

# Dairy Manure Export Support in the North Bosque and Leon River Watersheds

TSSWCB Projects 99-13, 00-08, 02-08 & 05-13

## Final Report



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# Dairy Manure Export Support in the North Bosque and Leon River Watersheds

In keeping with Texas' commitment to restore and maintain water quality in impaired water bodies, a regional dairy manure composting program was established in the North Bosque and Leon River watersheds of north-central Texas. The program was comprised of two component parts: the Dairy Manure Export Support (DMES) program, administered by the Texas State Soil and Water Conservation Board (TSSWCB), and the Composted Manure Incentive Project (CMIP), administered by the Texas Commission on Environmental Quality (TCEQ).

The DMES portion of the program provided financial support for the transport of raw material from dairies to compost facilities, while CMIP provided financial support for the purchase of compost by state agencies and political subdivisions of the state, most notably the Texas Department of Transportation (TxDOT). This report focuses on the DMES component or "supply side" of the composting program.

## Introduction

The Bosque River is located in north-central Texas, northwest of the City of Waco, and is a tributary of the Brazos River. The Bosque River is impounded at Waco, near its confluence with the Brazos, to form Lake Waco. The North Bosque River is the longest arm of the Bosque system, draining approximately 75 percent of the watershed.<sup>1</sup>

The North Bosque River region is representative of the heart of Texas. The upper watershed has medium-sized hills carved into a limestone plateau, with relatively shallow, rocky soils and areas of moderate to steep slope. The upper watershed has long been used for ranching, dairy production, and other forms of animal agriculture. The lower watershed, drained by the Middle and South Bosque Rivers, is comprised of rolling prairie and deep soils, with row crop production as the primary form of agriculture.<sup>2</sup> The North Bosque River is divided into the following designated water quality segments:

- The Upper North Bosque River (segment 1225)
- The North Bosque River (segment 1226)

The Leon River watershed lies to the west of the Bosque River watershed and has many of the same physical and land use characteristics. The Leon River is formed by the confluence of its North, Middle, and South Forks in Eastland County. The waterway flows approximately 185 miles southeast, where it joins the Lampasas River to form the Little River. The watershed

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<sup>1</sup> Texas Commission on Environmental Quality (TCEQ) & Texas State Soil and Water Conservation Board (TSSWCB), An Implementation Plan for Soluble Reactive Phosphorus in the North Bosque River Watershed, December 2002, available at <http://www.tceq.state.tx.us/assets/public/implementation/water/tmdl/06bosque/06-bosque-ip.pdf>.

<sup>2</sup> See *id.*

eventually drains into Lake Belton, a large reservoir that provides domestic water for about one-half million people.

Animal agriculture is an important part of the rural landscape in north-central Texas. It offers employment and significant economic opportunity for farmers, agriculture-related industries, and other businesses and individuals. During the 1980s the dairy industry expanded rapidly in the North Bosque and Leon River watersheds. Erath County became the leading county for milk production and the number of cows in the two watersheds increased greatly.<sup>3</sup> Along with this growth, agricultural operations shifted from relatively small dairies dispersed over the landscape, to large dairies that tend to cluster together for economic and cooperative reasons.<sup>4</sup>

As a result, at least in part, of this agricultural boom, two segments of the North Bosque River (1225 and 1226) were deemed impaired under narrative water quality standards related to nutrients and aquatic plant growth. Studies indicated that phosphorus was the limiting nutrient and that dairy waste application fields and municipal wastewater treatment plants were the major controllable sources of phosphorus.<sup>5</sup> Pursuant to section 303(d) of the federal Clean Water Act, TCEQ prepared two Total Maximum Daily Loads (TMDLs) designed to evaluate potential sources of phosphorus and establish goals for the reduction of phosphorus needed to achieve water quality standards.<sup>6</sup>

At about the same time, two stream segments in the Leon River watershed (1221 and 1222) were also deemed impaired for elevated bacteria levels, total dissolved solids, and low dissolved oxygen levels. In 2000, segment 1221 was placed on the Clean Water Act section 303(d) list for bacteria levels that did not support its contact recreation use.<sup>7</sup> A TMDL modeling report indicated that bacteria loadings in the segment would need to be reduced by approximately 21 percent to meet water quality standards and support the contact recreation use.<sup>8</sup>

In 2002, TCEQ and TSSWCB adopted an implementation plan for the North Bosque River TMDLs that identified regulatory and non-regulatory activities designed to reduce soluble reactive phosphorus concentrations by approximately 50 percent, as measured at five index sites.<sup>9</sup> To attain this goal, the implementation plan outlined four control actions and management strategies, one of which was to remove “approximately half of the dairy-generated manure from the North Bosque River watershed for use or disposal outside the watershed.”<sup>10</sup>

The goal of removing approximately 50 percent of dairy-generated manure recognized the importance of a fledgling regional dairy manure composting program. The TMDL

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<sup>3</sup> Texas Commission on Environmental Quality (TCEQ), Two Total Maximum Daily Loads for Phosphorus in the North Bosque River, February 2001, available at [http://www.tceq.state.tx.us/assets/public/implementation/water/tmdl/06bosque/06-bosque\\_tmdl.pdf](http://www.tceq.state.tx.us/assets/public/implementation/water/tmdl/06bosque/06-bosque_tmdl.pdf).

<sup>4</sup> *See id.*

<sup>5</sup> *See* TCEQ & TSSWCB, *supra* note 1.

<sup>6</sup> *See* TCEQ, *supra* note 3.

<sup>7</sup> Texas State Soil and Water Conservation Board (TSSWCB), Leon River Watershed Protection Plan, available at <http://www.tsswcb.state.tx.us/managementprogram/leonwpp>.

<sup>8</sup> *See id.*

<sup>9</sup> *See* TCEQ & TSSWCB, *supra* note 1.

<sup>10</sup> *See id.*

implementation plan stated that, “The composting program will provide an alternative way for dairies to dispose of manure, thereby reducing the amount of manure to be land applied within the North Bosque River watershed.”<sup>11</sup> Thus, a goal of the program was to create a sustainable market for compost so that compost facilities could be established and remain economically viable.

## **The DMES Program**

The “supply side” of the composting program, known as DMES, was funded and administered by TSSWCB. The transport of raw material from dairy operations to compost facilities was a major cost of the program and, quite possibly, represented the single biggest impediment to its success. The DMES program sought to overcome this challenge by providing financial support for the transport of raw manure from dairy operations to compost facilities. The amount of manure targeted to be removed during the original 36 month project period was 300,000 tons.

Work related to the DMES program focused on the following three activities:

- Coordination of project participants—i.e., dairy operators, composters, manure haulers, TSSWCB, TCEQ, local soil and water conservation districts, and the Natural Resources Conservation Service.
- Providing technical assistance to the dairy and compost industries.
- Providing financial assistance to haulers to offset the cost of transporting manure from dairy operations to compost facilities.

As originally conceived, the DMES program provided financial assistance to dairy operators to offset the cost of hauling manure to a compost facility. There was, however, a basic problem with this approach in that dairy operators had no real incentive to haul manure to a compost facility when other viable options existed. Thus, in order to help get the program off the ground, the financial incentive needed to be put into the hands of the people who might benefit the most: the manure haulers.

When the program began in November 2000, manure haulers received the DMES incentive on a cubic yard per mile basis. In April 2001, new policies and procedures were implemented to enhance the DMES program. With these changes, manure began to be measured in tons rather than cubic yards. The new procedures also required haulers to submit a job notification form (JNF) to the DMES office prior to hauling manure.

For manure haulers to be reimbursed, the new policies and procedures required an invoice signed by the hauler and a representative of the dairy from which the manure was hauled. Haulers also needed to document their load with a ticket signed by the receiving composter and a scale ticket verifying the weight of the load. When this information was received, the DMES office prepared semi-monthly reimbursement requests, which were submitted to TSSWCB for payment. TSSWCB then reimbursed haulers via direct deposit.

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<sup>11</sup> *See id.*

Due at least in part to the early success of DMES, a backlog of aged and degraded manure and compost accumulated during the initial stages of the program. Much of the manure was received and stockpiled prior to the availability of compost instruction and technical support. The initial deluge of manure overwhelmed the slow developing demand for compost, and the delayed purchase of the product by TxDOT. Unfortunately, during this time compost facilities were limited in their ability to receive and process new material. This decline in manure hauled and dollars invoiced is demonstrated in Figures 1 and 2 below.

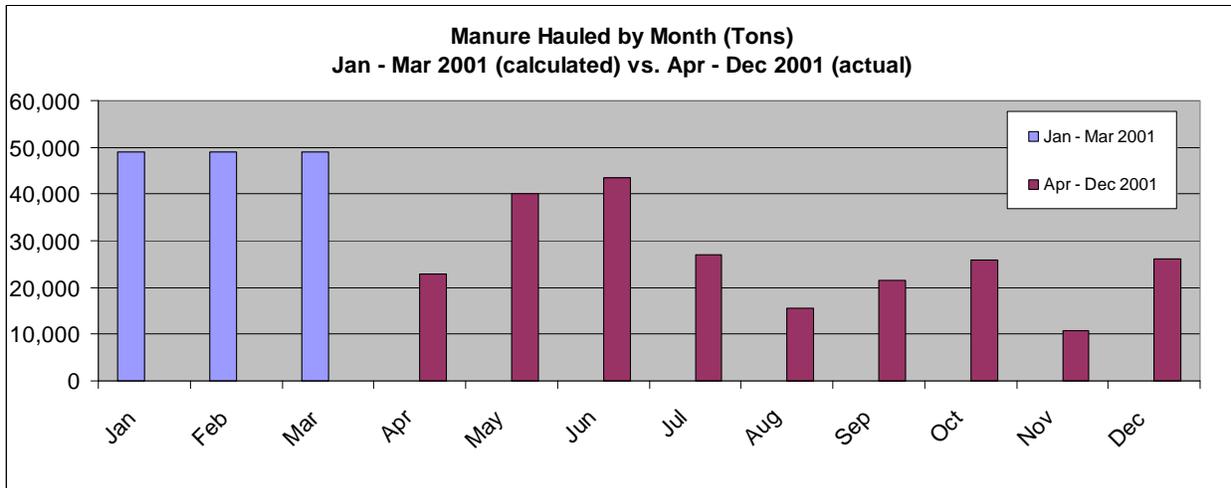


Figure 1. Manure hauled by month from January 1, 2001 through December 31, 2001.

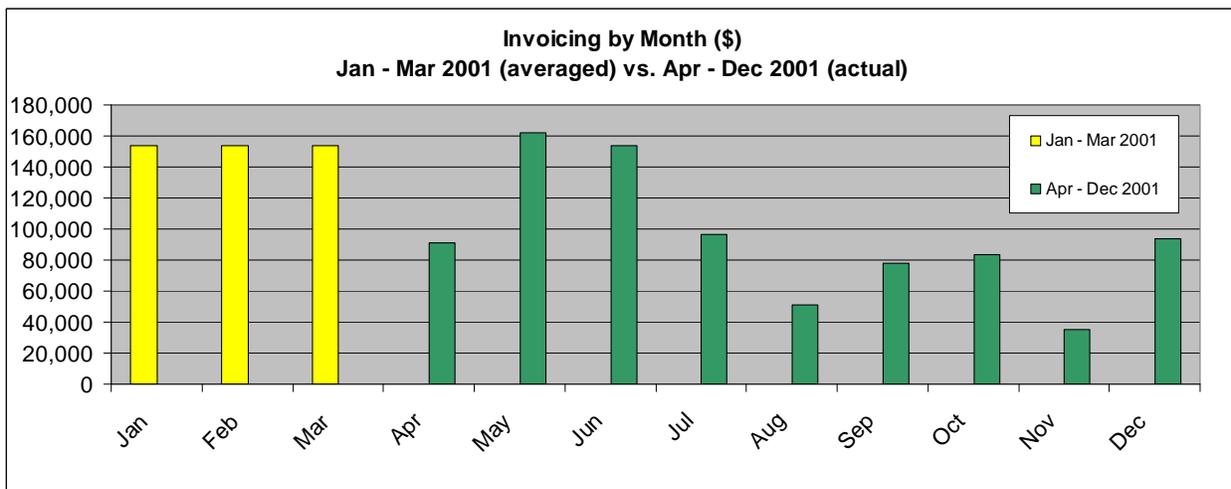


Figure 2. Dollars invoiced by month from January 1, 2001 through December 31, 2001.

## Sustaining the Program

The TSSWCB initially reimbursed manure haulers at the rate of \$2.25 per ton for the first mile manure was transported, and \$0.15 per ton for each additional mile. Because the goal was to establish a sustainable framework for DMES, it was understood that program funds needed to eventually come from the private sector. Thus, the idea was to gradually phase out public funding, which would allow private funding to cover manure removal and transportation costs.

In accordance with this plan, the program's first rate reduction went into effect in February 2002. The new rate was set at \$1.80 per ton for the first mile manure was hauled, and \$0.12 per ton for each additional mile. A second rate reduction went into effect shortly thereafter (October 2002) when the rate was reduced to \$1.35 per ton for the first mile, and \$0.10 for each additional mile.

With the program able to sustain itself through these first cuts, a third rate reduction occurred in October 2005. The new rate was set at \$0.90 per ton for the first mile manure was hauled, and \$0.08 for each additional mile. At this point, some questioned the continued viability of the program because the rate appeared too low to justify the amount of paperwork and time that would need to be expended by haulers. Figures 3 and 4 below show hauling trends for the six months preceding and following this third rate reduction.

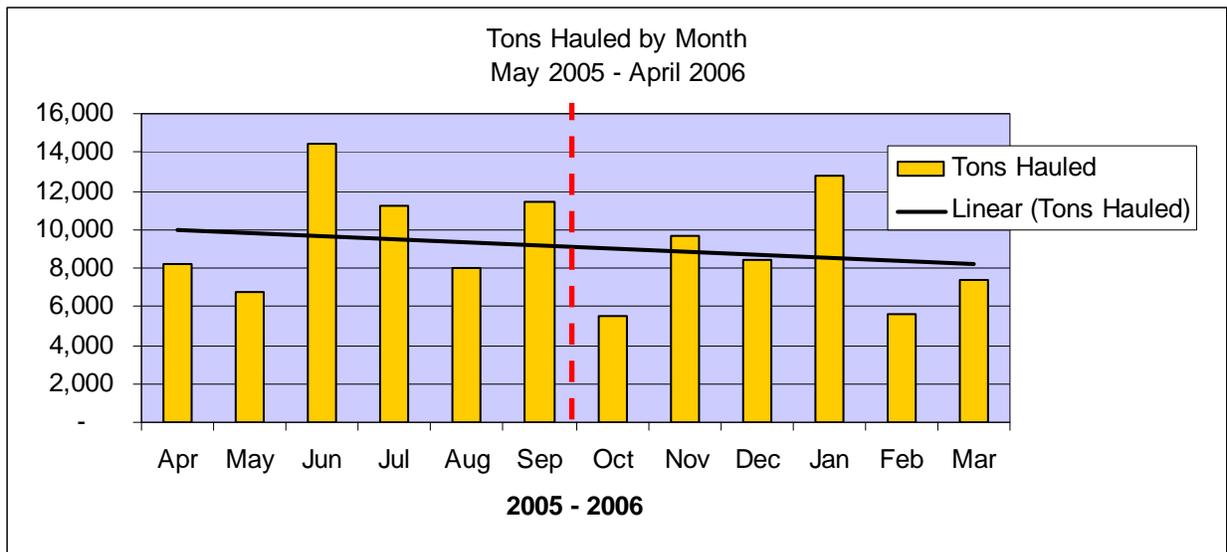


Figure 3. Manure hauled by month from April 1, 2005 through March 31, 2006.

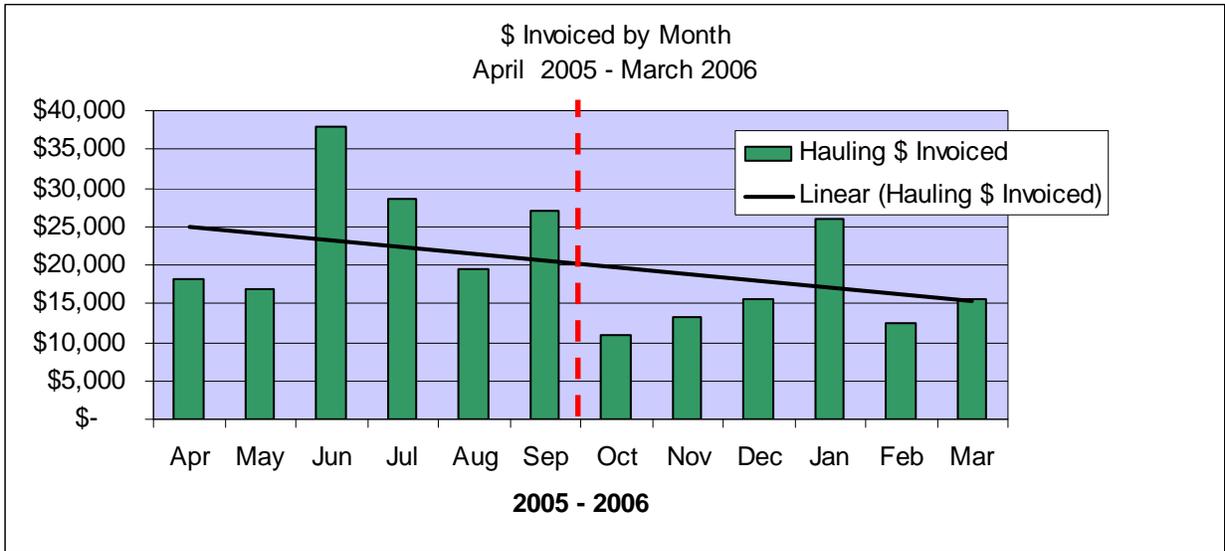


Figure 4. Dollars invoiced by month from April 1, 2005 through March 31, 2006.

A fourth and final rate reduction took effect in July 2006. The new rate was set at \$0.45 per ton for the first mile, and \$0.04 for each additional mile. At about this same time, the DMES incentive payments were slated to end. Program administrators decided, however, to extend the incentives to August 30, 2007, or until program funds were exhausted, whichever occurred first. Incentive payments under the DMES program ended for good in February 2007. Figures 5 and 6 below show the hauling trends for the six months preceding and following the final rate reduction.

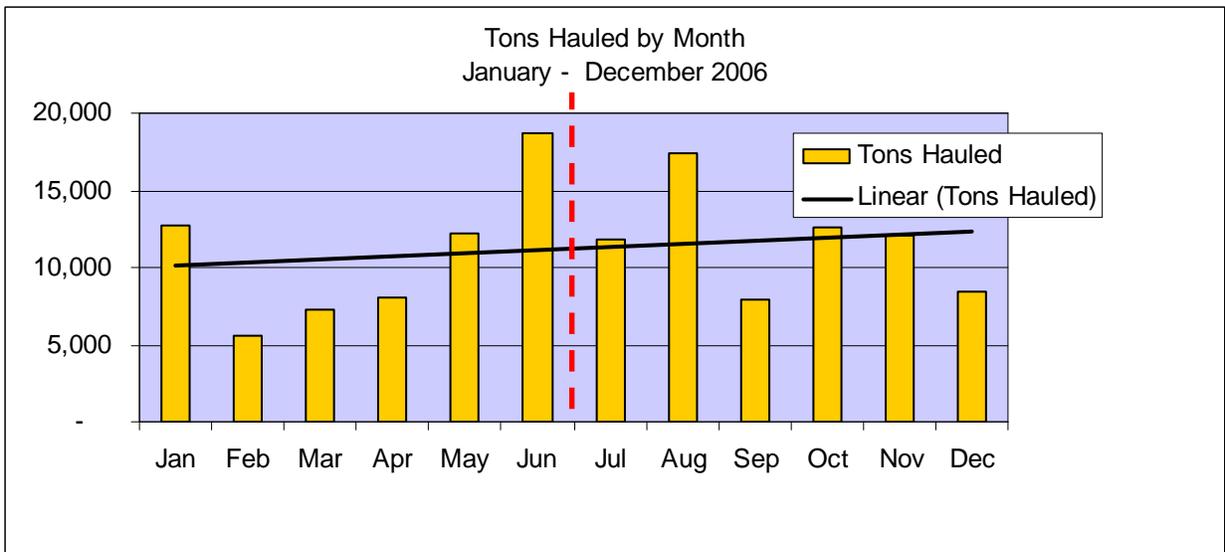


Figure 5. Manure hauled by month from January 1, 2006 through December 31, 2006.

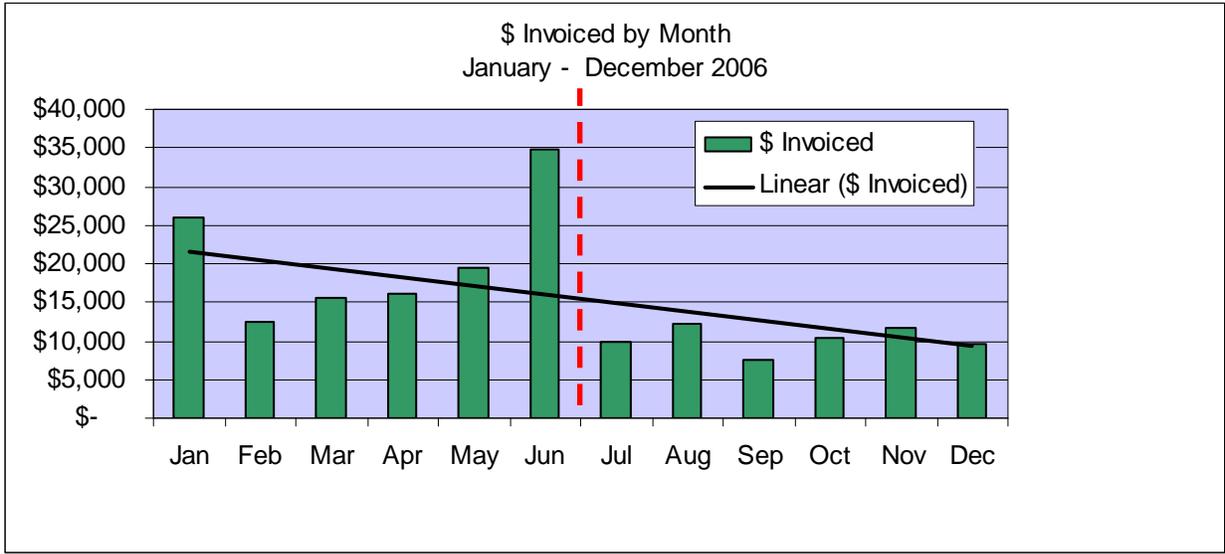


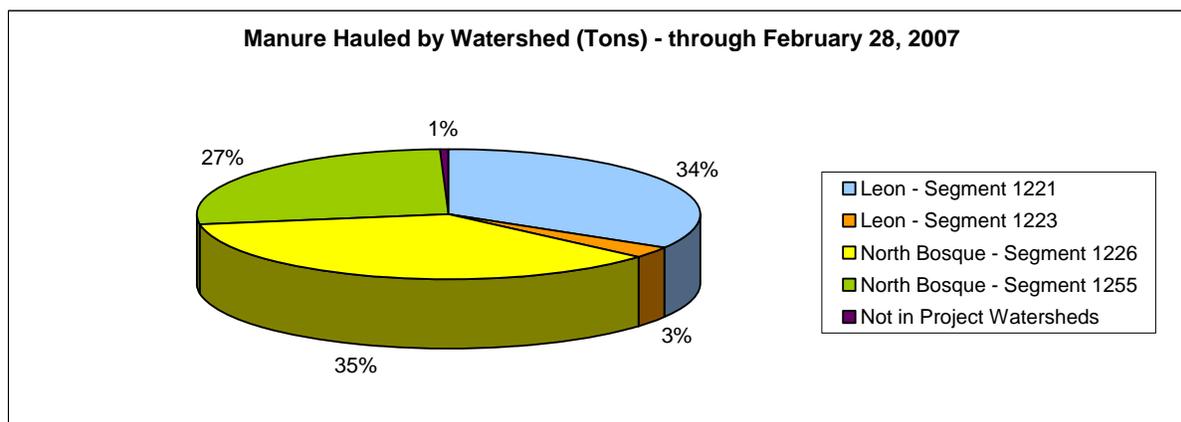
Figure 6. Dollars invoiced by month from January 1, 2006 through December 31, 2006.

As described above, TSSWCB and the DMES program office were periodically called upon to address challenges that cropped up after the program’s implementation. Although some of these challenges, particularly the early build-up of manure at compost facilities, proved formidable, they were for the most part resolved quickly, allowing the program to continue. Given the program’s overall success, it is reasonable to say that the dairy operators, manure haulers, composters, and program administrators effectively addressed these challenges to the extent that DMES exceeded expectations.

## Conclusion

The success of the regional dairy manure composting program confirmed that compost is a valuable commodity. It contains unique properties that are beneficial in a number of agricultural and horticultural applications, and it supplies soil organic matter in a stable form that minimizes odors and the risk of introducing pathogens or weed seeds.<sup>12</sup> It supplies a full complement of macro and micronutrients in low concentrations and in a form that limits the risk of rainwater runoff and pollutant loading.<sup>13</sup> It also has a proven capacity to absorb and immobilize a range of pollutants including metals and organic chemicals.<sup>14</sup> These qualities are particularly valuable for storm water erosion and sediment control.

With a good product to build upon, the DMES program can lay claim to a remarkable achievement: as of March 1, 2007 over 1,093,000 tons of manure were transported from North Bosque and Leon River watershed dairy operations to commercial composting facilities. This achievement is particularly startling in light of the program's original goal—i.e., the removal of 300,000 tons of manure from October 2000 to October 2003, a benchmark that was exceeded in less than two years. Figure 7 shows the breakdown of the total amount of manure hauled by watershed through the DMES Program.



Leon - Segment 1221	368,974
Leon - Segment 1223	30,182
North Bosque - Segment 1226	395,021
North Bosque - Segment 1255	292,542
Not in Project Watersheds	6,741

**Grand Total** 1,093,460

Figure 7. Total manure hauled by watershed through the DMES Program.

<sup>12</sup> Texas Institute for Applied Environmental Research. August 28, 2003. White Paper on Composting in the North Bosque River Watershed. Stephenville, TX: TIAER, Tarleton State University.

<sup>13</sup> See *id.*

<sup>14</sup> See *id.*

The DMES program produced other tangible benefits that are not as amenable to measurement. A composting infrastructure was established and strengthened, resulting in a program that continues today, some two years after its financial incentives were exhausted.

The success of DMES also enabled the CMIP component of the compost program to flourish. TCEQ, as administrator of CMIP, sought to develop markets for compost by educating consumers about the value of the product, by providing technical assistance to help composters produce a quality product, and by assisting composters to develop new markets. When CMIP ended on August 31, 2006, it recorded sales of over 575,000 cubic yards of manure compost.<sup>15</sup> Approximately 78 percent of the compost was sold for use outside the North Bosque and Leon River watersheds.<sup>16</sup> As expected, TxDOT proved to be the largest purchaser.

Despite these programmatic successes, the ultimate goal of the DMES program was to reduce agricultural nonpoint source water pollution by removing manure from the North Bosque and Leon River watersheds. To assess the program's environmental impact, TCEQ and the Brazos River Authority developed a monitoring strategy for the watersheds to help measure water quality improvements attributable to manure composting.

Information presented in a Texas Institute for Applied Environmental Research report entitled "Extending TMDL Efforts in the North Bosque River Watershed: Data Evaluation through 2007" indicated a positive correlation between participation in composting and reduction of phosphorus in streams.<sup>17</sup> At three sites representing drainage areas with the highest level of program participation on a per cow and unit area basis, measurements showed statistically significant reductions in concentrations of soluble reactive phosphorus from 8 to 27 percent.<sup>18</sup> These results suggest the program did indeed improve the quality of water in these two north-central Texas watersheds.

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<sup>15</sup> Texas Commission on Environmental Quality (TCEQ), Composted Manure Incentive Project, at <http://www.tceq.state.tx.us/compliance/monitoring/nps/projects/compost.html>.

<sup>16</sup> *See id.*

<sup>17</sup> Millican, Jimmy, and Anne McFarland. 2008. *Extending TMDL Efforts in the North Bosque River Watershed: Data Evaluation through 2007*. PR 0802. Stephenville, TX: TIAER, Tarleton State University.

<sup>18</sup> *See id.*