendix A.2.c is a more detailed description of the Recycling Certification Institute (RCI).

3.8.1. Reclamation Administration

One of the national resources is the Reclamation Administration (RA) which is an informal organization that manages a web site dedicated to the dissemination of information about C&D materials reuse and recycling. The RA website focuses mainly on providing practical C&D materials management information from states and cities throughout the United States. Appendix A.2.a provides condensed summaries pertaining to selected city C&D programs and policy initiatives. In general, the links provide information pertaining to the "who, how, what, when and where" relating to the recycling and reuse of C&D and benefits, both environmental and financial.

3.8.2. RCI Certification Data

The Recycling Certification Institute (RCI) oversees a national recycling rate certification program known as the Protocol and Certification of Real Rates (CORR). The RCI program assures users of certified facilities that the stated recycling rates are real, verifiable and reasonable. The goal of this certification is to provide transparent, cost effective, easy to follow, procedures for tracking and categorizing C&D materials. See Appendix A.2.b for a more detailed summary of the RCI certification program and process.

It is difficult to compare the diversion rate from one company to the next, one state to the next, let alone one region of the country to the next due to different definitions, measurement methods and calculation standards. For example, whether or not ADC or recovery via waste to energy facilities is included as "diversion" will make a big difference. The RCI program helps address these issues without trying to impose a mandated set of standard national definitions.

Table 3.5 indicates there currently are eight (8) RCI registered facilities and four (4) certified facilities in the U.S. The C&D diversion rates range from zero to one hundred percent. A wide variety of factors will likely influence these rates, including (but not limited) to the strength of local/regional markets for recycling and local/state regulations. Most of the RCI registered and certified participation is from California.

There are five (5) facilities that report a significant difference between their rates with alternative daily cover (ADC) included vs. without ADC. For these five facilities, the average difference is 28 percent which indicates that having ADC as beneficial use option for C&D diversion is a significant outlet. This average difference is similar to the percent increase due to recovery from ADC from other studies in Minnesota and Iowa.

Table 3.5
C&D Processors Certified or Registered by RCI[12]

Facility Name	City	State	Diversion Rates	
			With ADC	Without ADC
Certified Facilities:				
Broad Run Recycling	Manassas	VA	96%	96%
Dem-Con Recovery & Recycling, LLC	Shakopee	MN	63%	40%
Florin Perkins Public Disposal Site	Sacramento	CA	82%	63%
Zanker Road Resource Management	San Jose	CA	77%	64%
Registered Facilities:				
Commercial Waste & Recycling, LLC	Oakland	CA	76%	27%
Construction and Demolition Recycling Inc.	South Gate	CA	78%	78%
Cooper Tank Recycling	Brooklyn	NY	75%	37%
K. Hoving Recycling & Disposal	West Chicago	IL	80%	80%
L & J Waste Recycling, LLC	Baltimore	MD	78%	78%
Lautenbach Recycle Park	Mount Vernon	WA	0%	0%
Marpan Recycling	Tallahassee	FL	100% *	100% *
Premier Recycle Company	San Jose	CA	62%	62%

Source: RCI (March 2015)

* Note: The "Marpan Recycling" facility in Tallahassee, FL is able to count waste to energy use as "recycling" due to State of Florida rules.

Dem-Con is one of four certified RCI facilities in the country and the only certified processor from the Midwest region. Most of the other facilities are on the east or west coasts. The RCI registration and certification program is relatively new. In the future, more RCI registered facilities may help provide additional encouragement for standardized, independently verified recycling rate measurements.

3.8.3. Chicago, Illinois Metro Region

The Chicago metro region, including Cook and Lake Counties, have notable mandatory C&D recycling programs and policies as summarized below.

Chicago, Illinois - A city ordinance was passed in 2005 that required general contractors constructing, renovating or demolishing qualified projects to recycle at least 50 percent of recyclable debris generated by their operation. Contactors are required to complete C&D Recycling Compliance forms which include estimates for recyclable volumes generated at the job site. (See Appendix A.2.a for more details.)

Cook County, Illinois - Effective since November 21, 2012, contractors are required to divert a minimum of 70 percent of all demolition, dismantling and or renovation debris generated from single-family, commercial and industrial structures in Cook County, Illinois. This so called "3D ordinance" was made possible and developed with the help

of Cook County's nonprofit partner, the Delta Institute. The research used to come up with the diversion ordinance included the development of a deconstruction training program with the use of a pilot project to help determine the viability of requiring reuse as well as recycling of demolition debris. The ordinance also mandates that a minimum of 5 percent of the material in residential structures be reused. Cook County was the first local government in the Midwest to require the reuse of building materials. (See Appendix A.2.a for more details.)

Lake County, Illinois - Effective since January 1, 2014, Lake County adopted the "Lake County Solid Waste Hauling and Recycling Ordinance." This Ordinance requires 75 percent of Construction and demolition debris to be diverted from landfills for all new construction, renovation, demolition, entire re-roofing, or entire re-siding projects of 1,500 square feet or greater gross floor area, in unincorporated Lake County. A plan must be shown demonstrating at least 75 percent of all C&D Debris generated by the covered project will be diverted or the application will be returned marked as "Failed". (See Appendix A.2.a for more details.)

3.8.4. Madison, Wisconsin

As of January 1, 2010, the City required the recycling from construction, roofing and remodeling projects. The ordinance requires a 70 percent recycling rate requirement by weight for new construction and remodeling projects exceeding $20,000. These larger projects must recycle clean wood, clean drywall, shingles, corrugated cardboard and metals. (See Appendix A.2.a for more details.)

3.8.5. Portland, Oregon

Portland has a thriving deconstruction and reuse market. One local company, Elder Demolition, maintains an extensive web presence (www.elderdemolition.com). Elder Demolition provides tips and resources on salvage yards and material exchanges, C&D waste reduction, recovery and recycling tips, the concrete recycling process during industrial demolition, and a variety of other related topics. The company focuses on information relevant to the "real world," such as demolition and salvage of structurally unsound buildings and projections of drywall and plaster recycling opportunities.

4. Materials End Markets by Commodity

The end markets for C&D recyclables are the means to complete the recycling loop. Without adequate end use demand, recycling is not economically or technically feasible. This section discusses each commodity separately because the barriers and opportunities should be analyzed by the individual end use industry.

4.1. Aggregate

C&D waste materials that can make up aggregate products are among the largest portion of the C&D waste stream, on a weight basis. Potentially recyclable materials include concrete, brick, glass and even "dirt/fines". The composition analysis conducted in 2006 for the CD&I Study indicated the following composition of these categories of waste in the C&D waste stream:

- Glass 0.8 percent
- Concrete 9.7 percent
- Brick 5.6 percent
- Dirt/Fines 16.1 percent

The concrete and brick wastes are primarily generated from demolition of commercial structures and from foundations of residential structures. The primary components of an aggregate product include: concrete, brick, ceramics, and miscellaneous fines. Glass is not intentionally included but may end up in aggregate products as an incidental additional feedstock commodity.

The composition analysis conducted in 2006 for the CD&I Study found that the dirt/fines were significantly higher from demolition loads (compared to construction, roofing or transfer station loads). Dirt/fines consisted of dirt and smaller pieces of many of the typical categories found in demolition debris. Separating the fines into the categories was not possible for the Foth sort crew. This type of material is being separated at some mixed C&D processing facilities as part of the front-end screenings "2-inch minus" product. This is utilized as an ADC for sanitary landfills.

As a general rule, used aggregates from road construction, both old concrete and asphalt pavements, are not considered a part of the C&D waste stream. This is because these are very large volumes of relatively clean, readily reusable or recyclable materials that do not get into the mixed C&D waste stream. Therefore, while the use of recycled C&D aggregate into road construction will be considered a viable market outlet for recycled concrete, used concrete and recycled asphalt pavements is not part of the mixed C&D waste stream.

Recycling concrete saves on disposal fees for concrete contractors, reduces the expenses of buying new, virgin aggregate and decreases the cost of making new concrete paving material. A primary challenge in recycling old concrete is breaking the concrete and separating it from its steel reinforcement. Another challenge is to assure that brick material is excluded if the recycled aggregate is intended to be used according to Mn/DOT's aggregate base materials specifications for road construction.

Concrete that is crushed can be used as a low-grade backfill or solid fill material, roadbed aggregate or aggregate for making new concrete masonry units (a concrete "block" used in construction). Aggregate made from recycled concrete can also be used in cement and asphalt paving. Individual aggregate components like concrete, brick, and miscellaneous fines are more valuable when source separated, producing a higher-value end product.

Mn/DOT has a new set of Special Provisions (SP) specifications that detail the requirements for using recycled materials as an aggregate for surface and base courses for road construction.[13] Using recycled materials as a supplement to natural aggregate is not new. Recycled aggregates have been tested and proven successful in several engineering applications by the Mn/DOT, as well as county and city public works departments. For example, Portland cement concrete pavements are commonly recycled and used in place of virgin aggregate as base material.

The State of Minnesota uses around 300,000 tons of recycled concrete per year, with a significant portion of it used in road bases. The Mn/DOT specifications are very stringent about the maximum amounts of masonry block (10 percent) and brick (1 percent) that are allowed in recycled aggregates used as base for state-funded road construction projects.[14] Masonry block and brick are typically mixed in with other aggregate material. Processors are not able to guarantee that these restrictions are met by the mixed material. Therefore these stringent limits make the use of C&D waste aggregate extremely difficult at this time.

4.2. Asphalt Shingles

Asphalt shingles are the most common type of roofing material used in new home construction and re-roofing projects. Asphalt roofing shingles are a significant portion of a C&D waste stream. The composition analysis conducted for the CD&I Study indicated that total roofing waste (including shingles, post-consumer "tear off" waste and flat roofing) made up 17.1 percent of the total C&D waste stream. Shingles and other roofing project tear-off waste made up 15.2 percent and flat roofing made up 1.9 percent of the total C&D waste sorted.

Recyclable asphalt shingles are generated as post-industrial (i.e., "manufacturers' shingle scrap") and post-consumer primarily from re-roofing projects (i.e., "tear-off shingle scrap") and full building demolition projects. In addition, a relatively minor amount of shingle scrap is generated from new building construction, primarily residential homes.

Other types of roofing materials are also found in C&D waste including cedar shakes, clay tile, plastic, metal and commercial (e.g., "flat") roofing materials. Most often, these other types of roofing materials do not readily lend themselves to recycling due to the composite structure and lower relative composition compared to asphalt shingles. For example, the different layers within flat roofing waste are often still connected (e.g. rigid foam insulation, wood decking, various membranes and adhesives).

The primary recycling outlet for recycled asphalt shingles (RAS) is as a supplement in hot mix asphalt (HMA) for road construction. The Minnesota Department of Transportation (Mn/DOT) has adopted a specification for the use of RAS in HMA.[15]

A secondary market of RAS, direct extraction of the liquid asphalt for reuse, is under development and commercialization. This new shingle recycling technology is being developed by Recovery Technology Solutions (RTS, Shakopee, MN)[16] and the patented extraction system and equipment is provided by Crown Iron & Supply (Roseville, MN)[17]. The first RTS demonstration plant is located in Shakopee, MN, has been constructed and is in the process of shakedown. If successful, other RTS shingle extraction and recycling facilities are planned to be developed in the U.S. Primary outlets for the recycled liquid asphalt may include as a supplement for blending into virgin asphalt for use in:

- HMA for road construction;
- Roofing applications;
- Other sealants and coatings; and
- Asphalt oil as fuel.

RTS continues to develop its off-take markets for the recycled liquid asphalt and the other secondary products (e.g., aggregates, fiberglass, etc.) If successful, RTS should help increase the end use market capacity for RAS in the Twin Cities metro area.

There are a number of other potential end-uses for RAS including:

- Aggregate supplement for road base and other construction applications;
- Fuel supplement for cement kilns;
- Energy recovery in industrial boilers; and
- Aggregate use as a part of new shingles.

The use of asphalt shingles in HMA is the most well documented and proven end use application. Asphalt shingles are typically ground and screened to produce 3/8-inch-minus size pieces. Once processed into a specified product, the RAS in usually fed into the HMA plants along with recycled asphalt pavement (RAP). The high-grade asphalt, the fiber content, and mineral granules contained within the recycled roofing shingles are valuable components of traditional HMA.

The technical process, infrastructure, Mn/DOT specifications and environmental regulations are in place for continued and even expanded use of RAS in HMA in Minnesota. The sorting, grinding and screening process for recycling clean asphalt shingles into RAS is straightforward and well proven. Ample shingle grinding/screening capacity exists in the Twin Cities area, including at several of the mixed C&D processors themselves.18 There have been some minor changes since this report was published in 2010, but the overall shingle recycling infrastructure has remained relatively constant. Some of the companies listed have purchased or sold shingle processing equipment.

Despite the strong and diverse capacity at various shingle recycling facilities, all C&D processors interviewed for this study indicated that there is a currently very weak market demand for asphalt shingles. The barrier to expanded use of RAS in HMA is lack of demand from the HMA producers. HMA producers most often own large stockpiles of RAP for use as their

primary recycled feedstock. Due to the structure of the HMA industry and Mn/DOT specifications, RAP is preferred over RAS.

Opportunities for stimulating growth in shingle recycling are readily available to the State of Minnesota and counties. These include implementing HMA purchasing policies that explicitly allow RAS and require alternate bid prices for RAS-derived HMA. Hennepin County has utilized this approach consistently for approximately ten (10) years for maintenance projects such as asphalt "mill and overlay" road jobs. In the past, the bid prices for RAS-derived HMA were lower than price for traditional HMA without RAS. Recent results from these alternative bids have indicated that this cost savings due to RAS has decreased. The HMA producers that submit bids have indicated that their need to use RAS in HMA have decreased over time as the amount of RAP increases. Another alternative would be to require the use of RAS in HMA unless the project engineer determines that the RAS does not meet quality specifications or is not readily available.

Hennepin County specification and allowance for the use of RAS in HMA in new construction projects (e.g., new roads or full-depth reconstruction) is less known and documented. The data should be compiled to allow for further discussion with Hennepin County Transportation Department about using a similar alternate bid approach (i.e., line items for HMA supplies with and without RAS) for new asphalt pavement construction projects.

Mn/DOT recently released a new research study report on the use of RAS as an aggregate supplement. The research was funded in part by the Minnesota Local Road Research Board (LRRB).[19] While it is helpful to have alternative and supplemental end use applications for RAS, it should not displace the focus on the use of RAS in HMA.

4.3. Alternative Daily Cover

Mixed municipal solid waste (MSW) landfills are required by rule to cover the solid wastes delivered each day with a suitable cover. Historically, this has been accomplished with the use of at least 6 inches of soil as "daily cover." One form of alternative daily cover (ADC) is the use of alternate "soil type" materials that do not have other beneficial uses and may provide a revenue source to the landfill. Materials falling in this category may include materials such as contaminated soils, foundry sands, and other industrial waste by products. Clean, processed C&D waste is included as one of these types of potential ADCs.

It should be noted that there are two basic approaches to producing ADC from processed C&D wastes. In one approach previously used extensively in the eastern United States, after recyclable products such as fiber, wood, metals, and aggregates are sorted out of the mixed C&D wastes; the remaining materials are ground up and marketed as an ADC. This approach resulted in the drywall present in the C&D wastes being ground to small particle sizes. The ground up drywall, when exposed to moisture in an anaerobic environment of a landfill, reacts to form hydrogen sulfide gas. This gas has the odor of "rotten eggs" and ADC made from C&D wastes using this approach have been found to cause odor problems at landfills.

The second basic approach to producing an ADC from C&D wastes is to run all the wastes as delivered through a screen that separates the fines (such as "2 inch minus") from the remaining C&D wastes. The fines contain a great deal of dirt, dusts, concrete, brick, and other materials that are present as small pieces. The screen "size separates" the C&D wastes and most of the drywall present in the mixed C&D wastes is carried through the screening process with the rest of the materials. These "fines" are then potentially approved for beneficial use as an ADC. Depending on the mix of demolition versus construction wastes present in the mixed C&D waste stream, the use of these fines as ADC can provide a relatively significant percentage of recovered material.

While both methods have been used in this market, the approach of grinding waste to produce ADC is strongly discouraged due to the potential odor generation.

MPCA has determined that clean fines (i.e., 2-inch minus) from mixed C&D processing facilities when used as an ADC is a beneficial use. Without this material, the landfill would need soil or some other material to use as daily cover. Dem-Con and VONCO II use ADC for cover. SKB-Rosemount identified that they do not use ADC for daily cover as they have other materials available that work better for their facility.

The primary advantage to the C&D processing facility is that they are able to "market" the ADC at a much lower cost than if the materials had to be disposed in a landfill. This helps the overall economic feasibility of mixed C&D waste processing. All of the C&D processors are separating clean fines for use as ADC. This has become a standard practice.

4.4. Biomass Fuel

There is growing interest in the use of portions of the C&D waste stream as a fuel source. There are several categories of materials found in C&D wastes that are combustible with wood being the most prevalent (a total of 22.5 percent in Figure 3.1 of this report). Depending on availability of other markets, some other materials found in C&D wastes could also be recovered as fuel if they are not recovered for other, more cost-effective uses such as recycling.

Potential other material categories can include some paper, some plastics, yard wastes (very small amount present), and some textiles/carpets. Based on the composition, a total of over 34 percent of the wastes could be used as a fuel (excluding green-treated wood). C&D processing facilities in other states have reported a potential biomass fuel percentage of 40 percent plus or minus.

During development of the report entitled *Analysis of a Biomass/RDF Facility at Rock-Tenn,* Foth obtained a laboratory report on the chemical analysis of the biomass fuel produced at a C&D processing facility in Des Moines, Iowa. According to that laboratory analysis of a sample conducted on February 2, 2006, the Btu content was 6,435 per pound on an "as received basis."

For that report, Foth also developed an estimate of the Btu content using composition percentages from C&D Waste Composition data from the Des Moines area and Btu values for materials from the *Integrated Solid Waste Management Engineering Principles and Management Issues*[20]. That process resulted in an estimated Btu value of 6,470 per pound (close to the laboratory data point).

In addition, Foth obtained additional data from a C&D processing facility in Des Moines in October 2006 that showed the laboratory test data for Btu at 6,940 Btu per pound as received and 7,855 dry. The actual Btu heating value of biomass fuel from C&D wastes will depend on the composition of the fuel and will likely vary somewhat from load-to-load and day-to-day. It appears reasonable to use a range of 6,400 to 6,900 Btu per pound for preliminary planning purposes.

To produce such a fuel requires either source-separation of the combustible materials at the jobsite or processing of mixed C&D at a mechanical processing. After separation, the materials must be ground into a smaller particle size required by a specific solid fuel combustion facility (i.e., meeting the specifications of the facility market).

It should be noted that there could be two basic approaches to recovery of potential fuels from C&D. One approach could focus on dimensional lumber, pallets, tree waste, etc. This biomass fuel may be able to be used in a wider variety of solid fuel combustion processes. However, mulch markets may also compete for this separated wood.

The other approach is to recover the larger amounts of other wood and fibers along with some plastics, etc. This approach would require the combustion market to have controlled combustion processes and all the proper air pollution control equipment. Thus, markets for such a biomass fuel will be more limited, but if available, could likely use a much larger quantity of fuel from C&D wastes.

Due to the seasonal variation of C&D waste generation, there will likely be a seasonal variation in the amount of C&D based biomass fuel available with less available in winter months than during the summer months. This may be counter to the potential fuel market seasonal needs.

4.5. Gypsum or "Drywall"

Gypsum drywall, often referred to as gypsum wallboard or sheet rock, is a major component in the landfilled C&D waste stream. The composition analysis conducted in 2006 for the CD&I Study indicated that sheetrock made up 11.6 percent of the total C&D waste stream.

Recycling of drywall is still in the development phase especially for used, painted sheetrock coming from demolition projects. Most used drywall in Minnesota is still landfilled. On the construction site, waste reduction can be accomplished by carefully calculating the amount of wallboard needed. Also, use of standard carpentry and construction techniques (e.g., "measure twice, cut once," pre-constructed panel sections, etc.) can help reduce waste.

Landfilling of drywall has an additional challenge due to production of hydrogen sulfide gas that may be produced. The gypsum can combine with other waste materials and byproducts in the anaerobic environment of a landfill to produce hydrogen sulfide gas.

The Construction & Demolition Recycling Association (CDRA) web site on "Drywall Recycling" has provided an excellent resource on drywall recycling.[21] This web site states that gypsum, a naturally occurring mineral, is mined from deposits formed by ancient sea beds. Gypsum is used as a raw material in construction products, as an ingredient in Portland cement, and as a soil amendment. The vast majority of virgin gypsum is used in manufacturing of construction products such as drywall.

The CDRA Drywall Recycling web site outlines four potential end use applications for recycled drywall:

- New drywall;
- Portland cement;
- Land application; and
- Compost

The primary challenge for this material is to develop adequate markets. Such market development is challenged by the relatively low landfill tipping fees and that there are no Portland cement manufacturing kilns in the Minnesota.

A gypsum drywall recycling program may require a concentrated effort, perhaps including additional demonstrations and pilot projects (e.g., Dem-Con's gypsum CSBUD for land application). The C&D processors continue to look for outlets for gypsum. Continued research and development supported by the government sector will be helpful in expanding market demand for these types of emerging end markets.

4.6. Metals

Metals recovered from construction or demolition debris typically provide the highest market value of C&D waste stream materials, and are more commonly recovered than disposed. Aluminum, copper (non-ferrous), and steel (ferrous) are the most common metals found in C&D debris. The composition analysis conducted for the CD&I Study indicated that total metal made up 3.4 percent of the total C&D waste stream. Ferrous scrap metal made up 2.8 percent of the total C&D waste sorted and non-ferrous made up 0.5 percent.

Recycled metal is typically re-melted and reused in the manufacturing of new products. Due to its strength and durability, structural steel (such as I-beams and columns) may be reused in other construction projects or sold as scrap. Even white goods from demolition or deconstruction projects can be sold to scrap dealers, where mercury and CFCs are removed prior to recycling the metal components.

Often, metals are recovered as source separated materials directly from the job site (e.g., in roll-off boxes dedicated to scrap metal). This method of recycling via direct source separation generally would not be reported by mixed C&D processors as the material goes direct from the generator to the metal scrap dealer. These materials are typically accepted at all salvage yards and other metal recyclers directly from the contractor. If large enough volumes are being generated at a job site, metal recyclers will sometimes site containers for free, or at a minimal cost to cover transportation.

The actual market price for metal depends upon several factors:

- Quality of metals collected (ferrous vs. non-ferrous);
- Degree of contamination;
- Ease of separation of mixed metal materials received at salvage yard; and
- Current global and national market demand for metals.

The MPCA *Minnesota Recycling Markets Directory* currently lists 53 "ferrous metals" and 50 "non-ferrous metals" market outlets.[22] This MPCA *Directory* considers any collector, intermediate processor, broker or end use manufacturer that receives separated recyclables for reuse or recycling as a "market".

4.7. Paper

The composition analysis conducted for the CD&I Study indicated that total paper made up 4.2 percent of the total C&D waste stream. OCC made up 2.6 percent of the total C&D waste sorted and other paper made up 1.6 percent. On construction projects cardboard is used primarily as a packaging material. New home and commercial construction projects generate a significant amount of OCC from product packaging.

Composition studies indicate OCC makes up as much as 3 percent to 6 percent of the C&D waste stream. The Twin Cities metro area has a well-developed cardboard-recycling network consisting of private and municipal collection facilities and collection services. The MPCA's *Minnesota Recycling Markets* Directory currently lists 35 companies that accept and process recycled OCC/paper.[23] Most recovered OCC is used as feedstock to manufacture Kraft bags, corrugated medium, and boxboard. OCC is being used increasingly in linerboard.

Other markets for this material include tissue and toweling, core stock, and bleached board. The OCC is positively picked on a C&D Sorting line. The labor is trained to select only clean, marketable OCC. Any OCC contaminated with paint, grout, or other contaminants is not mixed with the marketable recyclables.

4.8. Plastic

Plastic is the most complex category of recyclables in the C&D waste stream. The composition analysis conducted for the CD&I Study indicated that total plastic made up 4.3 percent of the total C&D waste stream. Marketable plastic made up 0.6 percent of the total C&D waste sorted and other plastics made up 3.8 percent. Many types of plastics are used in building products and construction materials.

Some of those plastic products include:

- Polyvinyl chloride (PVC or simply "vinyl"): window frames, floors, gutters, siding, pipe and wiring insulation;
- Polyethylene film: vapor barriers and packaging;
- High-density polyethylene (HDPE): piping, joint compound, paint buckets, and caulk tubes;
- Polystyrene (PS): insulation board;
- Polypropylene (PP): electrical components; and
- Nylon: carpet.

Plastics are not typically recovered as a part of the C&D waste stream in the processing lines we interviewed. HDPE (buckets) are reused by contractors and are typically low in volume in the C&D waste stream. Film plastics used as window coverings are a seasonal product with volumes peaking in the spring. The processors indicated that the film plastic is difficult to handle and dirty when it is received at the processing facility. Markets prefer clean materials.

Vinyl siding contractors have the best opportunity to recover large amounts of scrap siding from construction projects. Once mixed with other C&D waste materials, vinyl siding is generally too contaminated to be considered recyclable. There is one vinyl siding market in Minnesota that has been in existence for 11 years.

4.9. Carpet

Carpet has some end markets, but it must be dry and clean. Typically carpet is not received with C&D materials in a recoverable condition.

4.10. Wood

The composition analysis conducted for the CD&I Study indicated that total wood waste (including tree waste and all other wood waste) made up 22.5 percent of the total C&D waste stream. The composition of subcategories of wood waste in the C&D waste stream include:

- Tree waste 0.2 percent
- Non-treated wood 3.2 percent
- Green-treated wood 0.8 percent
- Other woods 18.3 percent

Non-treated wood includes bare, unpainted dimensional lumber such as framing boards and most shipping pallets. Green-treated wood is a generic term for wood impregnated with chemical preservatives which is found in residential construction projects involving decks, fences, or foundations and other commercial applications such as telephone poles and railroad ties. Some of the more toxic wood preservatives used in the past were chromated copper arsenate (CCA), creosote, and pentachlorophenol.

Other wood includes manufactured or "engineered" wood, surface-coated wood, and other items such as wood furniture. Manufactured woods are "engineered" composite type products held together by glues and binder and generally include plywood, laminated wood, particle board, and oriented strand sheathing. Surface-coated wood is treated with paint or stain to resist moisture or for aesthetic purposes.

Untreated wood waste generated from construction activities involves off-cuts of solid sawn lumber, and engineered wood products. These waste materials are either separated at the jobsite or recovered from mixed loads delivered to C&D processors and are typically recovered for end uses like biofuel, mulch, animal bedding, or compost bulking agents. Recycled wood for use as landscaping mulch or compost must be untreated wood so that it is free of any chemicals, including paint, stain, waterproofing, CCA, creosote, pentachlorophenol, petroleum distillates, and other pressurizing treatments.

Building demolition projects can generate recoverable wood materials like timbers, trusses, framing lumber, flooring, decking, millwork, doors and cabinets, and window frames, all suitable for reuse or recycling depending on their condition. Recovering these materials through a salvaging or deconstruction process provides the greatest opportunity for their reuse back into the building process and also provides the highest potential market resale value.

Green-treated wood with preservatives and lead painted wood are considered hazardous materials in most states. In Minnesota, treated wood is classified as an industrial solid waste and regulations require that it be disposed of in lined landfills that are approved under their industrial waste management plan to accept this type of waste.

Most recycled clean wood waste is processed and sold locally or regionally to the highest price market. Market outlets for processed C&D wood wastes include:

- Livestock bedding;
- Erosion control and disaster remedies; and
- Biomass fuel.

C&D processors are able to control quality of the wood pulled from the mixed C&D waste. Wood materials are positively picked and only clean wood waste is pulled from the waste stream. Clean wood waste is then either directly delivered to the end market specification or in some cases ground on site to the size stipulated by the market. Based on the limited interviews, landscape mulch comes mainly from tree waste and other forestry byproducts and not from lumber or pallets.

Market opportunities for treated wood, especially CCA-treated wood, are limited due to their chemical contaminants. The 2000 Minnesota composition study indicated that treated wood accounted for 3.0 percent of MSW landfilled in 1999.[24] Treated wood was reported to have increased to 3.5 percent in 2004, according to the 2004 non-MSW waste characterization study.[25]

5. Findings

This Hennepin County *C&D Diversion Capacity Study* based a number of findings on tonnage reports from C&D facilities to the MPCA and host counties. The most recent MPCA data from 24 permitted facilities located in the Metro Area indicates that about 810,000 tons of mixed C&D was landfilled or recycled in 2013.

MPCA calculates a C&D diversion rate of 30 percent (242,000 tons recycled) based on permitted facility reports in the Metro Area alone. This diversion rate is very low compared to earlier targets suggested in the CD&I Study. Additional diversion takes place direct from the job site to end markets and reuse opportunities, these tons are not included in MPCA or county permit reports and were unable to be quantified in this Hennepin County study.

While often lacking in consistency and continuity, the county and MPCA tonnage reports help verify the description of the major C&D transfer stations, processing facilities and landfills serving Hennepin County.

This study provides the County with additional new data about the current C&D reuse and recovery infrastructure. This study did not include a field composition analysis. Previous sort studies were utilized to examine the assumed components in today's C&D waste stream and various recycling streams.

The deconstruction and reuse business sectors of the C&D industry are under-developed in Minnesota. However, there are many enterprises, including several non-profit organizations, which help provide valuable deconstruction and reuse services. Many of these were interviewed for this study. Further growth is needed for these practices to become main stream within the construction and demolition industries. Such growth would help increase C&D materials diversion.

There are currently very few organizations that specialize in full deconstruction services and further growth and development is needed. Promoting the environmental and tax benefits of planned deconstruction and materials reuse may help lower future costs of deconstruction. The Ramsey County 4R program is one local example of this type of government promotion.

The Twin Cities Metro Area has enjoyed ample and diverse C&D processing capacity in recent years. The five C&D processing facilities located in the Metro Area include:

- Broadway Resource Recovery (Minneapolis)
- Como Recycling / Veit (Minneapolis)
- Dem-Con (Shakopee)
- Shamrock (Blaine)
- SKB – Rosemount (Rosemount)

In 2013, these five C&D processing facilities reported to MPCA that about 169,000 tons of C&D materials were recycled. These facilities receive mixed C&D waste and then sort and process the material for the various markets. While each facility varies by the type of sorting/processing system, all use elevated sort platforms and most recover the same type of recyclables from mixed C&D waste including: clean wood, aggregate, metals, cardboard, and shingles (when market demand is adequate). The "recycling rate" from these facilities (including ADC) ranges from about 60 to 70 percent. When ADC is excluded, as per the calculation method by MPCA, the facility recycling rates range from about 40 to 50 percent. These facility specific recycling rates are self-reported by each company. In most cases, these reported recycling rates are not independently verified by MPCA or the counties.

One of the processors, Dem-Con, participates in the RCI program which provides a verifiable recycling rate certification service. RCI is based on an industry-designed protocol to provide transparent procedures for tracking and categorizing C&D materials.

There is ample C&D processing capacity in the greater Twin Cities area. Most of the processors currently operate only one shift. Under current operations, some of the C&D processing facilities are under-utilized. Plus, there is the possibility of adding additional shifts if supplies and commodity end markets warrant.

Transfer stations reported to MPCA that about 7,900 tons of C&D material was recycled. Transfer stations do not have elevated sorting platforms and typically use a simple "dump and pick" method of manual sorting from the tipping floor into nearby roll-off boxes. Typical recycling rates range from 10 to 15 percent (without ADC).

The most significant barrier to increased C&D diversion according to the processors interviewed is lack of adequate end use demand for the recyclables. The processors are generally agreed that the government sector should help stimulate end use demand through more affirmative purchasing of recycled materials. For example, they all stated the counties and Mn/DOT should expand their own purchase of hot mix asphalt and aggregates that contain recycled shingles and aggregates from C&D recycling operations. Some stated that the Mn/DOT specifications for recycled materials are too stringent.

Most C&D processors use their "2-inch minus" fines as alternative daily cover (ADC). The separate counting of ADC as a beneficial use is common practice. The Recycling Certification Institute (RCI) has five certified or registered facilities that show significant recycling rate differences with ADC vs. without ADC. For these five facilities, the average difference is 28 percent which indicates that having ADC as beneficial use option for C&D diversion is a significant outlet.

Landfills reporting to MPCA estimated that about 568,400 tons of C&D material was disposed in 2013. This includes ADC and C&D processing residuals. ADC is not always defined and reported to MPCA or the counties in the same manner. Two of the four landfills reported to MPCA a total of about 30,200 tons of ADC/processing residuals disposed in 2013. MPCA includes ADC and processing residuals within the landfilled tonnage (568,400).

The total amount of recycling in 2013 as reported by permitted facilities to MPCA was about 242,400 tons, including materials recovered from landfills, processors, transfer stations, MRFs and markets (see Table 3.1 for details). The calculated recycling rate is 30 percent of the total discards reported as recycled plus landfilled. This rate does not include ADC. This rate also does not include the significant amount of concrete, asphalt, wood and metal that is hauled direct to markets and does not end up as mixed C&D waste. These materials marketed directly from or reused at larger job sites do not show up on MPCA or county reports. Further analysis such as in-depth market interviews would be required to more fully quantify these tons of recyclables marketed directly. Once all tons directly hauled to market are included, the overall C&D recycling and diversion rate estimates for the Metro Area would be much higher than the 30 percent reported by MPCA.

Sheetrock continues to be a significant challenge for C&D processors to recycling. It makes up about 12 percent of C&D material landfilled. Landfilling of sheetrock, especially if it first ground, has an additional challenge due to production of hydrogen sulfide gas that may be produced. The gypsum can combine with other waste materials and byproducts in the anaerobic environment of a landfill to produce hydrogen sulfide gas which can cause very foul odors. The C&D processors interviewed all consistently stated there are no viable markets for sheetrock or processed gypsum. There are no industrial users (e.g., wallboard manufacturers) in Minnesota. Land application is either prohibited or not needed due to the type and quality of local soils.

In order to help increase diversion opportunities for C&D waste processors, market development efforts should focus on these materials:

- Gypsum wallboard
- Shingles
- Coated and other non-clean wood waste
- plastics

Foth's interviews and other research with Hennepin County cities indicated few current C&D materials recycling policies or initiatives as part of ongoing construction/demolition permitting processes. Hennepin County and the City of Minneapolis are contracting with Better Futures to provide residential building deconstruction services. The cost of each building deconstruction is relatively high compared to a standard demolition job. Better Futures estimates that it takes approximately eight (8) hours to demolish a house for landfilling, as opposed to six (6) days or more using "full deconstruction" techniques. Better Futures estimates that it is technically possible to recycle or reuse up to ninety percent (90 percent) of a home using advanced deconstruction techniques. But the relatively lower cost of standard demolition operations and landfilling compared to full deconstruction make this type of diversion economically challenging.

Deconstructing older homes built before the mid-50's and remodels provide more materials with value compared to newer properties (1960 and beyond). Also, residential tax forfeiture properties generally are less attractive candidates for deconstruction because the salvageable materials have lower value compared to other building demolition projects. For example, condemned properties that must be removed to construct a new highway expansion will often be more attractive candidates for deconstruction services.

This study also looked closely at the reuse retail sector. The reuse retailers serving the C&D industry are under-developed in the Twin Cities Metropolitan Area. Further growth and promotions of these opportunities is needed for these practices to become more main stream among the C&D industry and to help increase C&D materials diversion. Helping to promote demand for reused building materials could be a valuable market development option.

As the economy continues to improve, housing and other construction and demolition permits are expected to continue to increase. This increase will have a direct correlation to the amount of C&D waste. The increased supply may help with market development if the reuse and recovery organizations can adequately respond.

As part of this study, selected national C&D diversion programs and policies were reviewed. The following communities have passed C&D diversion policies worth noting:

1. Cook County, Illinois passed an ordinance that went into effect November 21, 2012 requiring contractors to divert a minimum of 70 percent of all demolition, dismantling and or renovation debris generated from single-family, commercial and industrial structures in the County. The ordinance also mandates that a minimum of 5 percent of the material in residential structures be reused. Cook County was the first local government in the Midwest to require the reuse of building materials.
2. Lake County, Illinois passed an ordinance that went into effect January 1, 2014 that requires 75 percent of Construction and demolition debris to be diverted from landfills for all new construction, renovation, demolition, entire re-roofing, or entire re-siding projects of 1,500 square feet or greater gross floor area.
3. Madison, Wisconsin passed an ordinance that went into effect on January 1, 2010 that requires recycling from construction, roofing and remodeling projects. The ordinance requires a 70 percent recycling rate requirement by weight for new construction and remodeling projects exceeding $20,000.

These and other communities may provide Hennepin County with working case studies to help learn more about diversion and market impacts from such policies. The City of Minneapolis is discussing these types of policies as well and there may be an opportunity to coordinate policy and program development with the City.

6. Recommendations

1. Data management for C&D waste and diversion has not kept pace with similar developments in MSW and residential recycling. Hennepin County may wish to consider developing its own system for C&D facility reporting. It may be helpful for all licensed and permitted C&D facilities in the county to provide regular annual reports on a standardized form provided by the county. The County should then publicize recycling rates and diversion rates for C&D facilities so more informed decisions on disposal options can be made based on documented facility performance.
2. There are a wide variety of C&D materials reuse retail outlets and recycling services that serve Hennepin County. It may be helpful to C&D contractors and building owners to have a one-stop web page from the county that itemizes these C&D diversion opportunities. This same information could be provided in written form at the time municipal construction and demolition permits are issued.
3. Hennepin County may wish to review possible policy options to encourage more deconstruction and salvage of materials through the permit and approval process for demolition projects.
4. Hennepin County is well known for its Fix-it Clinics to support repair. A similar form of community based outreach and training program could be provided to provide education for homeowners on incorporating reused building materials into do-it-yourself projects and home remodeling.
5. Hennepin County could develop an incentive to cities willing to pilot C&D diversion efforts.
6. Hennepin County could prioritize C&D recyclable commodities that need market development assistance and dive deeper into the opportunities for collaborating with the private recyclers to enhance end use demand. For example, coated wood, gypsum, shingles and plastics could be targeted for focused market development initiatives.

Appendices

[To be provided under separate cover.]

Endnotes

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