

CAPITAL AREA COUNCIL OF GOVERNMENTS

FINAL REPORT
Waste Minimization and Landfill Alternatives

R·W·BECK

June 2005



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WASTE MINIMIZATION AND LANDFILL ALTERNATIVES STUDY

JUNE 2005

PREPARED FOR:

**CAPITAL AREA COUNCIL OF GOVERNMENTS
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This study was funded through a solid waste management grant provided by the Texas Commission on Environmental Quality through the Capital Area Council of Governments. This funding does not necessarily indicate endorsement or support of the study's findings and recommendations.

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June 15, 2005



Mr. Keith Helmers
Solid Waste Coordinator
Capital Area Council of Governments
2512 IH 35 South, Suite 200
Austin, TX 78704

Re: Waste Minimization and Landfill Alternatives – Final Report

Dear Mr. Helmers:

R. W. Beck is pleased to submit this final report to the Capital Area Council of Governments (CAPCOG) of the Waste Minimization and Landfill Alternatives Study (Study) that we have completed.

If you have any questions concerning the enclosed final report please call me at (512) 450-0991.

Sincerely,

R. W. BECK, INC.

A handwritten signature in black ink, appearing to read 'Scott Pasternak', written in a cursive style.

Scott Pasternak
Manager

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R. W. BECK

Waste Minimization and Landfill Alternatives Study

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This report has been prepared for the use of the client for the specific purposes identified in the report. The conclusions, observations and recommendations contained herein attributed to R. W. Beck, Inc. (R. W. Beck) constitute the opinions of R. W. Beck. To the extent that statements, information and opinions provided by the client or others have been used in the preparation of this report, R. W. Beck has relied upon the same to be accurate, and for which no assurances are intended and no representations or warranties are made. R. W. Beck makes no certification and gives no assurances except as explicitly set forth in this report.

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Executive Summary

Introduction

The Capital Area Council of Governments (CAPCOG) is a regional planning organization that represents ten counties in central Texas. In 2004, CAPCOG requested proposals for the conduct of a study to evaluate the economic and operational feasibility of implementing various waste minimization options. CAPCOG retained R. W. Beck to conduct this Waste Minimization and Landfill Alternatives Study (Study). This Study entailed three primary tasks:

- Waste Stream Analysis
- Evaluation of Waste Minimization Options and Landfill Alternatives
- Review of Successful Waste Minimization Programs

As part of this Study, R. W. Beck also conducted a workshop for representatives of CAPCOG and members of the public. This workshop, held in December 2004, served to provide information gathered about the various waste minimization options and landfill alternatives.

Waste Stream Analysis

Waste Disposal at CAPCOG Landfills

Table 1 lists the active landfill in the CAPCOG region. The CAPCOG region has four active Type I landfills and two active Type IV landfills. Type I facilities accept non-hazardous municipal solid waste. Type IV facilities accept construction and demolition (C&D) debris and brush.

Table 1
Landfills in the CAPCOG Region

Landfill	Owner	Operator	County	Type
Sunset Farms Landfill	BFI	BFI	Travis	I
City of Austin Landfill	City of Austin	City of Austin	Travis	IV
IESI Travis County C&D Landfill	IESI	IESI	Travis	IV
Texas Disposal Systems Landfill	TDS	TDS	Travis	I
Austin Community Landfill	Waste Management (WM)	WM	Travis	I
Williamson County Landfill	Williamson County	WM	Williamson	I

Executive Summary

These landfills, along with all others in Texas, are required to file an annual report with the TCEQ. At the initiation of this Study, the most current annual report data available was from fiscal year (FY) 2003 (September 1, 2002 – August 31, 2003). Among other requirements, landfills must report the types of waste received. Table 2 contains a summary of the tonnage disposed of in FY 2003. This table also identifies the major types of waste that were disposed at each of the landfills.

Table 2
Waste Composition by Landfill (Tons)

Classification	BFI	City of Austin	IESI	TDS	WM	Williamson County	Total
Residential	328,093	0	0	338,600	116,479	19,136	802,308
Commercial	315,757	0	0	137,033	163,701	42,373	658,864
Institutional	91,370	0	0	0	0	0	91,370
Recreational	22,843	0	0	0	0	0	22,843
Brush	1,743	2	0	0	23,296	8,201	33,242
C&D	5,909	19,341	195,911	72,560	149,093	62,876	505,690
Class 2	29,855	0	0	8,280	4,659	0	42,794
Medical	0	0	0	3,006	0	0	3,006
Tire	0	856	0	0	0	0	856
Other Classes*	24,663	3,201	0	3,691	9,319	4,100	44,974
Total	820,234	23,400	195,911	563,170	466,547	136,686	2,205,948

Source: TCEQ 2003 Landfill Database

*Includes: Litter, Class 1, Class 1a, Class 3, Ash, Asbestos, Animals, Sludge, Grease, Grit, Septage, Soil, Spoiled, Other

The City of Austin Landfill and the IESI Travis County C&D Landfill are both Type IV landfills, meaning they can only accept inert material, primarily construction and demolition (C&D) debris.

Review of Specific Waste Types

As a part of this analysis, CAPCOG specifically requested that R. W. Beck review the extent to which the disposal of specific types of waste affects the waste stream and landfills within the CAPCOG region. The specific types of wastes included in this review were electronic waste, household hazardous waste and tires. Please note that Section 2 of the report evaluates options to minimize the disposal of these materials.

- Electronic Waste
- Household Hazardous Waste
- Scrap Tires

Capacity Projections

R. W. Beck developed waste projections for single-family residential, multi-family residential and commercial waste for counties and a limited number of cities in the CAPCOG region. R. W. Beck used Table 20 from the CAPCOG Regional Solid Waste Management Plan 2002-2022 as guidance for which cities to include in the analysis. Appendix A lists those counties and cities included in the analysis.

R. W. Beck used per capita disposal rates, along with population and employment data to develop waste projection for the CAPCOG region through 2025.

Table 3
Total MSW Projections (Tons)

County	2005	2010	2015	2020	2025
Bastrop County	97,624	110,570	126,862	143,153	162,318
Blanco County	13,065	14,152	15,439	16,727	17,959
Burnet County	56,639	62,429	69,220	76,010	82,963
Caldwell County	54,454	64,044	73,634	83,224	91,402
Fayette County	34,804	37,060	40,032	43,004	45,658
Hays County	189,701	239,117	293,533	347,949	391,609
Lee County	23,386	24,876	26,675	28,475	29,958
Llano County	22,751	22,960	22,960	22,960	22,960
Travis County	1,100,308	1,196,414	1,327,224	1,458,034	1,578,434
Williamson County	471,514	551,962	648,977	745,991	862,040
From outside CAPCOG	255,355	281,932	311,276	343,674	379,444
Total	2,319,600	2,605,517	2,955,832	3,309,202	3,664,744
Cumulative	6,788,272	19,242,971	33,320,340	49,158,326	66,769,543

Figure 1 contains map of the CAPCOG region, with the amount of waste generated in FY 2003, by county. Figure 1 also shows the amount of waste generated from within the region versus the amount estimated to have been imported from areas outside the region.

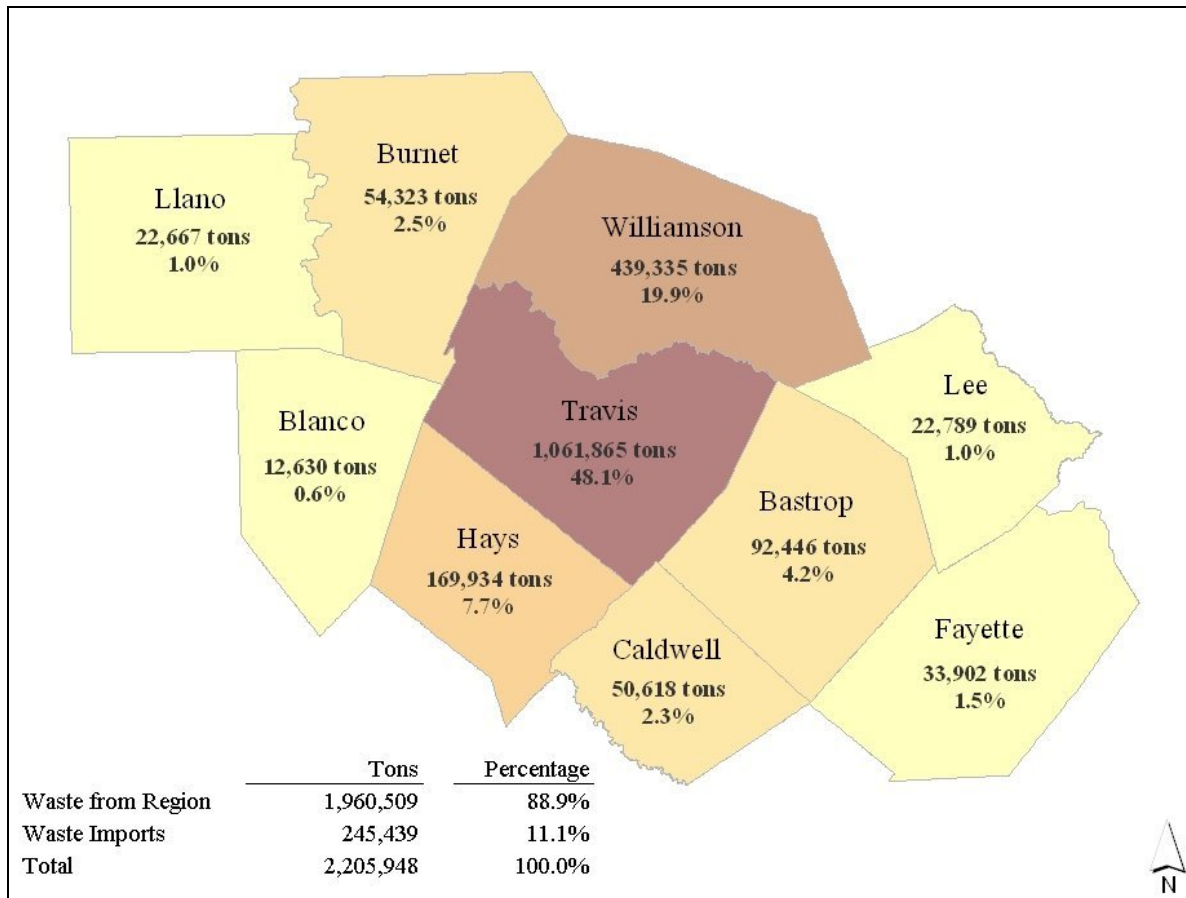


Figure 1: Waste Generation by County in FY 2003 (Tons)

Imported Waste

R. W. Beck also evaluated the extent waste imported from other regions will impact the remaining disposal capacity in the CAPCOG region. Each of the landfills in the region provided R. W. Beck with estimates concerning these quantities. Landfill representatives estimated that the vast majority of waste in the region is being generated from locations within the CAPCOG region. There are a few exceptions—primarily waste being transferred from cities such as San Antonio, Brenham, Copperas Cove, Killeen and Weimar.

Overall, waste imported from outside the CAPCOG region represented approximately 245,439 tons in FY 2003, which accounts for approximately 11 percent of the total. R. W. Beck would mention that the practice of waste flowing to landfills in the CAPCOG region is likely to continue given factors such as landfill availability, market conditions and existing contracts.

Disposal Capacity

Based on a current landfill capacity of 44,728,147 tons (see Table 4), R. W. Beck projected that current landfills will provide sufficient disposal capacity until

approximately 2018, inferring that the region has approximately 13 years of remaining capacity from 2005. The remaining capacity calculation for the region assumes that when one landfill reaches capacity, waste that was going to that facility would be disposed of at another landfill in the CAPCOG region.

Table 4
Total MSW Disposal Capacity

Landfill	Remaining Capacity (Tons)	Estimate of Capacity Available at each Landfill ^[1]
BFI Sunset Farms LF	6,897,033	35%
City of Austin LF	1,287,660	22%
IESI Travis County C&D LF	2,949,805	69%
Texas Disposal Systems LF	23,784,037	81%
WM - Austin Community LF	5,623,438	31%
WM - Williamson County LF	4,186,174	75%
Total	44,728,147	----

Source: 2003 TCEQ Annual Report

[1] For each landfill, R. W. Beck calculated this percentage based on the remaining capacity in cubic yards and the total capacity in cubic yards (remaining capacity plus volume of waste already in-place).

Waste Minimization Options and Landfill Alternatives

In order to extend the life of landfills in the CAPCOG region and reduce the environmental impact from the disposal of certain wastes, R. W. Beck researched and evaluated twelve waste minimization and landfill alternative options. Section 2 focuses on these options.

The following list contains the criteria by which each option was compared.

- Describe each option
- Identify the advantages and disadvantages of the option
- Identify environmental constraints and impacts with CAPCOG region
- Identify regulatory constraints and impacts within the CAPCOG region
- Identify what impact the option will have on the waste stream in this region
- Identify the policy issues to be considered

There are a number of approaches to minimizing the quantity of waste going into landfills. Section 2 describes several of these options, which include the following:

- Bioreactors
- Construction and Demolition Recycling
- Demand for Recycled Products

- Electronic Waste
- Extended Producer Responsibility
- Household Hazardous Wastes
- Public Education Programs
- Recycling
- Scrap Tires
- Variable Rate Structures
- Waste Incineration
- Yard Waste Diversion

Case Studies

As part of this Study, R. W. Beck searched for successful implementations of the waste minimization options discussed in Section 2. R. W. Beck divided programs into two categories: those located in the United States, and those located in Europe or Asia.

Domestic Case Studies

Throughout the United States, state and local governments struggle to find ways to implement programs that extend the life of area landfills and reduce the likelihood of harmful substances polluting the environment. Section 3 provides some examples of programs being implemented in different areas of the U.S.

This section includes case studies that highlight waste reduction methods discussed in Section 2 of this report. In this section, R. W. Beck described key components of waste diversion strategy in several communities throughout the U.S. The information provided in this section is not meant to serve as a comprehensive overview of waste reduction efforts for any of the communities discussed.

Table 5
Domestic Case Study Topics

Community	Case Study Topic
San Francisco, CA	Recycling, Variable Rate Structures
North Central Texas	C&D Recycling, HHW
University City, MO	Electronic Waste
State of New York	Scrap Tire Management
Crow Wing County, MN	Bioreactors, HHW

International Case Studies

A report published in 2004 by Planet Ark¹ compared the waste and recycling programs in 11 developed nations. Of those 11 nations, the four that ranked the highest, listed in alphabetical order, were:

- Germany
- Japan
- Sweden
- Switzerland

By comparison, the United States tied for 9th out of the 11 countries.

In Section 4, R. W. Beck highlights aspects of the waste management policies in each of the top four countries to provide some insight to the successes of each. Although each country has implemented unique programs to reduce, reuse, and recycle waste, there are also some common elements among them. The most common element is an organized effort to make manufacturers and importers of products responsible for the waste produced from the products, which includes the product itself as well as the packaging. Most recycling efforts are driven by national policy and regulations. In addition, each country has factors that contribute to high landfill costs.

This section includes case studies that highlight waste reduction methods discussed in Section 2 of this report. In this section, R. W. Beck described key components of waste diversion strategy in several countries in Europe and Asia. The information provided in this section is not meant to serve as a comprehensive overview of waste reduction efforts for any of the countries discussed.

Table 6
International Case Study Topics

Country	Case Study Topic
Germany	Producer Responsibility, Recycling
Japan	Shared Responsibility, Electronic Waste
Sweden	Producer Responsibility, Recycling, Waste Incineration
Switzerland	Recycling, Electronic Waste, Bioreactors, HHW

¹ Planet Ark is an Australian non-profit organization formed in 1991 aimed at promoting recycling in Australia and around the world.

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Section 1

Waste Stream Analysis

1.1 Introduction

To get a comprehensive view of the waste flows within the CAPCOG region, R. W. Beck reviewed publicly available data that is collected annually by the TCEQ, conducted in-person and conference call interviews with representatives of the six CAPCOG landfills, and conducted independent research.

Waste Management (WM), BFI, Texas Disposal Systems (TDS), IESI, and the City of Austin own and operate the six landfills in the CAPCOG region, with the exception of the Williamson County Landfill, which is owned by the County and operated by Waste Management.

1.2 Waste Disposal at Landfills in the CAPCOG Region

Table 1-1 lists the active landfill in the CAPCOG region. The CAPCOG region has four active Type I landfills and two active Type IV landfills. Type I facilities accept non-hazardous municipal solid waste. Type IV facilities accept construction and demolition (C&D) debris and brush.

Table 1-1
Landfills in the CAPCOG Region

Landfill	Owner	Operator	County	Type
Sunset Farms Landfill	BFI	BFI	Travis	I
City of Austin Landfill	City of Austin	City of Austin	Travis	IV
IESI Travis County C&D Landfill	IESI	IESI	Travis	IV
Texas Disposal Systems Landfill	TDS	TDS	Travis	I
Austin Community Landfill	WM	WM	Travis	I
Williamson County Landfill	Williamson County	WM	Williamson	I

These landfills, along with all others in Texas, are required to file an annual report with the TCEQ. At the initiation of this Study, the most current annual report data available was from fiscal year (FY) 2003 (September 1, 2002 – August 31, 2003). Among other requirements, landfills must report the types of waste received. Table 1-2 contains a summary of the tonnage disposed of in FY 2003. This table also identifies the major types of waste that were disposed at each of the landfills.

Section 1

**Table 1-2
Waste Composition by Landfill (Tons)**

Classification	BFI	City of Austin	IESI	TDS	WM	Williamson County	Total
Residential	328,093	0	0	338,600	116,479	19,136	802,308
Commercial	315,757	0	0	137,033	163,701	42,373	658,864
Institutional	91,370	0	0	0	0	0	91,370
Recreational	22,843	0	0	0	0	0	22,843
Brush	1,743	2	0	0	23,296	8,201	33,242
C&D ^[1]	5,909	19,341	195,911	72,560	149,093	62,876	505,690
Class 2 ^[2]	29,855	0	0	8,280	4,659	0	42,794
Medical	0	0	0	3,006	0	0	3,006
Tire	0	856	0	0	0	0	856
Other Classes ^[3]	24,663	3,201	0	3,691	9,319	4,100	44,974
Total	820,234	23,400	195,911	563,170	466,547	136,686	2,205,948

Source: TCEQ 2003 Landfill Database

[1] Construction and demolition debris. Includes materials such as wood, brick, concrete, scrap metal, etc.

[2] Class 2 industrial waste as defined by Texas Administrative Code Title 30, Part 1, Rule 335.506.

[3] Includes: Litter, Class 1, Class 1a, Class 3, Ash, Asbestos, Animals, Sludge, Grease, Grit, Septage, Soil, Spoiled, Other

Figure 1-1 shows the overall waste composition in the region, as a percentage of the total. Together, Residential and Commercial garbage comprise about 66 percent of all waste disposed in regional landfills. C&D waste represents an additional 30 percent, meaning the top three waste types represent 96 percent of the waste disposed.

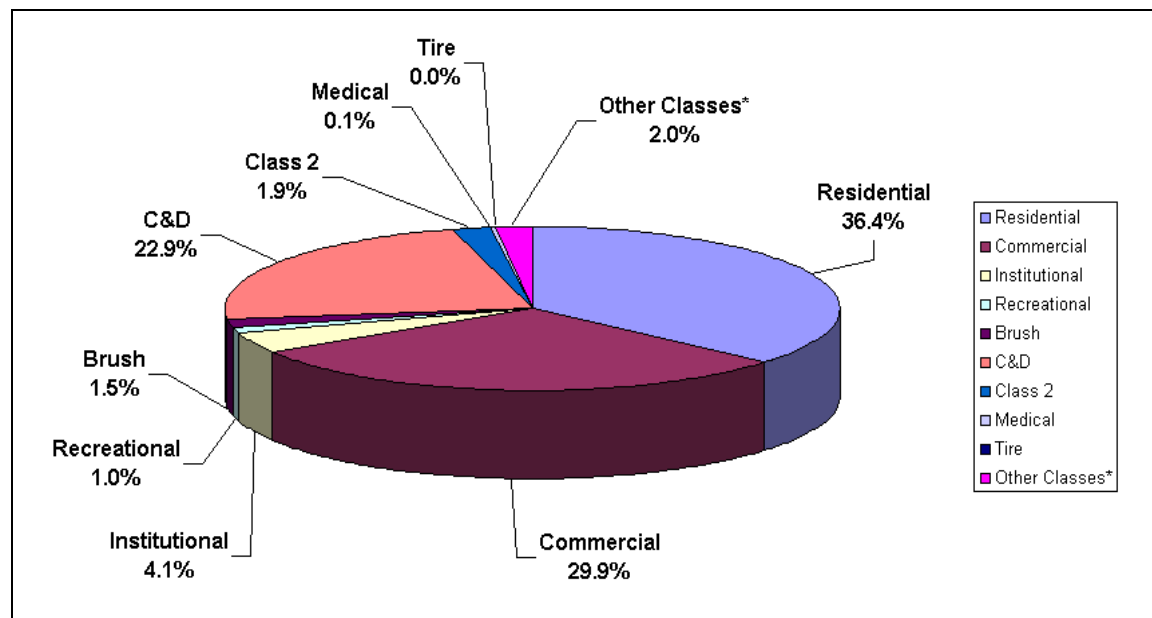


Figure 1-1: Waste Composition as Percent of Total

1.3 Review of Specific Waste Types

As a part of this analysis, CAPCOG specifically requested that R. W. Beck review the extent to which the disposal of specific types of waste affects the waste stream and landfills within the CAPCOG region. The specific types of wastes included in this review were electronic waste, household hazardous waste and tires. Please note that Section 2 of the report evaluates options to minimize the disposal of these materials.

1.3.1 Electronic Waste

Electronic waste, known as e-waste, has garnered much attention in recent years because of concerns that it could leach harmful substances into the landfills. However, when R. W. Beck interviewed representatives of the landfills in the CAPCOG region, they stated that there was minimal concern operationally or environmentally concerning the disposal of e-waste based on the results of testing conducted at their sites and within the solid waste industry. From a regulatory perspective, groundwater is monitored to track levels of certain substances, such as heavy metals. E-waste can account for up to 40 percent of the heavy metals, including lead, mercury and cadmium. Based on interviews with landfill staff, they stated that the amount of these metals present in the groundwater was well within the limits set forth in TCEQ regulations. Each of the landfill representatives noted that they do not knowingly allow e-waste into their landfills. However, since most e-waste is combined within the residential waste stream, it is difficult to know how much e-waste is being disposed at these landfills.

1.3.2 Household Hazardous Waste

As with e-waste, the area landfill representatives stated that they have not observed problems related to the disposal of household hazardous waste (HHW) within their landfills. Based on their comments, groundwater monitoring has not raised concerns that the amount of HHW found in the landfills was unacceptable. Each of the landfill representatives noted that they do not knowingly allow HHW into the landfills. However, since most HHW is combined within the residential waste stream, it is difficult to know how much HHW is being disposed at these landfills.

1.3.3 Scrap Tires

None of the Type I landfills in the CAPCOG region accept scrap tires for disposal. They will accept scrap tires and pay a third party to dispose or recycle them. Most of the landfills in the CAPCOG region send their tires to Able Tire Company in San Antonio. A representative from Able Tire Company stated that they have approximately 75% of the market share in Texas. He also estimated that they collect approximately 4,000 tires per day or 11,960 tons annually¹ from the Austin area from tire stores, as well as landfills and cities. They charge approximately \$115-125 per

¹ The tonnage estimate is based on 4,000 tires per day, assuming that an average car tires weighs 23 pounds and that tires are collected 260 workdays per year.

ton, including transportation costs. This means that they charge the equivalent of approximately \$1.40 – 1.50 per passenger tire, which is a reasonable fee for this service. The City of Austin did dispose of 856 tons of used tires in FY 2003 at its Type IV landfill.

1.4 Capacity Projections

R. W. Beck developed waste projections for single-family residential, multi-family residential and commercial waste for counties and a limited number of cities in the CAPCOG region. R. W. Beck used Table 20 from the CAPCOG Regional Solid Waste Management Plan 2002-2022 as guidance for which cities to include in the analysis. Appendix A lists those counties and cities included in the analysis.

1.4.1 Per Capita MSW Disposal Rates

In order to complete the analysis within the project budget, R. W. Beck relied on data from recently completed waste characterization studies for the Houston-Galveston Area Council of Governments (H-GAC) and the North Central Texas Council of Governments (NCTCOG). R. W. Beck averaged the per capita disposal rates for these two studies to estimate per capita disposal rates for the CAPCOG region. Table 1-3 provides the per capita rates used in this analysis. The per capita rates capture the amount of MSW disposed per resident or employee and does not include material that is diverted from the landfill.

Table 1-3
Per Capita Residential MSW Disposal Rates

Type	Disposal Rate (Annual Tons per Person)	Per Person Unit
Single-Family Residential	0.9296	Single-Family Resident
Multi-Family Residential	0.8185	Multi-Family Resident

The exception to the use of these per capita rates was the City of Austin single-family MSW disposal rate. During the course of this study, R. W. Beck received residential waste information from the City of Austin. R. W. Beck used the actual data from the City in its analysis.

R. W. Beck relied on data for from the recently completed waste characterization studies for the H-GAC and the NCTCOG for the other counties and cities listed in Appendix A for several reasons. These include:

- **Limited Data** – Data of waste generated by community is not readily available without individually surveying each community.
- **Private Waste Companies** – Private waste companies provide both commercial and residential waste collection services in the CAPCOG region. These companies typically do not openly share data regarding waste collected.

- **Project Scope** – The scope of services for this project did not budget time to collecting additional information regarding amount of waste collected in each community.

1.4.2 MSW Disposal Projections

In order to project MSW disposal through 2025, R. W. Beck applied the per capita MSW disposal rates from Table 1-3 to the population and employment projections for the CAPCOG region.

Residential Waste Projections

Although CAPCOG develops its own population projections for the region, data exists primarily at the county level. In order to develop projections for those cities listed in Appendix A, R. W. Beck relied on information published by the Texas Water Development Board (TWDB). The TWDB published projections in 10-year increments, so R. W. Beck assumed constant growth between each TWDB estimate. R. W. Beck developed population projections for each county and city in Appendix A and also included an estimate for the “remaining” area in each country, which accounts for smaller towns and those areas which are not incorporated.

Using housing data available from the U. S. Census, R. W. Beck allocated the total population in each city or county to either those living in single-family residences or those living in multi-family residents. R. W. Beck then used these sub-population projections (single-family or multi-family) and the appropriate per capita disposal rate from Table 1-3 to develop residential MSW disposal projections.

Commercial Waste Projections

R. W. Beck developed employment estimates for 2003 using data from the Texas Workforce Commission (TWC) and the U. S. Census Bureau. R. W. Beck projected employment proportionally to population growth through 2025.

The total commercial solid waste generated in the CAPCOG region for 2003 was determined to be total solid waste disposed in the region for 2003, as reported by the TCEQ, minus the single-family and multi-family waste generated in 2003, discussed in the section above. This total amount of commercial waste was then allocated to the various counties and cities based on employment. This methodology was used since there is typically a strong correlation between the number of employees in a region and the amount of commercial MSW generated in that region.

Figure 1-2 shows the distribution of waste generation for single-family residential, multi-family residential and commercial waste with each county in FY 2003. Figure 1-3 provides total waste generation tonnages by county.

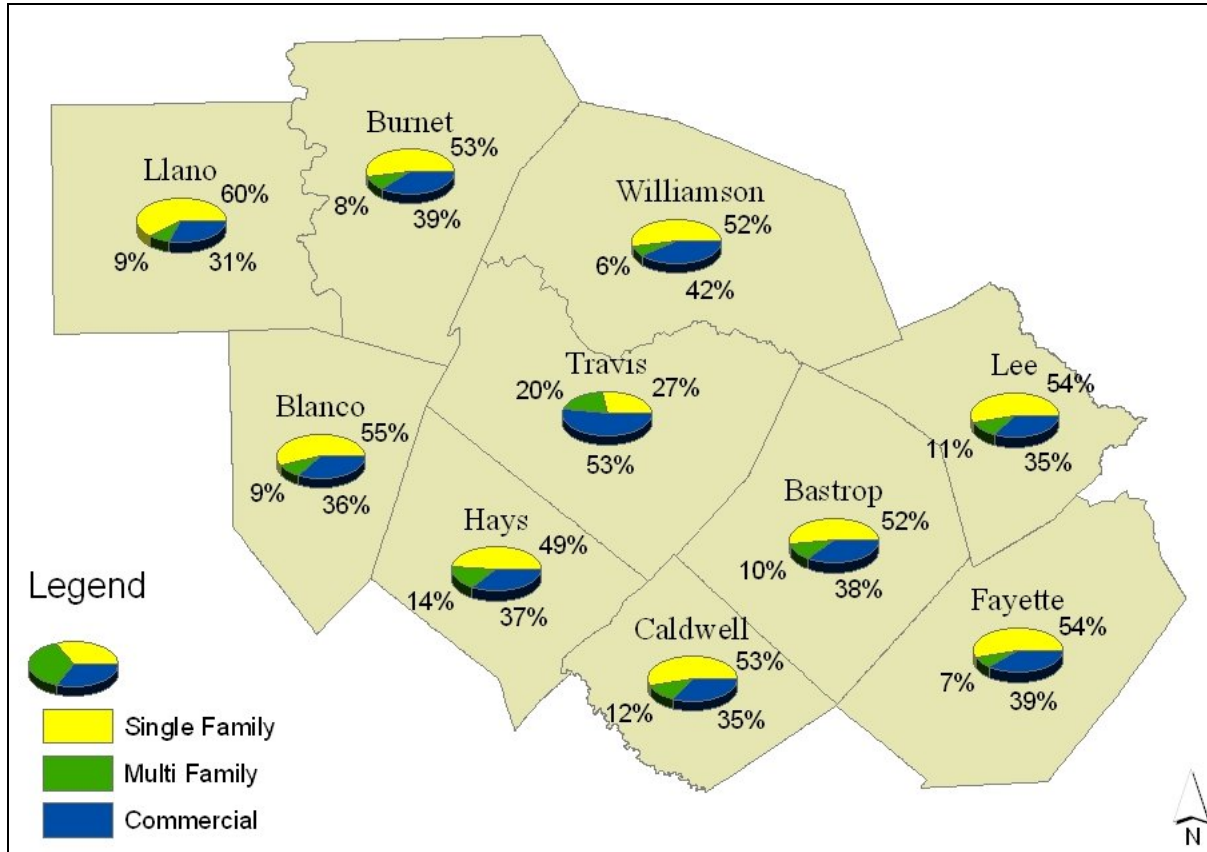


Figure 1-2: Waste Generation by Type in FY 2003

MSW Disposal Projections

Based on the methodologies discussed in this section, R. W. Beck developed the total waste projections as presented in Table 1-4. Appendix B contains more detailed projections for each county and city by the type of waste: single-family residential, multi-family residential and commercial.

Table 1-4
Total MSW Projections (Tons)

County ^[1]	2005	2010	2015	2020	2025
Bastrop County	97,791	110,759	127,078	143,398	162,596
Blanco County	13,086	14,175	15,464	16,754	17,988
Burnet County	56,738	62,538	69,340	76,143	83,107
Caldwell County	54,539	64,144	73,750	83,355	91,546
Fayette County	34,865	37,125	40,102	43,079	45,737
Hays County	190,018	239,517	294,024	348,531	392,264
Lee County	23,423	24,916	26,718	28,519	30,005
Llano County	22,783	22,992	22,992	22,992	22,992
Travis County	1,102,928	1,199,267	1,330,394	1,461,521	1,582,214
Williamson County	472,394	552,993	650,188	747,383	863,649
From outside CAPCOG	255,355	281,932	311,276	343,674	379,444
Total	2,323,920	2,610,358	2,961,327	3,315,350	3,671,542
Cumulative	6,800,920	19,278,779	33,382,312	49,249,731	66,893,640

[1] Waste generation amounts include any waste that is ultimately exported from the region for disposal.

Imported Waste

R. W. Beck also evaluated the extent waste imported from other regions will impact the remaining disposal capacity in the CAPCOG region. Each of the landfills in the region provided R. W. Beck with estimates concerning these quantities. Landfill representatives estimated that the vast majority of waste in the region is being generated from locations within the CAPCOG region. There are a few exceptions—primarily waste being transferred from cities such as San Antonio, Brenham, Copperas Cove, Killeen and Weimar.

Overall, waste imported from outside the CAPCOG region represented approximately 245,439 tons in 2003, which accounts for approximately 11 percent of the total. Figure 1-3 shows the amount of waste generated, in tons, for each county and the percentage of the total waste disposed in the CAPCOG region it represents. R. W. Beck projected the amount of waste imported into the region through 2025; this amount is included in Table 1-4. Table 1-5 shows the amount of waste accepted at each landfill from within the region, as a percent of the total waste accepted.² Appendix C lists the counties that contributed waste to the landfills in the region, although in many cases the amounts may not be significant.

R. W. Beck would mention that the practice of waste flowing to landfills in the CAPCOG region is likely to continue given factors such as landfill availability, market conditions and existing contracts.

² According to information provided by staff at each landfill.

Table 1-5
Percentage of Waste from within CAPCOG Region

Imports	Estimate from within CAPCOG
BFI	95% ^[1]
WM	95% ^[2]
WM - Williamson	"Most"
TDS	71.5% ^[2]
IESI	N/A
City of Austin	99%

[1] Imports include waste from Killeen

[2] Imports include waste from Brenham

[3] Imports includes waste from San Antonio, Copperas Cove, and Weimar

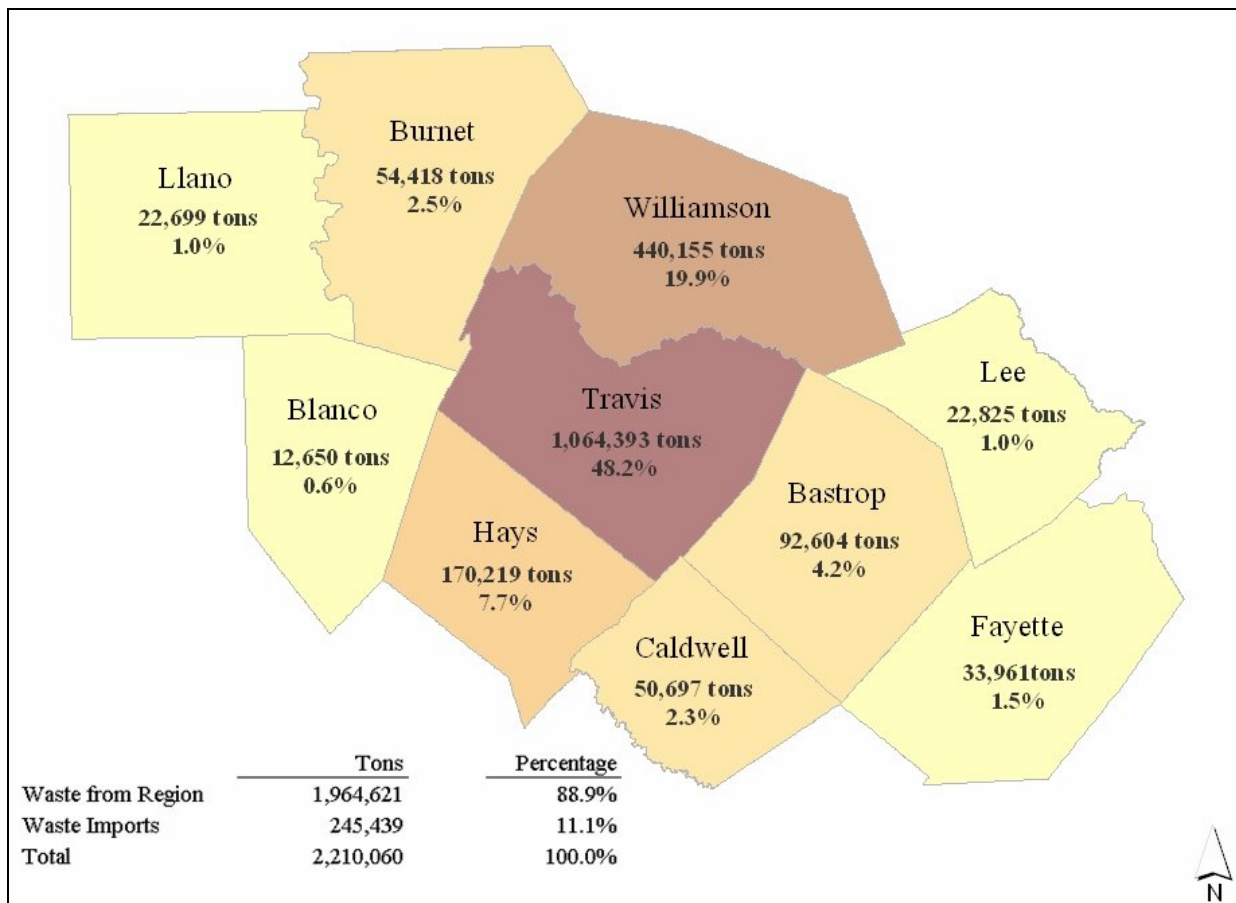


Figure 1-3: Waste Generation by County in FY 2003

1.4.3 Disposal Capacity

Based on a current landfill capacity of 44,728,147 tons (see Table 1-6), R. W. Beck projected that current landfills will provide sufficient disposal capacity until

approximately 2018, inferring that the region has approximately 13 years of remaining capacity from 2005. The remaining capacity calculation for the region assumes that once a landfill reaches capacity, waste that was going to that facility would be disposed of at another landfill in the CAPCOG region.

**Table 1-6
Total MSW Disposal Capacity**

Landfill	Remaining Capacity (Tons)	Estimate of Capacity Available ^[1]
BFI Sunset Farms LF	6,897,033	35%
City of Austin LF	1,287,660	22%
IESI Travis County C&D LF	2,949,805	69%
Texas Disposal Systems LF	23,784,037	81%
WM - Austin Community LF	5,623,438	31%
WM - Williamson County LF	4,186,174	75%
Total	44,728,147	----

Source: 2003 TCEQ Annual Report

[1] For each landfill, R. W. Beck calculated this percentage based on the remaining capacity in cubic yards and the total capacity in cubic yards (remaining capacity plus volume of waste already in-place).

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2.1 Introduction

There are a number of approaches to minimizing the quantity of waste going into landfills. The purpose of this section is to describe several of these options, which include the following:

- Bioreactors
- Construction and Demolition Recycling
- Demand for Recycled Products
- Electronic Waste
- Extended Producer Responsibility
- Household Hazardous Wastes
- Public Education Programs
- Recycling
- Scrap Tires
- Variable Rate Structures
- Waste Incineration
- Yard Waste Diversion

R. W. Beck followed a consistent pattern in the analysis of each option. Each discussion begins with a description of the option and an outline of the advantages and disadvantages. To provide an understanding of potential constraints, there is a discussion of environmental and regulatory constraints for each option. Understanding whether an option would have a material impact on the waste stream is a key component to evaluating each option. R. W. Beck also included a discussion of case studies in the CAPCOG region, and relevant policy issues. The discussion concludes with comments on the feasibility of each option within the CAPCOG region with respect to providing a realistic opportunity for waste minimization efforts.

2.2 Bioreactors

2.2.1 Description

In a typical landfill, moisture is minimized to reduce the amount of leachate generated. In a bioreactor landfill, the moisture and/or air content is increased to accelerate the decomposition and stabilization of waste in the landfill and in some cases, increase the production rate of landfill gas (LFG). Increasing the rate of decomposition in a landfill increases available airspace and therefore extends the life of the landfill. The EPA categorizes bioreactors into three primary types; as discussed below.

2.2.1.1 Anaerobic

Leachate is re-circulated into the landfill, supplemented with additional water in some cases, to increase the rate of waste decomposition and stabilization. The production rate of LFG increases, which can be captured and either sold or used for power generation projects.

2.2.1.2 Aerobic

In addition to leachate and supplemental water, air is also injected in the landfill. Of all the bioreactor types, LFG production rate is lowest for aerobic, but the rate of waste decomposition and stabilization is maximized.

2.2.1.3 Hybrid

These bioreactors are subject to sequential anaerobic and aerobic treatments to gain better LFG production in the lower portion of the landfill and better waste decomposition in the upper portion of the landfill.

The type of bioreactor chosen depends on the goals of the landfill and the variables specific to the region in which the landfill operates, such as tipping fees and the cost of energy.

2.2.2 Advantages

- Faster decomposition and stabilization of waste.
- Increased LFG production for energy projects.
- Reduction in leachate disposal costs.
- Increased amount of available airspace in the landfill.

2.2.3 Disadvantages

- Capital costs of implementing landfill higher than traditional landfill.
- Bioreactors are still a relatively unproven technology; existing bioreactors are still in pilot stage.

- TCEQ and the EPA is still collecting information on bioreactors so there is uncertainty regarding future regulations.
- May discourage certain types of recycling.

2.2.4 Environmental Constraints

In a typical landfill, leachate must be handled and disposed of properly. Since leachate is re-circulated in a bioreactor landfill, increased importance is placed on the durability and functionality of the landfill liner systems. Additionally, some alternative daily covers used in landfills may not be compatible with bioreactors since they may act as a barrier to leachate and moisture recirculation.

2.2.5 Regulatory Constraints

Section 30, Chapter 330 of the Texas Administrative Code does not allow liquid waste in MSW landfills. However, it does allow for condensate and leachate to be re-injected into the landfill. The TCEQ is open to the idea of landfill bioreactors, although no landfills are currently permitted to act as a bioreactor.

Currently, the EPA does not regulate bioreactors. However, Title 40, Part 258 of the Code of Federal Regulations has regulations governing Project XL, a program that provides some regulatory flexibility for innovative projects that may yield improvements in environmental performance of programs or processes. This is likely a forerunner to future EPA regulations that will provide guidelines for the construction and operation of bioreactor landfills.

2.2.6 Impact on Waste Stream

Studies have shown that the bioreactor process may increase landfill capacity by 20 percent to 30 percent. This increases the capacity of a landfill without increasing the permitted space. While only an estimate this point, it is certain that bioreactors have the ability to significantly increase the life of a landfill.

2.2.7 Policy Issues

During the planning stages of bioreactor landfill, there should be open dialogue between several parties to ensure the maximum benefit of the facility to the region. Among others, the landfill operator, the surrounding community, and private haulers can affect the success of a bioreactor facility. One issue to address is the affect a bioreactor landfill might have on any existing programs for the recycling of organic material.

2.2.8 Feasibility in the CAPCOG Region

Landfill representatives interviewed as a part of this study were open to the idea of bioreactors, or at least increased leachate recirculation. Some had concerns that the political pressures in the area would make any permit amendments to do so highly

contested. Additionally, two of the six landfills in the region are Type IV landfills, which are not compatible with the bioreactor concept. The City of Dallas McCommas Bluff Landfill will be the first bioreactor landfill in Texas. Monitoring the progress of the McCommas Bluff Landfill will provide further insight for the CAPCOG region.

2.3 Construction and Demolition Recycling

2.3.1 Description

Construction and demolition (C&D) projects generate debris that contains material such as concrete, wood, metal and cardboard. This C&D debris is often disposed of in either a Type IV landfill or a Type I landfill. Although C&D waste has been predominately landfilled in Texas, it contains materials that could be reused or recycled to further the long-term landfill capacity in the region. The diversion of C&D debris from landfills is occurring through various initiatives that include the following:

- On-site grinding of materials such as wood, drywall, concrete, bricks and stone for reuse at the site.
- Green building programs designed to minimize the amount of waste produced and to maximize waste diversion.
- C&D materials recovery facilities (MRFs) that process the C&D waste stream into reusable products.
- Deconstruction of existing buildings where materials are salvaged for reuse.

2.3.2 Advantages

- Can divert a significant portion of the waste stream from area landfills.
- There is generally public support for recycling facilities.

2.3.3 Disadvantages

- Requires a fundamental change in the construction and demolition industries.
- Economic feasibility can be a challenge due to processing costs and low disposal fees.
- Profitability tied to market-driven commodity prices.

2.3.4 Environmental Constraints

It is common for C&D processing to generate small particles of airborne debris. However, this concern can be controlled in several ways, depending on whether the processing occurs at a mobile location or at a permanent facility.

2.3.5 Regulatory Constraints

Title 30, Part I, Chapter 330, Subchapter G of the Texas Administrative Code outlines the operations standards for MSW processing sites. Otherwise there are no specific regulations concerning the recycling of C&D materials. Several local and regional governments outside of Texas have developed regulatory requirements for the recycling of C&D debris.

2.3.6 Impact on Waste Stream

According to data reported to the TCEQ for 2003, approximately 23 percent of all waste disposed of in CAPCOG landfills was C&D debris. This waste stream contains material that may be reused and thus diverted from the waste stream. The development of C&D waste minimization efforts could potentially have a significant impact on disposal quantities in the CAPCOG region, especially since there may be substantial opportunities to reduce this portion of the waste stream.

2.3.7 Policy Issues

C&D waste minimization may represent a portion of the waste stream where there are significant opportunities to reduce disposal quantities. Communities in other parts of the United States have recognized this, and have implemented a combination of voluntary and mandatory programs to encourage C&D waste minimization.

2.3.8 Feasibility in the CAPCOG Region

Diverting additional quantities of C&D material within the CAPCOG region is feasible. However, some management practices such as green building and on-site grinding may be more feasible than other programs like a C&D MRF.

2.4 Demand for Recycled Products

2.4.1 Description

While the general public may view recycling as a virtuous effort, one key to recycling success is generating demand for recycled products. This may be driven by market demand or imposed regulations, such as the federal government's Comprehensive Procurement Guideline (CPG) program.

Among other factors, market demand may be driven by new, innovative uses for recycled materials, the ability for recycled materials to be mixed with virgin raw materials, and consumer awareness of recycled products.

While demand must exist for recycling to work, demand alone is not sufficient. Individuals and businesses must still participate in recycling programs and governments must continue to operate or facilitate these programs.

2.4.2 Advantages

- Once market economics are favorable, recycling programs will be self-sustaining.
- Increased demand provides companies incentives to invest in recycling programs.

2.4.3 Disadvantages

- Government regulations artificially create market demand.
- Market drivers and demand are interdependent.

2.4.4 Environmental Constraints

There are no significant environmental constraints that affect efforts to increase demand in recycling products.

2.4.5 Regulatory Constraints

Section 361.426 of the Texas Health and Safety Code requires that state and local governments “shall give preference in purchasing to products made of recycled materials if the products meet applicable specifications as to quantity and quality.”

2.4.6 Impact on Waste Stream

The greater the demand for products containing post-recycled materials, the more likely than the diversion rate will increase, therefore reducing the amount of waste that is ultimately disposed of in the landfill. However, it is difficult to quantify the specific impact on the waste stream.

2.4.7 Feasibility in the CAPCOG Region

This option is feasible in the region to the extent that recycled products are available at a competitive price. This option will become more feasible with the development of more competitive markets.

2.5 Electronic Waste

2.5.1 Description

Electronic waste, e-waste, has been an escalating issue for society. Most commonly, e-waste refers to consumer electronics that may contain potentially harmful substances such as lead, cadmium, bromated flame retardants, and mercury. Televisions and computer monitors project visible images using cathode-ray tubes (CRTs), which contain significant concentrations of lead and other heavy metals. As technology advances at an accelerating pace, electronics become obsolete quicker, and the amount of e-waste requiring disposal grows exponentially. Often consumers store obsolete

items instead of attempting to recycle or dispose of them, which only delays the inevitable problem.

E-waste is sometimes disposed of in landfills because consumers lack the knowledge, incentive, or ability to do otherwise. According to the Computer TakeBack Campaign, about 40 percent of the heavy metals, including lead, mercury and cadmium, in landfills come from electronic equipment discards. The Environmental Protection Agency (EPA) considers e-waste materials hazardous, but households are exempt per the Resource Conservation and Recovery Act (RCRA) Subtitle C. A recent study conducted by the Solid Waste Association of North America (SWANA) “has found that heavy metal concentrations in leachate and landfill gas from municipal solid waste landfills are generally well below the statutory limits that have been established to protect human health and the environment.”¹

The public has put pressure on manufacturers to help alleviate the growing problem. Buy-back and take-back problems are partly a result of this pressure. Most manufacturers will charge a fee, at the time of purchase or disposal, to facilitate the proper disposal or recycling of e-waste. Recently, Office Depot and Hewlett Packard launched the only national, no-fee program to accept electronic waste.

2.5.2 Advantages

- Manufacturers are voluntarily starting e-waste recycling programs to appease the public and keep regulations to a minimum.
- Manufacturers have the ability to incorporate the costs of recycling into the product cost, making the fee more transparent to the consumer.

2.5.3 Disadvantages

- There are currently no regulations in Texas requiring manufacturers to implement programs to recycle e-waste.
- High costs often associated with recycling e-waste does not provide an incentive for consumers to participate in the programs.

2.5.4 Environmental Constraints

The harmful substances within e-waste require reuse or proper disposal. Although programs reduce the amount of the waste that occupies MSW landfills, the overall waste reduction requires that appropriate components are recycled once separated in order for these programs to have an impact. If not recycled, the hazardous materials must be disposed of properly.

¹ SWANA. *The Effectiveness of Municipal Solid Waste Landfills in Controlling the Releases of Heavy Metals in the Environment*. March 2004.

2.5.5 Regulatory Constraints

Several states, including California and Massachusetts, have banned cathode-ray tubes (CRTs) from MSW landfills. California classified CRTs, along with a number of other hazardous wastes, as “universal waste.” The term applies to wastes that are typically lower risk when examined individually, but are very common and generated by wide variety of people rather than just businesses and industrial firms. While no federal regulations currently exist, there is growing momentum in most states to follow with similar bans.

From the TCEQ website, “Although televisions and computer monitors are classified as hazardous waste by the EPA, electronic equipment generated as waste by a household is not subject to federal or state regulation as hazardous waste.”

2.5.6 Impact on Waste Stream

According to the “Municipal Solid Waste in The United States: 2001 Facts and Figures,” consumer electronic waste represented about 1 percent of the MSW generated. However, various sources have estimated that e-waste is growing three times faster than the overall waste stream. Of the approximately 2.3 million tons of consumer electronic waste generated nationally, only about 210,000 tons were recovered. Landfill representatives in the CAPCOG region stated that they have not observed material quantities of e-waste waste impacting their waste stream from a quantity or environmental perspective.

2.5.7 Policy Issues

Local governments will need to decide their appropriate role concerning e-waste issues.

2.5.8 Feasibility in the CAPCOG Region

Diverting e-waste from landfills in the CAPCOG region is a viable option by relying on developing efforts by the private sector. Local governments should facilitate and promote these options for the benefit of their residents.

2.6 Extended Producer Responsibility

2.6.1 Description

Extended producer responsibility (EPR) involves a more comprehensive approach by producers to both create products with less environmental impact and to be more proactive in the proper disposal of used or obsolete products.

Increasing responsibility often includes initiating buy-back or take-back programs, which is one of the more popular forms of EPR. These programs are arranged by manufacturers and third parties to retrieve wastes that might be improperly landfilled

and dispose of them more appropriately. While the programs use the terms “buy” and “take,” manufacturers typically charge for this service. Most buy-back programs collect a fee at the time that product is collected. However, many believe that incorporating the fee into the purchase price of the product would more effective.

Often, manufacturers can alter product designs to make them less toxic, more recyclable, or longer lasting. Manufacturers can also change the process to produce less waste, or initiate new recycling programs to reuse materials. EPR can also take the form of better dissemination of recycling information through public awareness campaigns.

The focus of EPR programs has shifted from the just the “producer” to the “product,” which implies a broader vision of responsibility. It requires the involvement and cooperation of distributors, retailers, consumers, and governments.

2.6.2 Advantages

- Reduces waste at the source.
- Efficient programs may reduce manufacturing costs.
- Actions by one manufacturer may put pressure on others.
- Many non-profit groups are already involved, such as Recycling Alliance of Texas.

2.6.3 Disadvantages

- Some efforts may result in an increased product cost, which may translate to a less competitive product.
- Currently depends on voluntary efforts.
- Difficult to develop implementation strategies at the local or regional level.

2.6.4 Environmental Constraints

The environmental constraints with EPR mainly revolve around finding new ways to design products and processes to reduce wastes. The challenge is often to bypass an easier design or process for a more environmentally friendly one. As such, environmental constraints do not typically impact EPR efforts.

2.6.5 Regulatory Constraints

There are no federal mandates for EPR. While some states have created laws that target specific problems, product responsibility has focused on voluntary efforts by all in the product life cycle.

However, effective July 1, 2006, printed circuit board assemblies sold in Europe and China are required by law to be 100 percent lead-free. This affects Austin-area

companies such as Dell, AMD, National Instruments, Solectron, and 3M, to name a few.

2.6.6 Impact on Waste Stream

Extended product responsibility is best seen as a long term solution. The impact on the waste stream is difficult to determine since it depends on the level of participation of all parties associated with the product. Additionally, the costs of reducing and diverting waste must be weighed against the costs, financial and non-financial, of landfill disposal.

2.6.7 Feasibility in the CAPCOG Region

Implementation of extended producer responsibility efforts in the CAPCOG region may not have a significant impact since these are typically decisions that require more national attention. However, efforts to initiate change can start with local or regional campaigns.

2.7 Household Hazardous Waste

2.7.1 Description

Household hazardous waste (HHW) consists of items used around the home such as paint, pesticides, motor oil, antifreeze, and car batteries that contain harmful or toxic substances. When deposited in a municipal solid waste (MSW) landfill, these harmful substances have the potential to leach contaminants into the groundwater near the landfill. In addition, they become a hazard to the collection and disposal personnel who may come in contact with the substances.

The EPA estimates that 1.6 million tons of HHW is generated per year in American homes and that the average home may store as much as 100 pounds of HHW. Without a proper disposal channel, these wastes have a high potential of entering the MSW waste stream.

One of the common methods of disposing of HHW involves special collection sites that operate either daily or on special occasion. The primary collection options include the following:

- Permanent sites that are open on a regular basis (e.g. daily, weekly, monthly); and
- One day collection events at temporary sites.

Materials are sorted by trained employees for removal and proper disposal. Proper handling may include recycling or disposal in a facility permitted to handle HHW. Other programs include scheduling individual HHW pick-ups from homes and a waste exchange, which allows citizens to drop-off and take materials that are reusable.

Regional collection programs make sense from an operational standpoint, but can be a challenge to coordinate financially. All the governmental entities within the region must commit to financing a proportional share of the costs.

Regardless of which options local governments decide to employ for the management of HHW, there is still a need to encourage residents to use these products in a responsible manner. Public education can serve as an important tool. Local governments could encourage more responsible behavior by developing public education campaigns that emphasize the following:

- Costs for processing and disposing of household chemicals can be expensive.
- Residents should only purchase amounts of chemicals they expect to use over a short period of time.
- Residents should explore non-toxic alternative products that can be used in place of typical household chemicals.

2.7.2 Advantages

- Reduces likelihood that harmful substances will enter MSW landfills.

2.7.3 Disadvantages

- May be expensive to implement and operate a program.
- Program success tied to public awareness of problem and available options.

2.7.4 Environmental Constraints

As previously discussed, HHW contains harmful substances that can contaminate groundwater, in addition to other adverse environmental effects. While this depends on several variables, including volume and concentration, the EPA and TCEQ regulations prohibit the direct disposal of these items as MSW garbage. Landfills operators must periodically test the groundwater around landfills to ensure that the substances contained in HHW do not appear in significant concentrations.

2.7.5 Regulatory Constraints

Several aspects of HHW, including car batteries and used oil, are discussed in the TAC 30, Part 1, Chapter 328. Subchapter N of Chapter 335 covers the management HHW and defines the regulations for the state.

2.7.6 Impact on Waste Stream

Area landfill representatives, interviewed as a part of this study, stated that HHW has not caused an environmental concern at their facilities. This observation is based on groundwater monitoring that did not raise concerns that the amount of HHW found in the landfills was unacceptable.

The City of Austin (COA) has a HHW collection site that accepted approximately 439 tons of waste in FY 02-03. The total quantity of municipal solid waste generated during this period was approximately 180,000 tons, which means that the quantity of HHW recycling was about 0.2 percent. While the quantity of HHW generated as a total of the waste stream is relatively small, proper management of this material is still important given the nature of HHW materials.

2.7.7 Policy Issues

Regionalization can be a key to a successful HHW program. When multiple communities can coordinate efforts to operate one site, the opportunity exists to achieve economies of scale. While discussions have occurred during the past several years concerning the development of a regional facility, no specific commitments have been made.

2.7.8 Feasibility in the CAPCOG Region

Implementation of HHW waste minimization activities are very feasible in the CAPCOG region based on the efforts of local governments such as Fayette County and the City of Austin. However, these programs only serve a portion of the region's residents. Other local governments will need to make decisions concerning the most effective methods to meet the HHW management needs of their community.

2.8 Public Education Programs

2.8.1 Description

Public education involves communicating two key aspects of waste minimization: (1) the importance of waste minimization; and (2) opportunities and rules for participation in available waste minimization programs. Public education is a critical but sometimes overlooked portion of a waste minimization strategy. Public education can involve a number of strategies, which include but are not limited to media campaigns, utility bill mailers, public events and direct communications with customers based on practices.

Many communities with successful waste minimization programs have recognized that there is a constant need to continue educating the community about waste minimization activities. R. W. Beck would typically recommend that local governments budget \$1 annually per household for public education programs. In addition, several councils of governments in Texas have implemented successful regional campaigns, which particularly benefit small communities that can lack needed resources for an effective campaign. In contrast, communities with less successful waste minimization programs often focus fewer resources on public education programs.

2.8.2 Advantages

- Can represent the key to ensuring that waste minimization programs are successful.
- Increases the effectiveness of existing programs via increased participation and reduced contamination rates.

2.8.3 Disadvantages

- During times when there is a need to reduce costs, eliminating or reducing public education budgets is common.
- Can be a challenge to evaluate the effectiveness of public education.

2.8.4 Environmental Constraints

There are no specific environmental constraints associated with public education.

2.8.5 Regulatory Constraints

There are no regulations in place at the federal or state level that would constrain public education efforts.

2.8.6 Impact on Waste Stream

While difficult to quantify, public education clearly makes a difference in the success of public education campaigns. In cases where a community has waste minimization programs in place, public education often represents the best opportunity to increase diversion rates.

2.8.7 Policy Issues

The most significant policy issue involves decisions concerning appropriate funding levels for public education programs, as they are often the target of budget cuts. A successful waste minimization program must involve dedicated and properly funded public education efforts.

2.8.8 Feasibility in the CAPCOG Region

Many local governments in the CAPCOG region already have some form of public education program in place. Future efforts may need to involve increased public education campaigns, as well as coordinated initiatives among multiple local and regional governments, including CAPCOG.

2.9 Recycling

2.9.1 Description

Recycling includes a series of activities, including collection, separation, and processing, by which materials are recovered from the solid waste stream for use in the form of raw materials in the manufacture of new products. Typical materials from the municipal solid waste stream that are recycled include but are not limited to paper, cardboard, aluminum and steel cans, plastics, and glass bottles.

The two most common types of recycling programs are curbside collection and drop-off centers. Curbside collection, which is most common in urban and suburban areas, involves the collection of materials on a regular basis (e.g. weekly) from residents' homes using collection vehicles and staff. Drop-off programs, which can be located in permanent or temporary locations, rely on residents to bring pre-sorted material. Drop-off programs typically serve rural areas and urban areas with a significant multi-family population.

Within the CAPCOG region, there are a number of cities that have an organized recycling program through either curbside collection or drop-off centers.

2.9.2 Advantages

- Recycling is a popular and socially accepted form of waste minimization.
- Many materials collected for recycling can be sold as commodities.

2.9.3 Disadvantages

- Collection and processing costs are typically greater than revenue generated from the sale of commodities.
- Access to processors or markets can present a challenge.
- Market fluctuations can negatively impact revenue generated from the sale of materials.
- Some materials, such as glass, are difficult to process and may have negative values.

2.9.4 Environmental Constraints

As a proactive measure to divert material from landfills, recycling is not typically constrained by environmental regulations. Facilities that process recyclable materials must adhere to regulations concerning odor, noise, and other types of pollution.

2.9.5 Regulatory Constraints

Typically, regulations exist to promote recycling programs rather than to limit them. As such, there are no significant regulatory constraints to the implementation and enhancement of recycling programs.

2.9.6 Impact on Waste Stream

Recycling typically represents the greatest opportunity to impact the waste stream from a reduction perspective. For example, the City of Austin diverts approximately 17 percent of its waste stream through its recycling program. With many other communities already recycling, this waste minimization effort is already having a material impact on the waste stream in the CAPCOG region.

2.9.7 Policy Issues

The primary policy issue focuses on whether communities are willing to make the financial commitment required to operate a recycling program. Another policy issue for some communities involves whether to continue recycling glass due to problems with processing and selling the material. One alternative may be to crush glass and use the aggregate for construction activities.

2.9.8 Feasibility in the CAPCOG Region

Since a number of communities in the CAPCOG region already have a recycling program in place, this option is very feasible. The key to further success will likely depend on factors such as public education programs and assistance with processing and marketing of commodities.

2.10 Scrap Tires

2.10.1 Description

The recycling of used tires is a way to cope with the large number of used tires that require disposal each year. Stockpiles of used tires can pose a fire hazard and be a refuge for animals and other pests. There have been instances of large stockpiles of used tires burning for several months before they were taken under control. Yet disposing of used tires in landfills consumes valuable space, in addition to wasting rubber and steel resources.

There have been new uses developed for scrap tires, such as tired-derived fuel (TDF) and crumb rubber -- a component in asphalt roads, athletic surfaces, etc. The key to the successful use of scrap tires is recycling them efficiently so that the material can be resold at a lower price than that of new rubber.

2.10.2 Advantages

- The number of applications for scrap rubber from tires has increased, providing a growing outlet for used tire collection programs.
- Reduces the likelihood of used tires being illegally dumped.

2.10.3 Disadvantages

- Many tire recycling programs need government support to remain profitable.

2.10.4 Environmental Constraints

One of the most common uses for scrap tires is TDF, which is used as a replacement to traditional fuel sources for boilers. This causes concern with some environmentalists who are concerned with the emissions from burning scrap tires.

2.10.5 Regulatory Constraints

Section 30 of the Texas Administrative Code (Chapter 328, Subchapter F and Chapter 330, Subchapter R) defines the management of scrap tires. The Texas Commission on Environmental Quality (TCEQ) regulates the management of scrap tires based on these statutes. Facilities that process or recycle tires must submit an annual report to the TCEQ. Anyone who stores more than 500 scrap tires must register with the TCEQ, but those who are not registered must also follow the rules and regulations.

2.10.6 Impact on Waste Stream

While the amount of scrap tires generated in 2001 was about double that of e-waste, the amount recovered through recycling was approximately 8-9 times that of e-waste. From these statistics, it appears that scrap tires programs have been more successful in diverting waste from landfills. According to the 2002 edition of the “Municipal Solid Waste in Texas: A Year in Review,” 3,827 tons of tire pieces were disposed of in Texas landfills, representing only 0.01 percent of all MSW waste disposed.

Landfills interviewed as a part of this study preferred to recycle tires rather than dispose of them in landfills. Most CAPCOG landfills keep tire disposal to a minimum. However, these used tires must be processed in some way to avoid the creation of used tire stockpiles. Able Tire’s San Antonio location, discussed below, recycles used tires for several of the landfills in the region.

Scrap tires do not currently have a significant impact on disposal capacity in the region. However, this does not mean that scrap tires are a non-issue. Recycling and reuse must keep pace with the amount of used tires that become available to avoid stockpiling and illegal dumping. Further, demand for recycled tires must continue to grow to ensure that a market exists for these recycled tires.

2.10.7 Policy Issues

The problem of illegal tire disposal is a concern for local governments throughout the CAPCOG region. Numerous local government officials in Texas have noted that since the termination of the State's waste tire recycling program, there has been a significant increase in the illegal dumping of tires.

The State of Texas operated a waste tire recycling program from 1992 through 1997. When the tire program was eliminated, the associated revenues generated through the \$2.00 recycling fee were no longer available for the clean-up of illegal sites or the ongoing collection of used tires. Currently, tire dealers are allowed to set their own fee for the disposal of scrap tires, although individuals may choose not to pay the fee and may take their scrap tires away with them. This current system is flawed and provides many opportunities for the illegal dumping of tires.

This issue cannot be resolved on the local or regional level. If one county or region develops a comprehensive scrap tire management and enforcement program, the illegal dumpers would be able to simply dump in a nearby area that does not have such a program in place. Therefore, communities in the CAPCOG region would benefit from a statewide program that is designed to comprehensively address the issue of scrap tire disposal.

2.10.8 Feasibility in the CAPCOG Region

The diversion of tires from landfills within the CAPCOG region is a very feasible option, as many tires are already being collected for use as TDF. However, it is important to understand that the cost of diverting these tires is approximately \$1.50 per passenger tire.

2.11 Variable Rate Structures

2.11.1 Description

Variable rate structures allow customers to pay varying amounts for their solid waste services, depending on how much service is needed. Also known as pay-as-you-throw (PAYT), this idea can be implemented a variety of ways. One of the keys to developing a successful variable rate structure is ensuring that residents have convenient opportunities to reduce waste quantities through recycling and yard waste diversion. Variable rates are intended to promote waste minimization by providing opportunities to reduce solid waste costs by disposing of less solid waste. Below are some of the common methods of implementing a PAYT program.

2.11.1.1 Variable Containers

The city or private collection company offers several containers of varying size. The monthly cost of service increases with the size of the container. Customers can choose the size of container that best meets their needs. These containers are usually

compatible with automated collection systems and provide a relatively stable revenue stream. Citizens pay for the container through their monthly utility bill.

2.11.1.2 Prepaid Bags

Citizens place trash in specially marked or colored bags. Revenue comes primarily from the sale of bags, although a fixed monthly charge may also apply. This system has a more direct correlation between garbage generated and fees paid for services. However, bags are not compatible with automatic collection systems and can result in greater revenue variation. This option is viable for communities that have a manual collection system or rural areas that rely on citizens' collection stations.

2.11.1.3 Prepaid Tags or Stickers

Prepaid tags or stickers work much the same way as bags, except the stickers are purchased, then placed on the customers' own bags or containers. Some programs, including the City of Austin (COA), offer stickers in addition to varying cart sizes. This has the advantage of allowing residents to set out extra garbage without a long-term commitment of a larger container.

2.11.2 Advantages

- Provides incentive for residents to reduce garbage generation.
- Promotes recycling when done in conjunction with curbside recycling program.

2.11.3 Disadvantages

- May lead to an increase in illegal dumping.
- Must be able to enforce any size or weight limits on containers.
- Collection costs for recycling programs can increase overall solid waste expenses.

2.11.4 Environmental Constraints

Since PAYT is a proactive program designed to limit waste generation and landfill disposal, there are no significant environmental constraints.

2.11.5 Regulatory Constraints

While no real regulatory constraints exist for Texas communities with variable rates, there are often issues involved with getting the residents' approval for a switch to PAYT. Educating residents about the equity of the program and the potential cost savings is an important part of getting a PAYT program approved.

2.11.6 Impact on Waste Stream

R. W. Beck's research indicates that there is a correlation between variable rate programs and diversion rates based on a survey of select cities with a PAYT program.

These results, as shown in Table 2.1, indicated that cities with greater variation in their rates have a higher recycling rate. Thus, in order for variable rates to have a significant impact, there must be a substantial cost increase associated with choosing the larger container sizes.

Table 2-1
Variable Cart Size Rates Curbside Recycling Rates by City, 2001

City	Cart Size Rates Per Month (Gallons)					Recycling Rate
	20	30 – 40	60 – 64	90 – 96	128	
San Jose	N/A	\$14.95	\$29.90	\$44.85	\$59.80	35%
San Francisco	\$7.13	\$11.89	\$23.78	\$35.67	N/A	35%
Seattle	\$12.35	\$16.10	\$32.30	\$64.40	\$128.80	29%
Portland	\$15.10	\$17.60	\$23.35	\$26.50	N/A	23%
Minneapolis	N/A	\$14.00 ^[1]	N/A	\$16.00 ¹	N/A	21%
Austin	N/A	\$11.75	\$14.50	\$17.25	N/A	17%
Oklahoma City	N/A	\$10.86	N/A	\$11.46	N/A	6%
Sacramento	N/A	\$11.32	\$12.60	\$13.90	N/A	3%

[1] Customers in Minneapolis only receive the \$14.00 and \$16.00 rates if they participate in the city's curbside recycling program; otherwise, the rates are \$21.00 and \$23.00.

2.11.7 Policy Issues

The decision of whether to implement a PAYT system is often a policy issue that needs to be determined by local governments and its rate payers. When considering this issue, there is a need to evaluate whether there is sufficient support for charging rates that vary based on volume. In addition, there is a need to ensure that support exists to fund programs needed to provide for waste diversion activities.

2.11.8 Feasibility in the CAPCOG Region

While variable rates are a feasible option in the CAPCOG region, individual local governments will need to evaluate whether this option is politically viable for their community.

2.12 Waste Incineration

2.12.1 Description

Waste incineration involves the burning of wastes to reduce the amount that is ultimately disposed of in landfills. Waste-to-energy (WTE) facilities, where the waste is burned to fuel power plants, have been subject to less criticism than traditional waste incineration facilities. While the newer WTE facilities are typically cleaner those of the past, due to the Clean Air Act of 1990, and produce a valuable

commodity, the general public is still concerned with potential air and groundwater pollution.

There are currently 98 WTE facilities in 29 states in the U.S. Currently, the only incineration facility in Texas taking municipal solid waste is the Chambers County Resource Recovery & Recycling Center. Other facilities accepting waste in Texas primarily accept medical waste.

Developing an incinerator in Texas is difficult to justify from an economic perspective because capital and operating costs for an incinerator are typically much more expensive than comparable costs for landfills in the State of Texas. For example, representatives from Chambers County, which will begin operating the largest incinerator in the State of Texas in 2001, estimated that costs per pound average about 4.5 cents for an incinerator versus 2.0 cents for a landfill. In order to make its facility economically viable, Chambers County plans to accept medical and industrial nonhazardous waste.

2.12.2 Advantages

- Electricity production for the surrounding community.
- Significantly reduces waste for landfill disposal.

2.12.3 Disadvantages

- Significant public opposition.
- More expensive than landfills in many parts of the U.S.
- High capital costs.
- Recyclable materials may be processed in an incinerator.

2.12.4 Environmental Constraints

According to the permit office of the Texas Commission on Environmental Quality (TCEQ), no new waste incineration permits are being sought. The primary reasons include high capital costs and stiff public opposition. There is public concern over the potential release of pollutants from these facilities and the impact it may have on air quality.

2.12.5 Regulatory Constraints

Title 40, Part 60, Subparts Eb and Cb of the Code of Federal Regulations govern the performance of waste incineration facilities, specifically those with at least 250 tons per day capacity.

2.12.6 Impact on Waste Stream

WTE facilities can achieve about a 90 percent reduction in waste volume and a 75-80% reduction in weight. The residual ash is usually disposed of in a landfill.

The September-October 2002 issue of *MSW Management* contains the article, “WTE Trends,” in which the 12 WTE facilities interviewed reported tipping fees of ranging from \$23-\$95 per ton, with an average of about \$60. As a comparison, the tipping fees reported to the TCEQ in 2003 for landfills in the CAPCOG region ranged from \$13-\$19 per ton. If a regional WTE existed and charged rates similar to the average reported in the article, haulers would not have an incentive to dispose of waste at the WTE facility. This is consistent with other articles on this subject that suggest that WTE’s are best suited to areas where landfill tipping fees are much higher.

2.12.7 Feasibility in the CAPCOG Region

Given the experience with a previous WTE project and the relative high cost of this alternative compared to landfills, the feasibility of using incinerators as a waste minimization alternative in the CAPCOG region is extremely low.

2.13 Yard Waste Diversion

2.13.1 Description

Yard waste that is collected separate from garbage collection operations can be used for either mulching or composting. Mulching typically involves breaking brush into small sized pieces (typically one to two inches) for reuse as mulch. Composting involves the natural conversion of organic material (yard trimmings, brush, food and paper) into a reusable “soil-like” substance that is used for a variety of purposes. Composting is a form of recycling in that it diverts reusable material from the landfill. Composting operations range from small-scale home composting bins to large-scale operations such as those operated by local governments and private industry. The many uses for compost include:

- Adding nutrients to soil
- Erosion control
- Compost remediation
- Disease control
- Alternative to chemical fertilizers

The Environmental Protection Agency (EPA) has published a comprehensive document on composting, “Composting Yard Trimmings and Municipal Solid Waste.” This document covers a wide range of topics, including facility planning, collection and processing methods, marketing and community development.

Another option includes the development of public education programs that focus on diverting yard waste from the waste stream through at-home yard waste diversion, which includes “grasscycling” and back-yard composting.

2.13.2 Advantages

- Diverts a large amount of waste from the landfill.
- Little public resistance.
- Creates a valuable commodity.

2.13.3 Disadvantages

- Costs for collection and processing can be significant.

2.13.4 Environmental Constraints

The environmental constraints for composting mirror the basic regulatory constraints described in the next section. Care must be taken to guard from problems such as odor and groundwater contamination.

2.13.5 Regulatory Constraints

Title 40 CFR Part 503, which pertains to the land application, surface disposal, and combustion of biosolids (sewage sludge), is often used as a guideline for composting when states lack specific regulations.

Texas Administrative Code (TAC) Title 30, Part 1, Chapter 332 regulates composting in Texas. Subchapters B, C, and D address the requirements for notification, registration, and permitting of composting facilities, respectively. A permit is required for facilities that add any amount of MSW as feedstock to the composting process, commercially compost grease trap waste, or compost mixed MSW not in compliance with the regulations for registration.

2.13.6 Impact on Waste Stream

Approximately 20 percent of the typical municipal solid waste stream consists of yard waste. Effective efforts to eliminate these materials from the disposal stream can increase the annual amount of waste diverted from landfills. Therefore, yard waste diversion represents a significant opportunity to reduce the quantity of material going into landfills in the CAPCOG region. The City of Austin’s yard waste and brush collection programs have been successful in diverting a significant amount of waste from the region’s landfills. In addition, many other communities in CAPCOG reported that they do provide options for diversion of yard waste through curbside collection or drop-off programs.

2.13.7 Policy Issues

Many communities in Texas, and some in the CAPCOG region, have decided to collect yard trimmings as a part of their garbage collection. The reason for this is that it is less expensive to operate one collection system than two. From a policy perspective, cities without yard waste diversion programs would need to decide whether developing a program would be economically viable.

2.13.8 Feasibility in the CAPCOG Region

Yard waste diversion is a viable option within the CAPCOG region, as many private businesses and several local governments already divert yard waste and brush. The greatest challenge for diverting additional material from more communities is the cost associated with a dedicated collection route, which may be cost prohibitive for many communities.

Communities in the CAPCOG region that do not offer opportunities for the diversion of yard waste could consider alternatives for curbside collection or drop-off programs. A key alternative would be to promote at home yard waste diversion programs that focus on minimizing any yard waste that would be included in refuse.

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3.1 Introduction

Throughout the United States, state and local governments struggle to find ways to implement programs that extend the life of area landfills and reduce the likelihood of harmful substances polluting the environment. This section provides some examples of programs being implemented in different areas of the U.S.

This section includes case studies that highlight waste reduction methods discussed in Section 2 of this report. In this section, R. W. Beck described key components of waste diversion strategy in several communities throughout the U.S. The information provided in this section is not meant to serve as a comprehensive overview of waste reduction efforts for any of the communities discussed.

3.2 San Francisco

Through legislation, the State of California has mandated a diversion rate of 50 percent. This target rate includes reuse, reduction, and recycling. Many cities in California have taken the necessary steps to meet this diversion rate. One example is the City of San Francisco, which has implemented an integrated solid waste management system that resulted in a waste diversion rate of 63 percent in 2003. Recognizing that solid waste management will continue to be an important issue for the City in the future, the City has adopted the following goals:

- 75 percent landfill diversion by 2010; and
- Zero waste by 2020.

3.2.1 Recycling

The City provides all residents with three 32-gallon carts for the separate collection of the following types of material:

- Recyclable paper, bottles and cans (blue container);
- Yard trimmings, food scraps and compostable paper (green container); and
- Garbage (black container).

The recyclable materials (e.g. paper, bottles and cans) are collected together in the same container through what is known as a single stream collection system. These materials are processed at a single stream material recovery facility (MRF), which is

operated by Norcal (a private solid waste company based in Northern California) at the Recycle Central MRF.

The yard and food waste diversion program contributes significantly to the overall diversion rate in the San Francisco area. Aside from the material collected through the residential collection program, compostable material is also collected from:

- Restaurants
- Food Markets
- Hotels and Sports Venues
- Fire Stations
- Special Events

Norcal operates the Jepsen Organics Regional Composting Facility, which accepts the compostable waste from the City. The compost from this facility is used primarily for landscaping and farming in the San Francisco area.

3.2.2 Variable Rates

All residents receive three 32-gallon carts, as described in the previous section. However, residents are only charged for the black cart, which contains garbage. The rate for the black cart is approximately \$18 per month. The City does not offer larger carts, but residents may get additional carts. Therefore, an additional cart would increase the rate paid by residents for garbage service by 100 percent. Although each additional black cart is \$18 per month, but additional blue and green carts are free. Residents may also get an insert in the 32-gallon black cart which reduces the capacity and the monthly fee. This differs from many variable rate programs that use the carts for automated or semi-automated collection. Many cities that offer cart service only add a small incremental cost for additional or larger garbage carts, so that upgrading to a larger cart has little consequence for the resident.

3.3 North Central Texas

R. W. Beck recently completed a preliminary planning level feasibility of several C&D reuse, recovery, and recycling options in the North Central Texas area. The options R. W. Beck evaluated include:

- C&D material recovery facility (MRF)
- Green building
- On-site grinding
- Building deconstruction with recovery and reuse

Two of these options, the C&D MRF and on-site grinding, are discussed in more detail below. R. W. Beck has specifically included a summary of this analysis given the general similarities between North Central Texas and Central Texas, such as disposal fees and significant population growth.

In addition, Fort Worth, TX, has implemented a HHW collection program that helps provide disposal opportunities for rural areas in the North Central Texas region while simultaneously lowering the cost associated with providing HHW disposal to its residents.

3.3.1 C&D Material Recovery Facility

A C&D MRF is a processing center that accepts mixed C&D debris, and then sorts it by material type. The MRF operator can then sell those materials that have an economic value. The remaining material which has little or no value, called residual, must be landfilled or otherwise disposed or reused.

Based on the planning-level analysis, R. W. Beck determined the costs associated with owning and operating a C&D MRF for a governmental entity are within the range of Type I and Type IV tipping fees in the North Central Texas region. However, there are several considerations.

The potential operator should develop confidence that haulers will bring mixed C&D debris to the facility and that there would be buyers for the sorted material. Markets can vary by region and what can be sold in one area may have to be given away in another.

Co-location of the C&D MRF with another permitted MSW facility can provide synergies that will help reduce the incremental cost of a C&D MRF. If the C&D MRF is co-located with another MSW facility, the costs associated with the scale house, support building, land, labor, and possibly some rolling stock may all be reduced or eliminated. An additional benefit is that if the facilities are co-located, the MRF could dispose of residual at the landfill at a reduced rate and reduced transfer costs. Lastly, locating a C&D MRF at a currently permitted MSW facility will reduce the permitting costs associated with the facility since a separate MSW permit is not required by TCEQ when the facilities are co-located.

3.3.2 On-site Grinding

On-site grinding is the practice of grinding or crushing building materials, which would traditionally be disposed of at a landfill, and depositing them onsite as a soil amendment or used as erosion control. From a waste management perspective, on-site grinding can divert from the waste stream up to 85 percent of C&D waste generated from new home construction.

Home builders have two options for on-site grinding. The home builder may choose to own and operate a grinder or subcontract on-site grinding services. Both methods use on-site grinders to process materials from the production of homes that have been designated for disposal. Once separated, the material is processed onsite into smaller chips or dust. This material is typically deposited on-site as a soil amendment or silt fencing.

The economic feasibility of on-site grinding can vary depending on the following factors:

- How the on-site grinding service is operated (owner-operated versus contracted).
- Number of homes being built by the builder.
- Whether the homes are production or custom built.

Grinders are available in a variety of sizes, which will determine the amount of throughput they are able to handle. The throughput capacity of a grinder is most often affected by its size, age, type of material and quantity of material it is processing.

3.3.3 HHW

Similar to other communities in Texas, cities and counties in North Central Texas have faced challenges concerning the management of HHW. Recognizing these issues, the North Central Texas Council of Governments has coordinated an initiative that is fostering increased opportunities for cities and counties to manage HHW in a more cost effective manner.

Under this new approach, the City of Fort Worth, which has a permanent HHW facility and drop-off program, is providing HHW collection services to rural counties in North Central Texas. Specifically, properly trained and certified Fort Worth staff manage one-day collection events for counties. This coordination benefits both the counties and the City of Fort Worth. Counties benefit by having access to collection events that are less expensive than what they could typically obtain from other service providers (e.g. average costs of approximately \$45 per resident via the Fort Worth program compared to \$70-90 from other service providers). Fort Worth also benefits by increasing its economies of scale, which provides the opportunity to reduce costs for its residents.

3.4 University City, MO

The City of University City, Missouri, is a suburb of St. Louis which has a population of 38,000 and approximately 16,000 households.

3.4.1 Electronic Waste

The City currently allows residents to place electronic waste (e-waste) at the curb for collection. On the appropriate collection day, the e-waste is placed along side the regular refuse container and the regular recycling container. The City collects the material and contracts with a private company to recycle it.

The City was the first in the state of Missouri to offer e-waste recycling events to its residents. As a precursor to the curbside collection program, the City initiated a series of three annual collection events for e-waste. The three events were held in Fall 2001, Spring 2002, and Spring 2003. Each event was held over a two-day period at a cost of \$23,000 to \$26,000 per event, which was paid for from grants received by the City. The goal was to collect 100,000 pounds (50 tons) of e-waste for all three events.

For each event, a series of large cardboard boxes were placed in an empty parking lot. As residents arrived, volunteers helped them remove the material from their cars. The

volunteers then categorized the items, weighed them, and then placed them in the appropriate box. In cases where computers and other devices were in working condition, the products were set aside and donated to groups that could use them. The City contracted with an e-waste recycler to haul away the e-waste material after each event. The City was able to collect 117,000 pounds during the three events.

The series of collection events enabled the City to judge to what extent residents would be willing to recycle e-waste and also to gather weight data they could use in planning the curbside program.

3.5 State of New York

3.5.1 Scrap Tire Recycling

In order to help cope with the scrap tire problem, the State of New York enacted the Waste Tire Management and Recycling Act of 2003 (Act). Included in the Act were the:

- Creation of a waste tire management and recycling fee of \$2.50 for each new tire sold;
- Establishment of the Waste Tire Management and Recycling Fund, which is the depository for the recycling fee, and
- Requirement for the New York State Department of Environmental Conservation (DEC) to develop a detail plan to address the cleanup tire stockpiles.

As a result of this Act, the DEC created a Waste Tire Stockpile Abatement Plan (Plan), which aims to eliminate all non-compliant tire stockpiles by 2010. DEC first analyzed the extent of the problem, finding that 95 noncompliant stockpiles contained an estimated 29 million tires.

DEC established a prioritized list of the noncompliant stockpiles, taking into account such measures as number of waste tires on site and proximity of primary aquifers, hospital, and densely populated areas. Based on this prioritized list, DEC has begun working with the highest priority sites to manage the voluntary reduction of tire stockpiles and will use its enforcement authority to require abatement. In cases, where the operator of the stockpile site is not able to reduce the stockpile, the DEC will take on a more significant role to help reduce the stockpile. However, in doing so, the DEC can seek recovery of abatement costs incurred.

Part of the focus of the overall management of waste tires is the development of alternative uses and the associated infrastructure. Table 3-1 describes some of the alternatives uses for scrap tires. This list not is meant to be a comprehensive list of all possible uses, but rather provide insight to the types of applications in which scrap tires are currently used.

**Table 3-1
Alternative Uses for Scrap Tires**

Form	Use
Worn Tires	Partially worn tires
	Retread tires
Ground Rubber	Road construction
	New tire manufacturing
	Athletic surfacing
	Molded Products
Tire Derived Aggregate	Road aggregate
	Landfill leachate collection and drainage systems
	Drainage in septic systems
Tire Derived Fuel	Electricity generation
	Other manufacturing operations
Other	Boat and marina bumpers
	Artificial reefs
	Fencing and terracing
	Retention wall backfill
	Animal Bedding
	Erosion control

3.6 Crow Wing Landfill, Minnesota

3.6.1 Bioreactor

R. W. Beck engineers have worked with the Crow Wing Landfill to develop several cells of a bioreactor landfill. More information on bioreactor landfills is available in Section 2.2.

At the Crow Wing Landfill, operators have seen a decrease in the amount of harmful chemicals in the leachate and have noticed acceleration in the amount of settlement, meaning the landfill could potentially add additional waste in the future and still remain under the permitted elevation of the landfill.

More information on the Crow Wing Landfill's bioreactor operation may be found on the EPA website.¹ The specific link is provided below.

<http://www.epa.gov/epaoswer/non-hw/muncpl/landfill/bio-work/doran.pdf>

¹ According to definitions put forth by the EPA, bioreactors contain a certain minimum moisture content level. A recirculation to energy (RTE) landfill, as described in the presentation, operates on the same principle as a bioreactor landfill, but there is less focus on achieving a specified moisture content level.

3.6.2 HHW

The Crow Wing Landfill also operates a drop-off site for HHW materials. Although the operation is located at the landfill, an identical operation could exist as a stand-alone facility or as part of another type of MSW facility. There are, however, advantages of co-locating the HHW facility with another MSW facility. These benefits include the ability to share staff or equipment and being located at a place where potential users of the facility are already visiting.

Crow Wing Landfill has a high number of small-volume customers, with small hauling businesses or residents from Crow Wing County. There are drop-off operations for e-waste, appliances, tires, recyclables, and HHW. In addition, small haulers and residents use a separate drop-off site for refuse. This site contains a series of roll-off containers that these small haulers to use reduce the traffic on the working face of the landfill and increase the level of safety.

The HHW drop-off site is a stand-alone building with a covered drive-through unloading area. Residents must present proof that they reside in Crow Wing County. The HHW staff helps residents place the material into an array of bins and containers. Inside the building, used oil is burned for heat, and there is a mechanism that empties cans of paint and crushes the empty container. There is also a device that can process aerosol cans for safe handling. For materials that are only slightly used, Crow Wing categorizes the material on a series of shelves and residents can take these materials as needed for their own personal use.

For materials that must ultimately be recycled or disposed in hazardous waste landfill, Crow Wing stores material in a separate storage building until sufficient material accumulates to warrant having a the hazardous material handler to haul away the material. The HHW drop-off site is operated twice a month from 9 AM until 4 PM from May through October.

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Section 4

International Case Studies

4.1 Introduction

A report published in 2004 by Planet Ark¹ compared the waste and recycling programs in 11 developed nations. Of those 11 nations, the four that ranked the highest, listed in alphabetical order, were:

- Germany
- Japan
- Sweden
- Switzerland

By comparison, the United States tied for 9th out of the 11 countries.

In this section, R. W. Beck highlights aspects of the waste management policies in each of the top four countries to provide some insight to the successes of each. Although each country has implemented unique programs to reduce, reuse, and recycle waste, there are also some common elements among them. The most common element is an organized effort to make manufacturers and importers of products responsible for the waste produced from the products, which includes the product itself as well as the packaging. Most recycling efforts are driven by national policy and regulations. In addition, each country has factors that contribute to high landfill costs.

This section includes case studies that highlight waste reduction methods discussed in Section 2 of this report. In this section, R. W. Beck described key components of waste diversion strategy in several countries in Europe and Asia. The information provided in this section is not meant to serve as a comprehensive overview of waste reduction efforts for any of the countries discussed.

4.2 Germany

The two primary programs in place that contribute to Germany's success in reduction and recycling are the Green Dot program, which promotes producer responsibility, and the collection system. In addition, as of October 2002, Germany used a system of 56 waste incineration plants to reduce the amount of waste requiring disposal in a landfill.

¹ Planet Ark is an Australian non-profit organization formed in 1991 aimed at promoting recycling in Australia and around the world.

4.2.1 Producer Responsibility

Germany developed an ordinance on packaging in 1991 that placed the responsibility of product package waste minimization on manufacturers. Manufacturers were therefore required to take back product packaging and either reuse or recycle it. Packaging was divided into three primary categories.

1. Transportation packaging, such as pallets and crates.
2. Secondary packaging, which includes packaging that is not essential to the product, such a box that is thrown away once the product is purchased.
3. Primary packaging, which is required to use the product, such as the “tube” for toothpaste.

In order to facilitate the collection of material from consumers, a non-profit organization was formed, Duales System Deutschland (DSD). Companies can become a member of the organization and pay a fee for the right to use a trademarked Green Dot on their packaging. The cost of the licensing fee depends on the amount of material used in the packaging, thus encouraging manufacturers to reduce excess packaging material. DSD then collects, or contracts with private companies to collect, any material with the Green Dot for recycling. There are also drop-off centers and curbside collection programs for Green Dot products. The DSD membership fee and Green Dot licensing fees pay for the cost of the program.

4.2.2 Recycling

Another aspect of recycling in Germany that lends to its success is the manner in which material is collected. Each household has four bins that allow residents to source separate material.

- **Brown** – Brown bins are for organic waste, such as food waste, yard waste, and other organic materials. These materials can be easily composted and thus diverted from the landfills.
- **Green** – Green bins are for paper and plastics, which are separated and sold at a material recovery facility (MRF).
- **Gray** – The gray bins are for the remaining inorganic, non-recyclable material that is either incinerated or landfilled.
- **Yellow** – The yellow bins are available in some areas and are for Green Dot products.

Glass is also collected through drop-off bins, located throughout residential neighborhoods.

4.3 Japan

Faced with a small land mass and a high degree of urban development, Japan has recognized the need to elevate the importance of reduction, reuse, and recycling in order to address the disposal capacity shortage.

4.3.1 Shared Responsibility

In contrast with much of Europe, which tends to place most of the responsibility on manufacturers, The Basic Law for Promoting the Creation of a Recycling-Oriented Society (Basic Law), enacted in Japan in May 2000, acts to distribute the responsibility between government, industry, and consumers.

For instance, the Home Appliance Recycling Law requires consumers to pay end-of-life recycling fees to retailers to dispose of used washing machines, televisions, refrigerators, and air conditioners. The retailers must then pay manufacturers to take back the used product. In this arrangement, the manufacturer receives some compensation from the retailers to accept the material, but it does not completely cover the costs to recycle the products. The retailers and consumers each contribute some portion of the total cost. According to a report issued by INFORM² in November 2003, fees set by the government ranged from as low as \$16 for washing machines to as high as \$38 for refrigerators.

What is unique about this system, as compared to programs in the U.S., is that consumers, retailers, and manufacturers all contribute to the cost of recycling these appliances. In addition, the system generally ensures that these appliances will be recycled, where as in the U. S. companies collect appliances with no guarantee that they will be ultimately recycled.

4.3.2 Electronic Waste

In addition to the appliances discussed in the previous section, Japan also has program in place to recycle other electronic or electrical waste. To address the growing numbers of obsolete personal computers (PCs) that require disposal, Japan revised the Law for Promotion of Effective Utilization of Resources in 2001. The revision to the Recycling Promotion Law called for all computers sold in Japan to have a PC recycling mark starting October 1, 2003. Those computers sold with the PC recycling mark have a built-in fee to cover the cost of recycling the computer. For those PCs purchased prior to October 1, 2003, consumers pay a fee to recycle the used PC.

Japan uses its network of post offices as drop-off locations. The post office is responsible for sorting the PCs by manufacturer and ensuring they are transported to the appropriate manufacturer or recycler.

² INFORM is a non-profit organization that researches practices and programs that encourage environmentally sustainable methods.

4.4 Sweden

The Swedish Environmental Protection Agency relies on laws passed by the Swedish Parliament to monitor and promote environmental issues at the national level. In Sweden, source reduction is the preferred method for waste reduction, followed by reuse, recycling, waste incineration and finally landfilling.

4.4.1 Producer Responsibility

Similar to Germany, Sweden has a system in place that requires manufacturers to take responsibility for waste produced, including packaging waste. To facilitate this, non-profit companies, called material companies, were formed. Each material company has primary responsibility for a particular type of recyclable material and works with producers to ensure responsibility is fulfilled.

4.4.2 Recycling

To collect material, Sweden implemented a national network of recycling stations, which are divided into stations for consumers and stations for industry. There are currently about 7,700 recycling stations in Sweden, which equates to about one station for each 1,200 residents.³ A ban on combustible waste (waste that is easily ignited and burned, such as paper, fibrous packaging material, wood, etc.) went into effect in January 2002 and similar ban will go into effect in 2005 for compostable waste.⁴

4.4.3 Waste Incineration

In the hierarchy of solid waste management, waste incineration is preferred to landfilling in Sweden. Approximately 42 percent of household waste is incinerated and all waste incineration plants in Sweden meet all European Union standards for dioxin emissions, which is the largest environmental concern of waste incineration.

4.5 Switzerland

According to a report by the International Solid Waste Association, only six percent of municipal solid waste generated in Switzerland in 2000 was disposed in a landfill. Approximately 48 percent was incinerated and the remainder was diverted through special collections for organic waste, paper, plastic, and other recyclables. This does not take into account construction waste, sewage sludge, or industrial waste.

4.5.1 Recycling

According to the chief of waste management for Switzerland's Agency for the Environment, Forests, and Landscape (SAEFL), "We're a small country of seven

³ According to Statistics Sweden, the government entity responsible for official statistics, there were approximately 9 million residents of Sweden at the end of 2004.

⁴ According to the Swedish Environmental Protection Agency

million with few of our own natural resources, so it's part of our national character to be good recyclers.”

Switzerland heavily targets PET plastic, which is generally considered to be easily recyclable. There are more than 40,000 collection points for PET plastic and approximately 82 percent of all PET sold in 2000 was recycled.

There is variable rate system in place through the use of special bags purchased for household waste. To avoid the cost, residents can choose to recycle. Grocery shoppers are also charged for plastic grocery bags, which encourages the use of reusable bags.⁵

4.5.2 Electronic Waste

The 1998 Ordinance of the Return, the Taking Back and Disposal of Electrical and Electronic Equipment (ORDEE) outlined a program of producer responsibility specific to electronic waste. Under ORDEE retailers, manufacturers and importers are required to take back, free of charge, certain electrical and electronic devices which they normally stock. Included in the program are:

- Consumer electronics
- Office, IT, and telecommunications equipment
- Refrigeration equipment
- Household appliances
- Common tools (does not include large industrial tools)
- Toys and other appliances

Some lighting fixtures and lamps will also be added to this list in 2005. To pay for this program, all of the items covered by ORDEE have a disposal charge included in the purchase price. The collection and disposal is managed by the Swiss Foundation for the Disposal of Wastes.

According to a study conducted by SAEFL, 82,000 metric tons of electrical and electronic waste is generated each year. About 71,000 metric tons of this material was recycled in 2003, which equates to about 87 percent of the total generated.⁶

4.5.3 Bioreactor

According to the SAEFL website, approximately 1.3 million metric tons of organic wastes are generated each year. Of this amount, 740,000 metric tons are processed in composting and anaerobic digestion plants and 300,000 metric tons are estimated to be recycled in private gardens and compost pile. The remaining 250,000 metric tons are either incinerated or landfilled.

⁵ According to an article by Jeff Burdick entitled, “Few Holes in Switzerland’s Recycling Program,” in the April-March 2003 issue of E/The Environmental Magazine.

⁶ According to the Swiss Agency for Environment, Forests, and Landscape website.

While the anaerobic digestion plants differ slightly from the typical bioreactor landfill in the United States, the principal is largely the same. In typical municipal solid waste (MSW) landfills in the U.S., organic material is mixed with inorganic and non-recyclable material. The purpose of the bioreactor landfill is to accelerate the decomposition of the organic portion of the waste, which accelerates the production of landfill gas and also causes the material to settle more quickly, freeing up space that could potentially be used for additional waste. The anaerobic digestion plants in Switzerland are similar to a landfill with 100 percent organic waste except that the material is readily accessible after digestion for other uses, such as for use in compost. In a bioreactor landfill, this material, along with other recyclable material, must be mined from the landfill.

4.5.4 Household Hazardous Waste (HHW)

One category of HHW, batteries, are collected and disposed similar to electrical and electronic devices. Consumers must return used batteries to sales outlets or take them to designated collection points. All dealers that sell products with batteries must accept them free of charge. A special recycling facility for batteries is operated by Batrec AG, which processes most used batteries in Switzerland. This program is financed and regulated through the Ordinance on Environmentally Hazardous Substances.

Appendix A

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Appendix A – Cities and Counties Included in Analysis

Bastrop County

Bastrop
Elgin
Smithville

Blanco County

Blanco
Johnson City

Burnet County

Burnet
Cottonwood Shores
Granite Shoals
Marble Falls

Caldwell County

Lockhart
Luling

Fayette County

Carmine
Fayetteville
Flatonia
La Grange
Schulenburg

Hays County

Buda
Dripping Springs
Hays County
Kyle
Mountain City
San Marcos
Wimberley
Woodcreek

Lee County

Giddings
Lexington

Llano County

Llano

Travis County

Austin
Bee Caves
Creedmoor
Jonestown
Lago Vista
Lakeway
Manor
Mustang Ridge
Pflugerville
Rollingwood
Sunset Valley
West Lake Hills

Williamson County

Cedar Park
Georgetown
Granger
Hutto
Leander
Liberty Hill
Round Rock
Taylor

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Appendix B

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Appendix B – Waste Projections (2005-2025)

Single-Family Waste Projections (Tons)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
Single-Family	50,897	52,247	53,597	54,947	56,297	57,647	58,997	60,347	61,697	63,047	64,397	65,747	67,097	68,447	69,797	71,147	72,497	73,847	75,197	76,547	77,897	79,247
Bastrop County	50,897	52,247	53,597	54,947	56,297	57,647	58,997	60,347	61,697	63,047	64,397	65,747	67,097	68,447	69,797	71,147	72,497	73,847	75,197	76,547	77,897	79,247
Bastrop	4,570	4,661	4,751	4,842	4,933	5,023	5,113	5,203	5,293	5,383	5,473	5,563	5,653	5,743	5,833	5,923	6,013	6,103	6,193	6,283	6,373	6,463
Blain	5,317	5,384	5,451	5,518	5,585	5,652	5,719	5,786	5,853	5,920	5,987	6,054	6,121	6,188	6,255	6,322	6,389	6,456	6,523	6,590	6,657	6,724
Smithville	3,668	3,724	3,779	3,835	3,890	3,946	4,001	4,056	4,111	4,166	4,221	4,276	4,331	4,386	4,441	4,496	4,551	4,606	4,661	4,716	4,771	4,826
Remaining	37,342	38,479	39,616	40,753	41,890	43,027	44,164	45,301	46,438	47,575	48,712	49,849	50,986	52,123	53,260	54,397	55,534	56,671	57,808	58,945	60,082	61,219
Blanco County	7,192	7,312	7,432	7,551	7,671	7,791	7,911	8,031	8,151	8,271	8,391	8,511	8,631	8,751	8,871	8,991	9,111	9,231	9,351	9,471	9,591	9,711
Blanco	1,204	1,217	1,229	1,242	1,255	1,268	1,281	1,294	1,307	1,320	1,333	1,346	1,359	1,372	1,385	1,398	1,411	1,424	1,437	1,450	1,463	1,476
Johnson City	986	999	1,011	1,024	1,036	1,049	1,062	1,075	1,088	1,101	1,114	1,127	1,140	1,153	1,166	1,179	1,192	1,205	1,218	1,231	1,244	1,257
Remaining	5,002	5,096	5,191	5,285	5,380	5,474	5,568	5,662	5,756	5,850	5,944	6,038	6,132	6,226	6,320	6,414	6,508	6,602	6,696	6,790	6,884	6,978
Burnet County	29,853	30,463	31,073	31,684	32,294	32,905	33,515	34,126	34,736	35,347	35,957	36,568	37,178	37,789	38,399	39,009	39,619	40,229	40,839	41,449	42,059	42,669
Burnet	4,025	4,094	4,163	4,232	4,302	4,371	4,441	4,510	4,580	4,649	4,719	4,788	4,858	4,927	5,000	5,069	5,138	5,208	5,277	5,347	5,416	5,486
Cottonwood Shores	816	835	853	872	890	908	927	945	964	982	1,000	1,018	1,036	1,054	1,072	1,090	1,108	1,126	1,144	1,162	1,180	1,198
Granite Shoals	1,793	1,829	1,864	1,900	1,935	1,971	2,006	2,042	2,077	2,112	2,147	2,182	2,217	2,252	2,287	2,322	2,357	2,392	2,427	2,462	2,497	2,532
Marble Falls	3,933	3,992	4,030	4,078	4,126	4,174	4,222	4,270	4,318	4,366	4,414	4,462	4,510	4,558	4,606	4,654	4,702	4,750	4,798	4,846	4,894	4,942
Remaining	19,285	19,724	20,163	20,602	21,041	21,480	21,919	22,358	22,797	23,236	23,675	24,114	24,553	24,992	25,431	25,870	26,309	26,748	27,187	27,626	28,065	28,504
Caldwell County	29,154	30,181	31,208	32,234	33,261	34,288	35,315	36,342	37,369	38,396	39,423	40,450	41,477	42,504	43,531	44,558	45,585	46,612	47,639	48,666	49,693	50,720
Lockhart	11,077	11,451	11,824	12,198	12,571	12,945	13,318	13,692	14,065	14,438	14,811	15,184	15,557	15,930	16,303	16,676	17,049	17,422	17,795	18,168	18,541	18,914
Luling	4,545	4,643	4,741	4,839	4,937	5,035	5,133	5,231	5,329	5,427	5,525	5,623	5,721	5,819	5,917	6,015	6,113	6,211	6,309	6,407	6,505	6,603
Remaining	13,532	14,087	14,642	15,197	15,752	16,307	16,862	17,417	17,972	18,527	19,082	19,637	20,192	20,747	21,302	21,857	22,412	22,967	23,522	24,077	24,632	25,187
Fayette County	18,987	19,213	19,438	19,664	19,890	20,116	20,342	20,568	20,794	21,020	21,246	21,472	21,698	21,924	22,150	22,376	22,602	22,828	23,054	23,280	23,506	23,732
Gamine	11,574	11,690	11,806	11,921	12,036	12,152	12,267	12,382	12,497	12,612	12,727	12,842	12,957	13,072	13,187	13,302	13,417	13,532	13,647	13,762	13,877	13,992
Fayetteville	1,228	1,235	1,243	1,250	1,258	1,265	1,273	1,281	1,289	1,296	1,304	1,312	1,320	1,328	1,336	1,344	1,352	1,360	1,368	1,376	1,384	1,392
Filadelfia	1,103	1,115	1,128	1,140	1,152	1,164	1,176	1,188	1,199	1,211	1,223	1,235	1,247	1,259	1,271	1,283	1,295	1,307	1,319	1,331	1,343	1,355
La Grange	3,816	3,898	3,979	4,060	4,142	4,223	4,305	4,386	4,467	4,548	4,629	4,710	4,791	4,872	4,953	5,034	5,115	5,196	5,277	5,358	5,439	5,520
Schulenburg	2,406	2,446	2,487	2,527	2,568	2,608	2,649	2,690	2,731	2,772	2,813	2,854	2,895	2,936	2,977	3,018	3,059	3,100	3,141	3,182	3,223	3,264
Remaining	(1,161)	(1,172)	(1,183)	(1,195)	(1,206)	(1,217)	(1,228)	(1,239)	(1,250)	(1,261)	(1,272)	(1,283)	(1,294)	(1,305)	(1,316)	(1,327)	(1,338)	(1,349)	(1,360)	(1,371)	(1,382)	(1,393)
Hays County	93,561	98,436	103,310	108,185	113,059	117,934	122,808	127,683	132,557	137,432	142,307	147,182	152,057	156,932	161,807	166,682	171,557	176,432	181,307	186,182	191,057	195,932
Buda	4,713	5,222	5,730	6,239	6,748	7,257	7,766	8,275	8,784	9,293	9,802	10,311	10,820	11,329	11,838	12,347	12,856	13,365	13,874	14,383	14,892	15,401
Dripping Springs	2,717	3,016	3,314	3,613	3,911	4,210	4,509	4,808	5,107	5,406	5,705	6,004	6,303	6,602	6,901	7,200	7,500	7,799	8,098	8,397	8,696	8,995
Hays	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628
Kyle	11,001	12,328	13,655	14,982	16,309	17,636	18,963	20,290	21,617	22,944	24,271	25,598	26,925	28,252	29,579	30,906	32,233	33,560	34,887	36,214	37,541	38,868
Mountain City	788	818	850	883	915	947	979	1,011	1,043	1,075	1,107	1,139	1,171	1,203	1,235	1,267	1,299	1,331	1,363	1,395	1,427	1,459
San Marcos	20,971	21,678	22,385	23,092	23,799	24,506	25,213	25,920	26,627	27,334	28,041	28,748	29,455	30,162	30,869	31,576	32,283	32,990	33,697	34,404	35,111	35,818
Wimberley	455	468	480	493	506	519	532	545	558	571	584	597	610	623	636	649	662	675	688	701	714	727
Woodstock	1,341	1,381	1,422	1,463	1,503	1,544	1,585	1,626	1,667	1,708	1,749	1,790	1,831	1,872	1,913	1,954	1,995	2,036	2,077	2,118	2,159	2,200
Remaining	50,972	52,928	54,884	56,840	58,796	60,752	62,708	64,664	66,620	68,576	70,532	72,488	74,444	76,400	78,356	80,312	82,268	84,224	86,180	88,136	90,092	92,048
Lee County	12,687	12,819	12,980	13,142	13,303	13,464	13,625	13,786	13,947	14,108	14,269	14,430	14,591	14,752	14,913	15,074	15,235	15,396	15,557	15,718	15,879	16,040
Giddings	4,076	4,134	4,191	4,248	4,305	4,362	4,419	4,476	4,533	4,590	4,647	4,704	4,761	4,818	4,875	4,932	4,989	5,046	5,103	5,160	5,217	5,274
Lexington	954	967	980	993	1,006	1,019	1,032	1,045	1,058	1,071	1,084	1,097	1,110	1,123	1,136	1,149	1,162	1,175	1,188	1,201	1,214	1,227
Remaining	7,657	7,718	7,809	7,901	7,992	8,083	8,174	8,265	8,356	8,447	8,538	8,629	8,720	8,811	8,902	8,993	9,084	9,175	9,266	9,357	9,448	9,539
Llano County	13,795	13,780	13,765	13,810	13,855	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861	13,861
Llano	2,689	2,704	2,709	2,714	2,719	2,724	2,729	2,734	2,739	2,744	2,749	2,754	2,759	2,764	2,769	2,774	2,779	2,784	2,789	2,794	2,799	2,804
Remaining	11,106	11,076	11,056	11,097	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137	11,137
Travis County	302,481	307,585	312,690	317,794	322,898	328,003	334,867	341,731	348,595	355,460	362,324	369,188	376,052	382,916	389,780	396,644	403,508	410,372	417,236	424,100	430,964	437,828
Austin	164,357	167,410	170,463	173,516	176,569	179,622																

Appendix B – Waste Projections (2005-2025)

Multi-Family Waste Projections (Tons)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Multi-Family	9,666	9,922	10,178	10,435	10,692	10,948	11,204	11,460	11,716	11,972	12,228	12,484	12,740	12,996	13,252	13,508	13,764	14,020	14,276	14,532	14,788
Bastrop County	828	844	861	877	893	910	926	942	958	974	990	1,006	1,022	1,038	1,054	1,070	1,086	1,102	1,118	1,134	1,150
Blain	298	302	306	309	313	317	321	325	329	333	337	341	345	349	353	357	361	365	369	373	377
Elgin	225	228	232	235	239	242	246	249	253	256	260	263	267	270	274	277	281	284	288	291	295
Smithville	8,315	8,548	8,781	9,014	9,246	9,479	9,712	9,945	10,178	10,411	10,644	10,877	11,110	11,343	11,576	11,809	12,042	12,275	12,508	12,741	12,974
Blanco County	1,183	1,203	1,222	1,242	1,262	1,282	1,302	1,322	1,342	1,362	1,382	1,402	1,422	1,442	1,462	1,482	1,502	1,522	1,542	1,562	1,582
Blanco	240	243	245	248	250	253	256	259	262	265	268	271	274	277	280	283	286	289	292	295	298
Johnson City	173	175	177	180	182	184	187	189	192	194	197	200	202	205	207	210	213	215	218	220	222
Remaining	770	785	800	815	830	845	860	875	890	905	920	935	950	965	980	995	1,010	1,025	1,040	1,055	1,070
Burnet County	4,848	4,947	5,046	5,145	5,245	5,344	5,443	5,542	5,641	5,740	5,839	5,938	6,037	6,136	6,235	6,334	6,433	6,532	6,631	6,730	6,829
Burnet	698	708	720	732	744	756	768	780	792	804	816	828	840	852	864	876	888	900	912	924	936
Cottonwood Shores	91	92	94	96	98	101	103	105	108	110	113	115	117	120	122	125	127	129	132	134	137
Granite Shoals	275	280	286	291	297	302	308	313	319	324	330	335	341	347	353	359	365	371	377	383	389
Marie Falls	861	870	881	891	902	912	924	937	949	961	974	988	999	1,011	1,023	1,035	1,048	1,061	1,073	1,086	1,098
Remaining	2,927	2,996	3,068	3,135	3,204	3,273	3,343	3,413	3,483	3,553	3,623	3,693	3,763	3,833	3,903	3,973	4,043	4,113	4,183	4,253	4,323
Caldwell County	6,315	6,538	6,760	6,982	7,205	7,427	7,650	7,872	8,095	8,317	8,539	8,762	8,984	9,207	9,429	9,652	9,874	10,097	10,320	10,543	10,766
Lockhart	1,683	1,740	1,797	1,853	1,910	1,967	2,024	2,081	2,138	2,195	2,252	2,310	2,367	2,424	2,481	2,538	2,595	2,652	2,709	2,766	2,823
Luling	659	674	688	702	716	731	745	759	773	788	801	815	829	843	857	871	885	899	913	927	941
Remaining	3,973	4,124	4,275	4,427	4,578	4,730	4,883	5,037	5,191	5,344	5,498	5,652	5,805	5,959	6,113	6,266	6,420	6,573	6,727	6,880	7,034
Fayette County	2,384	2,415	2,446	2,477	2,508	2,538	2,569	2,600	2,631	2,662	2,693	2,724	2,755	2,786	2,817	2,848	2,879	2,910	2,941	2,972	3,003
Ganite	901	911	918	928	937	947	957	967	977	987	997	1,007	1,017	1,027	1,037	1,047	1,057	1,067	1,077	1,087	1,097
Waynesville	74	77	80	83	86	89	92	95	98	101	104	107	110	113	116	119	122	125	128	131	134
Waynes	271	277	283	289	295	301	307	313	319	325	331	337	343	349	355	361	367	373	379	385	391
Waynesville	743	759	774	790	806	821	837	853	869	885	901	917	933	949	965	981	997	1,013	1,029	1,045	1,061
Sounderburg	293	298	303	308	313	318	323	328	333	338	343	348	353	358	363	368	373	378	383	388	393
Remaining	153	152	150	148	146	144	141	138	135	132	129	126	123	120	117	114	111	108	105	102	99
Hays County	25,637	26,973	28,308	29,644	30,980	32,315	33,766	35,217	36,728	38,198	39,669	41,140	42,611	44,082	45,552	47,023	48,203	49,383	50,563	51,743	52,923
Buda	126	130	133	136	139	142	145	148	151	154	157	160	163	166	169	172	175	178	181	184	187
Dripping Springs	421	487	513	559	606	652	701	749	798	847	896	944	993	1,042	1,091	1,139	1,168	1,197	1,225	1,254	1,283
Hays	1,270	1,423	1,576	1,730	1,883	2,036	2,188	2,341	2,494	2,647	2,799	2,952	3,105	3,258	3,411	3,564	3,717	3,870	4,023	4,176	4,329
Mountain City	15,727	16,257	16,788	17,318	17,848	18,378	18,908	19,438	19,968	20,498	21,028	21,558	22,088	22,618	23,148	23,678	24,208	24,738	25,268	25,798	26,328
Wimberley	48	49	49	50	50	50	51	51	51	51	52	52	52	52	52	53	53	53	53	53	53
Woodcreek	48	51	52	54	55	57	58	60	62	63	65	67	69	71	72	74	75	77	79	81	82
Remaining	7,995	8,586	9,177	9,768	10,358	10,948	11,538	12,128	12,718	13,308	13,898	14,488	15,078	15,668	16,258	16,848	17,438	18,028	18,618	19,208	19,798
Lee County	2,543	2,576	2,608	2,641	2,673	2,706	2,739	2,772	2,805	2,838	2,871	2,904	2,937	2,970	2,999	3,028	3,057	3,086	3,115	3,144	3,173
Giddings	4,076	4,134	4,191	4,248	4,305	4,362	4,419	4,476	4,533	4,590	4,647	4,704	4,761	4,818	4,875	4,932	4,989	5,046	5,103	5,160	5,217
Lexington	954	967	980	993	1,006	1,019	1,032	1,045	1,058	1,071	1,084	1,097	1,110	1,123	1,136	1,149	1,162	1,175	1,188	1,201	1,214
Remaining	(2,487)	(2,563)	(2,639)	(2,715)	(2,791)	(2,867)	(2,943)	(3,019)	(3,095)	(3,171)	(3,247)	(3,323)	(3,399)	(3,475)	(3,551)	(3,627)	(3,703)	(3,779)	(3,855)	(3,931)	(4,007)
Llano County	1,987	1,991	1,995	1,998	2,002	2,005	2,008	2,011	2,014	2,017	2,020	2,023	2,026	2,029	2,032	2,035	2,038	2,041	2,044	2,047	2,050
Llano	371	371	372	373	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374	374
Remaining	1,616	1,619	1,622	1,625	1,628	1,631	1,634	1,637	1,640	1,643	1,646	1,649	1,652	1,655	1,658	1,661	1,664	1,667	1,670	1,673	1,676
Travis County	215,928	219,749	223,568	227,387	231,206	235,025	238,844	242,663	246,482	250,301	254,120	257,939	261,758	265,577	269,396	273,215	277,034	280,853	284,672	288,491	292,310
Austin	200,581	204,307	208,033	211,759	215,485	219,211	222,937	226,663	230,389	234,115	237,841	241,567	245,293	249,019	252,745	256,471	260,197	263,923	267,649	271,375	275,101
Bee Caves	22	23	24	24	25	26	26	27	28	28	29	30	30	31	31	32	32	33	33	34	34
Creedmoor	73	73	74	74	75	75	76	76	77	77	78	78	79	79	80	80	81	81	82	82	83
Jonestown	159	161	164	167	169	172	175	178	181	184	187	190	193	196	199	202	205	208	211	214	217
Lago Vista	754	777	800	823	846	869	892	915	938	961	984	1,007	1,030	1,053	1,076	1,099	1,122	1,145	1,168	1,191	1,214
Lakeway	184	189	195	200	206	211	218	226	233	240	248	255	262	269	277	284	291	297	304	311	318
Manor	179	180	182	184	185	187	189	191	193	195	198	200	202	204	206	209	211	213	215	217	219
Mustang Ridge	170	174	178	184	189	193	198	204	210	215	221	226	232	237	243	248	253	258	263	268	273
Pflugerville	791	824	856	888	921	953	986	1,019	1,052	1,085	1,118	1,151	1,184	1,217	1,250	1,283	1,316	1,349	1,382	1,415	1,448
Rollingwood	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sunset Valley	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
West Lake Hills	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Remaining	13,016	13,040	13,063	13,087	13,110	13,134</															

Appendix B – Waste Projections (2005-2025)

Commercial Waste Projections (Tons)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
Bastrop County	37,228	38,215	39,202	40,190	41,177	42,164	43,151	44,138	45,125	46,112	47,099	48,086	49,073	50,060	51,047	52,034	53,021	54,008	55,000	56,000	57,000	58,000
Bastrop	3,670	3,743	3,816	3,889	3,961	4,034	4,106	4,178	4,250	4,322	4,394	4,466	4,538	4,610	4,682	4,754	4,826	4,898	4,970	5,042	5,114	5,186
Elgin	4,007	4,058	4,108	4,159	4,209	4,259	4,309	4,359	4,409	4,459	4,509	4,559	4,609	4,659	4,709	4,759	4,809	4,859	4,909	4,959	5,009	5,059
Smithville	2,578	2,617	2,656	2,695	2,734	2,773	2,812	2,851	2,890	2,929	2,968	3,007	3,046	3,085	3,124	3,163	3,202	3,241	3,280	3,319	3,358	3,397
Remaining	26,972	27,797	28,622	29,447	30,272	31,097	31,922	32,747	33,572	34,397	35,222	36,047	36,872	37,697	38,522	39,347	40,172	41,000	41,828	42,656	43,484	44,312
Blanco County	4,710	4,789	4,867	4,946	5,024	5,102	5,180	5,258	5,336	5,414	5,492	5,570	5,648	5,726	5,804	5,882	5,960	6,038	6,116	6,194	6,272	6,350
Blanco	880	889	898	907	917	926	935	944	953	962	971	980	989	998	1,007	1,016	1,025	1,034	1,043	1,052	1,061	1,070
Johnson City	666	674	683	691	700	708	717	726	734	743	752	761	770	779	788	797	806	815	824	833	842	851
Remaining	3,165	3,226	3,286	3,347	3,408	3,468	3,529	3,589	3,649	3,710	3,770	3,830	3,891	3,951	4,011	4,071	4,131	4,191	4,251	4,311	4,371	4,431
Burnet County	22,037	22,488	22,938	23,389	23,839	24,290	24,740	25,191	25,641	26,092	26,542	27,000	27,458	27,916	28,374	28,832	29,290	29,748	30,206	30,664	31,122	31,580
Burnet	2,084	2,120	2,156	2,192	2,228	2,263	2,300	2,336	2,372	2,408	2,444	2,480	2,516	2,552	2,588	2,624	2,660	2,696	2,732	2,768	2,804	2,840
Cottonwood Shores	489	500	511	523	534	545	556	567	578	589	600	611	622	633	644	655	666	677	688	699	710	721
Granite Shoals	1,031	1,051	1,071	1,092	1,112	1,133	1,153	1,174	1,194	1,214	1,234	1,254	1,274	1,294	1,314	1,334	1,354	1,374	1,394	1,414	1,434	1,454
Marble Falls	4,312	4,365	4,418	4,470	4,523	4,576	4,629	4,681	4,734	4,787	4,840	4,893	4,946	5,000	5,053	5,106	5,159	5,212	5,265	5,318	5,371	5,424
Remaining	14,120	14,451	14,782	15,112	15,443	15,773	16,103	16,433	16,763	17,093	17,423	17,753	18,083	18,413	18,743	19,073	19,403	19,733	20,063	20,393	20,723	21,053
Caldwell County	19,070	19,742	20,414	21,085	21,757	22,429	23,101	23,772	24,444	25,115	25,786	26,457	27,128	27,800	28,471	29,142	29,813	30,484	31,155	31,826	32,497	33,168
Lockhart	6,340	6,554	6,767	6,981	7,195	7,409	7,623	7,837	8,051	8,265	8,479	8,693	8,907	9,121	9,335	9,549	9,763	9,977	10,191	10,405	10,619	10,833
Luling	2,440	2,492	2,544	2,596	2,648	2,700	2,752	2,804	2,856	2,908	2,960	3,012	3,064	3,116	3,168	3,220	3,272	3,324	3,376	3,428	3,480	3,532
Remaining	10,291	10,696	11,101	11,507	11,912	12,317	12,722	13,127	13,532	13,937	14,342	14,747	15,152	15,557	15,962	16,367	16,772	17,177	17,582	17,987	18,392	18,797
Fayette County	13,514	13,689	13,865	14,040	14,215	14,390	14,565	14,740	14,915	15,090	15,265	15,440	15,615	15,790	15,965	16,140	16,315	16,490	16,665	16,840	17,015	17,190
Carmine	116	117	118	119	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138
Fayetteville	149	150	151	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169
Flintonia	638	645	652	660	667	674	682	689	696	704	711	719	726	733	741	748	756	764	772	780	788	796
La Grange	2,259	2,308	2,356	2,404	2,452	2,500	2,549	2,598	2,646	2,694	2,742	2,790	2,838	2,886	2,934	2,982	3,030	3,078	3,126	3,174	3,222	3,270
Schulenburg	1,442	1,467	1,491	1,515	1,539	1,564	1,588	1,613	1,637	1,661	1,686	1,710	1,735	1,760	1,784	1,809	1,833	1,858	1,882	1,907	1,931	1,956
Remaining	8,910	9,003	9,097	9,190	9,284	9,377	9,471	9,565	9,659	9,753	9,847	9,941	10,035	10,129	10,223	10,317	10,411	10,505	10,599	10,693	10,787	10,881
Hays County	70,820	74,510	78,199	81,889	85,579	89,269	93,331	97,394	101,457	105,520	109,583	113,646	117,709	121,772	125,835	129,898	133,961	138,024	142,087	146,150	150,213	154,276
Buda	2,343	2,536	2,849	3,102	3,355	3,607	3,873	4,139	4,405	4,671	4,937	5,203	5,469	5,735	6,001	6,267	6,533	6,799	7,065	7,331	7,597	7,863
Dripping Springs	1,238	1,374	1,510	1,646	1,782	1,918	2,061	2,205	2,348	2,492	2,635	2,779	2,922	3,065	3,209	3,352	3,500	3,643	3,786	3,929	4,072	4,215
Hays	186	186	186	187	187	187	188	188	189	189	189	190	191	191	191	192	192	192	192	192	192	192
Kyle	2,342	2,625	2,907	3,190	3,472	3,755	4,038	4,321	4,604	4,887	5,170	5,453	5,736	6,019	6,302	6,585	6,868	7,151	7,434	7,717	8,000	8,283
Mountain City	430	448	466	484	501	519	538	556	575	593	612	630	649	667	686	704	723	741	760	778	797	815
San Marcos	28,426	29,364	30,342	31,300	32,258	33,217	34,175	35,134	36,092	37,051	38,010	38,969	39,928	40,887	41,846	42,805	43,764	44,723	45,682	46,641	47,600	48,559
Wimberley	2,054	2,067	2,080	2,092	2,105	2,117	2,127	2,137	2,146	2,155	2,165	2,174	2,183	2,192	2,201	2,210	2,219	2,228	2,237	2,246	2,255	2,264
Woodcreek	678	596	613	631	648	666	686	706	726	746	766	787	807	827	847	867	888	909	929	950	971	
Remaining	33,223	35,235	37,246	39,258	41,270	43,281	45,292	47,303	49,314	51,325	53,336	55,347	57,358	59,369	61,380	63,391	65,402	67,413	69,424	71,435	73,446	
Lee County	8,222	8,327	8,431	8,536	8,641	8,746	8,872	8,999	9,125	9,252	9,378	9,505	9,631	9,758	9,884	10,011	10,138	10,264	10,391	10,517	10,643	10,769
Giddings	2,460	2,494	2,529	2,563	2,598	2,632	2,674	2,715	2,757	2,798	2,840	2,882	2,923	2,965	3,007	3,048	3,089	3,131	3,172	3,213	3,254	3,295
Lexington	591	599	607	615	623	631	641	651	660	670	680	689	699	709	718	728	736	746	755	764	773	782
Remaining	5,171	5,233	5,296	5,358	5,420	5,483	5,558	5,633	5,708	5,783	5,858	5,934	6,009	6,084	6,159	6,234	6,309	6,384	6,459	6,534	6,609	6,684
Llano County	7,061	7,074	7,087	7,100	7,113	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126	7,126
Llano	2,262	2,266	2,271	2,275	2,279	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283	2,283
Remaining	4,799	4,807	4,816	4,825	4,834	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843	4,843
Travis County	584,520	594,862	605,205	615,547	625,890	636,232	650,371	664,509	678,648	692,786	706,924	721,063	735,201	749,340	763,478	777,616	791,754	805,892	820,030	834,168	848,306	862,444
Austin	473,521	482,317	491,113	499,909	508,706	517,502	529,718	541,935	554,152	566,368	578,585	590,801	603,018	615,235	627,451	639,668	651,884	664,101	676,317	688,534	700,750	712,967
Bee Caves	317	329	340	352	363	375	380	406	421	437	452	467	483	498	514	529	544	559	574	589	604	619
Creedmoor	104	105	106	106	107	108	109	109	110	111	112	112	113	114	115	116	116	117	118	118	119	120
Jonestown	1,199	1,219	1,239	1,259	1,279	1,299	1,325	1,352	1,379	1,405												

Appendix C

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Appendix C – Origin of Waste Disposed at Landfills in the CAPCOG Region

County	BFI	City of Austin	IESI	TDS	WM	Williamson County
Atascosa				X		
Bandera				X		
Bastrop	X	X	X	X	X	
Bell						X
Bexar				X		
Blanco	X		X	X		
Burleson	X					
Burnet	X		X	X	X	X
Caldwell	X	X	X	X		
Comal				X		
Coryell	X					
Fayette	X		X	X		
Gillespie				X		
Gonzales				X		
Guadalupe			X	X		
Hays	X	X	X	X	X	
Kendall				X		
Lampasas						X
Lee	X					
Llano	X				X	X
Mason						X
Medina				X		
McLennan	X					
Milam	X					X
San Saba	X					
Travis	X	X	X	X	X	X
Washington	X				X	
Williamson	X	X	X	X	X	X

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