

# Using Scrap Tire and Crumb Rubber



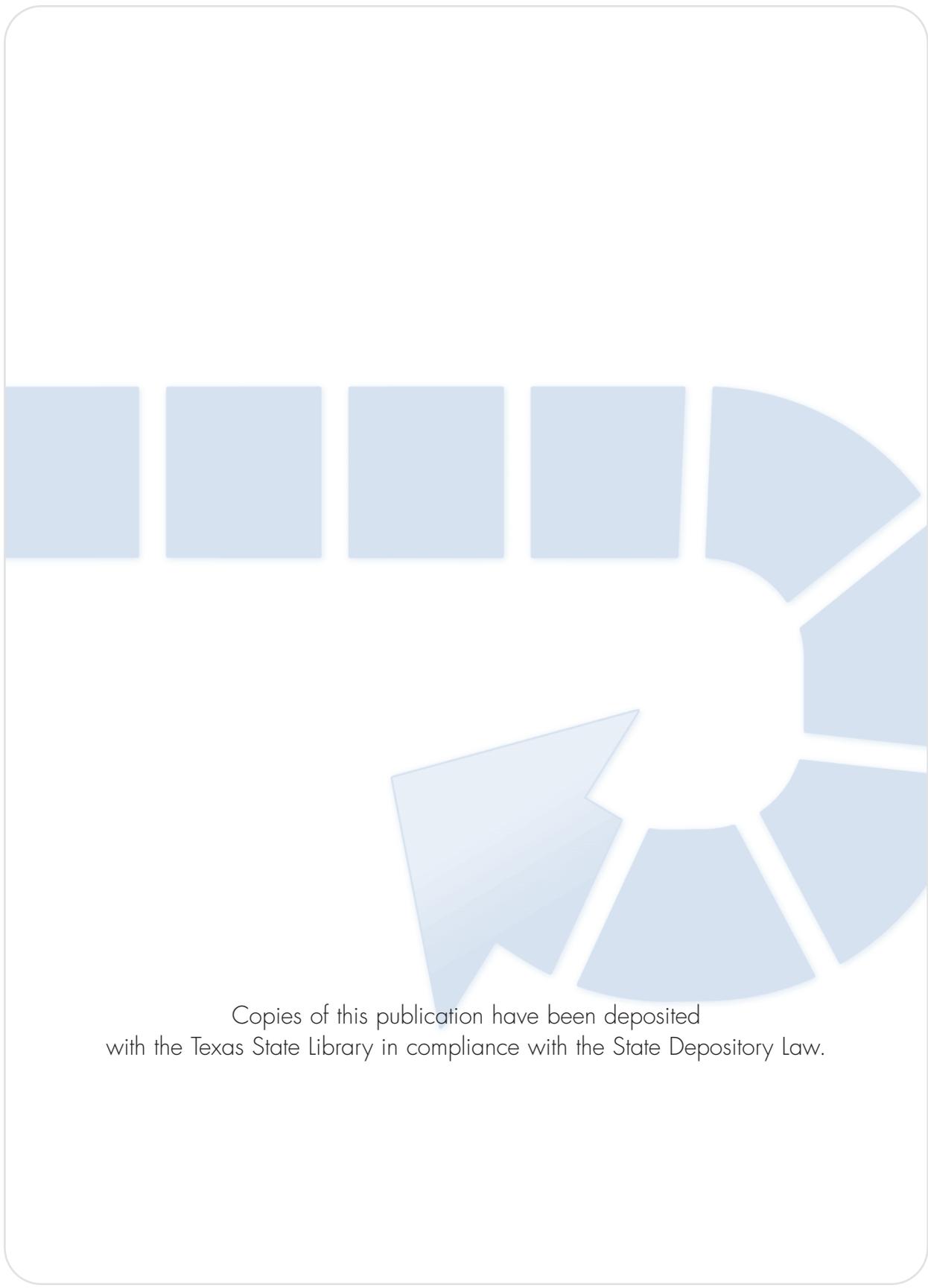


# **2007 Progress Report on Using Scrap Tires and Crumb Rubber in Texas Highway Construction Projects**



Submitted by  
The Texas Department of Transportation (TxDOT)  
in cooperation with the Texas Commission on Environmental Quality  
as required by Senate Bill 1, 79th Legislature  
Article VII, TxDOT Rider 22

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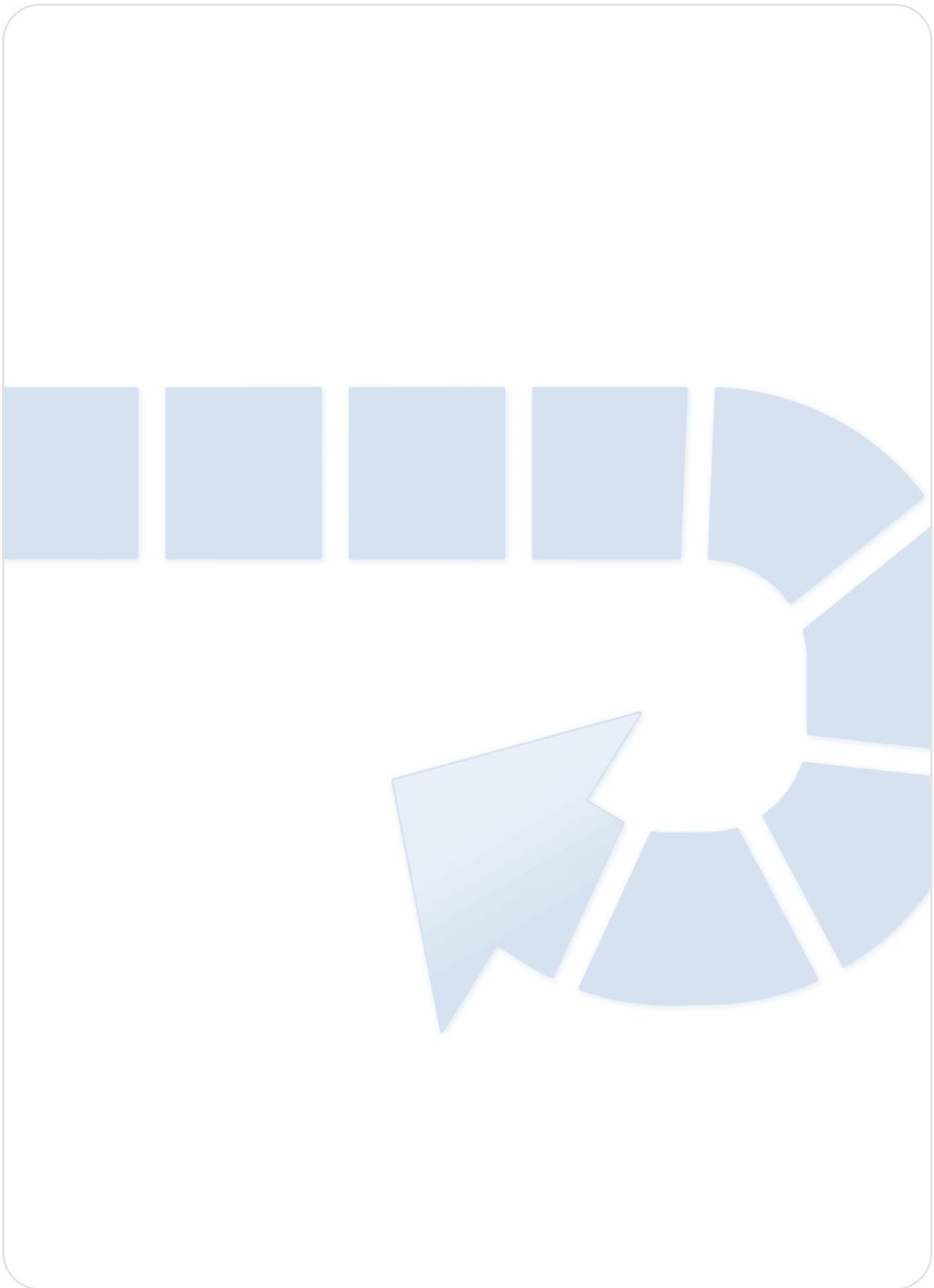
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## **Preface**

This report is being submitted as required by Senate Bill 1, Article VII, the Texas Department of Transportation Rider 22, 79th Legislature:

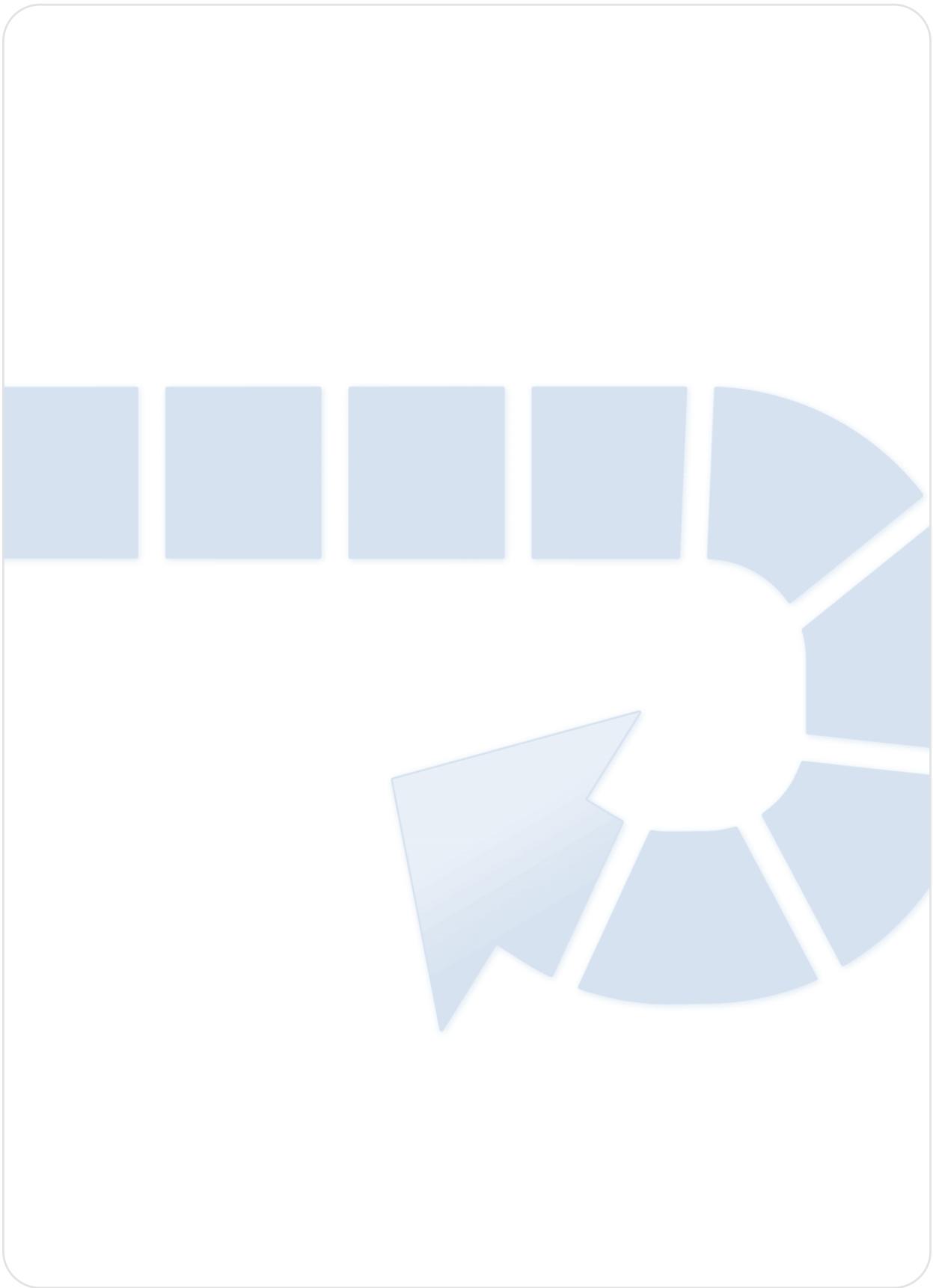
### **Agency Coordination**

The Texas Department of Transportation and the Texas Commission on Environmental Quality shall coordinate their efforts on the acquisition and potential uses of crumb rubber and shredded tire pieces in the various phases of highway construction. The Texas Department of Transportation and the Texas Commission on Environmental Quality shall provide to the appropriate Legislative Committees a report on their progress by January 1 of each fiscal year.





# ***Executive Summary***



## **Executive Summary**

This is the eighth annual Progress Report on Using Scrap Tires and Crumb Rubber in Texas Highway Construction Projects. This report represents the cooperative effort between the Texas Commission on Environmental Quality (TCEQ) and the Texas Department of Transportation (TxDOT) to assess the storage, disposal and beneficial use of scrap tires in Texas.

During calendar years 2005 and 2006, both TCEQ and TxDOT oversaw significant progress in the state's scrap tire situation. Major developments include the following:

- Substantially more Texas scrap tires were disposed or used beneficially than were generated in calendar year 2005. The number of scrap tires disposed or recycled was 28.5 million scrap tire units (STUs) in 2005, which was 4.5 million more than were assumed generated.
- The number of Texas scrap tires consumed as tire-derived fuel (TDF) continues to increase and constitutes the major scrap tire end-use category. Approximately 61.3 percent of the scrap tires consumed in Texas during 2005 were used as TDF. In-state and out-of-state cement kilns and paper and pulp mills increased the volume of Texas scrap tires they consumed as TDF by 640,000 tires, representing a 3.7 percent category increase in 2005.

### **TCEQ Progress**

- TCEQ and industry efforts helped reduce the volume of scrap-tire material stockpiled at previously registered scrap tire storage sites by approximately 10.1 million STUs during 2005, and an estimated nine million STUs during 2006. This 19.1 million STU reduction represents a 52 percent reduction in state stockpile volumes since 2004.
- TCEQ used funds appropriated by the 77th Legislature (2001) to contract in 2003 for cleanup of the two largest scrap tire piles in the state. Its contractors completed one of the cleanups in 2004 and will complete the other in May of 2007. These cleanups have resulted in the elimination of 42.5 million of the estimated 45 million scrap tires originally present on the sites.
- In 2006, TCEQ completed a cleanup project that resulted in the removal of approximately 850,000 scrap tires from an abandoned storage site in San Antonio.
- TCEQ awarded a contract in 2006 for cleanup by August 2007 of an abandoned scrap tire site in El Paso that contains approximately 250,000 whole scrap tires.
- TCEQ entered into cleanup agreements in 2006 that resulted in the removal of approximately 750,000 scrap tires from abandoned scrap tires sites in Cleveland and Midlothian.
- TCEQ also used funds appropriated by the 77th Legislature (2001) to award grants in 2002 to two cement kilns to retrofit their facilities to use TDF. One of the two cement kilns completed their retrofit during 2003 and burned a total of 2.7 million whole scrap tires in 2005 and an estimated three million whole scrap tires in 2006. TCEQ expects the second cement kiln to complete its facility retrofit and initiate TDF burning operations during 2007. The facilities should consume four to six million whole tires as TDF annually.

### **TxDOT Progress**

- The use of rubber from tires align with TxDOT's goals as outlined in our Strategic Plan for 2007-2011, including:
  - enhancing the safety of its roadways

- supporting an environmentally sustainable economy in Texas
- increasing the value of its roadways through greater durability.
- TxDOT's FY '06 contracts call for using 15,300 tons of rubber, about 2.2 million tires' worth, primarily in paving applications, which will cost the department \$161 million.
- While the cost for these applications rose about 17 percent from FY '05, the quantity of rubber dropped about 11 percent.
- Rising petroleum prices drove up the cost of asphalt, which, in turn reduced the quantity of paving with rubber in contracts that TxDOT awarded in FY '06.
- TxDOT continues to evaluate and demonstrate other innovative uses for transportation-related tire-rubber products, launching new research into the geotechnical characteristics of tire bales to develop specifications for slope repair and for embankment construction.

### **Trends and Continuing Issues**

Several significant developments during 2005 and 2006 are improving the scrap tire situation in Texas:

- TCEQ contractor completed recycling operations at the state's largest scrap tire site, the Gibson Recycling site in Atlanta, in October 2006 and should complete all cleanup operations at the site by the end of May 2007.
- Completion of recycling operations at the Gibson Recycling site in Atlanta resulted in a change in the area of the state from which some TDF end-users obtain their TDF supply.
- The number of Texas scrap tires consumed as tire-derived fuel (TDF) continued to increase and constitute the major scrap tire end-use category.
- The number of scrap tires consumed by Land Reclamation Projects Using Tires (LRPUT), crumb rubber, civil engineering projects and septic system end-users decreased.
- The number of Texas scrap tires consumed by "other" end uses and landfill disposal increased.
- TCEQ awarded a contract for cleanup of an abandoned scrap tire site in El Paso that contains approximately 250,000 whole scrap tires.
- TCEQ entered into cleanup agreements that resulted in removal of approximately 750,000 scrap tires from sites in Cleveland and Midlothian.
- TxDOT's use of tire rubber in paving applications may level off or even drop in the short term as petroleum prices continue to climb.
- TxDOT's use of molded tire-rubber products will continue to grow.
- Tire-bale research may result in more use in Texas of this application.
- Education and outreach events encouraged other innovative uses for scrap tires and tire rubber material at both the state and local level.

Although TCEQ and TxDOT continue to reduce and prevent scrap tire stockpiles and use products with tire rubber, three primary issues persist.

- Illegal scrap tire dumping is likely to continue in areas of the state that have few end-use or disposal facilities.
- Demand for scrap-tire material and tire rubber products is not strong enough to result in the cleanup of existing scrap tire stockpiles.
- TCEQ funding is insufficient to clean up remaining scrap-tire stockpiles.

When funds appropriated by the 77th Legislature (2001) for cleanup of the state's two largest scrap tire stockpiles have been exhausted, very limited funding will be available for cleanup of the remaining stockpiles. Consequently, the remaining scrap tire sites will continue to present a risk to the environment

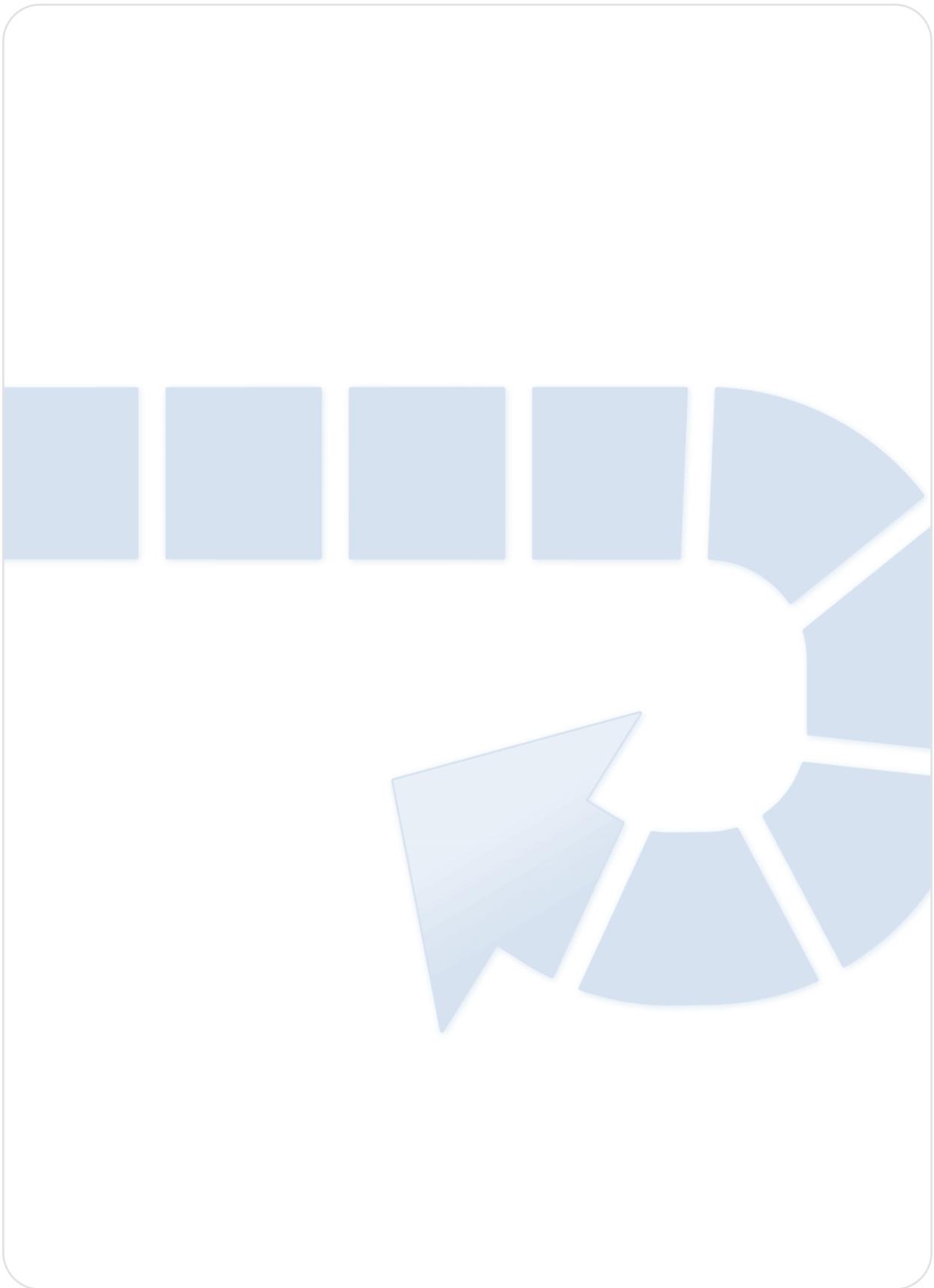
and human health because the sites pose a fire threat and provide an environment favorable for breeding of mosquitoes that can transmit West Nile and other viruses.

## **Conclusions**

While significant challenges remain, TCEQ and TxDOT made significant progress toward addressing scrap tire issues during 2005 and 2006. The TCEQ aggressively pursues opportunities to reduce the number of scrap tires in illegal stockpiles. TCEQ also works with the scrap tire industry and TxDOT to encourage growth in existing and developing scrap tire markets and to ensure scrap tire handlers comply with all market and product requirements. As the production of crumb rubber and use of other scrap-tire material increases in Texas, the demand for innovative ways to use scrap-tire materials also increases.

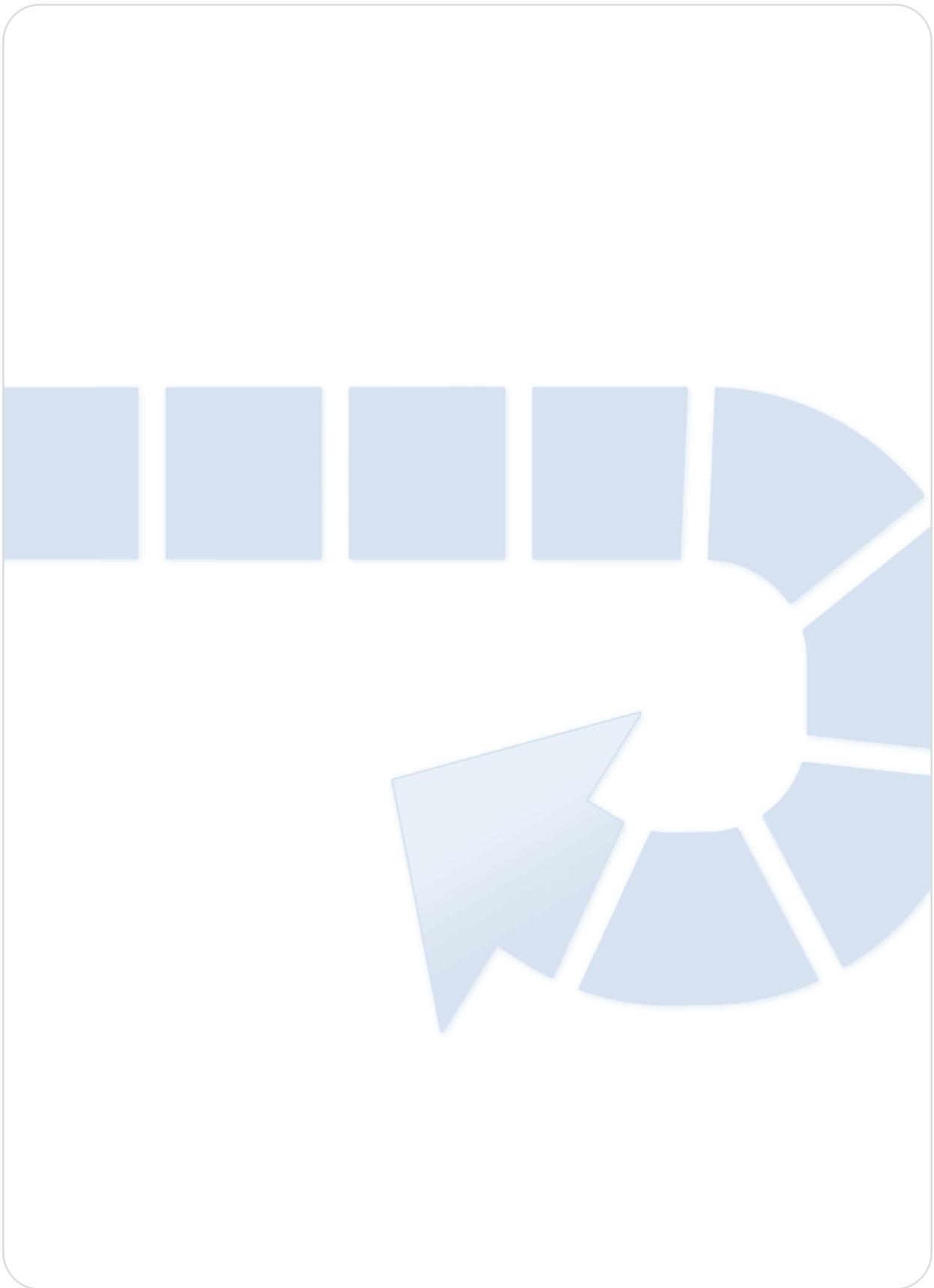
Despite this progress, ongoing challenges and opportunities that offer direction for future progress include:

- funding cleanup efforts for existing and newly created stockpiles
- expanding existing markets or developing new markets and end-users where needed
- minimizing the illegal dumping of scrap tires
- researching and developing additional transportation-related uses.





# ***Overview of Texas Scrap Tire Management***



## Overview of Texas Scrap Tire Management

Scrap tire management continues to present a worldwide challenge, with more than 299 million scrap tires generated in the United States in 2005, the latest year with available data. Of that number, the U.S. used approximately 259 million scrap tires. The Rubber Manufacturers Association reported that at the end of 2005, U.S. stockpiles contained 188 million scrap tires, down from 275 million at the end of 2003.<sup>1</sup>

### Scrap Tire Availability in Texas

Based on industry estimates, Texans generate 24 million scrap tires each year – more than one tire for every person residing in the state. In addition, at the end of calendar year 2006, the equivalent of approximately 23.8 million scrap tires lay on the ground in Texas – 28 percent fewer than at the end of 2005. (See Table 1, below.)

**Table 1. Texas Scrap Tire Stockpiles, End of Calendar Year 2006**

Type of Site	No. of Sites	Quantity (STUs*)	Form of Material
Formerly Registered Facilities (see Appendix A)	12	17.8 million	Mainly tire shreds and chip pieces; few whole tires
Known Illegal Dumps	approx. 150	4.5 million	Mainly whole tires
Registered Facilities (see Appendix B)	14	1.5 million	Mainly tire chips but also tire shreds and whole tires
<b>Total</b>	<b>approx. 176</b>	<b>23.8 million</b>	<b>All</b>

\* Scrap tire unit. 1 STU = 20 pounds of scrap-tire material. This measurement is used because scrap-tire material can take many different forms. For large volumes, it is helpful to note that one million STUs equal 10,000 tons of scrap-tire material.

This accumulation of tires is primarily a carryover from the state's Waste Tire Recycling Program (WTRP), which operated from 1993 through 1997. During that time, the state managed all scrap tires, charging a \$2 recycling fee for every tire replaced on vehicles. The proceeds ensured that transporters hauled scrap tires from local businesses to processors for shredding or recycling. The funds also helped clean up illegal sites, retrofit energy recovery facilities and reimburse facilities for using tires as fuel. Because adequate end markets did not exist to accept large amounts of shredded scrap-tire material, by the end of the WTRP in 1997, an estimated 75 million scrap tires had accumulated in these stockpiles. The majority of these stockpiles were abandoned shortly after the WTRP ended.

When the tire program sunsetted in 1997, the state dropped the mandatory fee, allowing tire dealers to set their own fees to cover their costs to handle their administrative and tire removal costs. Since the end of the WTRP, all scrap-tire management activities in Texas have operated under the free-market system. This free-market system has developed into a scrap tire economy that, from all indications, is efficiently handling newly scrapped tires and reducing the volume of scrap tires in abandoned stockpiles located near end-use markets.

<sup>1</sup>Scrap Tire Markets in the United States, 2005 Edition, November 2006. Rubber Manufacturers Association Web site, [www.rma.org/scrap\\_tires](http://www.rma.org/scrap_tires)

## Scrap Tire Usage and Landfill Disposal in Texas

As shown in Table 2, below, Texas scrap tire transporters and end-users reported beneficially using 27.4 million scrap tires during 2005 – significantly exceeding the 24 million scrap tires assumed generated annually in Texas. In addition, landfills reported legally accepting approximately one million scrap tires that were shredded, split or quartered.

The number of scrap tires reported as beneficially used essentially remained constant with 27.3 beneficially used in 2004 and 27.4 million beneficially used in 2005. The number of scrap tires reported as placed in landfills slightly increased from 800,000 scrap tires in 2004 to one million scrap tires in 2005. The reported increase in landfill disposal could be the result of better reporting by landfills instead of an actual increase in the number of scrap tires accepted by landfills for disposal.

Demand for scrap tires increased for tire-derived fuel (TDF), “other” end uses, and landfill disposal and decreased for land reclamation projects using tires, crumb rubber products, civil engineering projects and septic systems during 2005. Table 2, below, presents each category’s consumption of scrap-tire material in the years 2001 to 2005 and the percentage change for the category from 2004 to 2005.

**Table 2. Texas Scrap Tire Usage and Landfill Disposal, 2001 to 2005**

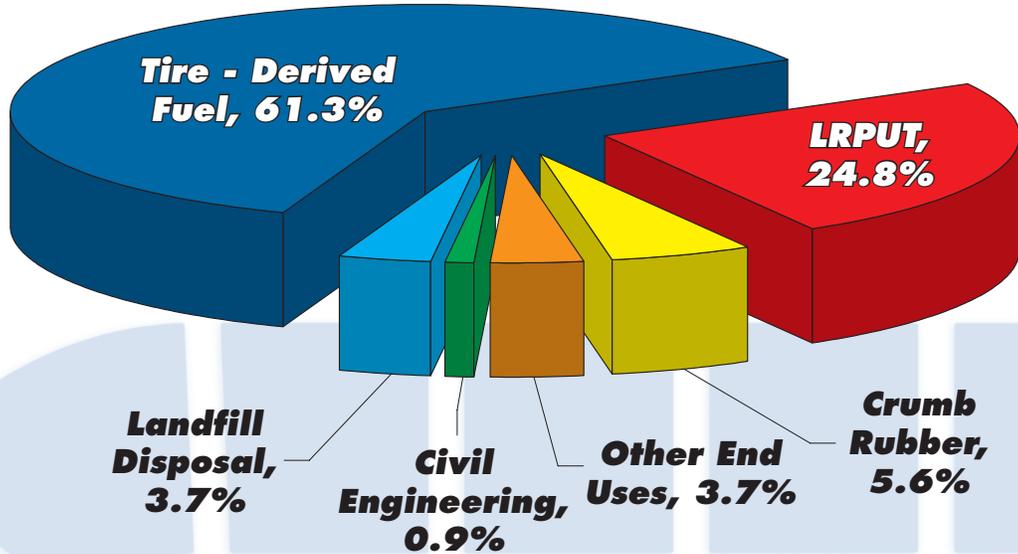
Category	Consumption (Scrap Tire Units*)					Change from 2004 to 2005
	2001	2002	2003	2004	2005	
<b>End Uses</b>						
Tire-Derived Fuel	11,179,401	11,632,968	12,068,845	16,823,282	17,463,316	+4%
LRPUT**	4,639,575	7,847,146	6,696,538	7,269,066	7,068,988	-3%
Crumb Rubber Products	7,485	340,573	1,484,920	1,817,654	1,584,357	-13%
Civil Engineering Projects	5,019,091	3,810,200	1,748,156	806,758	260,146	-68%
Septic Systems	672,146	504,426	213,118	204,791	16,442	-92%
Other End Uses	1,592,197	827,392	966,028	414,802	1,046,902	+152%
<b>End Uses Subtotal</b>	<b>23,109,895</b>	<b>24,962,705</b>	<b>23,177,605</b>	<b>27,336,353</b>	<b>27,440,151</b>	<b>+0.4%</b>
<b>Landfill Disposal</b>	2,338,578	1,037,834	1,201,929	803,649	1,042,701	+30%
<b>Total</b>	<b>25,448,469</b>	<b>26,000,539</b>	<b>24,379,534</b>	<b>28,140,002</b>	<b>28,482,852</b>	<b>+1.2%</b>

\* Scrap tire unit. 1 STU = 20 pounds of scrap-tire material. This unit of measurement is used because scrap-tire material can take many different forms.

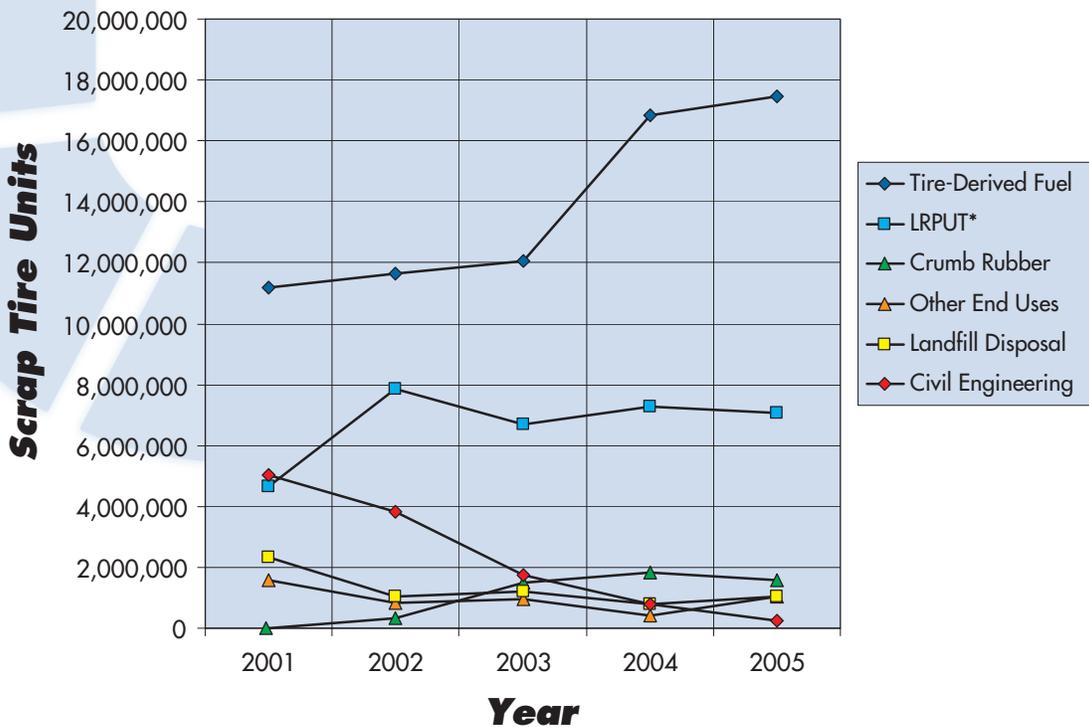
\*\* LRPUT - Land Reclamation Project Using Tires

Figure 1, below, presents the percentages in 2005 for each of the end-use and landfill disposal categories discussed above. Figure 2 charts the annual quantities for each use and disposal from 2001 to 2005.

**Figure 1. Percent Scrap Tire Usage and Disposal in Texas, 2005**



**Figure 2. Scrap Tire Usage and Disposal in Texas, 2001-2005**



\* LRPUT - Land Reclamation Project Using Tires

## **Tire-Derived Fuel (TDF)**

The largest single use for scrap tires in Texas is TDF. Whole and shredded scrap tires have been an increasing source of fuel for industries in the United States, Europe and Asia for a number of years. Due to their intensive fuel requirements, cement kilns, paper and pulp mills and electric utilities have been the main users of TDF. The use of TDF in Texas has increased steadily since 1995, growing four percent from 2004 to 2005 primarily due to increased usage by in-state cement plants and by out-of-state pulp and paper mills. Use of tire material as TDF accounted for approximately 61.3 percent (17.5 million STUs) of the scrap tires consumed in 2005. Appendix C lists 10 Texas facilities, three Louisiana facilities, and two Arkansas facilities that use TDF generated in Texas.

TCEQ used funds appropriated by the 77th Legislature (2001) to award grants in 2002 to retrofit a cement kiln in New Braunfels and another near Midlothian that had not previously used scrap tires as fuel to utilize TDF. The cement kiln located in New Braunfels completed its retrofit in 2003 and has consumed 6.7 million scrap tires since then. The cement kiln in Midlothian is currently working to obtain authorization from the TCEQ that will allow the use of TDF. The facility could obtain the authorization, complete its retrofit, and initiate burning operations in 2007. The two facilities should consume from four to six million whole scrap tires as TDF annually.

In 2005, because the demand for scrap-tire material significantly exceeded scrap tire generation, several TDF end-users met their demand by accepting scrap-tire material from abandoned stockpiles located close to their facilities. For example, the International Paper mills located in Mansfield and Bastrop, Louisiana obtained approximately three to six million scrap tires worth of TDF from the Gibson Recycling site in Atlanta, Texas each year from 2003 until the Gibson Recycling site ceased TDF production in October 2006.

When TDF end-users use up nearby scrap tire stockpiles, they typically either reduce their TDF use or meet their TDF demand from more distant stockpiles or from new scrap tire generation. These alternative sources are usually more costly than their original source. Meeting their demand diverts the materials from other beneficial uses, such as Land Reclamation Projects Using Tires (LRPUTs), civil engineering projects, on-site septic systems and other end uses.

Upon completion of the recycling phase of the Gibson-Atlanta cleanup, International Paper's Louisiana paper mills may switch to new tire generation and existing abandoned scrap tire stockpiles in the Houston and San Antonio areas as sources for TDF. The redirection of demand from Atlanta to the Houston and San Antonio areas could significantly decrease the number of scrap tires consumed by a Houston-area LRPUT and reduce the number of scrap tires in stockpiles in the Houston and San Antonio areas.

Since the tire management system in Texas operates under a free-market system, increasing end-use is resulting in a continued decrease in scrap-tire material in stockpiles, and an increase in the number of scrap tires directed to TDF end-users at the expense of other end-user categories. TCEQ expects the amount of Texas-generated TDF consumed by end-users to decrease during calendar year 2007 due to termination of tire chip manufacturing operations at the Gibson Recycling site. TCEQ expects this category decrease to be temporary, however, with TDF usage rates ultimately rebounding and continuing to increase as end-users establish alternate sources for TDF.

## **Land Reclamation Projects Using Tires (LRPUTs)**

The second largest use category for scrap tires in Texas is Land Reclamation Projects Using Tires (LRPUTs). Civil engineering and reclamation projects routinely use shredded scrap tires as fill material. In areas that

have been mined for sand and gravel, a 50:50 mixture of tire pieces and soil can be used as fill material to reclaim the mined area.

There are currently five LRPUs operating in the state. The number of scrap tires consumed by these facilities decreased three percent in 2005 primarily due to the redirection of scrap tires from the State's largest LRPUL located in Houston to TDF end-users. (TDF is typically the more cost-efficient option in areas where LRPULs and TDF are competing end uses.) LRPUL operations accounted for 7.1 million scrap tires or 24.8 percent of those consumed in 2005. The number of scrap tires consumed by LRPULs should decrease as TDF end-users consume some of these scrap tires.

### **Crumb Rubber Products**

The third largest use category for scrap tires in Texas is crumb rubber products. Crumb rubber is finely ground tire rubber that can be used to modify asphalt or to manufacture traffic control devices, rubberized lumber, soft playground surfaces, running tracks, synthetic sports turf underlayment, equestrian arena material, rubber mats and other rubber products.

Crumb rubber comes from two sources – grinding scrap tires and rubber buffings, which are byproducts from retreading used tires. Rubber buffings are limited in quantity, so grinding scrap tires will meet increased demand for crumb rubber.

Crumb rubber consumption accounted for 5.6 percent (1.56 million STUs) of the scrap tires that were consumed in 2005 – a 13 percent decrease from 2004. Crumb rubber delivery prices increased in 2005 because of higher fuel prices and resulted in a decrease in the amount of crumb delivered to end-users. Higher petroleum prices also added to the cost of asphalt paving with crumb rubber – further reducing crumb rubber use. With a stabilization of fuel prices, the development of new processing capabilities, and a growing level of use in roadways and other applications, the amount of scrap tires turned into crumb rubber should increase.

### **Other End Uses**

Among many other end uses, some manufacturers use scrap tires to make cattle water tanks, tire bales, pet toys, fences, sidewall rings for agricultural purposes, boat bumpers, park features and weights for highway safety barrels. This category accounted for approximately 3.7 percent (1.05 million STUs) of the scrap tires used in 2005. Use in this category varies significantly from year to year depending upon the number and size of individual projects in a given year. Usage in this category increased approximately 600,000 scrap tires (152 percent) in 2005 and should remain constant or decrease slightly in 2006.

### **Civil Engineering Projects**

Although this category can include any landfill-engineering project that utilizes scrap-tire material (i.e., slope stabilization, roadway and berm construction, etc.), landfill leachate construction projects consumed all of the scrap-tire material in this category during 2005. Leachate collection systems require scrap tires shredded to a specific size to substitute for gravel.

The consumption rate for this category decreased 68 percent from 2004 levels. Annual usage under this category has steadily decreased since 2001 as the cleanup of scrap tire stockpiles has reduced the

availability of scrap-tire chip material in areas close to landfills with leachate collection system construction projects. In addition, several landfills chose to discontinue use of tire chips in collection systems due to fire concerns.

Schedules for civil engineering projects in landfills are variable so annual usage for this category can vary significantly from year to year. In 2005, this use accounted for approximately one percent (about 260,000) of the scrap tires consumed. Use levels could remain at current levels or increase slightly in 2006.

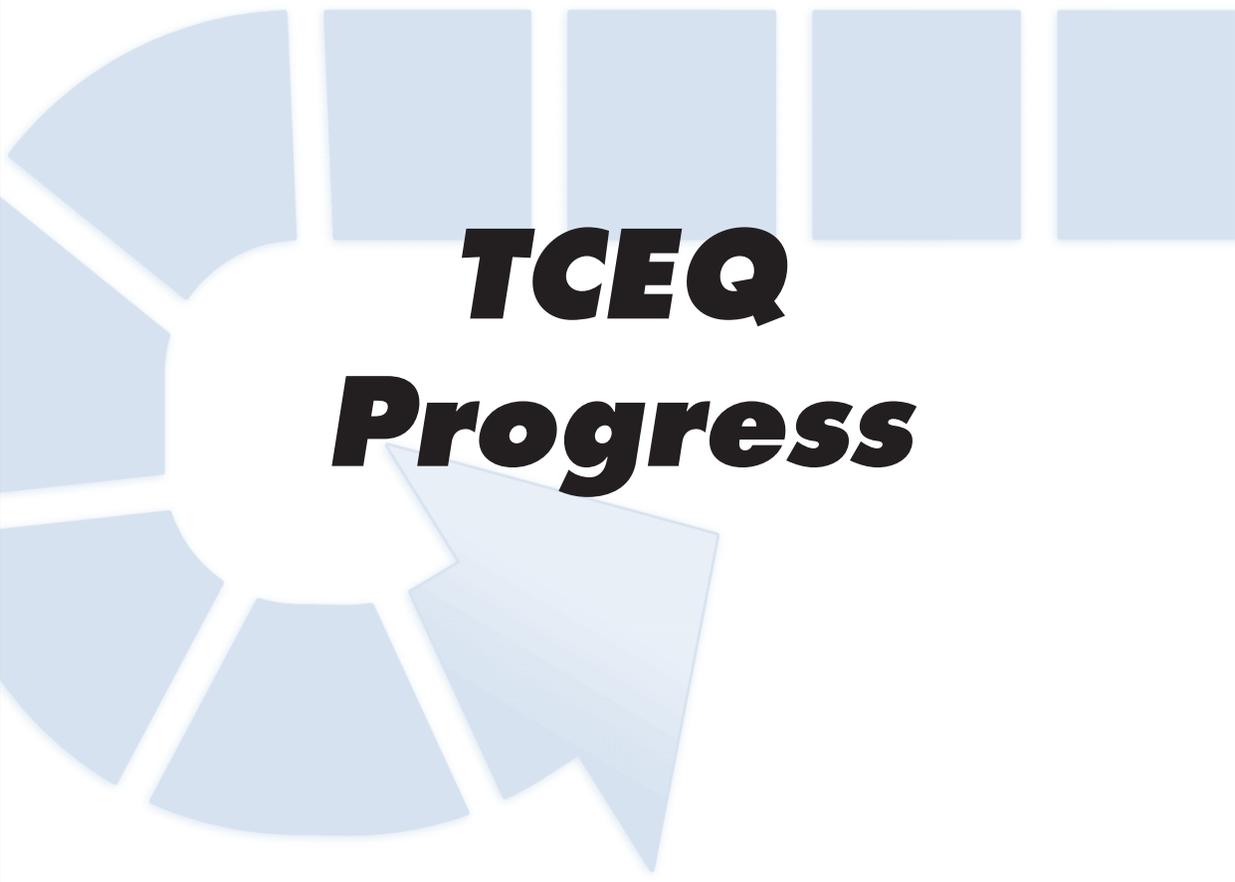
### **Septic Systems**

Shredded tires provide good filter material in place of gravel in drain fields of septic systems. This category accounted for only about 16,000 of the scrap tires consumed in Texas in 2005 and the number of scrap tires consumed by this category decreased approximately 190,000 scrap tires between 2004 and 2005. Annual usage under this category has steadily decreased since 2001 as scrap tire stockpile cleanups have reduced the availability of scrap tire chip material. However, because a large portion of the scrap-tire material from a site cleanup in Cleveland is being directed to area septic system installations, the amount of scrap-tire material consumed by this category is expected to increase during 2006.

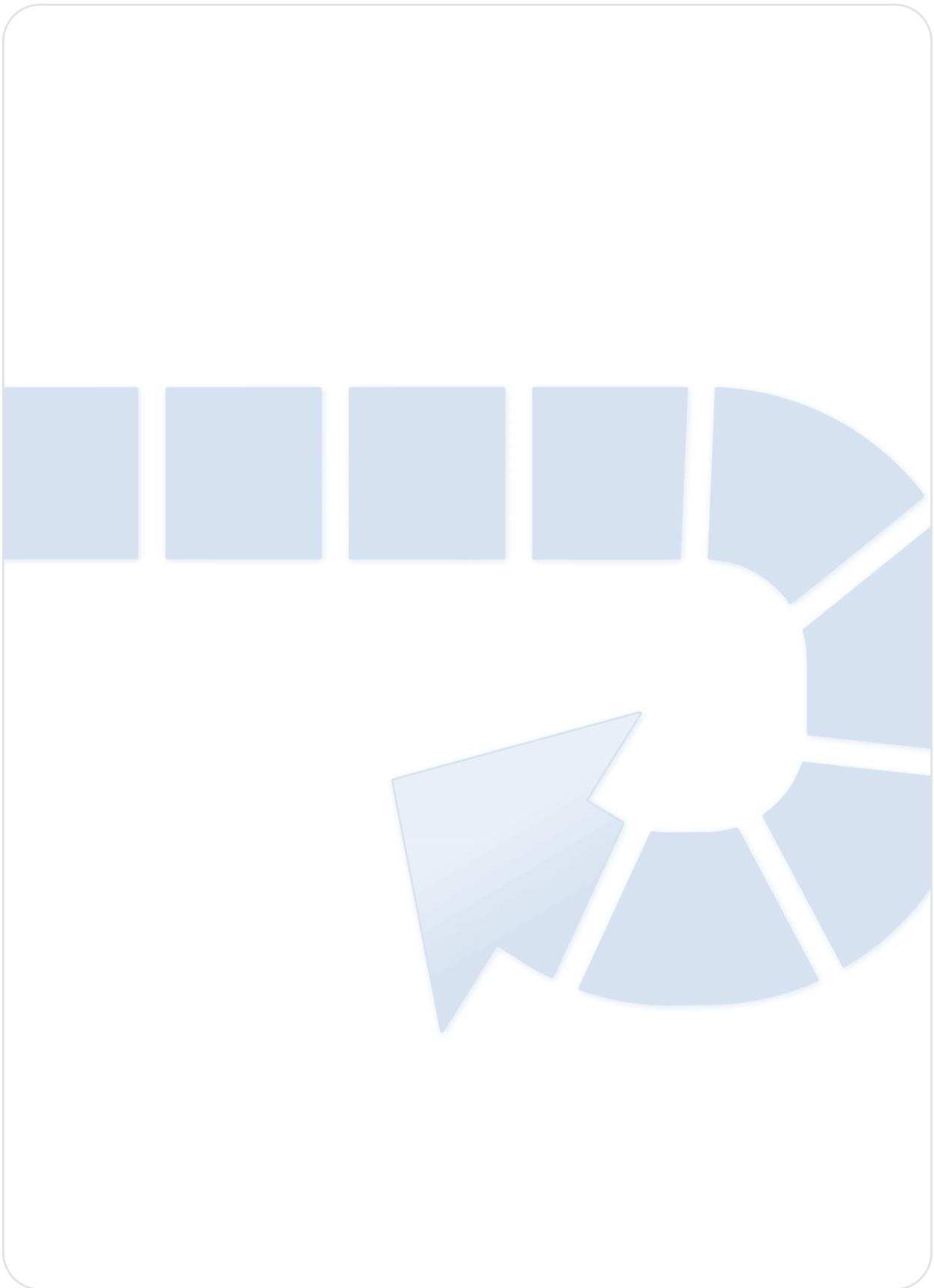
### **Landfill Disposal**

Permitted municipal solid waste landfills may dispose of split, quartered or shredded scrap tires, a necessary scrap-tire management option in areas where few end-users exist.

Landfill disposal accounted for approximately 3.7 percent (1,042,701) of the scrap tires consumed in calendar year 2005. The reported consumption rate for this category increased 30 percent from 2004 levels, which is probably the result of better reporting by landfills instead of an actual increase in the number of scrap tires accepted by landfills for disposal. The number of scrap tires reported as consumed by this category could increase slightly in calendar year 2006.



# **TCEQ** **Progress**



## **TCEQ Progress**

### **Compliance**

TCEQ has taken action to ensure that all scrap tire generators, transporters, processors and end-users comply with all applicable regulations. These TCEQ actions include participation in numerous outreach and educational events, coordination with local governments and industry organizations and members, and initiation of investigation and enforcement procedures.

### **Reduction of Scrap Tire Stockpiles**

TCEQ and private industry worked together to reduce the number of scrap tires stockpiled at previously registered scrap tire storage sites by approximately 6.3 million in 2002, 14.9 million in 2003, 10.3 million in 2004, 10.1 million in 2005, and an estimated nine million scrap tires in 2006. This 51.3 million-scrap tire reduction represents a 74 percent decrease in state stockpile volumes since 2001.

### **Contracts for Cleaning Up Atlanta and Stamford Stockpiles**

The 77th Legislature appropriated \$7.5 million through Senate Bill 1, Article VI, Rider 35, "Waste Tire Disposal Grants," to TCEQ to address scrap tire stockpiles. In turn, TCEQ awarded contracts in March of 2003 for the remediation of the two largest scrap tire stockpiles in the State – the Gibson Recycling, Inc. site in Atlanta (30 million STUs) and the ERRI/TCI site in Stamford (14.5 million STUs). TCEQ awarded a contract to Merrick Construction Company to remediate the Gibson Recycling, Inc. site and to Silver Creek Materials, Inc. to remediate the ERRI/TCI site.

As of the end of 2006, TCEQ contractors have remediated all of the 14.5 million scrap tires originally stored on the ERRI/TCI site and 27.3 million of the 29.8 million scrap tires originally stored on the Gibson site. By the end of May 2007, both cleanups should be complete. Cleanup of these two sites will eliminate approximately 45 million scrap tires from Texas stockpiles.

### **Clean Up of Other Non-Compliant Sites**

In 2004, TCEQ used financial assurance funds to contract for removing 850,000 scrap tires from an abandoned scrap-tire storage site in San Antonio, completing the project in 2006.

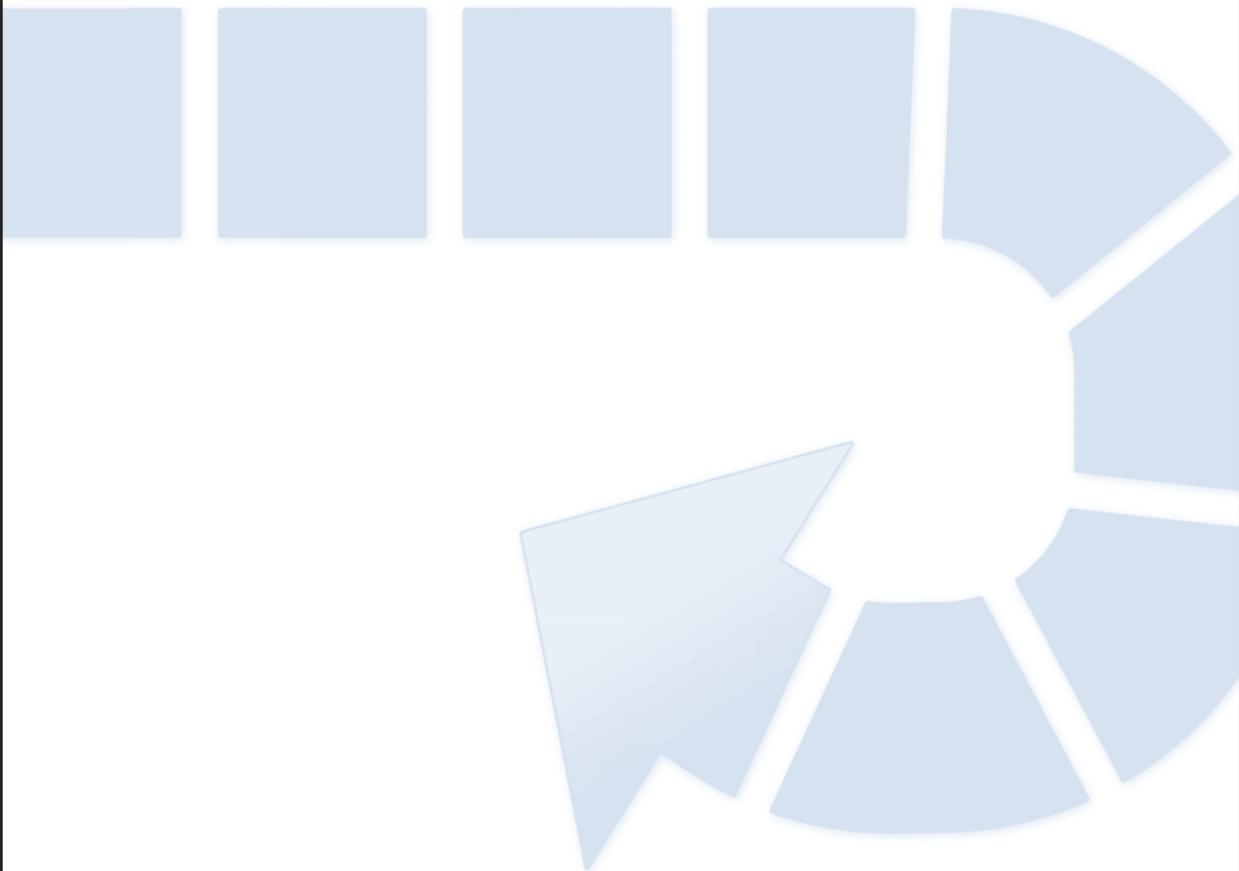
In 2006, TCEQ awarded a contract for cleanup of an abandoned scrap tire site in El Paso that contains approximately 250,000 whole scrap tires. The contractor removed approximately 50,000 scrap tires during 2006 and should complete the project by August 2007.

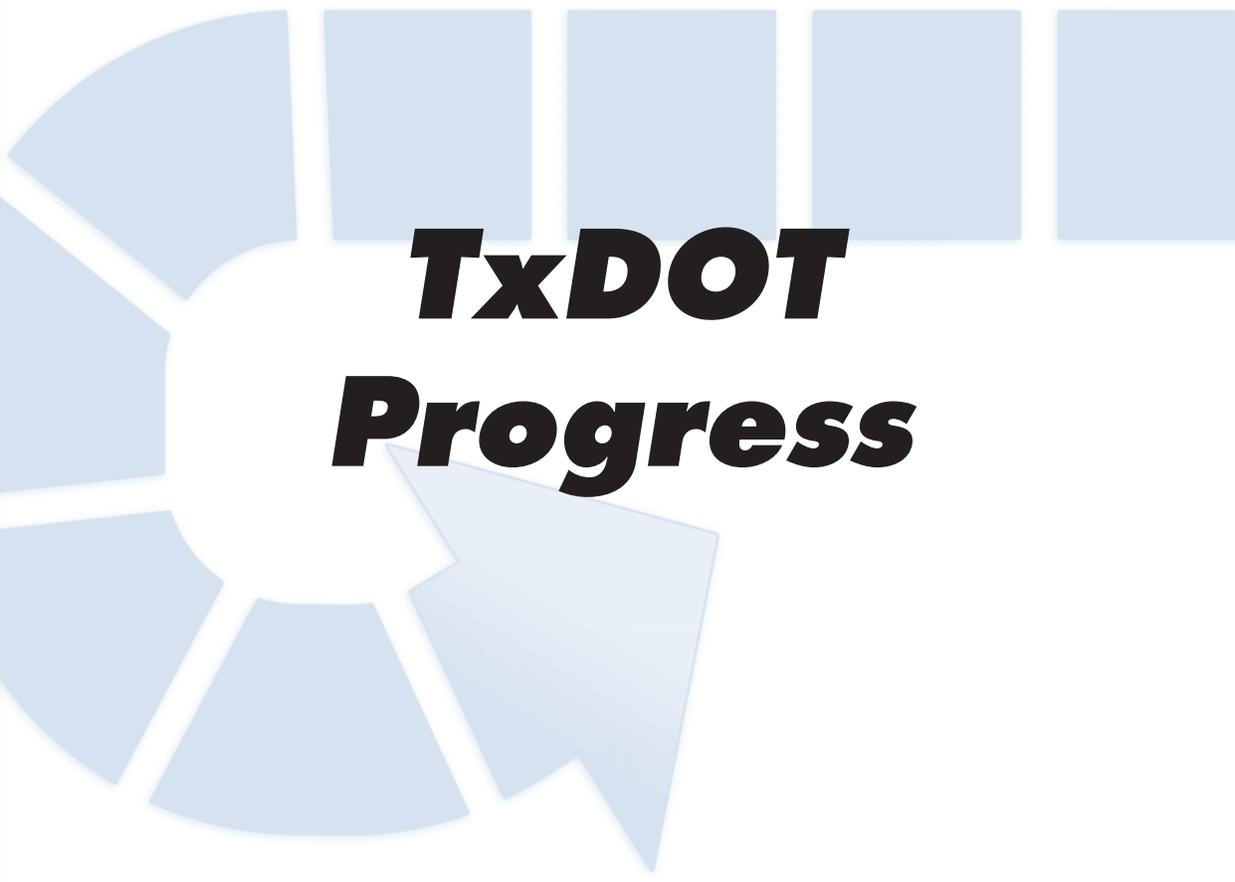
TCEQ entered into cleanup agreements in 2006 that resulted in the removal of approximately 750,000 scrap tires from abandoned scrap tires sites in Cleveland and Midlothian.

### **Cement Kiln Retrofits**

In 2002, TCEQ used funding appropriated by the 77th Legislature to award grants to two cement kilns to retrofit them to burn scrap tires as fuel, which they had not used previously. One of the two cement kilns

retrofit and burned a total of 1.4 million whole tires in 2003, 2.6 million whole tires in 2004, 2.7 million whole scrap tires in 2005 and an estimated three million whole tires in 2006. The second cement kiln is working with TCEQ to amend its air quality permit to allow the use of TDF and could complete the permit activities and initiate TDF burning operations by mid-2007. The facilities should consume a combined four to six million whole tires as TDF annually.





# ***TxDOT Progress***



## **TxDOT Progress**

In addition to helping resolve environmental and social issues associated with scrap tires, TxDOT has many reasons to use rubber from tires; including enhanced safety of roadways, support of an environmentally sustainable economy in Texas, and increased value of roadways through greater durability.

Further, by using tire-rubber products, TxDOT helps assure that cheaper non-disposal options exist for the scrap tires and tire pieces that TxDOT districts generate. In FY '06, TxDOT districts paid more than \$800,000 to handle nearly 390,000 tires' worth of rubber collected from roadways and 34,200 scrap tires that generated through maintenance and roadway cleanup that could not be re-treaded.

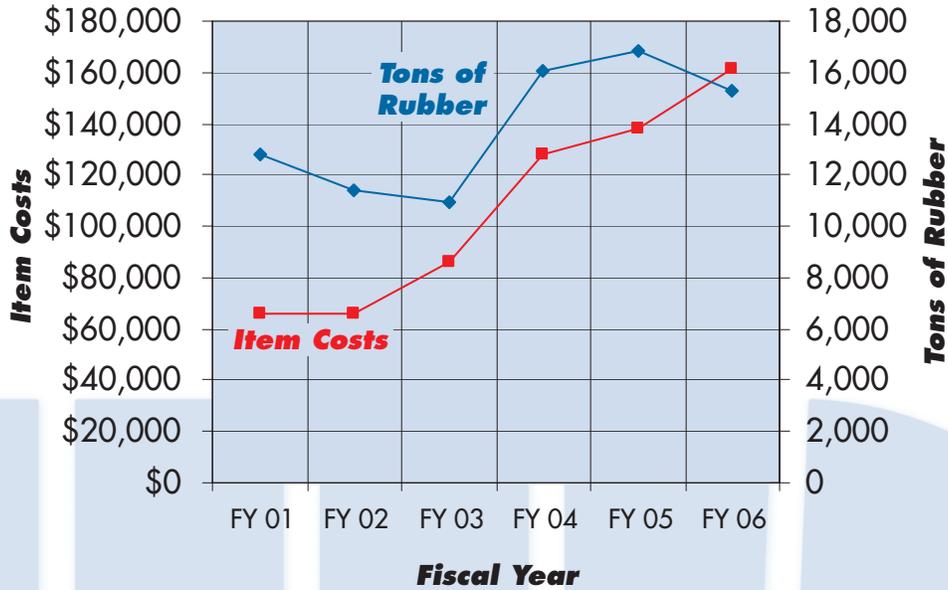
TxDOT has identified, developed, and adopted several uses for scrap tires and crumb rubber in roadway construction and maintenance projects that meet the department's stringent engineering and environmental standards. Not only do they compete financially with traditional products and materials, but also many of these applications perform even better.

Not immune from rising petroleum prices, however, TxDOT contracted in FY '06 to pay more for rubber asphalt products than in previous years but will use slightly fewer tons of rubber.

TxDOT's FY '06 contracts call for using 15,300 tons of rubber, about 2.2 million tires' worth, primarily in paving applications. While the cost for these applications rose about 17 percent to \$161 million from FY '05, the quantity of rubber dropped nine percent.

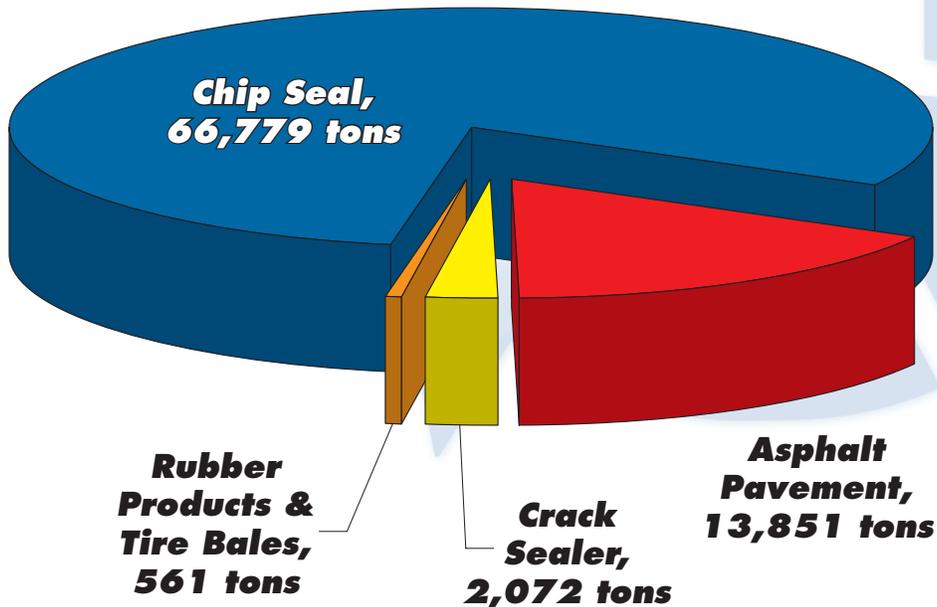
As Figure 3 shows, TxDOT's contracted quantities of rubber usage peaked for the contracts awarded in FY '05, while their expense continued to grow in FY '06. Rising petroleum prices drove up the cost of asphalt, which, in turn reduced the quantity of paving in contracts with rubber that TxDOT awarded in FY '06.

**Figure 3. TxDOT Expenditures and Rubber Usage for Roadway Contracts Awarded FY '01 to FY '06**



TxDOT's primary uses for rubber are in chip seals and asphalt pavement, as shown in Figure 4. Molded rubber products and tire bales are comparatively smaller uses but have potential for growth.

**Figure 4. Tire Rubber Used in TxDOT Applications, FY '01 to FY '06**



## **Chip Seals**

Chip seals, also known as seal coats, are a layer of asphalt, covered with a layer of rocks to provide either a new driving surface or a waterproof layer under the surface layer. Engineers choose chip seals with as much as 15 percent tire rubber in the asphalt to hold the rocks in place better and provide greater durability. TxDOT's FY '06 contracts call for using about 10,600 tons of tire rubber for chip seals – 19 percent less than in FY '05 due largely to rising petroleum prices.

## **Asphalt Pavement**

Hot mix asphalt pavements are compacted mixtures of rock and asphalt. The asphalt ranges from five to eight percent of the mixture. Many TxDOT engineers choose asphalts with five to 15 percent rubber to increase pavement life. Through its FY '06 contracts, TxDOT will consume about 4,200 tons of rubber for hot mix asphalt pavement – about 32 percent more than in FY '05.

TxDOT's use of rubber in asphalt paving will continue to grow for several reasons. TxDOT's 2004 standard specifications provide for expanded use of crumb-rubber modified asphalt over the 1993 specifications. In particular, crumb-rubber modified asphalt is an option in two relatively new hot-mix asphalt applications that districts are specifying increasingly – Item 342, Permeable Friction Course (PFC), and Item 346, Stone-Matrix Asphalt (SMA).

TxDOT road designers choose PFC because it reduces traffic noise and improves skid resistance, visibility in wet weather, pavement durability and ride quality. They choose SMA because of its durability and improved ride quality. TxDOT engineers choose the rubber option for these two types of pavement because it adds even greater durability and ride quality – two of TxDOT's five goals.

## **Crack Sealer**

To extend the life of existing pavements, TxDOT seals pavement cracks with asphalt-rubber products that contain 22 percent tire rubber. This application will account for an additional 500 tons of rubber used through FY '06 contracts.

TxDOT's commitment and satisfaction with rubber in pavements is well known even outside the department. In the spring of 2006, the Rubber Pavements Association recognized the TxDOT Houston District for "Outstanding Contributions to the Expanded Use of Crumb Rubber in Asphalt in 2005."

TxDOT is also pioneering and adopting many non-paving applications for tires and tire rubber such as tire bales and molded rubber products.

## **Embankment Construction or Repair with Tire Bales**

TxDOT continues to develop innovative uses for tire bales. Comprised of about 100 passenger-car tires and weighing about one ton each, tire bales are about five feet square and 2 1/2 feet high. With a density between water and soil, designers consider them lightweight, permeable building blocks.

As discussed in previous reports, in 2002, the TxDOT Fort Worth District experimented with repairing a failing embankment on I-30 by replacing poor quality soils with layers of tire bales. The success of that

demonstration project led the TxDOT's Fort Worth District Materials Engineer to work with the Center for Transportation Research (CTR) at the University of Texas, Austin, to determine basic engineering properties of tire bales.

In the summer of 2005, TxDOT's Fort Worth District used the results of CTR's work and input from other TxDOT engineers and consultants to develop an improved design for constructing or repairing embankments with tire bales. The Fort Worth District used this new design to repair another problematic embankment adjacent to the previously repaired stretch on I-30 using 161 tire bales.

Based in part on that work, TxDOT awarded a two-year research project to CTR in September 2006 to analyze further the engineering properties of tire bales, develop a computer model to examine various tire-bale embankment designs, produce specifications and design guidelines and conduct an engineering workshop.

### **Tire-Rubber Molded Products**

The total quantity of rubber in the molded products TxDOT uses is small, especially when compared to the amount in roadway applications, but it continues to grow.

**Vegetation-control mats.** TxDOT continues to explore the use of mats comprised primarily of rubber from scrap tires to control vegetation along guardrails or around signposts to reduce herbicide use and string trimming.

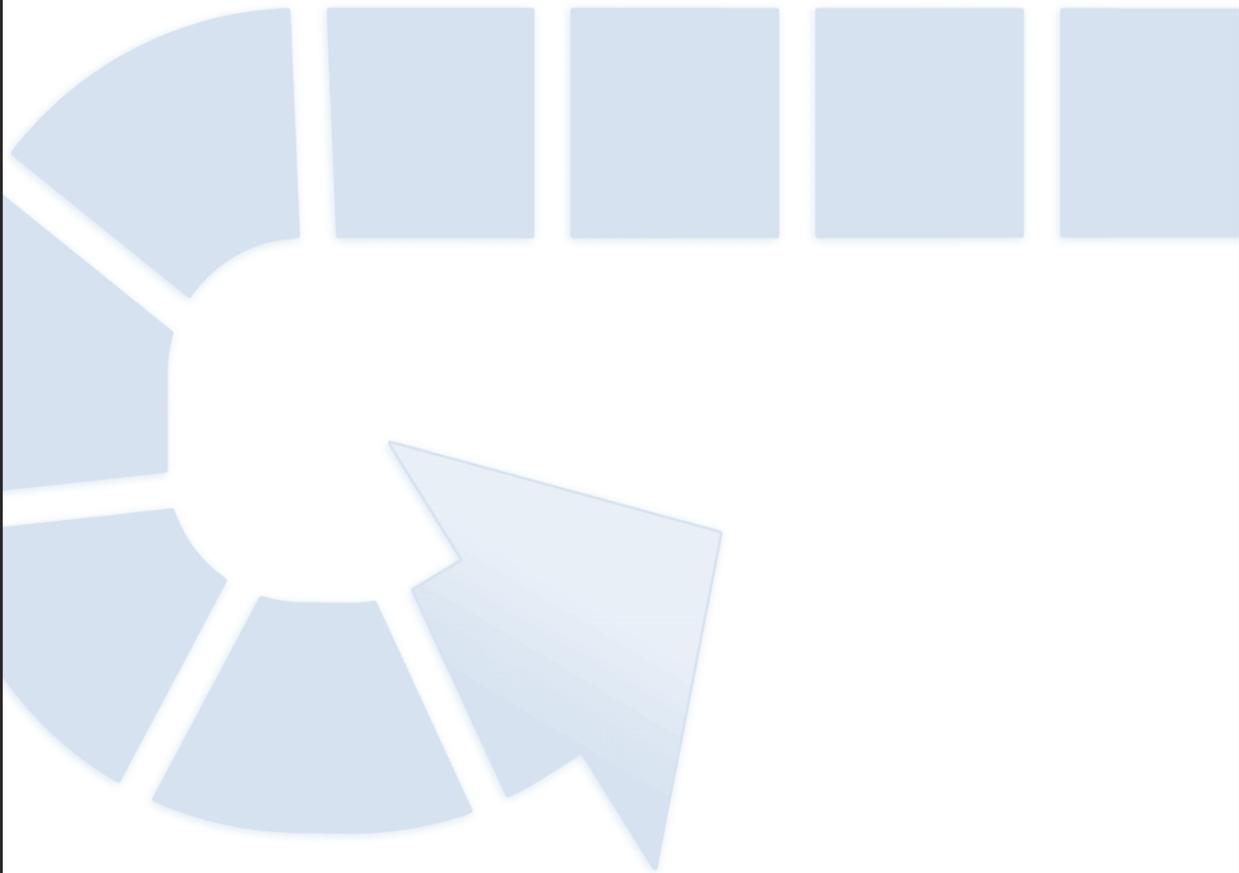
With safety always a top priority, TxDOT considered whether these mats could be a hazard. The Federal Highway Administration (FHWA) Office of Safety Design concluded that using these types of mats or poured-in-place rubber as mow strips under any type of post and beam traffic barrier (including a wire rope or cable design) would have no adverse affect on the crash performance of the barrier. The FHWA's statement assumes that the barrier height remains within the manufacturer's specifications, the mats do not affect the performance of the posts, and that the mat itself does not create a hazard.

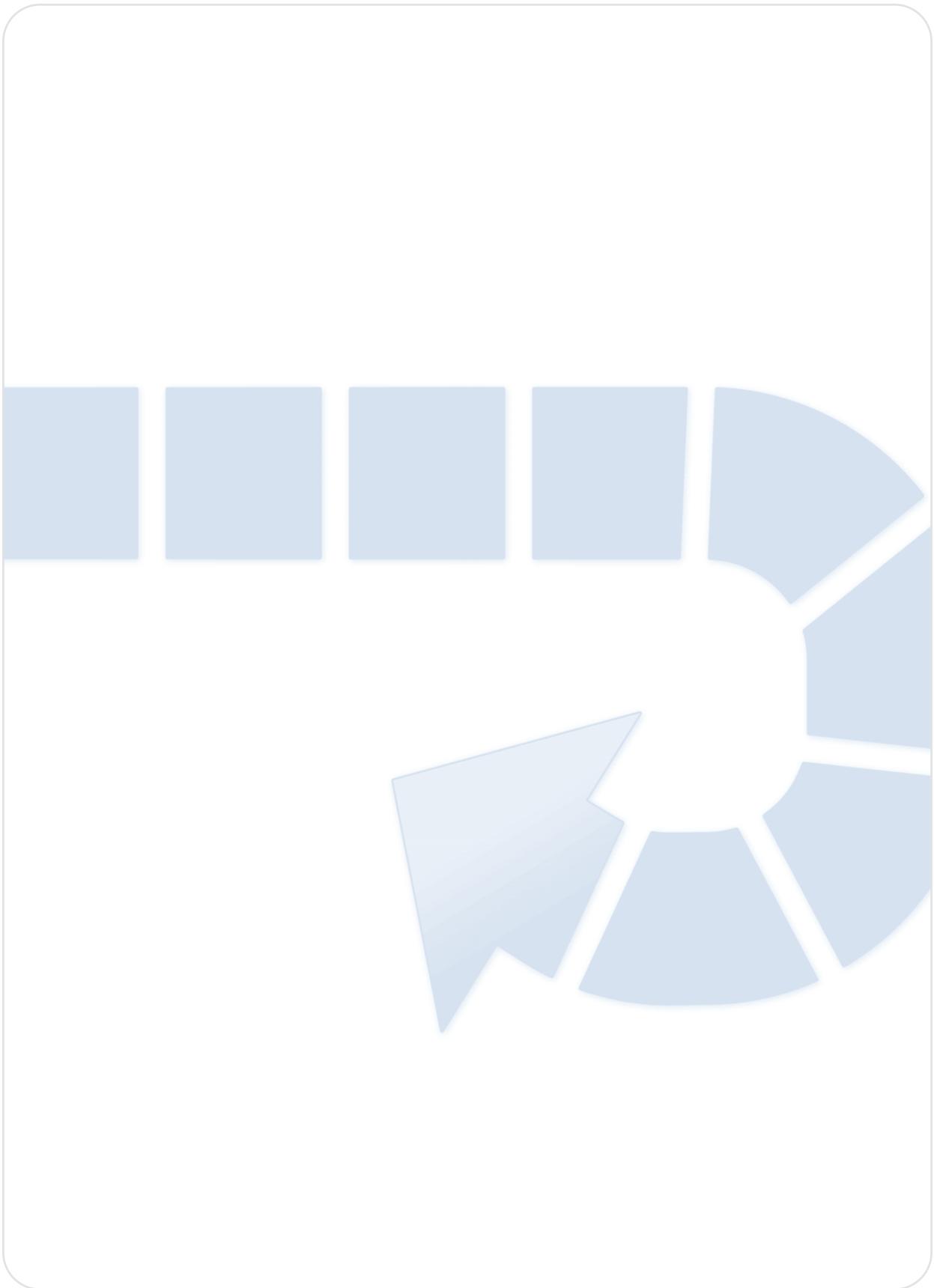
**Delineator posts.** Several years ago, TxDOT's Traffic Operations Division, TxDOT's Pharr District and CaminoVerde developed several recycled delineator post designs with 20 percent recycled tire rubber. This delineator post performs as well as, or better, than the designs it replaces. While the overall cost to install this product costs a little more than other designs, maintenance operations report that it lasts longer and that they can replace it more easily, saving money over the long term. Consequently, TxDOT maintenance sections are asking construction designers to specify this product on new construction projects instead of giving contractors the option to choose from among several approved designs.

**Guardrail spacer blocks.** TxDOT contractors can choose from several TxDOT-approved manufacturers' composite spacer blocks with crumb rubber content. Many contractors chose composite blocks because they are lighter and easier to install than timber blocks.

**Guardrail spacer blocks.** TxDOT Department Material Specification 6310 (DMS-6310) presents the requirements for joint fillers used to fill concrete expansion joints. While this specification currently does not allow rubber products, TxDOT recognized that rubber expansion

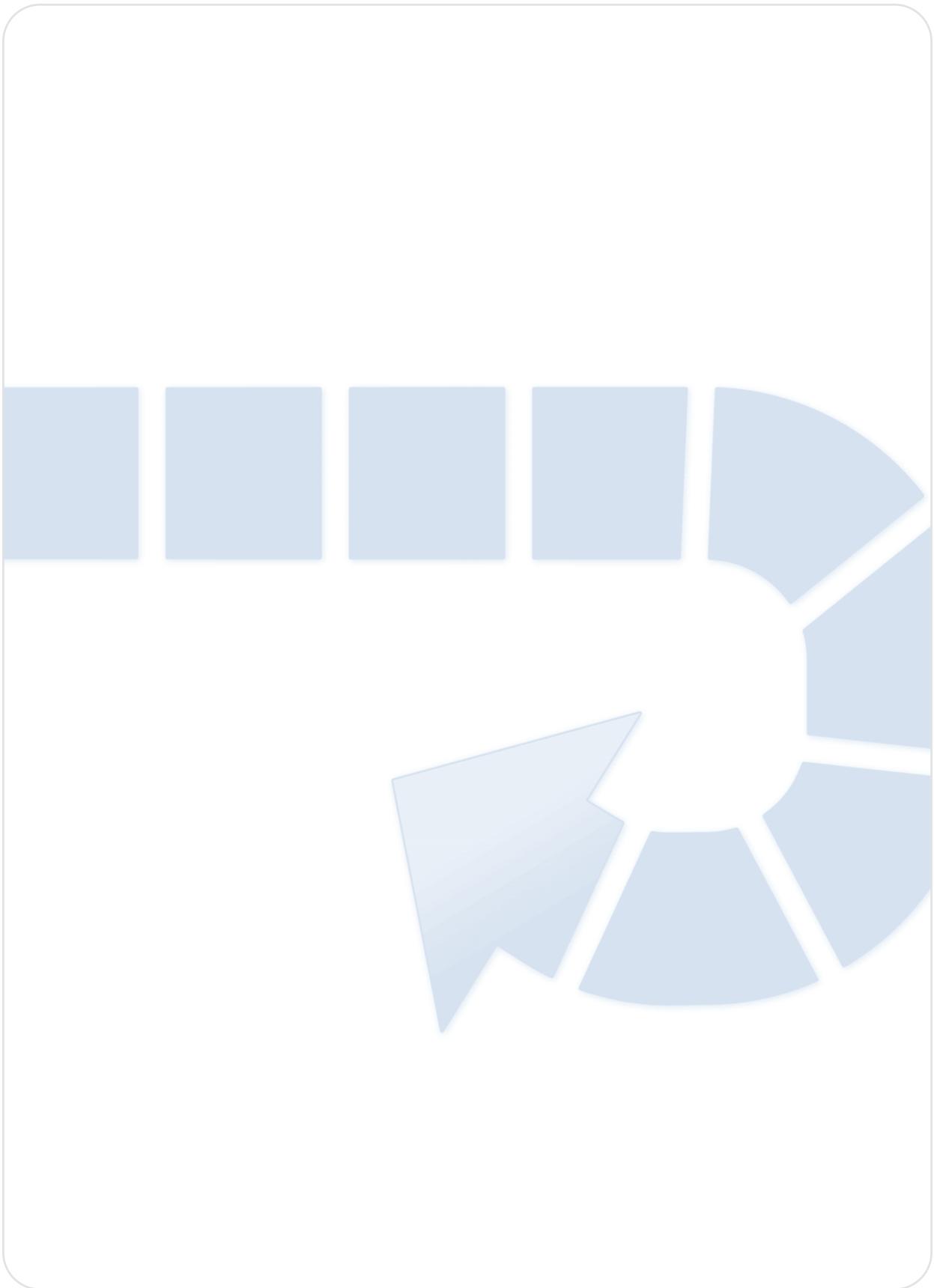
joint materials could meet the performance requirements of DMS-6310. Consequently, TxDOT is modifying this specification also to allow rubber products that meet other performance requirements. This action will allow rubber products to compete evenly with others not only for TxDOT projects, but also for projects engineered by local governments that use TxDOT's specifications.







# ***Trends and Continuing Issues***



## **Trends and Continuing Issues**

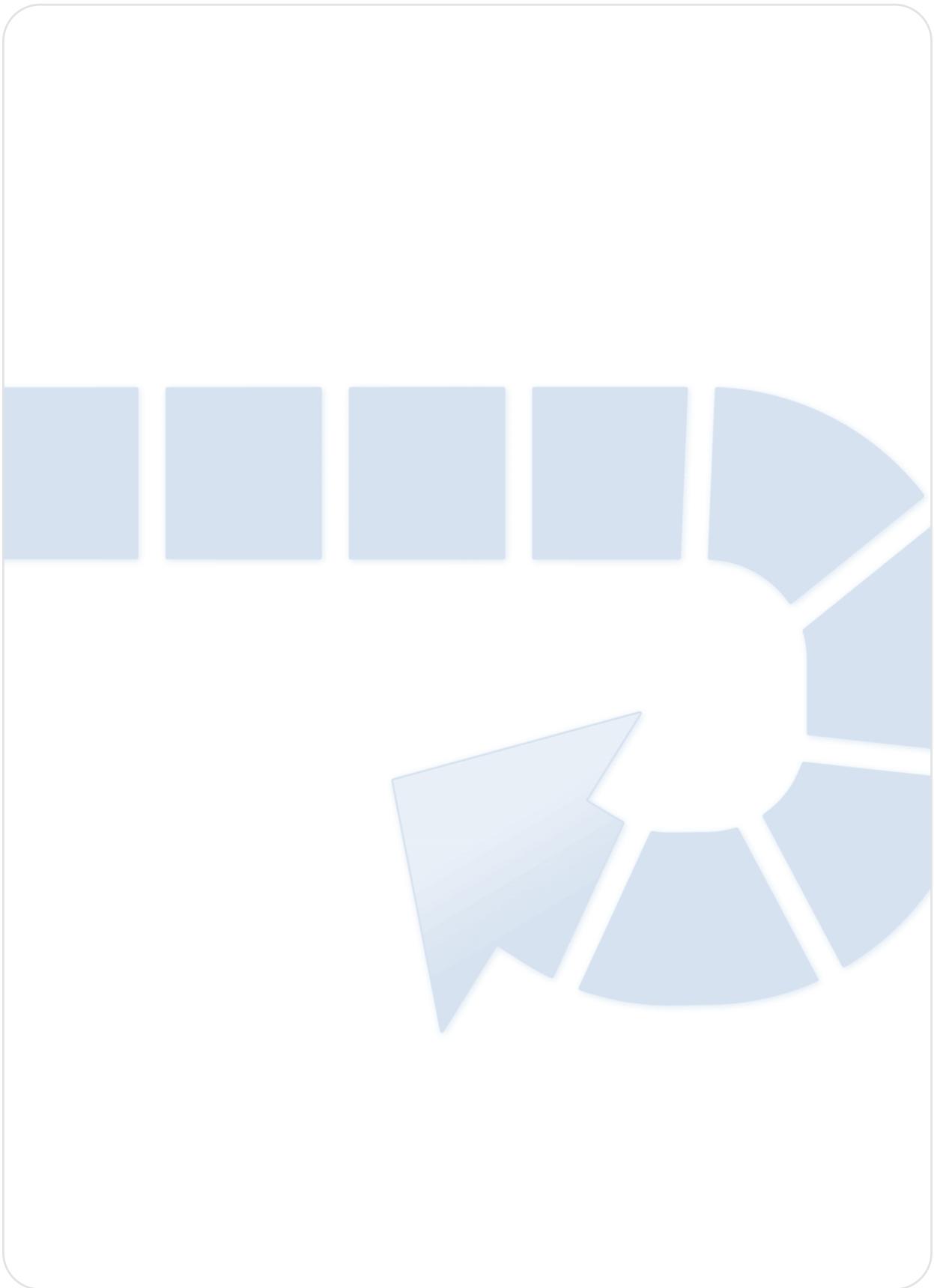
Several significant developments are improving the scrap tire situation in Texas:

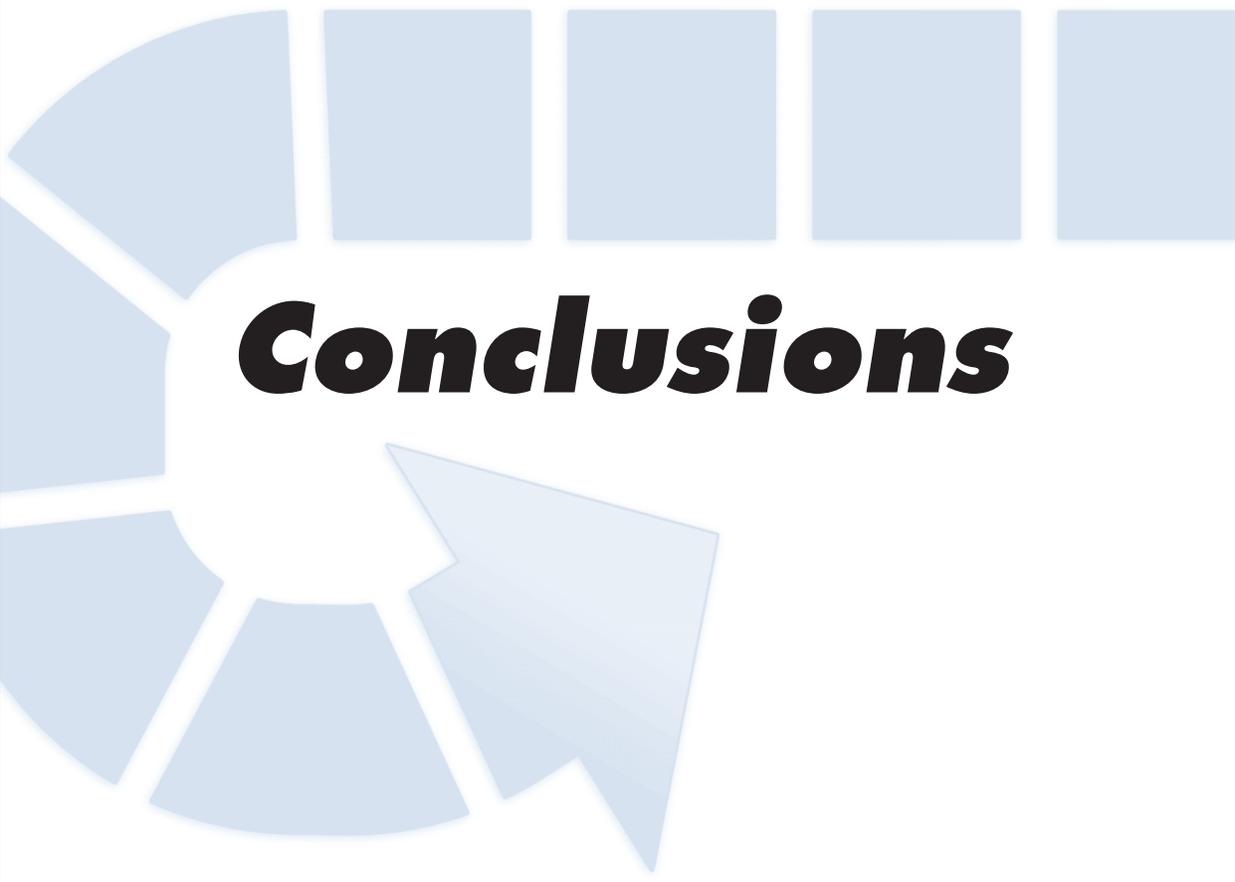
- TCEQ contractor will continue remediating the state's largest scrap-tire site, the Gibson Recycling site in Atlanta, which is 92 percent complete.
- Completion of recycling operations at the Gibson Recycling site in Atlanta is resulting in a change in the areas of the state from which TDF end-users obtain their TDF supply.
- TDF usage rates could temporarily decrease as TDF end-users establish alternate sources for TDF.
- The use of Texas scrap tires as TDF by in- and out-of-state users should continue to increase, in the long term, and be Texas' largest end-use category.
- A TCEQ contractor will clean up a scrap tire site in El Paso.
- Scrap tires consumed by Land Reclamation Projects Using Tires (LRPUT) could decrease, particularly where TDF and LRPUTs are competing end uses.
- Crumb rubber uses could increase.
- Use of scrap tires for on-site septic systems may increase.
- Civil engineering projects, landfill disposal and "other" end-use categories may consume more scrap tires.
- TxDOT's use of tire rubber in paving applications may level off or even drop in the short term as petroleum prices continue to climb.
- TxDOT's use of molded tire-rubber products will continue to grow.
- Tire-bale research may result in more use in Texas of this application.
- Education and outreach events are encouraging other innovative uses for scrap tires and tire rubber material at both the state and local level.

Although TCEQ and TxDOT continue to reduce and prevent scrap tire stockpiles and use products with tire rubber, three primary issues persist.

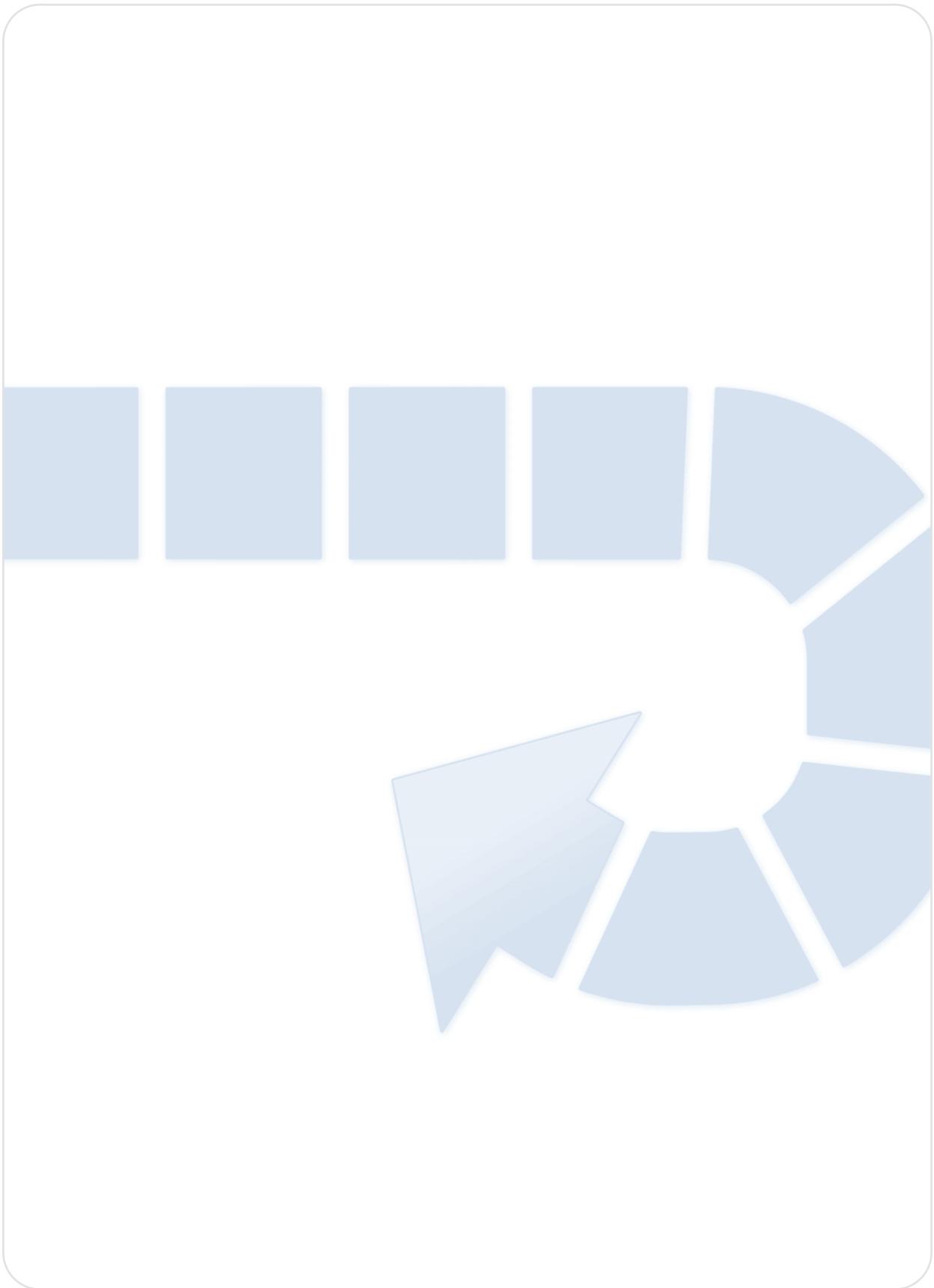
- Illegal scrap tire dumping is likely to continue in areas of the state that have few end-use or disposal facilities.
- Demand for scrap-tire material and tire rubber products is not strong enough to result in the cleanup all existing abandoned and illegal scrap tire stockpiles.
- TCEQ funding is insufficient to clean up remaining scrap-tire stockpiles.

When the funds appropriated by the 77th Legislature (2001) for the cleanup of the state's two largest scrap-tire stockpiles have been exhausted, very limited funding will be available for the maintenance or cleanup of the remaining stockpiles. Consequently, tire fires and the breeding of mosquitoes that can transmit West Nile and other viruses will continue to be risks to the environment and human health.





# ***Conclusions***

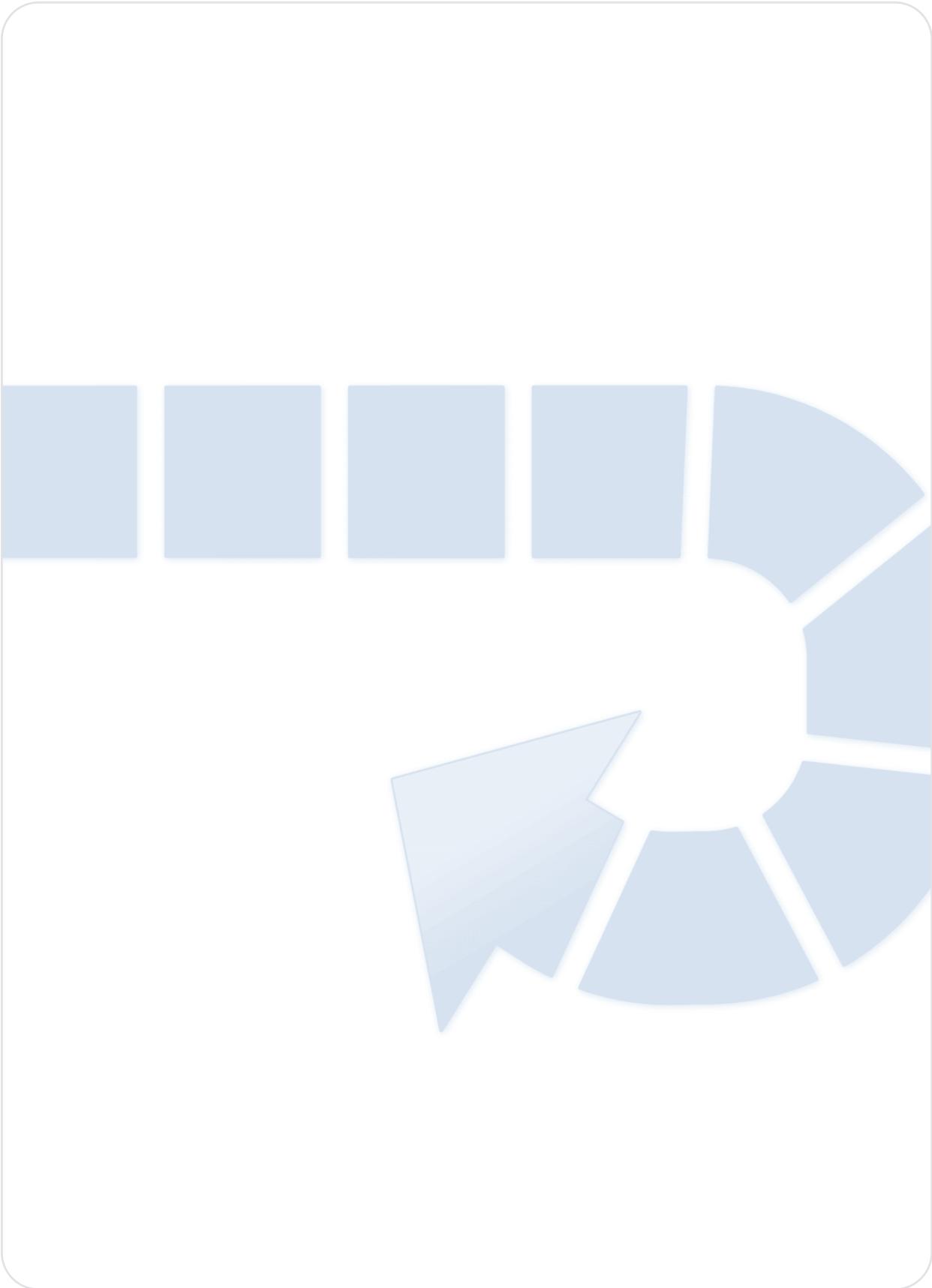


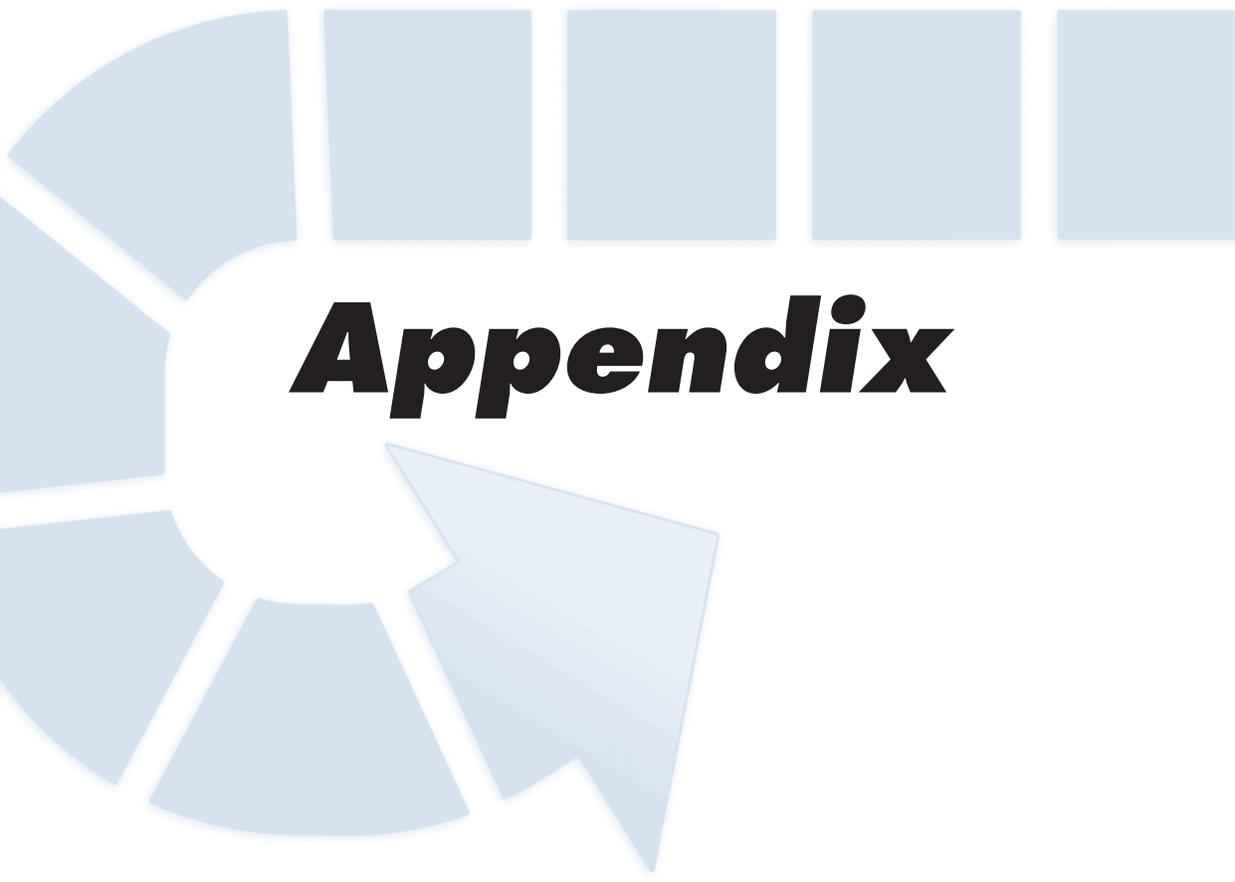
## Conclusions

While significant challenges remain, TCEQ and TxDOT made progress addressing scrap tires during 2005 and 2006. TCEQ continues to work towards reduction or elimination of existing scrap tire stockpiles and to ensure that scrap tire handlers comply with all applicable regulations. Additionally, TCEQ and TxDOT have worked to encourage the development of existing and additional scrap tire markets and products. As the volume of crumb rubber and other scrap-tire rubber material processed in the state increases, the potential for productive use grows.

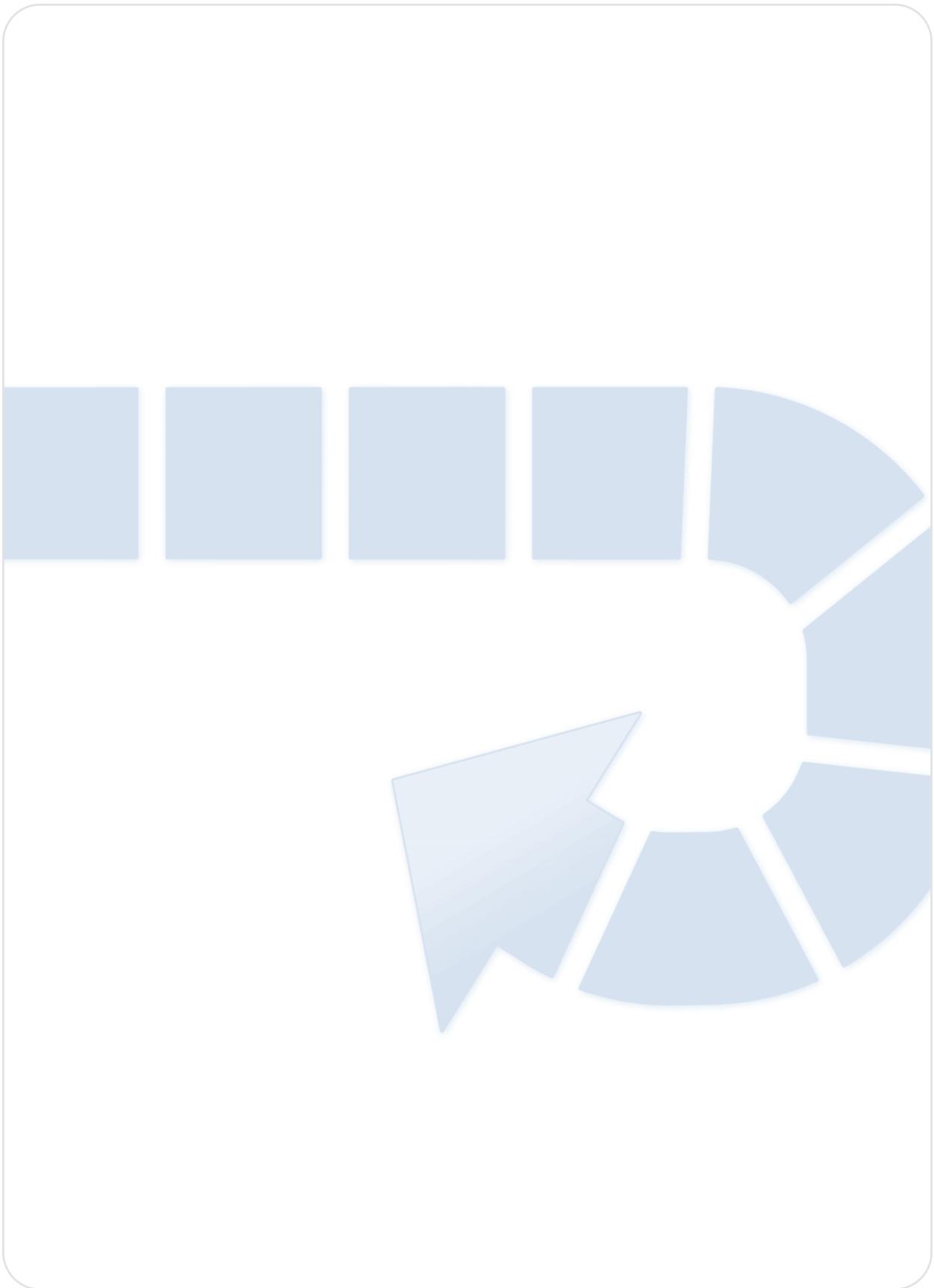
Despite this progress, ongoing challenges and opportunities that offer direction for future progress include:

- funding cleanup efforts for existing and newly created stockpiles
- expanding existing markets or developing new markets and end-users where needed
- minimizing the illegal dumping of scrap tires
- researching and developing additional transportation-related uses.





# ***Appendix***



**APPENDIX A. STOCKPILE VOLUMES AT FORMERLY REGISTERED FACILITIES, ENDS OF CALENDAR YEARS 2003 THROUGH 2006**

Facility Name	City	County	Stockpile Volume (in Scrap Tire Units*)			
			2003	2004	2005	2006
American Tire Recycling**	San Antonio	Bexar	850,000	535,000	314,248	0
ERRI/TCI**	Stamford	Haskell	2,899,520	1,830,070	0	0
Gibson Recycling, Inc.**	Atlanta	Cass	27,740,530	18,869,510	10,206,461	2,500,000
Gibson Recycling, Inc.	Beaumont	Jefferson	2,048,100	2,048,100	2,048,100	2,048,100
Quantum Tech, Inc.**	Houston	Harris	60,000	60,000	60,000	60,000
Safe Tire Disposal Corp.	Cleveland	Liberty	1,381,679	1,381,679	1,160,158	400,000
Safe Tire Disposal Corp.**	Midlothian	Ellis	1,126,891	768,000	1,250,000	1,007,500
Safe Tire Disposal Corp.	Penwell	Ector	4,967,897	4,967,897	4,967,897	4,967,897
Safe Tire Disposal Corp.	San Antonio	Bexar	3,402,456	3,402,456	3,751,980	3,751,980
Scrap Tire Recycling, Inc.**	Pasadena	Harris	2,025,000	1,800,000	1,800,000	1,800,000
Touche International**	Whitesboro	Grayson	300,000	300,000	300,000	300,000
World Tire Recycling**	Brownsville	Cameron	1,000,000	1,000,000	1,000,000	1,000,000
<b>Total</b>			<b>47,802,073</b>	<b>36,962,712</b>	<b>26,858,844</b>	<b>17,835,477</b>

\* One scrap tire unit equals 20 pounds of any type of scrap tire material.

\*\* TCEQ estimated the number of STUs in these stockpiles as of December 31, 2006. All other values were obtained from 2005 annual reports.

**APPENDIX B. INVENTORIES AT REGISTERED FACILITIES, END OF CALENDAR YEAR 2005**

<b>Facility Name</b>	<b>City</b>	<b>County</b>	<b>TCEQ Reference No.</b>	<b>Inventory*, End of 2005</b>
Ash Grove - Texas	Midlothian	Ellis	76905	33,005
C.C. Crawford Retreading	Ennis	Ellis	6025279	75,456
Cameron Land and Cattle Company	McCook	Starr	6079547	520
Cemex Cement	New Braunfels	Comal	6200152	14,700
Foster and Sons	Hawkins	Wood	6200295	15,645
Holcim	Midlothian	Ellis	76900	5,431
J & M Truck Tire Shop	San Antonio	Bexar	79543	1,600
Latham Tire	Spring	Montgomery	6025141	9,433
Nathaniel Energy Corp.	Hutchins	Dallas	6044115	971,986
Polymerix	Stamford	Haskell	6200254	4,000
State Rubber and Environmental Solutions	Denver City	Yoakum	6200195	157,253
Synergy	Stamford	Haskell	6200140	8,979
Texas Department of Transportation	Ft. Worth	Tarrant	6200209	11,600
TTR, Inc..	Baytown	Harris	6044095	192,773
<b>Total</b>				<b>1,502,381</b>

\* In scrap tire units (STUs). One STU equals 20 pounds of scrap tire material.

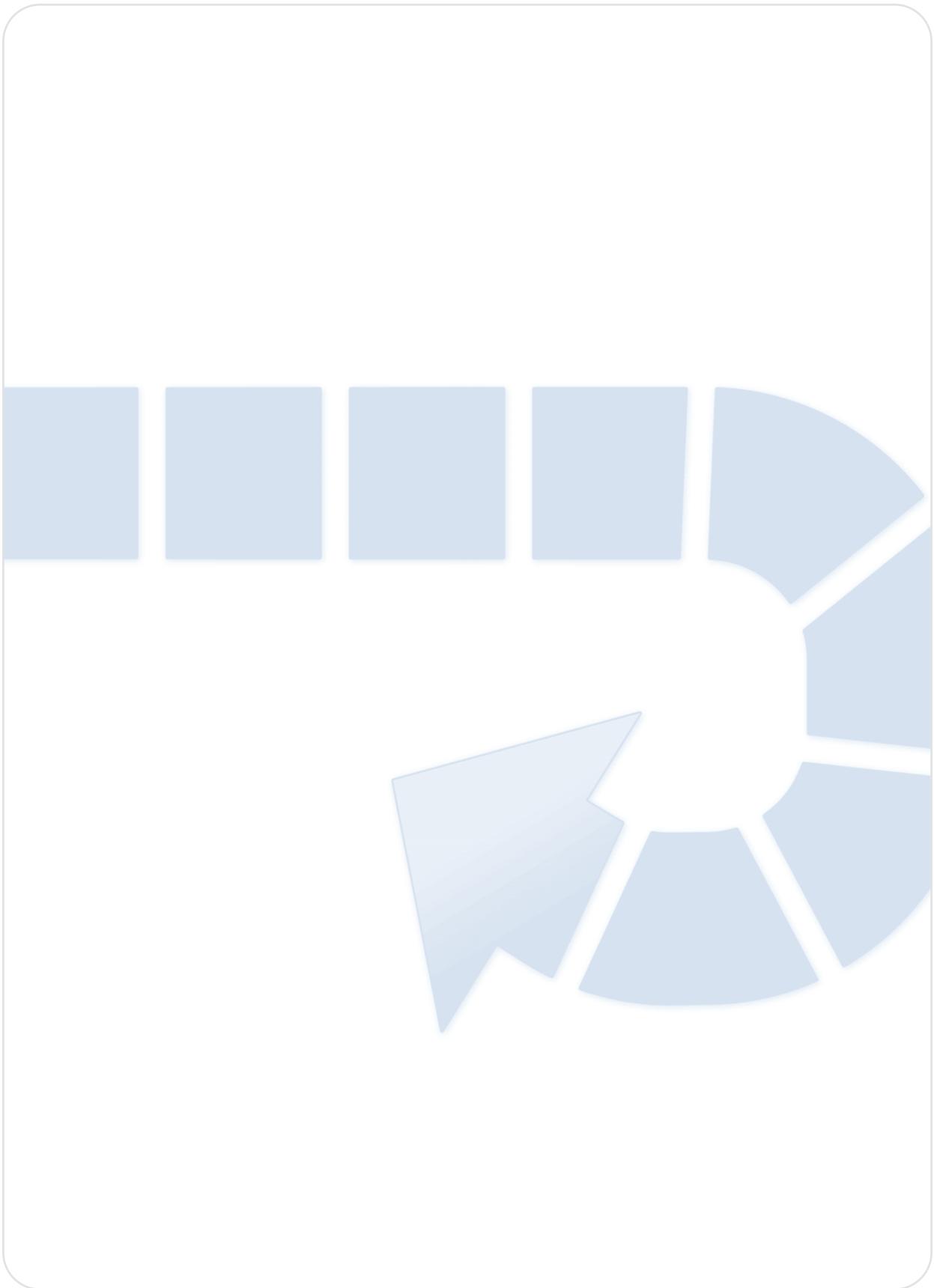


## APPENDIX C. FACILITIES THAT USE TEXAS TIRE-DERIVED FUEL, CALENDAR YEARS 2003 THROUGH 2005

The following table presents each facility's consumption of Texas TDF in 2005.

Facility	Product; Location	Quantity Burned (STUs)		
		in 2003	in 2004	in 2005
<b>TDF Used in Texas</b>				
American Rubber Tech		0	0	1,858
Ash Grove - Texas*	Cement; Midlothian	3,964,572	4,366,875	4,327,792
Capital*	Cement; San Antonio	263,053	511,617	609,063
Cemex Cement*	Cement; New Braunfels	1,436,655	2,572,127	2,650,300
Cemex/Southdown*	Cement; Odessa	105,082	189,886	87,507
Holcim	Cement; Midlothian	2,318,324	840,402	1,324,867
Lone Star*	Cement; Mary Neal	0	423,760	638,762
Texas Lehigh*	Cement; Buda	39,302	22,516	5,600
Texas Industries	Cement; New Braunfels	537,056	303,498	87,000
Texas Tech	Testing; Lubbock	0	0	0
<b>Texas TDF Sent Out of State</b>				
Ash Grove	Cement; Foreman, AR	0	0	67,969
Boise Cascade	Paper/Pulp; DeRidder, LA	0	1,059,541	1,219,753
Domtar	Paper/Pulp; Ashdown, AR	0	0	270,669
International Paper	Paper/Pulp; Mansfield, LA	3,404,801	4,611,500	5,327,399
International Paper	Paper/Pulp; Bastrop, LA	0	1,921,560	844,777
<b>Total Texas TDF</b>		<b>12,068,845</b>	<b>16,823,282</b>	<b>17,463,316</b>

\* These users burn whole tires. All others burn tire shreds.





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