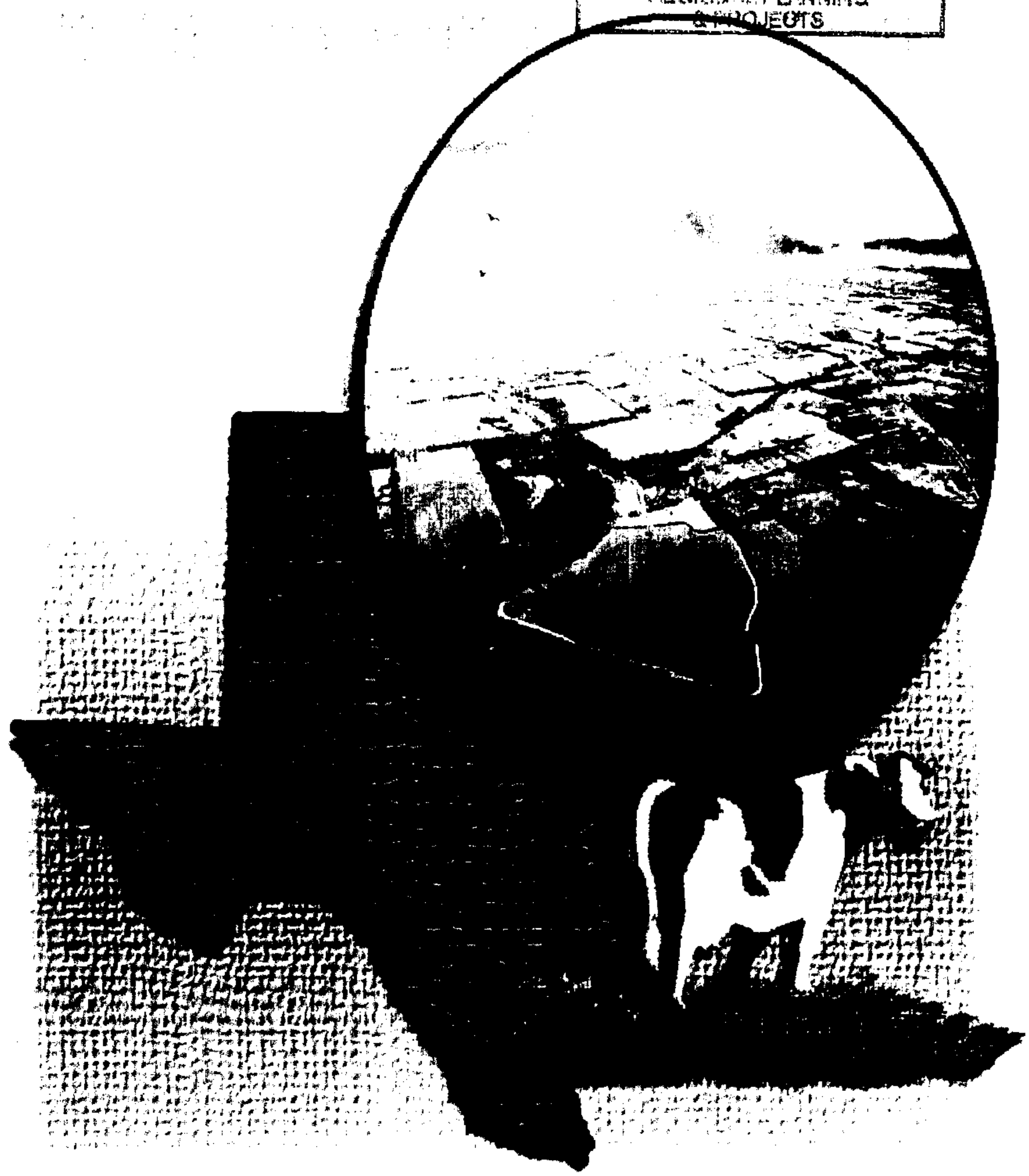
Report

Brazos River Authority

Erath County
Animal Waste Management Study

September 1998



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Erath County
Animal Waste Management Study

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Executive Summary

With almost 100,000 dairy cows, Erath County is one of the major dairy regions in Texas. Roughly one quarter of the state's dairy population is located in the County. Although the dairies bring many economic benefits to the region, there are environmental trade-offs as well.

Specifically, the Brazos River Authority (BRA) and the Texas Institute for Applied Environmental Research (TIAER) found consistently high levels of nutrients (especially phosphorus) in reaches of the North Bosque River located in the County. TIAER has reported that approximately 65% of the nutrients in the river above Hico are attributed to manure management practices at large dairies located within the area.

In 1997, Erath County selected the BRA to examine the feasibility of processing animal waste as a means to address water quality concerns in the Bosque River watershed. After eliciting local support, and securing funding commitments from the Texas Water Development Board, the Environmental Protection Agency, the Natural Resource Conservation Service, and the City of Waco, Texas, BRA selected Camp Dresser & McKee (CDM) to perform the feasibility study. Study participants included representatives from: CDM; BRA; TIAER; Roming-Parker and Associates; E&A Environmental Consultants; JMD Consulting; Hicks & Associates; and GSG, Inc. A Technical Advisory Committee (TAC) representing concerned citizens, regulatory agencies, regional dairy producers, research experts and other interested parties also provided input to the project through regular project meetings and reviews of project documents.

Elements of this feasibility study include manure quantity, technology, siting, cost, and marketing evaluations. Findings of these evaluations are highlighted below.

Manure Quantities

Estimates of dairy manure quantities to be handled at an Erath County regional facility were based upon the following assumptions.

- *Actual herd sizes are only about 89% of permitted herd sizes.*
- *Only two-thirds of the dairies in the county would participate in a regional program.*
- *Manure could be collected only from lactating cows and calves.*
- *Only 43% of the manure from lactating cows and 50% of the manure from calves can be collected.*

Based on these assumptions, and on a manure generation rate of 2.19 dry tons/1,000 lb liveweight/yr obtained from the American Society of Agricultural Engineers (ASAE), CDM estimates that roughly 140,000 wet tons of collectable manure are generated in Erath County each year. Solids content of the collectable manure is estimated to be 50%.

Technology Assessments

CDM identified conventional and innovative technologies to process manures. Conventional technologies investigated included windrow composting and anaerobic digestion. Innovative processes explored included both new manure management processes and municipal sludge management processes that might be applied to manures. Innovative processes studied are listed below.

- Constructed wetland systems
- Bioset
- In-vessel composting
- Vermicomposting
- Incineration
- Heat-drying
- Brick production
- N-Viro processing

Based on the technology assessments, it appears that only one economically feasible process — windrow composting — provides a proven regional solution for the management of Erath County manures. Windrow composting is the only proven technology that has been successfully adopted on a regional scale in the United States. It is a "low-tech" process that can be implemented without the need to design and purchase costly and complex processing equipment, and it requires no new equipment to be purchased by individual dairies.

Although they have not traditionally been applied to manure management, both the heat-drying and new N-Viro technologies might also be appropriate for application in Erath County. Heat-drying is a process that essentially removes virtually all of the water from the material to be dried (solids contents of 90% to 95% are typically achieved). Advantages of the heat-drying process include volume and weight reduction of feedstock (which decreases product transportation costs), and the generation of a potentially marketable product. The new N-Viro process creates a soil-like material from manure through the addition of alkaline additives. A demonstration of the process is currently being performed at Beltsville, MD under a grant from the USDA. Reportedly, the N-Viro process immobilizes the phosphorus contained in manure, such that the product could be used to improve soils within the County.

Because composting, heat-drying, and N-Viro facilities can be developed on a regional scale, they were selected for further evaluation.

Siting Analysis

A siting analysis was conducted to identify potential locations within the County that might host a manure management facility. This determination was made through an evaluation of the traffic impacts, environmental suitability, and regulatory considerations for each location.

Based upon visual assessments and an estimate of cow densities, a total of nine potential facility locations were identified within the County. The surveys considered transportation access, proximity to dairies, terrain suitability, proximity to residences and visual screening. Site selection also considered the relative density of dairies and the number of cows on each dairy by attempting to locate sites in areas that would be proximate to relatively large quantities of manure, reducing transportation costs. Figure ES-1 shows the selected sites. As indicated on the figure, the nine sites were broken into two categories — regional and subregional. Regional sites were sites deemed potentially suitable to serve the entire county, while subregional sites are expected to serve smaller areas in the county.

Based on the siting analysis, Sites 4A and 4B (the Lingleville sites) appear to offer the greatest potential for the development of a subregional manure processing facility, while Site 9 (the Harbin site) is the preferred site for a regional facility. None of the sites examined, however, exhibited "fatal flaws" that would prohibit their development; further analyses are recommended to identify specific parcels for development as manure processing sites.

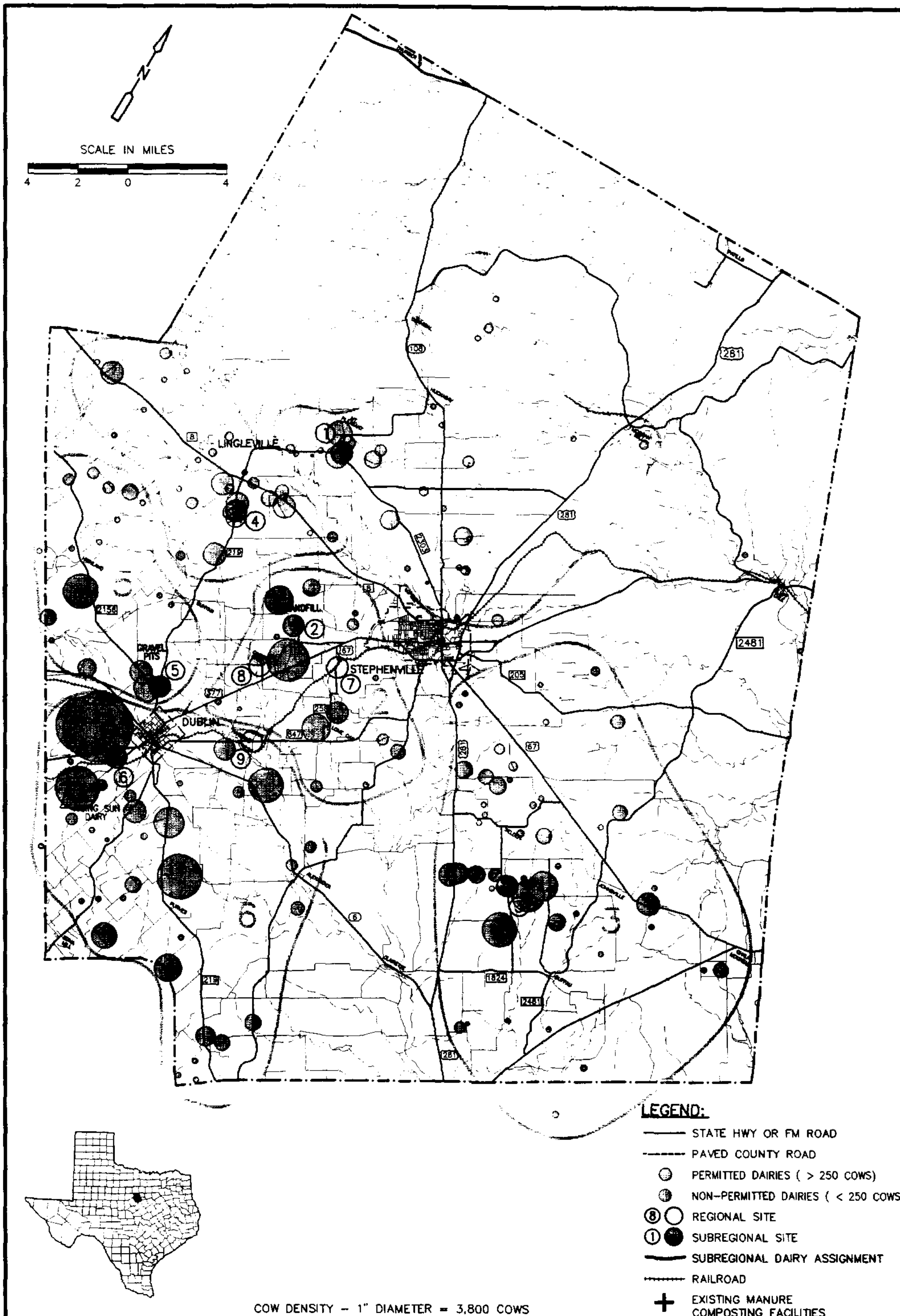
Marketing Analysis

TIAER conducted an assessment of potential markets for an Erath County manure product. The goals of the analysis were:

- to define product characteristics and benefits;
- to identify and describe potential end users and markets; and
- to identify strategies to penetrate existing markets and develop potential markets.

The marketing assessment found that there is no "silver bullet", no lucrative market in-waiting for a processed manure. Over time, it appears that markets for a compost product could be developed, but a slowly developing market will not address the critical need to remove significant amounts of phosphorus from the watershed or provide adequate revenues (in initial years of operation) to support manure processing activities. Consequently, other avenues may need to be pursued in addition to composting to meet water quality needs.

The marketing assessment makes several recommendations to help remove phosphorus from the county, but all are based upon the construction of a manure processing and research center that includes a composting operation and, potentially, innovative technologies as well. The facility(ies) will serve as a product market development center for compost and a technology testing center for innovative processes. This recommendation has been incorporated into the implementation plan for the next phase of this project (Phase II).



ERATH COUNTY, TEXAS

PROCESSING SITES AND DAIRY COW DISTRIBUTION

FIGURE No ES-1

Finally, regardless of the market segment targeted or processing technology used, funding assistance will likely be required to help establish a sustainable market for Erath County product(s). The promotion of private sector manure processing in the County is one of several mechanisms that might be pursued to develop sustainable markets.

At this time, however, the private sector does not have adequate profit incentive to establish manure processing enterprises in the County. Essentially, there is a "gap" between the *value* of manure products and the *cost* of processing and marketing. The private sector requires incentives — in the form of public subsidies or regulatory mandates (that would ensure a consistent supply of manure to their operations) in order to close this "gap".

Private sector development and other potential funding mechanisms are presented in the implementation plan.

Processing Costs

Table ES-1 presents total capital, annualized capital, operating and total annualized costs for each of the processing alternatives considered. As shown in the table, composting and the N-Viro process appear to offer the lowest annualized cost for manure management. Many factors can affect the overall cost-effectiveness of a given option, however, not the least of which are the degree of funding available, and revenues from product sale and/or fees charged to dairy operators. Regardless of these impacts, it appears that composting and the N-Viro process offer the greatest opportunity to meet the primary project goal — improving water quality — in the near term and we recommend that both be incorporated into diversified management strategy for the County.

Both share risks, however, that favor the construction of subregional facilities over regional facilities. For composting, the ability and means to develop a sustainable market is in question; for the N-Viro process, claims regarding process capabilities have yet to be proven. For both technologies, the construction of demonstration facilities seems prudent.

Implementation Plan

Based upon the efforts summarized in Sections 3 through 6, CDM recommends a phased and diversified approach to manure management in Erath County. The recommended plan is based upon conventional treatment technologies, but incorporates innovative technologies as well. The cornerstone of the plan is the construction of a research center that will include a subregional composting operation, but may include the parallel development of innovative processes.

The composting facility will provide a means to export manure from the Bosque River watershed and perform research to support market development for manure compost products.

Table ES-1
Comparison of Estimated Manure Processing Costs [1]

Technology	***Capital Cost***	***Annualized Capital Cost*** [2]	***Annual Operating Cost***	***Total Annual Cost***
Composting				
Regional	$6,024,800	$639,900	$1,195,700	$1,835,600
Subregional	$5,942,100	$708,500	$1,042,800	$1,751,300
Heat-drying	$26,413,200	$2,165,700	$2,444,000	$4,609,700
N-Viro Processing				
Regional	$1,717,800	$196,500	$1,733,500	$1,930,000
Subregional	$4,067,300	$441,300	$1,356,400	$1,797,700

Notes:

[1] Costs for regional alternatives assume that all collectable manure (estimated to be 232,500 cubic yards annually) will be handled at a single facility. Subregional costs assume that up to six facilities will be constructed, each handling about one sixth of the collectable manure generated (roughly 38,500 cy/year).

[2] Assumes a 20 year life for structures, 7 year life for equipment, 5 year life for office equipment, and an interest rate of 5%.

While the composting aspect of the proposed research center is under development, we recommend further investigations into both the N-Viro process and heat-drying. For the N-Viro process, this effort would include a review of results from an ongoing demonstration project in Beltsville, MD and, if warranted, a visit to the facility. If the technology appears promising, a subregional demonstration project in Erath County is recommended. If site size allows, the N-Viro operation could be co-located with the composting operation (although co-location is not mandatory, it is recommended to facilitate research activities). For heat-drying, small-scale piloting could also be conducted at the research center. To simplify permitting, we suggest limiting the output from the heat-drying facility to 10 tons per day. Alternately, it may be possible to perform a short-term pilot study (one week or so) at the BRA Waco drying facility.

Costs to construct and operate the composting facility portion of the research center are presented in Table ES-2. The costs are preliminarily based on a subregional facility sized to handle one sixth of the total collectable manure in the county. As shown in the table, capital costs for this initial facility will be higher than the average per facility cost under the subregional composting alternative (estimated to be roughly one sixth of the capital cost for six facilities, or $853,750 per facility). The heavy reliance on shared equipment in the subregional approach is the primary difference for the relatively higher cost of the initial facility. Costs for the second and third facilities constructed in the county (should this technology prove sustainable) are expected be far lower than initial facility costs as many pieces of equipment are to be shared among three facilities and will have already been purchased.

Establishing manure processing operations in Erath County will require financial assistance. Figure ES-2 (based upon costs presented in Table ES-2) illustrates the need for external funding. The figure shows the tip fee (a fee levied for waste management) required to offset total facility annualized costs as a function of the amount of capital subsidized and potential revenues (expressed as $/cy). Tip fee requirements are shown in terms of $/cubic yard of product generated and $/cow. Curves on the table are based upon facility costs presented in Table ES-2. As shown on the figure, a 50% subsidy of capital costs would reduce the required tip fee by about $5/cy and a complete subsidy of construction costs would offset the required tip fee by a total of about $10/cy (regardless of revenues from product sale). Revenues from product sale further reduce the tip fee.

At this time, it is envisioned that dairy operators would be asked to pay a voluntary tip fee for use of the waste management facility, which would offset facility costs. Currently, there are no contractual obligations on the part of dairy producers in the county to contribute funds to the proposed facility. However, there is a possibility that dairies would be willing to contribute an amount approximately equal to what they currently pay for manure management (See Section 7 and Appendix I).

Table ES-2
Cost Estimate for Single Erath County Subregional Composting Facility

Item	Size/No.	Unit	Unit Cost	Estimated Cost	Life of Equipment	Annual Cost
I. *Capital Costs*						
Site Aquisition	20	acres	$3,000	$60,000	20	$4,800
Site Development*	15	acres	$6,000	$90,000	20	$7,200
Water Well & Distribution	1	ea	$30,000	$30,000	20	$2,400
Admin Building	400	SF	$70	$28,000	20	$2,200
Front End Loader	1	ea	$91,000	$91,000	7	$15,700
Tractors	1	ea	$62,000	$62,000	7	$10,700
Dump Truck **	1	ea	$73,000	$73,000	7	$12,600
Pick Up Truck	1	ea	$30,000	$30,000	7	$5,200
Small Compost Turners**	1	ea	$36,000	$36,000	7	$6,200
Compost Watering System	1	ea	$5,000	$5,000	7	$900
Mobile Compost Screen***	1	ea	$150,000	$150,000	7	$25,900
Machinery Barn	4,000	SF	$20	$80,000	20	$6,400
Compost Hauler/Spreader	1	ea	$80,000	$80,000	7	$13,800
Bagging Equipment**	1	ea	$85,000	$85,000	7	$14,700
Fork Lift	1	ea	$45,000	$45,000	7	$7,800
Office Furnishings/Supplies	1	ea	$3,500	$3,500	5	$800
Scales	1	LS	$50,000	$50,000	20	$4,000
Roads/Parking	500	SY	$20	$10,000	20	$800
			Subtotal	$1,008,500		$142,100
			Overhead (20 %)	$201,700		$28,400
			Contingencies (25%)	$252,100		$35,500
			Total Capital Cost	$1,462,300		**$206,000**
II. *Operation Costs*						
Power	12	month	$100	$1,200	annual	$1,200
Maintenance	1	LS	$17,000	$17,000	annual	$17,000
Personnel (Supervisor)	1	per.	$50,000	$50,000	annual	$50,000
Personnel (operators, admin)	1	per	$30,000	$30,000	annual	$30,000
Analytical Testing	1	LS	$1,000	$1,000	annual	$1,000
Hauling Costs to Site	23,208	ton	$3.5	$81,200	annual	$81,200
Fuel	1	LS	$2,000	$2,000	annual	$2,000
Miscellaneous	1	LS	$2,000	$2,000	annual	$2,000
			Total Operational Cost			**$184,400**
III. *Total Annual Cost*						**$390,400**
Annual Compost Production, CY						19,400
Cost per Cubic Yard of Compost						**$20.12**

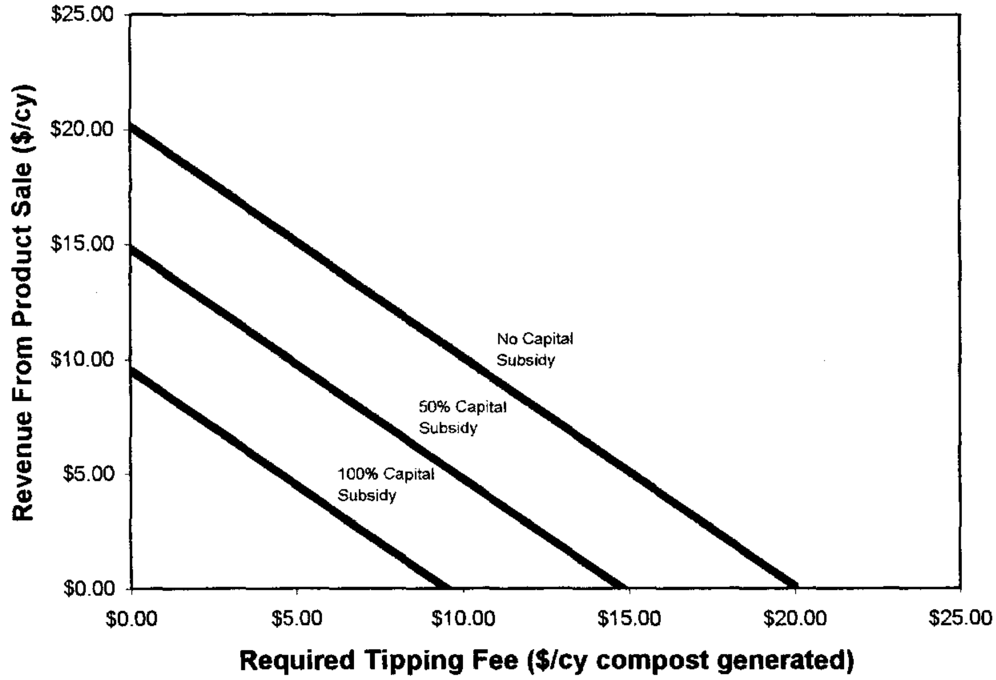
* Includes costs for detention pond

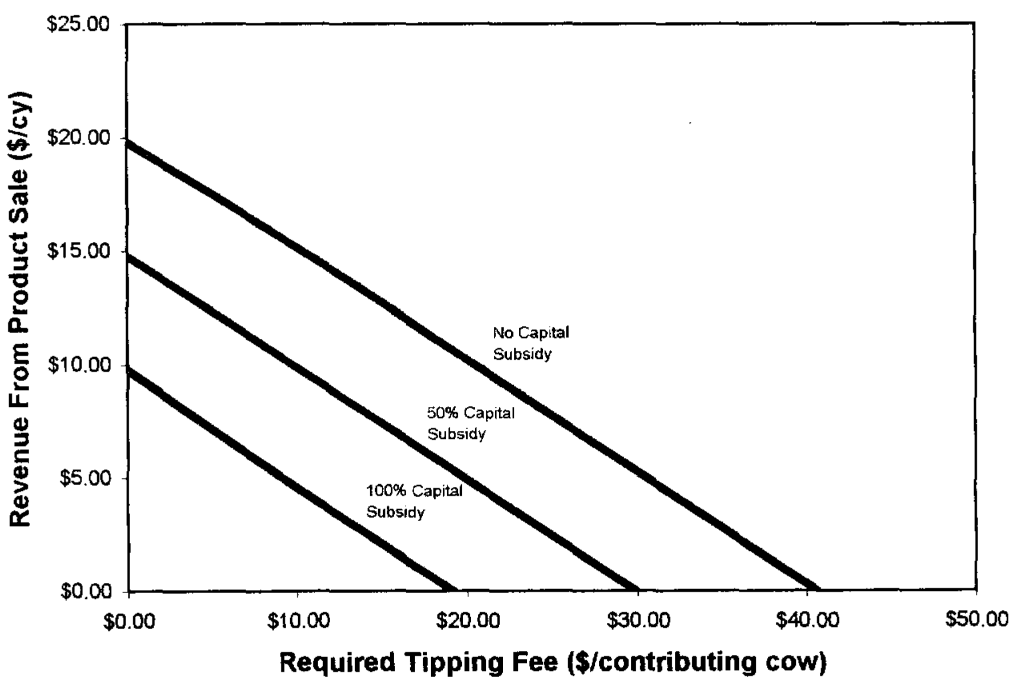
** Equipment to be shared between 2 subregional sites

*** Equipment to be shared between 3 subregional sites

**** Services all subregional sites

Figure ES-2 Impact of Subsidies and Revenues on Required Tipping Fee





In summary, we recommend that the next phase of this project (Phase II) consist of the following eight steps.

1. *Secure financing for the manure processing and research center.* At this time, we suggest that funds for the composting aspect of the center (including monies for market research) be pursued only. If sufficient information is available from the Beltsville, MD project to assure the applicability (and cost-effectiveness) of the N-Viro process in Erath County, then funding should potentially include monies for a demonstration of this process as well.

   Both traditional funding mechanisms (grants through government programs) and innovative strategies (milk stewardship, private sector development) should be pursued.

2. *Site, permit and construct composting facilities for research center.*

3. *Continue investigations of the N-Viro process and heat-drying.* For the N-Viro process, this requires monitoring of progress at Beltsville, MD. For heat-drying, this investigation will potentially include analytical testing of Erath County manures to assess nitrogen content, discussions with vendors regarding product enhancement options and costs, and a pilot study.

4. *Perform demonstration N-Viro and/or heat-drying projects if investigations warrant.*

5. *Investigate on-farm approaches to animal waste management.* Although on-farm approaches such as digestion are not expected to provide a regional waste management solution, they may supplement regional approaches and enhance management diversity.

6. *Conduct activities to support market development for an Erath County manure compost* (as outlined in Section 5) through the research center.

7. *Complete technical assessments of the N-Viro and heat-drying processes.*

8. *Finalize long-term sustainable animal waste management plan for Erath County.*

In conclusion, this project has identified opportunities for collaboration between government, dairy operators, researchers, and the private sector to improve water quality in the Bosque River watershed. Further investigations and a concerted effort on the part of all interested parties will be required to transform these opportunities into the reality of an improved environment with minimal impact to the dairy operations that are such a vital component of Erath County's economy.

1 Section One

Section 1
Introduction

1.1 Background

With almost 100,000 dairy cows, Erath County is one of the major dairy regions in Texas. Roughly one quarter of the state's dairy population is located in the County. Although the dairies bring many economic benefits to the region, there are environmental trade-offs as well.

Specifically, the Brazos River Authority (BRA) and the Texas Institute for Applied Environmental Research (TIAER) found consistently high levels of nutrients (especially phosphorus) in reaches of the North Bosque River located in the County. TIAER has reported that approximately 65% of the nutrients in the river above Hico are attributed to manure management practices at large dairies located within the area.

Despite the fact that larger dairies near the upper reaches of the Bosque River have implemented structural best management practices (constructing lagoons to contain runoff from the milking and feeding areas), water quality in the river remains degraded. The Texas Institute for Applied Environmental Research (TIAER) reports that the land application of manures for agricultural purposes is a continuing source of phosphorus and other nutrients in the river.

Current manure application practices contribute phosphorus loads in two ways. First, operators apply manure at the agronomic rate for nitrogen, which in many cases results in an over-supply of phosphorus to crops. Over time, the soil becomes saturated with phosphorus, which is carried into watercourses by stormwater runoff. Secondly, manure is often surface-applied, not tilled into the soil. The unincorporated phosphorous cannot bind to the soil and is easily washed into receiving waters with runoff.

Historically, dairy manures have been land-applied on agricultural fields near the dairies where they are generated. The large concentration of cows in a relatively small area means that there is insufficient proximate land on which to spread the manure. Based on phosphorus concentrations in the river, it appears that land-application in the County has, at the very least, been maximized from an economic standpoint, and that an alternative manure management strategy is needed.

In 1997, Erath County selected the BRA to examine the feasibility of processing animal waste as a means to address water quality concerns in the Bosque River watershed. After eliciting local support, and securing funding commitments from the Texas Water Development Board, the Environmental Protection Agency, the Natural Resource Conservation Service, and the City of Waco, Texas, BRA selected

Camp Dresser & McKee (CDM) to perform the feasibility study. Study participants included representatives from: CDM; BRA; TIAER; Roming-Parker and Associates; E&A Environmental Consultants; JMD Consulting; Hicks & Associates; and GSG, Inc. A Technical Advisory Committee (TAC) representing concerned citizens, regulatory agencies, regional dairy producers, research experts and other interested parties also provided input to the project through regular project meetings and reviews of project documents.

1.2 Purpose

The goal of this study is straightforward — to improve water quality in the Bosque River watershed by modifying existing manure management practices. To ensure that manure impacts to water quality are minimized, large quantities of processed dairy manure must be removed from this watershed.

Toward this end, this study assesses the feasibility of constructing and operating a regional processing facility to prepare Erath County manure for export to out-of-county markets. Elements of this assessment include manure quantity, technology, siting, cost, and marketing evaluations. Each of these evaluations are presented in subsequent sections of this report.

1.3 Acknowledgements

The authors are grateful for the valuable assistance provided by Mr. Mike Meadows, Watershed Protection Program Coordinator for the Brazos River Authority, during the completion of this study. Additionally, we wish to thank the members of the Technical Advisory Committee (TAC), an advisory panel consisting mostly of Erath County citizens who generously agreed to attend a series of review meetings of preliminary findings, provide a critique of the work in progress, and offer concrete suggestions for improvement. Minutes from TAC meetings are attached in Appendix A.

The meaningful participation of the following individuals as members of the committee served to significantly enhance the quality of this document:

- Judge Tab Thompson
- Jack White
- Brad Lamb
- C. Allan Jones
- John Hatchel
- Clyde Bohmfalk
- Jim Wimberly
- James Terrell
- John Gilliam
- Ned Meister
- Willard Howle
- Dar Anderson
- James Traweek
- John Burt
- James Young
- Joe Bob Huddleston
- James Wilson
- Mike Meadows
- U.S. Congressman Chet Edwards
- U.S. Congressman Charles Stenholm
- State Senator David Sibley
- U.S. Senator Kay Bailey Hutchinson

- Ron Alexander
- Beade O. Northcut
- Larry Beran
- Scott McCoy
- H.L. Self

The assistance and support of Congressmen Charles Stenholm and Chet Edwards, Representative from the 17^{th} and 11^{th} Congressional Districts (respectively) to the U.S. Congress, and Texas State Senator David Sibley is greatly appreciated.

Finally, we gratefully acknowledge the financial support of the Natural Resource Conservation Service, the Environmental Protection Agency, the Texas Water Development Board, and the City of Waco. These agencies provided the funding necessary to perform this study, which we envision to be the critical first step in resolving water quality issues in the Bosque River watershed.

2 Section Two

Section 2
Manure Quantity Assessment

In order to determine the costs and applicability of any manure management strategy, it is important to know the quantity of the manure to be handled. This section discusses the methodologies and assumptions used to estimate manure quantities for Erath County, and presents the results of the quantity assessment.

Dairy manure quantities to be handled at a regional facility are presented in Table 2.1-1. Basic assumptions that guided the development of information in the table are as follows:

- *Actual herd sizes are smaller than permitted herds.* County statistics indicate that actual herds are only about 89% of permitted herd sizes.

- *Only two-thirds of the dairies in the county would participate in a regional program.* A 67% participation rate was estimated assuming that not all operators would voluntarily take part in a manure processing program (some dairy operations, for example, might do "on-site" processing.

- *Manure could be collected only from lactating cows and calves.* These are the only animals kept in confined areas where manure could be easily collected. Dry cows and heifers are usually kept in pastures where manure collection is impractical.

- *Only a portion of the manure from lactating cows and calves can be collected.* It is estimated that 43% of the manure from lactating cows is collectable, while 50% of all calf manure generated can be collected. The 43% value considers the time spent by lactating cows in open lots, feed lanes, and milking centers.

As shown in Figure 2.1-1, most of the manure generated by lactating cows is deposited in open lots. The remainder is deposited in equal proportions in the dairy feed lanes and milking centers. About half of the manure deposited in the open lot is not collectable, as it decomposes and is ground into the dirt. Additionally, manure washed away when cleaning feed lanes and the majority of the liquid manure flushed from the milking center cannot be collected as solids for off-site processing. In total, only about 43% of the manure deposited by lactating cows (at the types of dairies found in Erath Count) can be collected as solids.

Based on these assumptions, and on a manure generation rate of 2.19 dry tons/1,000 lb liveweight/yr obtained from the American Society of Agricultural Engineers (ASAE), CDM estimates that roughly 140,000 wet tons of collectable manure are generated in Erath County each year.

Figure 2.1-1

Fractional Dairy Manure Composition by Source and Use

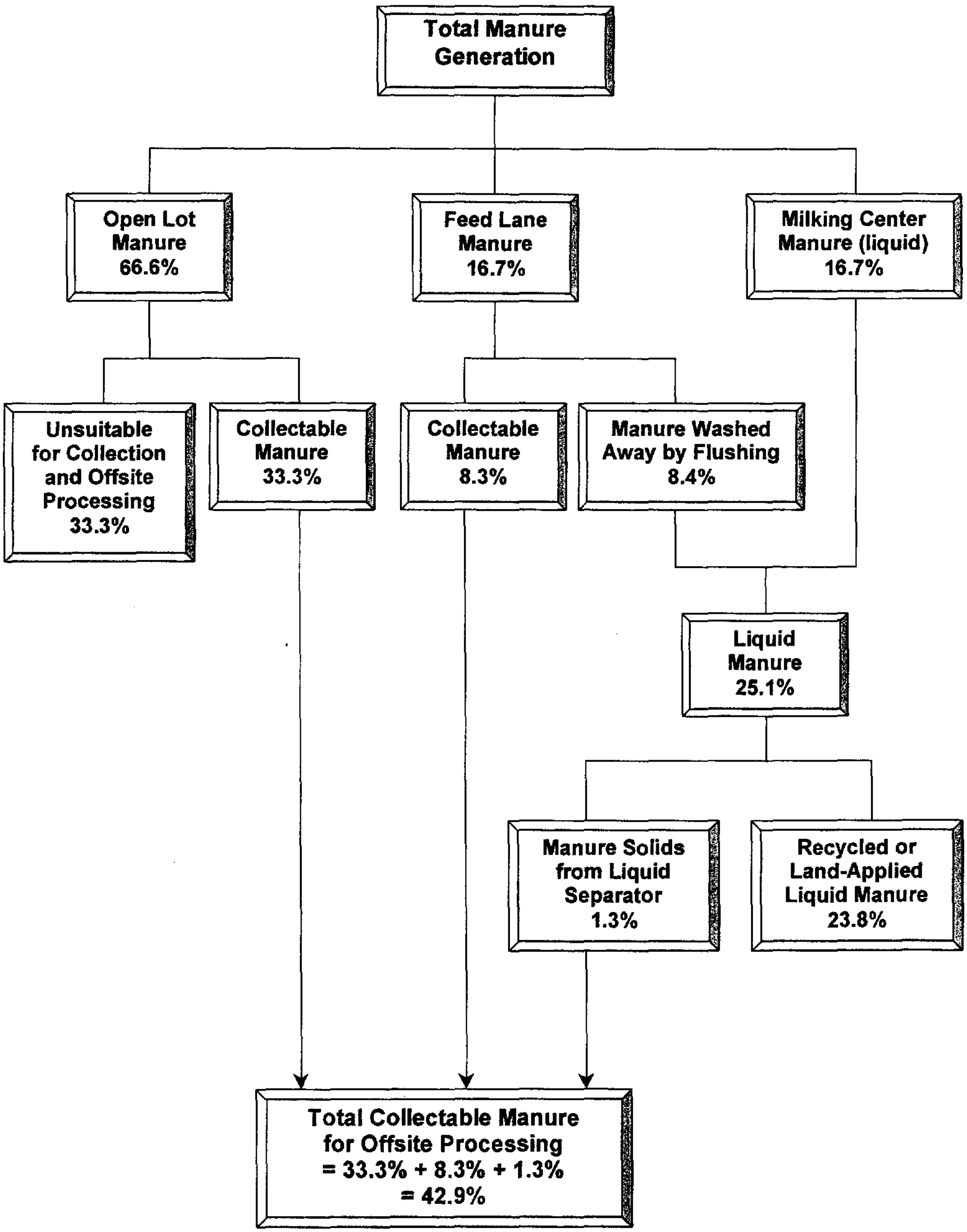


Table 2.1-1
Collectable Manure Estimates[1]

Item	*Lactating Cows*	*Calves*	*Total*
Animal weight (lbs)[2]	1,400	400	---
Manure production/animal (dt/yr)[3]	3.07	0.88	---
Number of contributing animals[4]	48,023	14,410	62,430
Generated manure			
Dry tons/year	147,400	12,700	160,100
Wet tons/year[5]	294,800	25,400	320,200
Cubic yards/year[6]	491,300	42,300	533,600
Collectable manure[7]			
Dry tons/year	63,400	6,400	69,800
Wet tons/year[5]	126,800	12,700	139,500
Cubic yards/year[6]	211,300	21,200	232,500
Cubic yards/yr/contributing animal	4.40	1.47	---

NOTES:
(1) Estimates are rounded to the nearest 100 cubic yards
(2) From American Society of Agricultural Engineers (ASAE), 1991
(3) Assumes 2.19 dt/1,000 lb liveweight/yr, from ASAE, 1991
(4) Assumes actual lactating herd size of 71,677 animals, with 3 calves for each 10 lactating cows, and a dairy participation rate of 67%
(5) Assumes 50% solids content
(6) Assumes a density of 1,200 lb/cubic yard
(7) Assumes 43% of lactating cow manure and 50% of calf manure can be collected

Most manures are stockpiled for a period before use or transportation where some drying occurs, increasing their solids contents from a low of 13% (for fresh manure from feed lanes) to about 50%. There are benefits to continuing this practice if manure is to be hauled to a regional facility, as it reduces transportation costs. For this analysis, we have assumed that collected manure would have a solids content of 50%. At this solids content, the quantity of manure collected in Erath County would be almost 139,500 wet tons. Based on a density of 1,200 lb/cy (ASAE), this tonnage equates to an annual collected manure volume of about 232,500 cubic yards.

3

Section Three

Section 3
Manure Treatment Technology Assessment

Throughout the history of waste management, proven treatment technologies in one industry have been adopted as fledgling technologies in another. This cross-pollination of technological advances is continuing today between sewage sludge and manure management. In this section, we explore technologies developed to manage sewage sludge that have been successfully adopted for manure management, as well as innovative sludge processes that might be appropriate for this purpose. Additionally, we examine some new technologies that have been developed expressly to address critical environmental issues facing the livestock industry.

Based on this effort, we identify technologies that might offer a regional management solution for Erath County.

3.1 Conventional Treatment Technologies

Conventional technologies for manure management are those that have been used to successfully treat animal wastes at numerous facilities in this country, and thus have proven record of successful operation. To date, the only technologies that meet this criterion are windrow composting and anaerobic digestion.

3.1.1 Windrow Composting

Windrow composting refers to the creation of long, relatively low piles of organic wastes to speed their decomposition. The piles (windrows) are agitated or turned on a regular basis. Windrows can be of any length and range in height from about 3 feet for dense materials like manure to 12 feet for fluffy materials like leaves. Windrow widths vary from about 10 to 20 feet. Windrow shape and spacing are largely determined by the turning equipment that will be used, while windrow height is dependent both on equipment and the porosity of the mix to be composted. Figure 3.1-1 illustrates a typical windrow composting operation for manure.

Figure 3.1-1 Windrow composting facility for manure

Windrow composting offers multiple benefits as a manure management practice. It reduces manure odors, creates a easily-handleable material, can be performed using readily available farming equipment, and generates a valuable commodity. Additionally, composting converts the nitrogen in manure to a more stable organic form, which minimizes surface water impacts and the leaching of ammonia from the manure into groundwater. Finally, composting destroys pathogens in the manure, reducing the risk of adverse health impacts to humans and livestock.

Although windrow composting has many advantages, it is not without drawbacks. Equipment requirements are relatively few, but the process is labor and land intensive. Process odors may also be a problem at smaller sites with proximate neighbors. The need to develop an effective product distribution network for large facilities seems on the surface to be a drawback to regional composting, but this apparent disadvantage may in fact be offset by revenues from product sales.

The success and cost-effectiveness of windrow composting across the nation warrants further investigation of this alternative for Erath County manures.

3.1.2 Anaerobic Digestion

Anaerobic digestion is essentially the microbial breakdown of organic materials in the absence of oxygen. The process reduces the pathogen content and odor of human and animal wastes, and results in a potentially valuable byproduct — biogas (a combination of methane, carbon dioxide and other gases).

Anaerobic digestion of manures is practiced around the globe on both on-farm and regional levels. In 1986, China reportedly had more than seven million digesters to handle manures and other organic wastes. The process is also popular in India, where its use is spurred by the need for energy (from biogas) in rural areas. The production of biogas is, in fact, one of the primary benefits of this process and is often cited as the basis for its use.

The process had fallen into relative obscurity in the U.S., but concerns regarding greenhouse gases has recently renewed interest in the digestion of animal wastes. By 1994, the number of farm-based anaerobic digesters in the U.S. had fallen from a high of about 140 to 25, although it is estimated that 2,000 to 4,000 of the country's farms could benefit from the technology. Concerns regarding global warming gave rise in the early 1990s, however, to the AgSTAR program, an EPA and USDA-based initiative to reduce the emission of greenhouse gases to the atmosphere by using farm-generated biogas as an energy source. The program provides guidance to farmers wishing to pursue this technology through a hotline, handbook and software. Additionally, the program supports research and has participated in the construction of about 20 anaerobic digesters since its inception in 1994.

Two types of anaerobic digesters are most commonly applied to manure management. Mixed digesters are usually vertical cylindrical tanks containing mixing systems to agitate tank contents. Plug-flow systems are long concrete vessels, usually built into the ground, covered by a flexible plastic membrane. For both systems, the manure is fed to the digester as a liquid, and is retained in the unit for about three to five weeks. Biogas generated by the process can be used to generate electricity for use or sale, while the digested manure and process effluent can be land-applied. Digestion reduces organic nutrient content and converts nutrients to less-available forms, reducing potential groundwater and surface water impacts from land application.

With respect to application in Erath County, the fact that anaerobic digestion is a liquid process is considered to be a major drawback. Manures would have to be slurried at a centralized facility or hydraulic flushing systems would need to be installed at individual farms to implement this option. In addition to this major drawback, the economics of this option may not be favorable as the energy that could be generated at a digestion facility may not be as inexpensive as readily available energy sources and would not offset processing costs. Costs to haul the liquid to farms for land application would also adversely impact the economics of this alternative.

Based on the lack of a need for an inexpensive energy source, the usual high capital cost of large digestion facilities, and expected high cost for the transportation of digested manures to land application sites, the construction of a regional or subregional digestion facilities for Erath County in not considered to be economical. Smaller on-farm units may be appropriate to manage manures at some locations, but the labor-intensive nature of these units may limit farmer's interest in their use.

3.2 Innovative Treatment Technologies

This category includes: new sludge treatment processes that have been demonstrated at a full-scale in this country; manure management processes that have been proven overseas, but have not seen widespread use in the United States; and new manure management processes that have been demonstrated full-scale at several facilities in this country.

Processes that fall into this category include:

- Constructed wetland systems (Bion);
- In-vessel composting;
- Heat-drying;
- N-Viro;
- Incineration;
- Bioset;
- Vermicomposting; and
- Brick production.

Each of these processes, and their potential application for Erath County manures, are described below.

3.2.1 Constructed Wetland Systems

The use of constructed wetlands to treat manures is the focus of ongoing investigations at Purdue University and is the premise behind Bion Technologies' Nutrient Management System (NMS). At this time, Bion's system has been installed at approximately 16 facilities (dairy, poultry, and swine) across the nation with a total of 76 systems under contract.

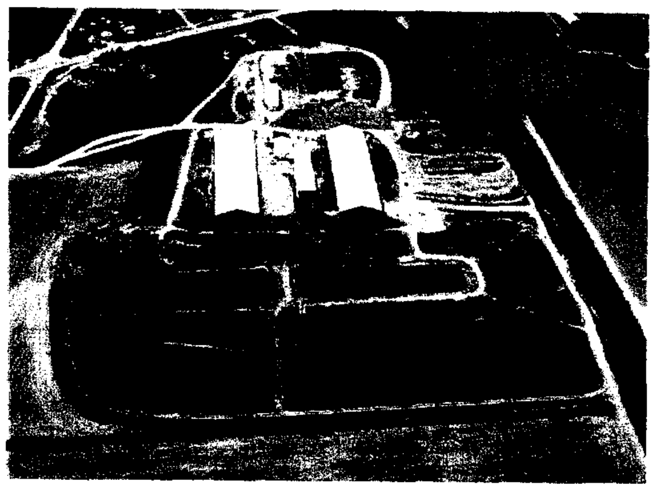


Figure 3.2-1 Bion NMS™ producing BionSoil™ on a 1,200 cow dairy in New York

The Bion NMS uses natural vegetation and bacteria to stabilize the nutrients in manures flushed from freestall barns. The system consists of several shallow ponds (see Figure 3.2-1). Materials flushed from the barn enter a lagoon where solids are separated from the liquid by settling. Any solids that don't settle are transported along with the liquid into the "bioreactor", essentially a waste storage pond with a large bacterial population that consumes many of the nutrients in the manure. The nutrients consumed by the microbes then pass with the microbes and liquids into the system's "ecoreactor" cells. Cattails, reed canarygrass and other vegetation in the ecoreactor bind up most of the soluble nutrients in the manure. As the liquid passes from one cell of the ecoreactor to another, it becomes progressively cleaner. At the end of the system, the cleaned water is collected for recycling back to the barn flush system.

The system is designed such that individual ecoreactor cells can be shut-off from the system, allowing the collected solids in those cells to dry. The dried material has a solids content of about 30 to 40%, is humus-like in appearance when removed from the beds and is marketed as BionSoil. BionSoil is reportedly being sold at retail garden supply outlets for about $70 per cubic yard in New York and Florida. Revenues from sales as a bulk soil amendment for agriculture are expected to be about $18 to $30 per cubic yard.

Benefits of the process include: the generation of clean water for discharge or reuse, as well as a marketable soil supplement; reportedly low construction and operating costs; and, minimal impact to farmers, as Bion staff are responsible for process operation and all BionSoil generated.

Despite its advantages, the system has several drawbacks which may limit immediate applicability in Erath County. First, Bion NMS is a liquid process most appropriately used for dairy operations with hydraulic flushing systems. At this time, only about 10% of the dairies in Erath County have flushing systems. Additionally, the system has been limited to on-farm use: no regional facilities have been constructed and there are currently no plans to do so. Because the process treats liquid wastes, manures would have to be hauled as liquids from farms for treatment or semi-liquid wastes would have to be slurried (potentially, recycled water could be used for this purpose). The impacts of these efforts on system economics are not expected to be favorable. Without these economic burdens, the system reportedly costs about $100 to $200/cow.

Because it processes only liquid wastes and is relatively costly compared to some conventional systems, Bion NMS is not recommended as the sole management practice for Erath County manures at this time. Nonetheless, the system appears to offer many benefits that may warrant further investigation. It is possible that the system may have a role in a diversified manure management plan for the County in the future.

3.2.2 In-Vessel Composting

Over the last decade, in-vessel composting has become increasingly popular as a means to compost sewage sludge. Today, in-vessel systems are also beginning to see use in manure applications. A variety of in-vessel systems have been used at a handful of dairy operations, including bin and agitated bed systems (the most popular in-vessel system for composting sewage sludge).

Bin composting is the simplest of the two methods. Using this system compost feedstocks are contained by long walls (forming bins), which allow a better use of space than windrow composting. The bins are usually covered by a roof to protect the composting process from the weather. Aeration for the process is provided by air forced through a distribution system in the floor of the bins.

Agitated bed composting is similar to bin composting, but adds one additional step. Composting material is turned by a mechanical agitator that rides along the top of the bin walls. In this process, compost feedstocks are placed at one end of the bin and are gradually moved to the opposite end by the compost turner. The combination of forced aeration from the bin floor and compost turning dramatically reduces the period required for composting compared to windrow systems.

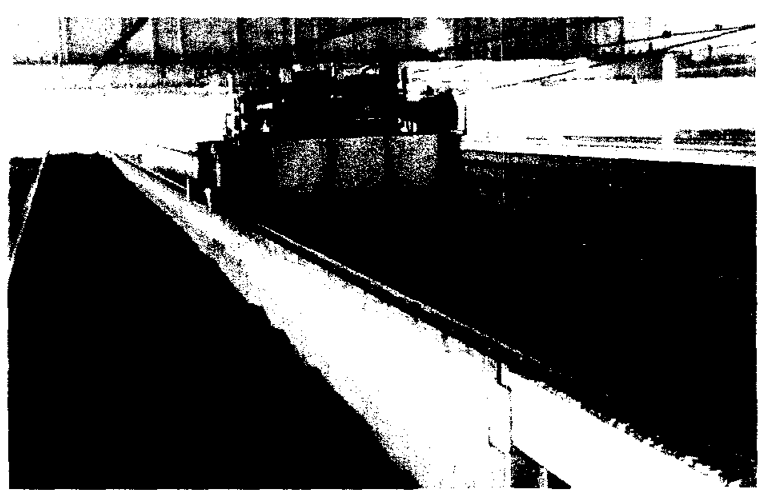


Figure 3.2-2 Agitated bed composting system

Figure 3.2-2 shows a typical agitated bed system.

Although both of the above methods show promise for manure management, they are significantly more costly than the simpler windrow systems. In-vessel composting operations usually cost about $65 to $80/wet ton processed to construct and operate. The relatively high cost of these facilities reflects aeration requirements (blowers, etc.) and, in some cases, odor control and product turning requirements as well. Overall, windrow systems are simpler to construct and operate; accordingly, they are less costly as well, with costs of less of than $50 wet ton readily attainable. Because of their simplicity and lower costs, future investigations of composting in this report will focus on windrow methods.

3.2.3 Heat-Drying

The heat-drying process has traditionally been applied to sewage and industrial sludge management. Heat-drying reduces, through heating at high temperatures, the volume and moisture content of organic wastes. Solids contents between 90% and 95% can be achieved. The dried product can be pellet-like in appearance and is often used as a soil conditioner.

Two types of dryers are generally used, including direct and indirect systems. Direct systems bring heated air into direct contact with the drying material, while indirect heating systems rely on the contact between the drying material and a heated surface for drying. For the purposes of this report, we assume that direct dryer would be used for Erath County. This type of dryer is roughly equivalent in cost to indirect systems.

Primary system components of a direct drying system include a conveyor, mixer, rotary dryer, recycle bin, screen, crusher, air pollution control equipment and product storage facilities.

Material to be dried is conveyed to the mixer where it is blended with recycled dry material, increasing the solids contents of the dryer feed to 60-75 percent. The blended material enters the cylindrical rotary dryer, where it is dried to a solids content of 90 percent or more. Process exhaust gases and the dried sludge exit the dryer at 120-130 °F. A cyclone fabric filter is used to separate the dried material from the hot gases. The dried material is then sent to a screen which separates the oversized and fine material from the marketable fraction. Both undersized and crushed oversized materials are recycled to increase dryer feed solids. Marketable materials (which are pellet-like and about 2 mm in diameter) are conveyed to storage facilities.

The primary advantage of drying systems is volume reduction. Disadvantages of drying systems include their high costs, operational complexity, odor control requirements, product storage requirements, and dangers associated with the self-combustion of stored materials when not handled properly. Dust is also a problem at some facilities.

At this time, CDM is not aware of any large-scale dryer applications for manure treatment. A primary concern that may limit the application of this process for manure management is the somewhat heterogeneous characteristic of manures caused by the bedding or rocks that they may contain. The bedding may limit the ability to form the dried material into pellets, which are the most marketable form of the product. For Erath County, rocks gathered when the manure is collected would need to be removed prior to drying, thus requiring additional equipment and operational cost.

A final concern with regard to this process is marketability of the product with respect to odors. Once heat-dried materials are wetted, they take on the odor of material from which they were made. While this may not be an issue if a heat-dried manure is marketed in the agricultural sector, it may be a concern if the more lucrative homeowner/golf course markets are pursued. Many successful heat-dried biosolids sold in these higher-end markets are derived from digested materials. Digestion significantly reduces the odor of heat-dried products, so much so, in fact, that some marketers of these products refuse to handle undigested products. Product odor, and the potential need for digestion, should therefore be considered in any marketing plans for a heat-dried manure.

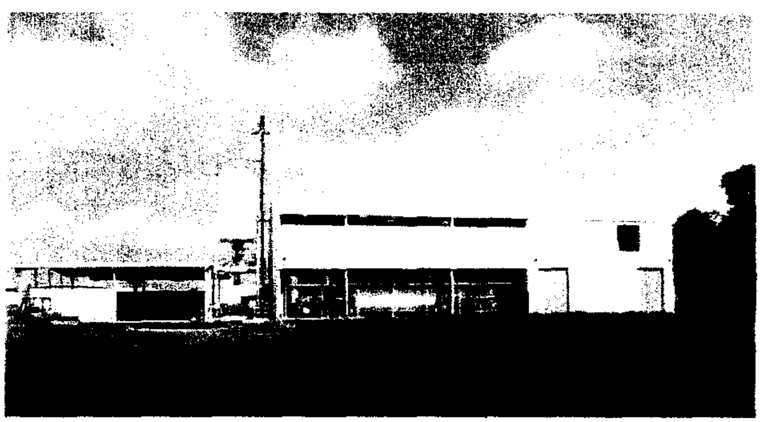


Figure 3.2-3 BRA biosolids drying facility

The BRA currently operates a 20 dry ton per day (dtpd) municipal sludge drying facility in Waco, and because of that facility's success, this option is explored further. Figure 3.2-3 shows the BRA dryer. Although BRA and other facilities have a history of successful heat-drying and product marketing, concerns regarding technical feasibility for application to Erath County manures, as well as concerns regarding product odor, indicate that pilot testing would be prudent.

3.2.4 N-Viro Processing

The N-Viro International Corporation, developers and marketer of an advanced alkaline stabilization process for sewage sludge, have developed two new pasteurization processes to treat animal manures. The company is now seeking patents and is unwilling to disclose details regarding either process. Nonetheless, they do note that the new processes build upon the experience gained with their "traditional" alkaline stabilization process, and they have noted the reported benefits of the processes, which include disinfection of the manure and the immobilization of phosphorus.

Both the disinfection and immobilization processes apparently require the addition of alkaline materials to the manure. For disinfection, the added materials raise the solid content of the manure, creating pores that fill with ammonia liberated by the increased pH from alkaline addition. The ammonia destroys pathogens in the manure. Although the company has not provided information on mechanisms involved in their immobilization process, we assume that phosphorus in the manure is bound (to some extent) by minerals in the alkaline additives. Representatives of the company note that the process can immobilize approximately 90% of the soluble phosphorus in manure. The proprietary nature of the processes stem both from the types of alkaline additives used and the method in which they are added.

The processes have not yet been applied full-scale, but the company expects to start-up a demonstration project in Beltsville, MD this summer. The manure-treatment facility is the central component of a $500,000 USDA grant designed to demonstrate the ability of their patent-pending process to disinfect animal manures, reduce odors, immobilize soluble nutrients, particularly phosphorus, and "fix" metals.

If the immobilization process functions as reported, then it may be appropriate for application in Erath County. Equipment requirements for the process are expected to be minimal and similar in many respects to conventional lime stabilization facilities. These types of operations are typically "low-tech" and correspondingly, have low capital costs. N-Viro staff report that the process equipment would be able to accommodate rocks and stones that might be encountered in manures (as is expected in Erath County) and that the process can readily accommodate the relatively dry manure that is expected to be delivered to a regional facility in the county. Finally, the immobilization of soluble phosphorus provided would allow dairy operators to apply the product to their fields without adversely impacting water quality. In essence, operators would be able to take advantage of the soil conditioning properties of the manure (because of its organic content) without adding significant quantities of phosphorus to the soil and surface waters.

The primary concern regarding this process is its operating cost and effectiveness. It is hoped that the demonstration project at Beltsville can address these concerns. At this time, we believe that the process has, at the very least, the potential to offer a regional manure management solution in Erath County and accordingly, it is considered further in this study.

3.2.5 Incineration

Reportedly, at least one facility in California is incinerating manure. This process, traditionally applied to sewage sludge, municipal solid waste and other materials, reduces wastes to ash through combustion. Typically, sophisticated air pollution control devices are required to remove combustion by-products and particulates from flue gases.

For a manure application, a fluidized bed system would be recommended. This system generally includes a vertical cylindrical unit with a grid near its base to support a sandbed. Manure would be injected above the grid. Combustion air is added below the grid and flows upward, fluidizing the sand and manure mixture. Ash from resulting from the process is carried along with combustion gases to the top of the unit, where it is separated from the gas by air pollution control equipment.

The incineration of manure offers three advantages. First, it significantly reduces the volume of manure to be disposed of. Secondly, with additional capital investments, the fluidized system could be used essentially as a power plant (with manure as the fuel). Finally, it lends itself to regionalization.

Primary disadvantages of this approach include high costs, the need to dispose of the final product, the generally unfavorable perception of combustion (in both the public and regulatory arenas), difficulty in siting new incineration facilities and the lack of a proven track record as a manure management strategy.

Preliminarily, it is estimated that a combustion facility without power producing capabilities would cost in excess of $10,000,000 to construct (a very high cost for manure management). Further, this type of facility would not offer revenue potential, and would be burdened by disposal costs for ash. The addition of power production would raise construction costs to more than $20,000,000, but could potentially offer some cost recovery if power could be sold for more than $0.04/kilowatt-hour.

Despite the potential for some cost recovery through power sales, this option is not cost-effective compared to other alternatives studied. For this reason, and because of the other disadvantages listed above, incineration is not considered to be a preferred management strategy for Erath County. This situation would not be expected to change until an independent power producer or other host facility moved into the area with a need for an alternative fuel supply.

3.2.6 Bioset

This innovative process has been used to convert raw sewage sludge into liquid fertilizer and a organic-rich liming agent at a single facility in Kingwood, Texas. Reportedly, process developers are planning to explore its use as a treatment process for manures as well.

In the process, semi-liquid (about 20% solids content) sludge is pumped into a reactor where alkaline and acid materials (such as lime and sulfamic acid) are added. Sludge is retained in the reactor for about 4 minutes under pressure (6 to 50 psi) and high temperatures (20°C to 90°C). The chemical and sludge mixture, when wet, increases the process temperature, reducing pathogens in the sludge. When the process is complete, reactor pressure is dropped to atmospheric levels. Steam and ammonia released from the process can be captured and used to produce liquid ammonium phosphate fertilizer. The process also generates a solid product with a pH of about 12 which can be land-applied.

Because this process has seen limited application and has never been used to treat manures, it is not recommended for use Erath County at this time. Additionally, the highly-alkaline characteristic of the product may not be appealing or useful to dairy operators in the Erath County region, reducing the viability of a Bioset facility in the County. The product might find market acceptance in East Texas or other areas with acidic soils, but is unlikely to have sufficient value to farmers to support transportation costs to those areas.

3.2.7 Vermicomposting

Vermicomposting involves the degradation of organic wastes by earthworms. Some earthworm species thrive in managed conditions on a diet composed almost entirely of organic matter. When added to shallow beds of organic materials such as sewage sludge and manures, the worms feed on and digest a portion of the organic matter. They expel the undigested remains as feces, or castings. The breakdown of organics initiated by the worms continues after the castings are expelled. The rate of organic decomposition is accelerated (over what would occur without worm activity) due to the small size of the castings, which increases the surface area available for drying, aeration, and microbial activity.

The process begins by adding the worms to a bed or pile of organic materials. The worms work their way through the bed, leaving castings in their wake. As they move through the bed, new material can be added to the end of the bed or in a thin layer at the top (depending on the system used). Decomposed material can be removed and screened to separate the worms and castings. The worms can be recycled in the process or sold as fish bait. The castings too have value, as recycle to enhance the process, as a source of protein for animal feed, or as a soil amendment.

The process has reportedly been applied on-farm and is appropriate for manure management. A benefit of the process is its low capital cost (few capital expenditures are required as most needed equipment is available on-farm) and simplicity of operation. Labor requirements can be intensive; however, required activities include adding material to the composting beds, screening the compost, and preparing the worms and compost for their respective markets (supplemental heating or drying may be required for the compost). Flies can also be a problem, as vermicomposting takes place at relatively low temperatures (65-85 °F).

To our knowledge, vermicomposting of manure has not been conducted on a regional scale and has seen only limited applications on-farm. At this time, there is insufficient basis to assess the feasibility or economics of a regional operation and this process will not be considered further.

3.2.8 Brick Production

Municipal wastewater sludges (and potentially manures as well) may be substituted for other organic substances, such as sawdust, normally used in the production of building bricks. The high temperature to which the bricks are subjected in the kiln destroys all organic matter in the sludge, including pathogenic organisms. The bricks so produced are nearly identical to ordinary bricks by all measurable standards and are called biobricks. The idea of incorporating municipal sludge into bricks was actually patented nearly 100 years ago. More recently, a demonstration-scale production of biobricks was completed by the Washington Suburban Sanitary Commission and the Maryland Clay Products Company. The biobricks were used to construct the electrical and mechanical buildings at the Parkway and Western Branch wastewater treatment plants as well as several smaller structures. The finished bricks had the look, feel, and smell of ordinary bricks and met all ASTM requirements for strength and other properties. The bricks were also tested by the extraction procedure test for leaching and were judged satisfactory. Bricks were made with 15, 30, and 50% sludge by volume. None of the biobricks were as strong as regular brick; however, all were well within ASTM requirements.

Since this successful demonstration project, biobricks have not been made or used in this country. A 1996 survey indicated that an unfavorable perception of the bricks because of their origin may have been a factor in their failure to become widely used. Others have speculated that economics may have also been a contributing factor.

Because this process has never been applied to manures and because a manure-based brick may be subject to the same stigma as a sludge-based brick, this option is not recommended for application to Erath County manures. However, it might warrant further exploration on a pilot basis in the future.

3.3 Selection of Candidate Technologies

Based on the above assessments, it appears that only one technology — windrow composting — provides a proven regional solution for the management of Erath County manures. Windrow composting is the only proven technology that has been successfully adopted on a regional scale in the United States. It is a "low-tech" process that can be implemented without the need to design and purchase costly and complex processing equipment, and it requires no new equipment to be purchased by individual dairies. Because land area constraints are not an issue in Erath County, the land-intensive nature of the process and occasional composting odors that might occur are not as critical as they might be in a more space-limited area.

Although they have not traditionally been applied to manure management, both the heat-drying and new N-Viro technologies might also be appropriate for application in Erath County. Advantages of the heat drying process include volume and weight reduction of feedstock (which decreases product transportation costs), and the generation of a potentially marketable product. The N-Viro process immobilizes the phosphorus contained in manure, such that the stabilized product could be used to improve soils within the county.

Because composting, heat-drying, and N-Viro facilities can be developed on a regional scale, they have been selected for further evaluation. Section 6 presents a cost comparison of these alternatives.

If, in the future, some Erath County dairy operators elect to install hydraulic flushing systems, then the Bion NMS system or anaerobic digestion might provide "on-farm" processing alternatives that could be incorporated into a diversified manure management plan for the County. Both of these systems have been used with some success in this country. Their future use at some dairies in the County would not adversely impact the recommendation to pursue composting at this time. Adoption of these processes in addition to composting could, in fact, help Erath County meet water quality improvement goals by potentially increasing the number of dairy operators that are participating in manure management programs.

4 Section Four

Section 4
Siting Analysis

The purpose of this section is to identify potential locations within the County that might host a manure management facility. This determination is made through an evaluation of the traffic impacts, environmental suitability, and regulatory considerations for each location, as described below.

4.1 Identification of Candidate Sites

Based upon visual assessments and an estimate of cow densities, a total of nine potential facility locations were identified within the County. The surveys considered transportation access, proximity to dairies, terrain suitability, proximity to residences and visual screening.

Site selection also considered the relative density of dairies and the number of cows on each dairy by attempting to locate sites in areas that would be proximate to relatively large quantities of manure, reducing transportation costs. To make this assessment, a dairy cow distribution map was generated. Data collected to generate this map is presented in Appendix B. Figure 4.1-1 shows the distribution of dairy cows in Erath County.

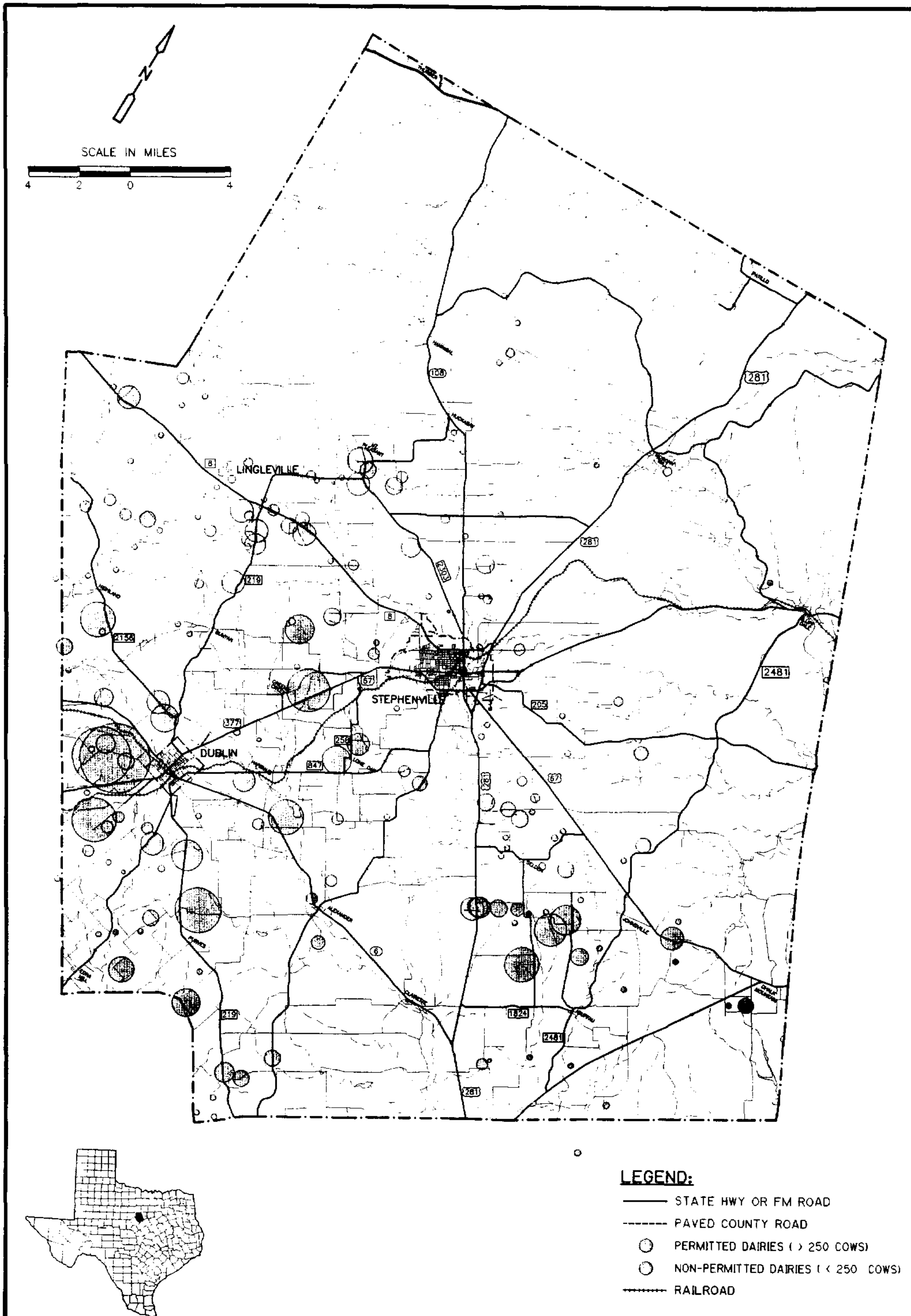
Selected sites are shown on Figure 4.1-2.

While specific locations are shown on the figure for each of the nine sites, in most cases there are numerous tracts in the immediate vicinity of each site that could host a manure management facility. Because the availability of individual tracts is not deemed to be a limiting factor at this time, this siting assessment focuses on the relative merits of the general locations (sites) shown on Figure 4.1-2.

Brief descriptions of each site are presented below.

1. *Mt. Pleasant Site* – This would be a potential subregional site, serving a localized area together with several other subregional processing facilities in different parts of Erath County. The Mt. Pleasant site is located near the intersection of FM 219 and FM 2303. There are numerous tracts of land near this intersection that could serve as a manure processing facility. For study purposes, a site was identified near the northwest corner.

2. *Landfill Site* – The City of Stephenville operates a municipal solid waste landfill on CR 385. Parts of the landfill have been closed, which would have the potential for serving as a manure processing facility.



ERATH COUNTY, TEXAS

DAIRY COW DISTRIBUTION

FIGURE No 4.1-1

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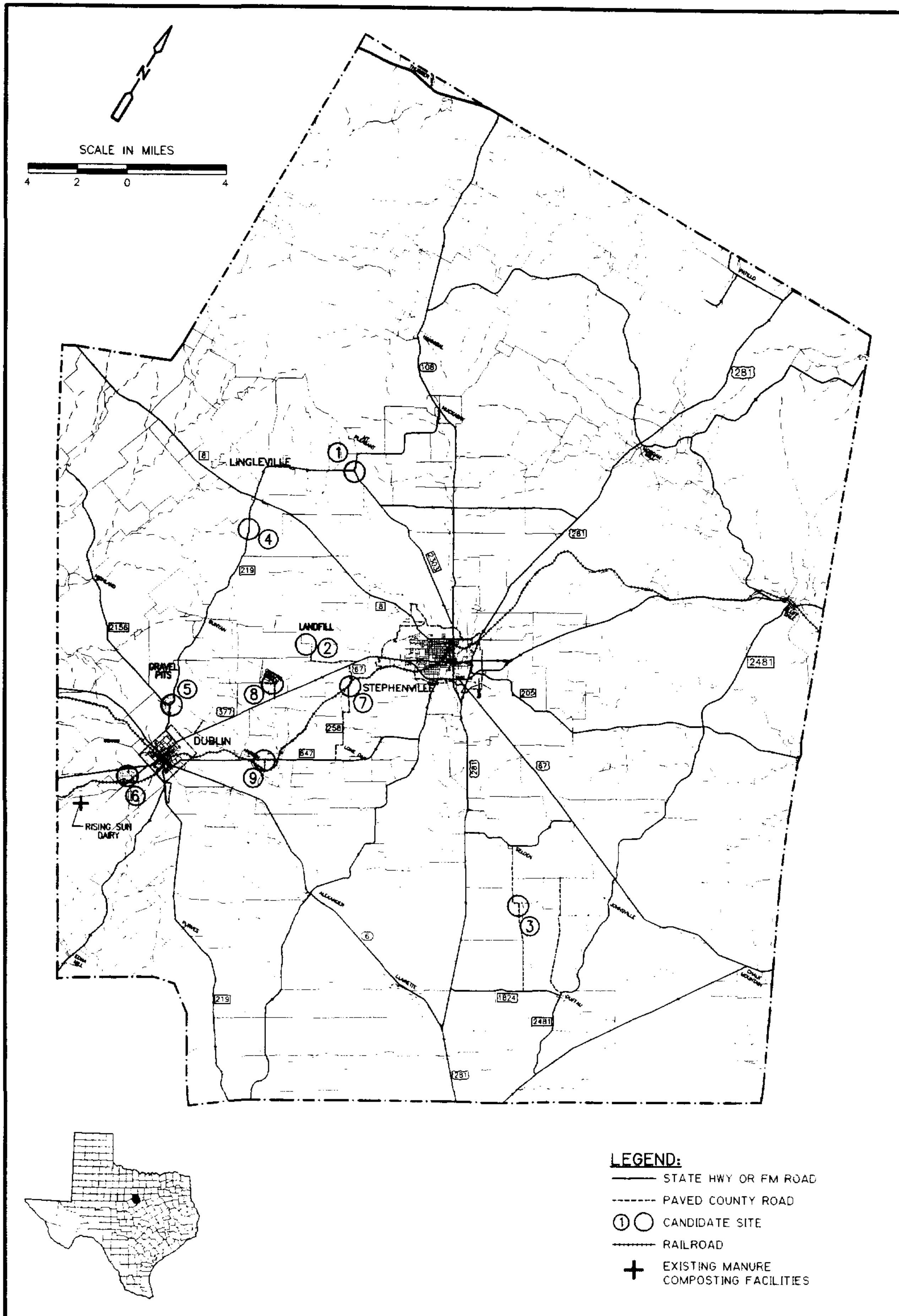
environmental engineers, scientists, planners, & management consultants



CDM
environmental engineers, scientists, planners, & management consultants

ERATH COUNTY, TEXAS

POTENTIAL MANURE PROCESSING SITES

FIGURE No 4.1-2

3. *Selden Site* – This site is located about two miles south of the Selden community and about two miles east of Hwy. 281.

4. *Lingleville Site* – There are several potential sites in the Lingleville area, such as north and west of the intersection of FM 219 and FM 8. For study purposes, a site was selected near the largest dairy concentration. The site is located on either side of FM 219 about one mile south of Lingleville.

5. *Gravel Pits* – This site is located in old gravel pits about one mile north of Dublin on FM 219, a short distance north of its junction with FM 2156.

6. *Dublin Site* – This site is located between the railroad and CR 330, about ¼-mile south of Hwy. 67 on the outskirts of Dublin. It is located near the largest concentration of dairies in the county.

7. *CR 258 Site* – This site could potentially serve as a single regional composting site for the entire country. It is located adjacent to CR 258 and the railroad, about three miles west of Stephenville. CR 258 is paved between Hwy. 281 and FM 647.

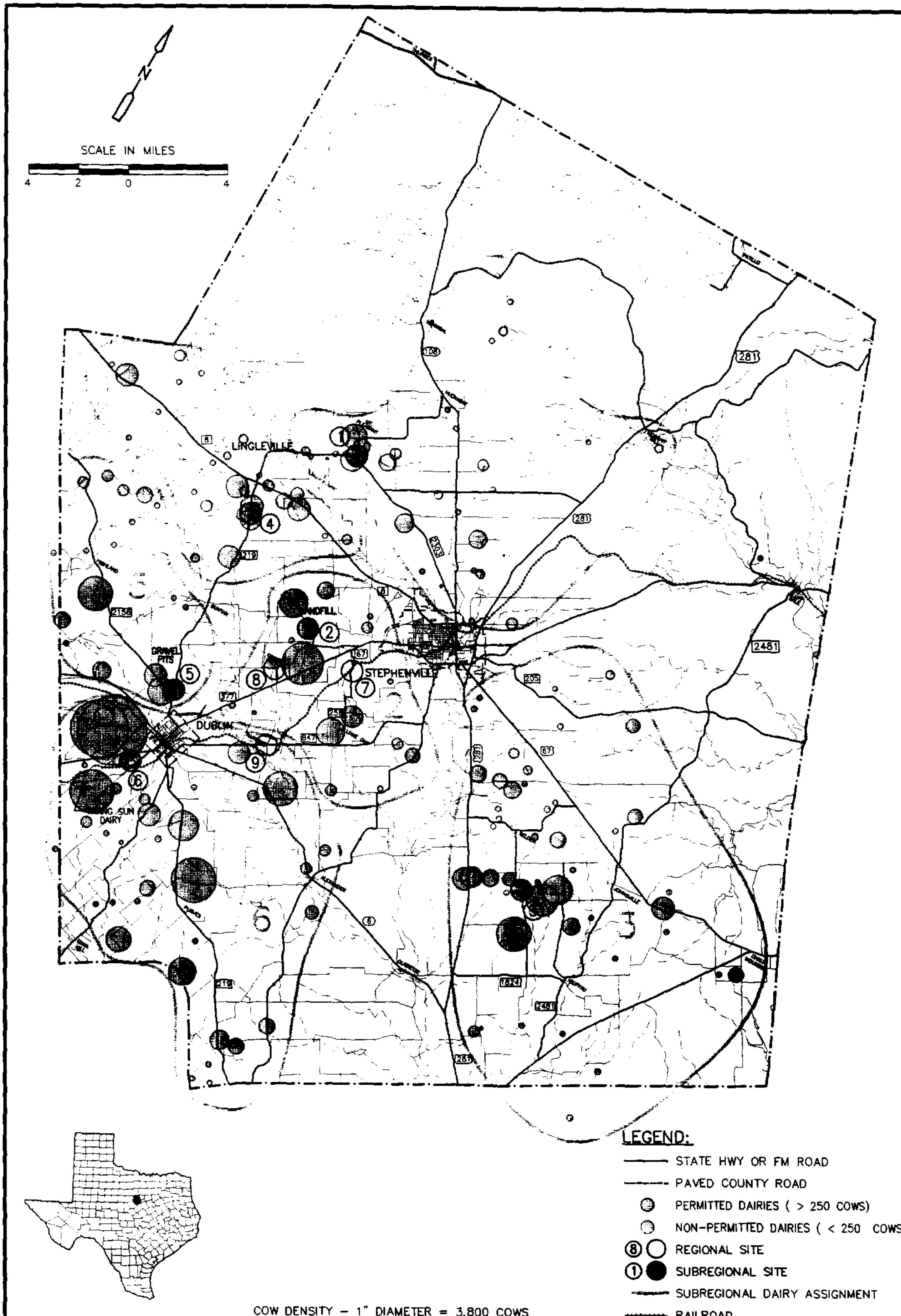
8. *Green's Creek Site* – This site is situated midway between Stephenville and Dublin. It is located about ½ mile north of Hwy. 281 and CR 380. This site could potentially serve as a single regional manure processing site for the entire county.

9. *Harbin Site* – This site is located in a triangular shaped tract between FM 647 and the railroad, about three miles east of Dublin.

For study purposes, we have divided the nine sites into two categories: regional and subregional. Three sites (CR 258, Green's Creek, and Harbin — Sites 7, 8 and 9, respectively) are centrally located and have been tentatively designated as regional sites as they could potentially serve the entire county.

Subregional sites (Sites 1 through 6) would serve dairies only in their respective areas. Figure 4.1-3 shows the dairies assigned to each subregional site. This assignment qualitatively considers both travel distances to subregional sites and the concentration of dairies in the area.

Dairy assignments and concentrations (shown in Figure 4.1-3) were also used to roughly estimate the required site areas for subregional facilities. Estimated site area requirements were based upon the most land-intensive processing alternative evaluated (composting). Using this data and manure generation rates presented in Section 2, and also assuming that a subregional facility would require about one acre to accommodate each 1,900 cubic yards of material processed, estimated subregional site requirements were computed (see Table 4.1-1).



ERATH COUNTY, TEXAS

CDM

PROCESSING SITES AND DAIRY COW DISTRIBUTION

FIGURE No. 4.1-3

Table 4.1-1
Estimated Subregional Site Area Requirements

Site	Permitted Cows	Contributing Animals (1)		Collectable Manure (cy/yr) (2)	Estimated Site Requirement (ac)
		Lactating Cows	Calves		
1 - Mt. Pleasant	12,555	6,214	1,864	30,100	16
2- Landfill	10,380	5,137	1,541	24,900	13
3 - Selden	22,050	10,913	3,274	52,800	28
4 - Lingleville	13,850	6,855	2,056	33,200	17
5 - Gravel Pits	9,634	4,768	1,430	23,100	12
6 - Dublin	28,562	14,136	4,241	68,400	36
Totals	97,031	48,023	14,407	232,500	Avg = 20 acre

Notes:
(1) Assumes:
- actual herd is 89% of permitted herd
- lactating herd is 83% of actual herd
- 3 calves for every 10 lactating cows
- 67% dairy participation

(2) Based on estimated 4.4 cy/contributing lactating cow and 1.47 cy/contributing calf (see Table 2.1-1), computed quantities are rounded to nearest 100 cy.

In reality, the only difference in the regional and subregional categories is the ultimate size of the site. A regional facility would require roughly 60 acres, while a subregional site would require about 20 acres (on average). It is important to remember, however, that at this preliminary planning stage, there is considerable flexibility with respect to how a site could be developed. For example, some subregional sites could ultimately be developed as regional facilities. Additionally, dairy assignments to subregional sites could be modified to optimize the use of available land at a given site. These issues should be explored in the next phase of this project.

4.2 Assessment of Candidate Sites

The goal of this assessment is to screen the 9 candidate sites down to three or four sites that show the greatest promise for development as manure processing facilities. Further studies will be required to definitively select a final site. Toward this end, candidate sites are evaluated with respect to traffic impacts, environmental suitability, and regulatory considerations. At the end of the section, a summary matrix incorporating each of these siting criteria is presented to identify preferred sites.

4.2.1 Transportation Impact Analysis

GSG, Inc. and Bledsoe Consultants, Inc. (BCI) of Austin, Texas assessed the relative merits of each site with respect to traffic impacts. Their assessment is presented in full in Appendix C and is summarized in this section. The purpose of the GSG/BCI study was to provide a "fatal flaw" analysis rather than a refined comparison of the sites (a more refined assessment should be performed when final candidate sites have been selected).

The GSG/BCI Team spent January 14 and 15, 1998 in Erath County conducting field investigations of the candidate sites. They used Field Sheets to codify data gathered in the field and in the office [including information such as access route, pavement width and number of lanes, 1996 Average Daily Traffic Volumes (if available), and pavement condition], and to record notes and the photographic information for each site.

GSG inventoried all of the bridges which would be impacted within the catchment area of each site. Bridges in the study area were divided into those which were in the influence area of the regional sites, and those which fell in the area of subregional sites. Within these two major categories, bridges were further separated into on-system (state highway bridges) and off-system (county and local bridges) classifications. An initial bridge assessment of the potential impacts that a composting facility might have on surrounding bridge structures was performed based on information acquired from the TxDOT Fort Worth District. The bridges were then ranked based on their adequacy in the following areas: load restrictions, clear travel width, and loading type/frequency. The bridge adequacy ranking was included as a variable in the final ranking exercise.

For evaluation and ranking purposes, the nine sites were divided into those which were being considered as regional facilities (Sites 7, 8 and 9), and those being considered for subregional facilities (Sites 1 through 6). Evaluation of the potential sites in each group for overall transportation access was made using the following variables:

- Accessibility;
- Roadway geometrics and surface condition;
- Safety factors; and
- Magnitude of remedial action.

The sites have been given a rating of "favorable", "neutral" or "unfavorable" for each variable. The ratings for each variable are presented in matrix format in Figure 4.2-1 (subregional sites) and Figure 4.2-2 (regional sites). The "weighted totals" row at the bottom of each matrix indicates the overall transportation desirability of that site. The sites are then ranked within each category or matrix (subregional and regional) on the last row of the matrix.

Figure 4.2-1
Transportation Analysis Matrix – Subregional Sites

Variables	***Site Number***					
	1	***2***	***3***	***4***	***5***	***6***
Accessibility	○	◑	●	○	○	◑
Pavement Condition and Ride	○	○	○	◑	○	◑
Safety	○	◑	○	○	●	◑
Magnitude of Remedial Action	○	●	●	○	◑	◑
WEIGHTED TOTALS	○	◑	◑	○	◑	◑

○ = Favorable
◑ = Neutral
● = Unfavorable

Figure 4.2-2
Transportation Analysis Matrix – Regional Sites

Variables	***Site Number***		
	7	***8***	***9***
Accessibility	◑	○	○
Pavement Condition and Ride	●	◑	○
Safety	●	○	◑
Magnitude of Remedial Action	●	◑	◑
WEIGHTED TOTALS	●	○	○

○ = Favorable
◑ = Neutral
● = Unfavorable

Evaluation criteria applied to each variable are presented below.

- *Accessibility* – Accessibility is defined as "ease of access" to the site. Criteria which influence accessibility include:

  1. Accessibility to all-weather State-maintained roadway;
  2. Number of intervening roadways or driveways;
  3. Other intervening traffic generators (schools, businesses, etc.);
  4. Intervening (substandard) bridge structures;
  5. Proximity to uncontrolled railroad crossings; and
  6. Average Daily Traffic Volume (ADTs) and Levels of Service.

- *Roadway Geometrics and Surface Condition* – The adequacy of the roadway geometrics and surface condition for routes to the various sites is a factor of the design of the roadway, condition of the pavement, and general terrain features. The following criteria were considered:

  1. Geometric design of roadway, including horizontal and vertical curves;
  2. Compacted dirt/gravel or bituminous pavement
     — for each of above, condition of surface (level or not, cracked or bumpy, pot holes, etc.)
     — drainage adequacy; and
  3. Smoothness of ride.

- *Safety Factors* – Safe traffic access for both the motoring public and for Animal Waste Management Facility transport is an important consideration in ranking and selecting sites.

1. Sight distance restrictions (reverse curves or other factors limiting adequate sight distance);
2. Railroad crossings
   — controlled or uncontrolled; caution lights or bars, etc.;
3. Schools or school zones; school bus routes; and
4. Residences.

- *Magnitude of Remedial Action* – For this variable, the rankings were "good" if little remedial action was necessary, "fair" if a medium amount of remedial action was needed, and "poor" if major improvements to intersections, roadway geometrics, bridge structures, or railroad crossings would be required. Applicable criteria include:

  1. Miles of roadway from site to good State-maintained roadway requiring upgrading;
  2. Magnitude of intersection upgrades (main routes only); and
  3. Modification of structures (bridges; on- and off-system).

As shown in Figures 4.2-1 and 4.2-2, the interim transportation analysis ranks subregional Site 1 as most desirable, and subregional Site 2 as least desirable from a transportation access, safety and remedial action basis. For regional sites, Site 8 was found to be most adequate, and Site 7 was deemed least adequate from a transportation perspective.

4.2.2 Preliminary Environmental Assessment

CDM retained Hicks & Company to perform an environmental assessment of the nine candidate sites. The resulting report is presented in Appendix D and is summarized below.

For the analysis, Hicks and Company identified multiple non-contiguous parcels that might support animal waste processing operations for several of the nine candidate sites, including Sites 1, 4, 6 and 8. These non-contiguous sites are designated by the site number followed by an "A" or "B" suffix (e.g, in the regional of Site 4, two sites — Sites 4A and 4B — were evaluated).

The environmental constraints analysis evaluated the potential for federally listed threatened/endangered species habitat, wetlands or other waters of the U.S., cultural resource sites, and areas within the 100-year floodplain. Each site was noted as "favorable", "neutral" or "unfavorable" for each of these.

Environmental siting constraints were evaluated using available data, maps, aerial photography, and site visits by a Hicks & Company biologist and an archeologist. Due to the lack of landowner-approved access to the sites, field evaluation consisted of observing the tracts from public road right-of-ways adjacent to the site.

Specific siting constraints evaluated, along with their associated criteria and rating basis, are presented below.

- *100-Year Floodplain* – This variable assesses the extent of the site that may lie within the floodplain. 100-year floodplain information was derived from Flood Hazard Boundary Maps for Erath County developed by the U.S. Department of Housing and Urban Development, Federal Insurance Administration. Evaluation criteria are as follows:

  1. *"Favorable"* – No 100-year floodplain mapped for the tract.
  2. *"Neutral"* – Small avoidable area in the 100-year floodplain, usually at the edge or corner of a tract.
  3. *"Unfavorable"* – Extensive areas (over 30 percent of tract) in the 100-year floodplain.

- *Wetlands and Other Waters of the U.S.* – This variable reflects the extent of the site that may be located in wetland areas. Wetlands and other waters of the U.S. (stream channels) information was derived from the U.S. Fish and Wildlife Service, National Wetlands Inventory Maps, analysis of aerial photography (USGS NAPP B&W 1995), USGS 7.5-Minute Topographic maps, and limited field observation from the perimeter of the tract. Evaluation criteria are as follows:

  1. *"Favorable"* – Probably no jurisdictional wetlands or other waters of the U.S.
  2. *"Neutral"* – Small, avoidable areas of potential jurisdictional wetlands or other waters of the U.S., usually at the edge or corner of a tract. These areas are of a size that may be covered under a Section 404 Nationwide Permit.
  3. *"Unfavorable"* – Extensive areas (over 30 percent of tract) with high potential for jurisdictional wetlands or other waters of the U.S.

- *Cultural Resources* – Erath County is an area that is potentially rich in cultural resource sites, and so this variable was included in the analysis. The potential for cultural resource sites was evaluated using several factors. These included: the location and condition of previously recorded sites in the area; presence of topographic highs with proximity to substantial streams; the condition of such locations in terms of exhibiting intact soils or sediments (as opposed to exposed bedrock on surface); and current use of the landscape. Several locations exhibited some of these characteristics; however, these tracts appeared to exhibit very thin surface soils that would tend to preclude the potential for intact sites. Evaluation criteria for this variable are as follows:

  1. *"Favorable"* – Areas with thin surface soils on uplands and slopes, shallow floodplains, and disturbed areas.
  2. *"Neutral"* – Areas exhibiting topographic highs near substantial drainages. These areas exhibit fairly thin surface soils; however, there is a potential for buried or partially intact sites.
  3. *"Unfavorable"* – Tracts that exhibit elevated areas that provide substantial viewshed, and are above the floodplain and yet have good proximity to

water. Additionally, these areas exhibit intact soils/sediments, even on ridge tops, suggesting the potential for intact, possibly buried cultural materials.

- *Threatened/Endangered Species* – A list of potential threatened and endangered species occurring in Erath County was obtained from Texas Parks and Wildlife, Texas Biological Conservation Data System to assess this potential environmental constraint. The main species of concern in the project area are the black-capped vireo and the golden-cheeked warbler, both federally listed endangered species. Potential habitat for the species was evaluated by analysis of aerial photography and limited field observation from the perimeter of the tract. No potential habitat for either species occurs on any of the proposed sites. Evaluation criteria for this variable are as follows:

    1. *"Favorable"* – No potential threatened/endangered species habitat.
    2. *"Neutral"* – Possible potential threatened/endangered species habitat. Habitat assessment recommended.
    3. *"Unfavorable"* – High potential for threatened/endangered species habitat. Habitat assessment recommended.

Figures 4.2-3 and 4.2-4 present the results of the environmental assessment in matrix format for subregional and regional sites, respectively. As shown in the table, CDM has added a "generally favorable" rating to reflect sites that received both favorable and neutral ratings for a given constraint. Although no ranking of sites was performed, Figure 4.2-3 shows that Sites 2, 4A and 6A received unanimously favorable ratings with respect to environmental suitability. For the regional sites, Site 7 received the highest rating.

Figure 4.2-3
Potential Environmental Suitability Matrix – Subregional Sites

Site Name & Number	***Variable***			
	100-Year Floodplain	***Wetlands and Other Waters of the U.S.***	***Potential for Cultural Resource Sites***	***Threatened/ Endangered Species***
Site 1A	○	○	●	○
Site 1B	○	◔	●	○
Site 2	○	○	○	○
Site 3	○	○	◑	○
Site 4A	○	○	○	○
Site 4B	○	◔	○	○
Site 5	○	◑	○	○
Site 6A	○	○	○	○
Site 6B	◔	◔	◑	○

○ = Favorable
◔ = Generally Favorable
◑ = Neutral
● = Unfavorable

Figure 4.2-4
Potential Environmental Suitability Matrix – Regional Sites

Site Name & Number	***Variable***			
	100-Year Floodplain	***Wetlands and Other Waters of the U.S.***	***Potential for Cultural Resource Sites***	***Threatened/ Endangered Species***
Site 7	○	○	○	○
Site 8A	◔	◔	○	○
Site 8B	○	◑	○	○
Site 6B	◔	◔	◔	○

○ = Favorable
◔ = Generally Favorable
◑ = Neutral
● = Unfavorable

4.2.3 Regulatory Considerations

The following analysis of regulatory considerations is based primarily on Texas Natural Resource Conservation Commission (TNRCC) regulations for manure composting. The reasons for this focus are twofold. First, there are no specific regulations that would cover heat-drying of manure or N-Viro processing — regulatory requirements for these processes would likely need to be "pieced together" from regulations applying to similar facilities. Secondly, at least one TNRCC staffer contacted for this study believed that there was a reasonable possibility that other manure processes would be subject to the State's composting regulations, even though these other processes are not identical to composting, per se. As the development process for a regional or subregional facility progresses, it is recommended that the project developers meet with TNRCC staff to map out specific permitting requirements for the facility. Such an effort is preliminary at this time, as neither a site, technology, or facility size have been selected.

Booth, Ahrens & Werkenthin, P.C. of Austin, Texas reviewed regulations that govern the siting of manure composting operations. Their review is presented in Appendix E of this report and summarized here.

For the most part, manure composting operations are exempt from the stringent regulations that govern the construction and operation of facilities that take in other, less innocuous, wastes (such as sewage sludge and municipal solid wastes).

Regulations that may impact the ability to successfully site a manure composting facility are as follows:

- *Texas Natural Resource Conservation Commission (TNRCC) Compost Rules [30 Texas Administrative Code (TAC), Chapter 32].* Manure composting for Erath County would be accorded an "exempt" status under these rules, as long as certain operating parameters are met. Only one of the parameters — a 50-foot setback requirement for facilities processing greater than 2,000 cubic yards at any given time — might affect facility siting. At this preliminary planning stage, we assume that a minimum 150-foot buffer will be provided and that this TNRCC requirement will not impact facility siting.

  Although exempt facilities are not required to construct many of the pollution prevention measures required for non-exempt operations, they nonetheless must comply with the TNRCC general requirements prohibiting adverse impacts to groundwater and surface water. Accordingly, the TNRCC recommends that exempt facilities incorporate the following pollution prevention measures:

  — A lined detention pond to capture rainfall from a 25-year, 24-hour storm;
  — A setback of 500 feet from public water wells and 150 feet from private water wells;

— A 100-foot setback from lakes, creeks, rivers and intermittent streams; and
— Construction outside of the 100-year floodplain.

At this planning stage (where site boundaries have not yet been established), CDM believes that all sites could incorporate the above measures. Accordingly, TNRCC requirements are not expected to limit the ability to develop any of the sites under consideration at this time.

- *Wetlands Protection* - Under the Clean Water Act, construction in a wetlands area would require a "Section 404" permit from the U.S. Army Corps of Engineers. The permit would not likely be granted unless the benefits of a composting operation outweighed the damage to the wetland system.

In essence, regulatory requirements would impact facility siting only when development was planned in wetland or floodplain areas. The presence of wetlands and floodplains were criteria used in the environmental site assessment (Section 4.2) and have therefore not been used here as siting criteria.

Excluding wetland and floodplain criteria leaves only TNRCC setback requirements as a basis for a comparison of sites. Because it is expected that all sites will meet the TNRCC criteria, there is no regulatory basis to compare sites and the site selection effort described below focuses on environmental and traffic issues.

4.3 Selection of Recommended Site(s)

Based on the evaluations presented in Sections 4.1 and 4.2, a summary matrix was prepared to identify preferred sites. The matrix, shown in Figure 4.3-1, also shows the approximate available land area on this site.

The availability of land for development was not formally considered as a siting criterion because the configuration and size of the sites have not been finalized. Nonetheless, available land can be used to assess the relative ease of siting a manure processing facility within a given parcel (larger parcels naturally provide greater siting flexibility). In short, inadequate land area is not considered a fatal flaw at this planning stage, but sites with ample developable land are preferred over smaller sites.

Figure 4.3-1 indicates that preferred subregional sites (those that received generally favorable ratings from both environmental and traffic perspectives) include Sites 4A and 4B (the Lingleville sites). A comparison of the available land area for these sites (24 acres and 29 acres, respectively) and the estimated land requirements for a subregional facility (about 17 acres) indicates that each could accommodate a manure processing operation. The presence of wetlands on Site 4B diminishes the site's usable area, but it is expected that about 75% of the site (over 20 acres) could be developed.

Figure 4.3-1
Site Assessment Summary Matrix

Site Name & Number	***Approximate Available Area (acres)***	***Traffic Impacts***	***Environmental Suitability***	***Comments***
SUBREGIONAL				
Site 1A	41	○	◑	Unfavorable rating for cultural resource sites
Site 1B	22	○	◑	Unfavorable rating for cultural resource sites
Site 2	56	◑	○	
Site 3	23	◑	◔	Potential for cultural resource sites on western half of tract
Site 4A	24	○	○	
Site 4B	29	○	○	Neutral rating for wetlands on NE corner of site
Site 5	18	◑	◔	Neutral rating for wetlands; 404 Evaluation required
Site 6A	75	◑	○	
Site 6B	107	◑	◔	Neutral rating for wetlands and floodplain on NE corner of tract
REGIONAL				
Site 7	38	●	○	
Site 8A	37	○	○	
Site 8B	47	○	◔	
Site 9	174	◔	○	

○ = Favorable
◔ = Generally Favorable
◑ = Neutral
● = Unfavorable

For a regional facility, Sites 8A, 8B and 9 received high ratings. Only Site 9, however, with an estimated 147 acres available, appears to have sufficient area to support a regional manure processing facility. Sites 8A and 8B are split only by a road, however, and together provide enough land for a regional operation (although wetlands and a stream bisecting the sites may reduce the usable land area).

In summary, Sites 4A and 4B appear to offer the greatest potential for the development of a subregional manure processing facility, while Site 9 is the preferred site for a regional facility. Other sites may, upon more detailed investigation, also prove to be suitable for the development of a manure processing facility.

5
Section Five

Section 5
Marketing Analysis

This section, prepared mostly by the Texas Institute for Applied Environmental Research (TIAER), presents a marketing analysis for dairy manure products that might be generated in Erath County. The goals of the analysis are:

- to define product characteristics and benefits;
- to identify and describe potential end users and markets; and
- to identify strategies to penetrate existing markets and develop potential markets.

To assess current markets for processed dairy manure, information was obtained through a regional survey of businesses and institutions, personal interviews and a review of existing literature. Through these sources, end user preferences, trends in the consumption and production of organic soil amendments, and current retail and wholesale prices for manure products were defined.

In addition to the market analysis itself, the following section presents a general discussion of manure product characteristics, benefits and quantities, as well as regulations that govern product distribution and sale.

5.1 Product Definition

In the recent past, animal manure has been manufactured into value added products and sold as soil amendments and specialty fertilizers to a wide range of consumers. Manure products have also been used as animal feed because of their crude fiber content as well as a fuel product through digestion and pelletization. There are two types of products under consideration for production in Erath County: 1) composted dairy manure that can be marketed as a soil amendment; and 2) heat-dried dairy manure that can be blended with organic and/or synthetic fertilizers and marketed as a soil amendment and fertilizer. Each of these products are described below.

5.1.1 Compost

Compost is the product that results from the controlled decomposition of organic materials. The heat generated by the process stabilizes the material to the point where it is beneficial to plant growth. Finished compost bears little physical resemblance to the raw material from which it originated. The product is generally marketed as an organic soil amendment that has the ability to improve the chemical, biological and physical characteristics of soils and growing media. Compost contains plant nutrients, but is generally marketed as a soil conditioner rather than a fertilizer.

In many areas around the country, compost has become a standard commodity within the "green" industry and is becoming increasingly available. National markets for compost are expected to grow at an annual rate of six to eight percent a year.[1] The growth results from a variety of factors including an increase in waste reduction mandates and/or goals adopted by municipalities and the federal government, and an increase in environmental awareness and on the part of the general public. Currently, there are over 3,000 yard trimmings composting facilities and over 200 municipal sewage sludge composting facilities, as well as several mixed solid waste, food waste, industrial by-products and other commercial by-product composting facilities.

Many of these are owned and operated by municipalities, and sales revenue is generally used to offset processing costs. Very few municipal composting facilities are profitable.

Private sector market-driven facilities are also numerous. Probably the best known and largest national company is Scotts/Hyponex, which concentrates its marketing effort through mass merchandisers such as K-Mart and Wal-Mart. Firms such as Hyponex primarily use compost as a filler and blend it with other ingredients such as peat and topsoil to produce a variety of soil amendments. Various regional companies exist which can compete with Scotts/Hyponex on both a quality and price basis. However, these smaller firms tend to concentrate their marketing efforts on garden centers/retail nurseries and landscaping industry professionals.

5.1.2 Heat-Dried or Granular Manure

To generate this product, manures are exposed to a mechanical heating process to evaporate moisture. The end result is a granular or powdery material that can be blended with fertilizers. Temperatures attained during the drying process destroy pathogens and significantly reduce the weight and volume of the material. Dried animal manure and dried sewage sludge are often amended with other organic nutrient sources such as humate and marketed as processed organic fertilizers. Together these products account for an estimated 50-55% of the total annual U.S. supply of processed organic fertilizers. The supply of heat-dried products decreased significantly between 1978 and 1988 due to the high energy costs of heat drying. However, since 1988 the annual supply of heat-dried sludge has more than doubled. The increase is primarily due to reauthorization of the Clean Water Act, which essentially banned the ocean dumping of sewage sludge. The majority of heat-drying facilities are owned and operated by large municipalities such as Milwaukee, Boston, New York and Houston. Together these facilities will produce an estimated 193 thousand short tons of processed organic fertilizers in 1998.[2] Products are

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1 Ron Albrecht Associates Inc., "Study of National Markets for Humus Products", January 1992.

2 Landels, S.P., Kalt, Fredi, P.K. Tekei, N., *CEH Marketing Research Report: Controlled Release Fertilizers*, Chemical Economics Handbook-SRI International. August 1994.

marketed primarily to homeowners and golf courses. Probably the most popular organic fertilizer available, Milorganite, was first developed and distributed by the Milwaukee Metropolitan Sewerage District. Today, Milorganite is distributed nationally and is the predominant organic fertilizer used by golf courses.

5.2 Product Quality and Quantity

5.2.1 Compost Characteristics

Compost characteristics vary depending upon feedstocks and the processing technology used, and, particularly, the knowledge and expertise of compost producer. For instance, cattle manure compost that is properly composted and stabilized possesses a pH near neutral, and much of its nitrogen is converted from ammonia to nitrate. This type of product is highly desirable. Unstable or immature compost will possess a higher pH and a higher concentration of ammoniacal nitrogen, both of which have the potential to damage the crops or plants to which it is applied. Overall, it is important to stress that compost characteristics determine product quality and potential product applications, both of which are essential in the identification of target markets.

Compost quality is usually defined by up to fourteen characteristics. These include: pH, concentration of soluble salts, nutrient content, water holding capacity, bulk density, moisture content, organic matter content, particle size, trace elements and heavy metals, stability, growth screening and maturity, contaminants, weed seeds, and pathogens. The significance of these characteristics is related to their effects on soil or growing media, product handling and transportation, product aesthetics, and product safety. Table 5.2-1 outlines specific compost parameters associated with each of the characteristics listed above. The term "system management" used in the table refers to the characteristic's importance as it relates to plant growth and development.

Certain compost products possess unique characteristics worth reviewing. For example, composts produced from agricultural crop residues typically possess higher nutrient contents and are reasonably free of physical contaminants. Manure based products, however, typically possess a higher soluble salt content than do composts produced from other agricultural by-products. Yard trimmings composts are produced from grass clippings, leaves, brush, etc. and vary widely in quality. Coarser brush based products are sometimes composted and marketed as mulch, where as finely screened products are marketed as compost. Yard trimmings compost is typically lower in soluble salts and nutrient content. Mixed solid waste (MSW) composts tend to possess a higher pH and water holding capacity because of their higher paper content. MSW composts may also include glass, hard plastic, and film plastic contaminants.

Table 5.2-1
Physical Characteristics of Compost and Cow/Steer Manure Compost

Compost Characteristics	***Importance of this Characteristic***	***Typical Range for Various Composts***	***Preferred Range for Average Field Conditions***	***Cow/Steer Manure Compost Typical Range***
PH	Necessary for system management	5.0 - 8.5	6.0 - 7.5	6.5 - 8.3
Soluble Salts	System management, potential toxicity, Watering regime, Fertilizer application rate System management	1 - 10 dS (mmhos/cm)	5 dS (mmhos/cm) or below	5 - 10 dS (mmhos/cm)
Nutrient Content (N-P-K, Ca, Mg) (Dry weight basis)	System management, fertilizer requirements	N 0.5 - 2.5% P 0.2 - 2.0% K 0.3 - 1.5%	N 1.0% or above P 1.0% or above	N 0.5 - 1.5% P 0.5 - 1.0% K 0.5 - 2.5%
Water Holding Capacity (Dry weight basis)	System management, watering regime	75 - 200%	100% or above	Variable
Bulk Density (lbs./cu.yd.)	Product handling, transportation, application rates	700 - 1,200 lbs./cu.yd.	800 - 1,000 lbs./cu.yd.	800 - 1200 lbs./cu.yd.
Moisture Content	Handling and transportation	30 - 60%	40 - 50%	30 - 60%
Organic Matter Content	System management, application rates, cost effectiveness	30 - 70%	50 - 60%	30 - 70%
Particle Size	System management, porosity, specific situation usability	Varies	Pass through 1″ screen or smaller	Pass through ½″ screen or smaller
Trace Elements/Heavy Metals	System management, fertilizer requirements, toxicity, public concern	Varies	Meet US EPA Part 503 Regulations	N/A
Stability	System management, nutrient availability (N), odor generation	Varies	Stable to highly stable	Varies
Growth Screening/ Maturity	System management, seed germination and plant growth	Varies	Must pass seed germination, plant growth assays	Varies

5.2.2 Benefits of Compost

Compost provides broad array of physical, chemical, and biological benefits to soils and growing media, including the following:

- *Improved Structure* – Compost can greatly enhance the physical structure of soil. In fine-textured (clay, clay loam) soils, the addition of compost will reduce bulk density, improve friability (workability) and porosity, and increase its gas and water permeability, thus reducing erosion. When used in sufficient quantities, the addition of compost has both an immediate and long-term positive impact on soil structure. It resists compaction in fine-textured soils and increases water-holding capacity and improves soil aggregation in coarse-textured (sandy) soils. The soil-binding properties of compost are due to its humus content. Humus is a stable residue resulting from a high degree of organic matter decomposition. The constituents of the humus act as a soil 'glue', holding soil particles together, making them more resistant to erosion and improving the soil's ability to hold moisture.

- *Improved Moisture Management* – The addition of compost may provide greater drought resistance and more efficient water utilization. Therefore, the frequency and intensity of irrigation may be reduced. Recent research also suggests that the addition of compost in sandy soils can facilitate moisture dispersion by allowing water to more readily move laterally from its point of application.

- *Modifies and Stabilizes pH* – The addition of compost to soil may modify the pH of the final mix. Depending on the pH of the compost and of the native soil, compost addition may raise or lower the soil/compost blend's pH. Therefore, the addition of a neutral to slightly alkaline compost to an acidic soil will increase soil pH if added in appropriate quantities. In specific conditions, compost has been found to affect soil pH even when applied at quantities as low as 10-20 tons per acre. The incorporation of compost also has the ability to buffer or stabilize soil pH, whereby it will more effectively resist pH change.

- *Increases Cation Exchange Capacity* – Compost will also improve the cation exchange capacity of soils, enabling them to retain nutrients longer. It will also allow crops to more effectively utilize nutrients, while reducing nutrient loss by leaching. For this reason, the fertility of soils is often tied to their organic matter content. Improving the cation exchange capacity of sandy soils by adding compost can greatly improve the retention of plant nutrients in the root zone.

- *Provides Slow-Release Nutrients* – Compost products contain a considerable variety of macro and micronutrients. Although often seen as a good source of nitrogen, phosphorous, and potassium, compost also contains micronutrients essential for plant growth. Since compost contains relatively stable sources of organic matter, these nutrients are supplied in a slow-release form. On a pound-by-pound basis, large quantities of nutrients are not typically found in compost in comparison to most commercial fertilizers. However, compost is usually applied at much greater rates; therefore, it can have a significant cumulative effect on nutrient availability. The addition of compost can affect both fertilizer and pH adjustment (lime/sulfur addition). Compost not only provides some nutrition, but also has the potential to make current fertilizer programs more effective.

- *Provides Soil Biota* – The activity of soil organisms is essential in productive soils and for healthy plants. Their activity is largely based on the presence of organic matter. Soil microorganisms include bacteria, protozoa, actinomycetes, and fungi. They are not only found within compost, but proliferate within soil media. Microorganisms play an important role in organic matter decomposition which, in turn, leads to humus formation and nutrient availability. Microorganisms can also promote root activity as specific fungi work symbiotically with plant roots, assisting them in the extraction of nutrients from soils. Sufficient levels of organic matter also encourage the growth of earthworms, which through tunneling increase water infiltration and aeration.

- *Suppresses Plant Diseases* – Disease incidence on many plants may be influenced by the level and type of organic matter and microorganisms present in soils. Research has shown that increased population of certain microorganisms may suppress specific plant diseases such as pythium and fusarium as well as nematodes. Efforts are being made to optimize the composting process in order to increase the population of these beneficial microbes.

- *Binds Contaminants* – Compost has the ability to bind heavy metals and other contaminants, reducing both their leachability and absorption by plants. Therefore, sites contaminated with various pollutants may often be improved by amending the native soil with compost. The same binding affect allows compost to be used as a filter media for storm water treatment and has been shown to minimize leaching of pesticides in soil systems.

- *Degrades Compounds* – The microbes found in compost are also able to degrade some toxic organic compounds, including petroleum (hydrocarbons). This is one of the reasons why compost is being used in the bioremediation of petroleum contaminated soils.

5.2.3 Characteristics and Benefits of Heat-Dried Manure

Characteristics and benefits of heat-dried or granulized manure are very similar to those of compost in terms of its impact on soil structure and ecology. The primary differences are that the drying process significantly reduces manure weight and volume, and reduces microorganisms present in the material. In addition, heat-dried manure is sometimes fortified with other sources of organic nutrients such as humate. The reduction in weight combined with the dry granular form and relatively high nutrient content make the product suitable for competition as an organic fertilizer. In the fertilizer market, nutrient content is especially critical, and nitrogen content should be at least four percent to effectively compete. Dairy manures generally have a nitrogen content of only about 3%, and if dried, would need to be supplemented (with humate or other nutrient sources) to enhance their value. The consistency and shape of a dried manure product will also affect marketability. For example, large diameter granules may be acceptable for home use, but less acceptable for golf courses. Also, a powdery product can be carried by the wind during and after spreading which can be highly objectionable to both the user and neighbors.

5.2.4 Characteristics and Benefits of N-Viro Processed Manure

Like compost and heat-dried manure, the primary benefit of the N-Viro product is its soil conditioning properties. Because of its organic content, it improves moisture retention in the soil to which it is applied. Other benefits include phosphorus immobilization (which is critical in Erath County), good handling characteristics (the N-Viro product is soil-like in texture and is easily spread with a conventional manure spreader), and the reduction of pathogens. The addition of alkaline materials required to generate the product results in a pH of about 10. A relatively high pH product would benefit acidic soils, but could not be applied in sufficient quantity to degrade alkaline soils.

5.2.5 Product Quantities

When assessing market strategies, it is important to know how much material must be placed in the market. For this study, we have assumed that the volume reduction achieved through composting and drying are roughly equivalent, and a 50% reduction through processing has been adopted. The volume of N-Viro product is slightly larger than the volume of raw manure used in the process because of the alkaline additives. N-Viro estimates that their process will increase the manure volume by about 10%.

Assuming that 232,500 cubic yards of manure is collected in the County annually, we expect that about 116,300 cubic yards (rounded) of compost or heat-dried product would be generated by a regional facility. About 255,800 cubic yards of N-Viro product would be generated. Table 5.2-2 presents the expected product quantities generated by both regional and subregional facilities, based upon the subregional dairy assignments presented in Section 4.

Table 5.2-2
Estimated Manure Product Quantities

Site	Collectable Manure (cy/yr)[1]	Compost or Heat-Dried Product Generated (cy/yr)[2]	N-Viro Product (cy/yr)[3]
1. Mt. Pleasant	30,100	15,100	33,100
2. Landfill	24,900	12,500	27,400
3. Selden	52,800	26,400	58,100
4. Lingleville	33,200	16,600	36,500
5. Gravel Pits	23,100	11,600	25,400
6. Dublin	68,400	34,200	75,200
TOTAL	232,500	116,300	255,800

NOTES:
(1) From Table 4.1-1.
(2) Assumes 50% reduction in manure volume through composting or heat-drying.
(3) Assumes 10% increase in manure volume through processing.

5.3 Product Marketing Regulations

Two federal laws regulate the distribution and sale of products in interstate commerce — the Fair Packaging and Labeling Program (FPLP) and the Federal Trade Commission Act (FTCA). The Federal Trade Commission (FTC) administers both acts. The FPLP establishes labeling requirements for goods, including the affixing of the manufacturer's, packer's, or distributor's name and place of business, as well as the quantity of the contents. The act also establishes guidelines for how that information is presented. The FTCA prohibits unfair trade practices affecting interstate commerce, which includes the dissemination of false or misleading information. The FTC has promulgated an environmental marketing guide under this law to help provide examples of what is an unfair or deceptive act in the context of an environmental claim. The guide does not specifically reference fertilizers, manure, or compost. While these laws are directly relevant to the marketing of manure compost, other federal laws might peripherally apply. Of special note are the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) which would regulate any pesticide mixed with manure compost.

While the federal government clearly regulates interstate commerce, including marketing and labeling of products distributed in interstate commerce, the state of Texas is primarily responsible for regulating fertilizer marketing within the state. The applicable law is Chapter 63 of Title 5 of the Ag. Code, on Commercial Fertilizers. The Texas fertilizer and seed law and regulations state the following: 1) pure processed manure is not regulated by the code, unless claims of its nutrient value to plants are made; 2) processed manure mixed with fertilizer or blends of fertilizer material are considered fertilizer and are regulated by the code; and 3) the code requires processed manure blended with fertilizers or ones labeled with nutrient claims to be registered, and that each distributor and or manufacturer be licensed. This would also impose labeling requirements, inspection and fee requirements, and reporting requirements.

These regulations will have an impact on product production and sale. If no claims regarding the nutrient content of a compost are made, the regulations will allow a significant degree of latitude in product content, quality, and labeling. In addition, there will be no additional costs associated with reporting, inspection and licensing requirements as mandated by the Texas Feed and Fertilizer Control Service (TFFCS). If an organic fertilizer is manufactured and marketed, then the facility will be required to obtain and license from the TFFCS and each distinct fertilizer mixture must be registered. Each registrant must also pay an inspection fee. The basic fee is $0.30 per ton of fertilizer. In addition, a flat fee of $50 dollars per fiscal year is imposed on vendors whose product is sold in five-pound bags or less. Other fees may also apply. Another imposition will be the requirement that the distributor or manufacturer maintain records and file reports when required by the TFFCS.[3]

5.4 Market Definition

The regional market for processed dairy manure will be limited to within approximately a 150-mile radius of the facility. Transportation costs will most likely restrict bulk sales to within a 50 to 100 miles radius depending on the end user.[4] The distribution of bagged compost or organic fertilizer will likely be restricted to a 150-mile radius in the short run; however, as markets are developed and distribution networks established, bagged product can potentially be distributed on a wider basis. The regional market is subdivided to account for differences in population densities and the presence of large urban centers such as Austin and Dallas-Fort Worth (DFW). Each subregional market comprises three or more adjacent counties. Figure 5.4-1 displays each subregional market, and Appendix F contains tabular descriptions for each area.

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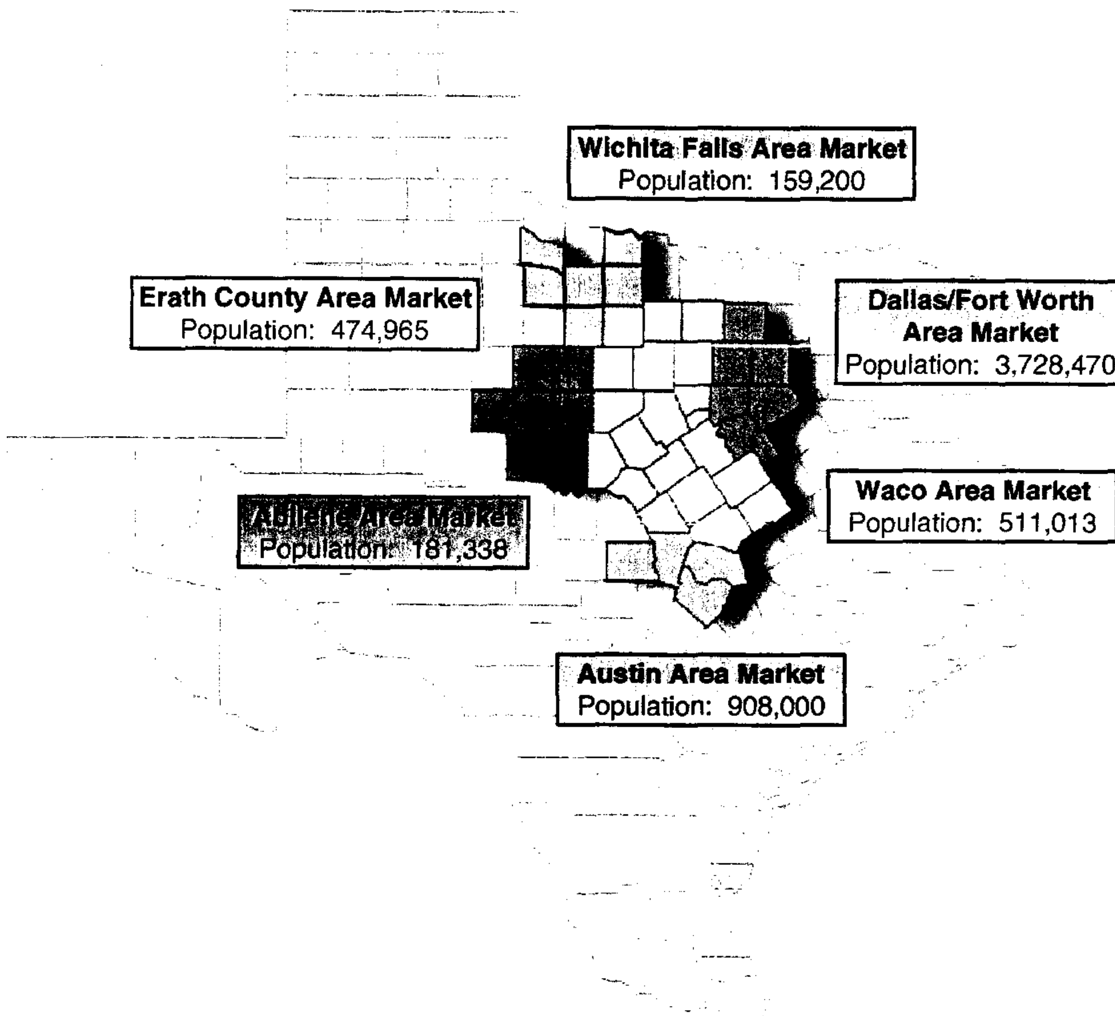
3 See Rottler, C., "The Regulatory Scheme for Manure Marketing". Prepared for the Erath County Animal Waste Management Feasibility Study. Texas Institute for Applied Environmental Research. Tarleton State University, November 1998.

4 This assumes that no back haul opportunities are available. The use of back haul is a very effective distribution tactic used extensively by successful composting entrepreneurs.

Figure 5.4-1
Regional Markets for Compost in Central Texas



5.5 Regional Markets for Compost

An estimated 583,000 cubic yards of compost are consumed throughout the regional market each year, and over ninety percent are sold in the large metropolitan areas of DFW and Austin.[5] Sales in these markets are brisk for a number of reasons. Primarily, DFW and Austin have large concentrations of consumers, particularly in the middle to upper income brackets. Traditionally this group is a large consumer of

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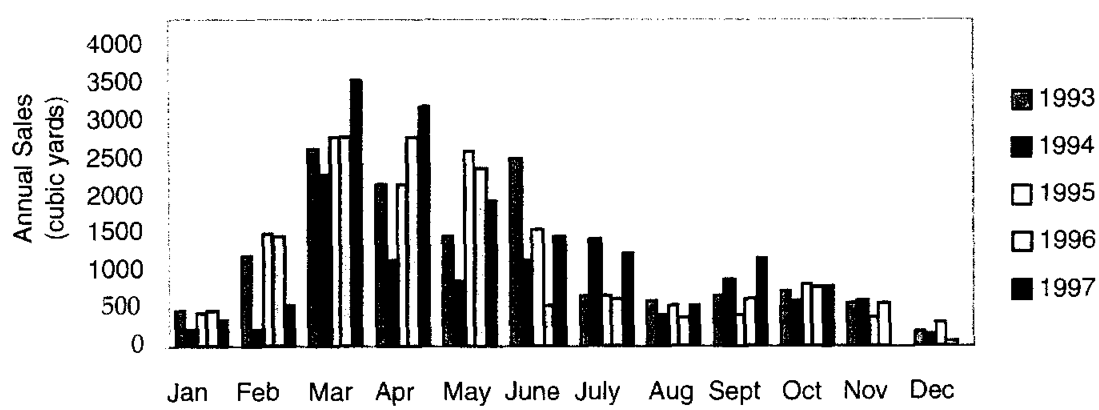
[5] Demand estimates are discussed in greater detail in Section 5.5.4 of this report.

home gardening products such as compost. In addition, environmental awareness and efforts to promote and market "environmentally friendly" products in DFW and Austin are greater than in rural areas. For example, the DFW area hosts a major syndicated talk radio program dedicated exclusively to organic gardening and sustainable agriculture. Although targeted to a specific audience, the program provides a major media outlet for the promotion and sale of compost and related products. Commercial and residential real estate development in DFW and Austin is extensive, and much of the compost sold is blended with soil and distributed to construction and landscaping companies.

Compost sales exhibit a strong seasonal pattern in regions with temperate weather and variable growing seasons. Figure 5.5-1 displays annual sales data for the "Dillo Dirt" compost produced at the Hornsby Bend Composting Facility in Austin, Texas. The data serve as a good proxy for seasonal sales trends throughout the regional market. The majority of compost is distributed from February through July with peak sales in March, April and May.

Most high-volume compost producers increase output substantially in the months of September through December to meet spring demand. During these months, bagged compost designated for distribution to major retail outlets is bagged, palletized and staged on site.

Figure 5.5-1
Monthly Sales for "Dillo Dirt" Compost, 1993-1997



5.5.1 End-User Preferences

Desired compost characteristics vary according to the end-user, but in general, the following are important:

1. Nutrient Value;
2. Properly cured, close to natural humus as possible;
3. Consistent fine texture;

4. No objectionable odor; and
5. No contamination such as weed seeds, pathogens, or debris (rocks, plastic, concrete etc.).

Nutrient value is more important for compost marketed to home gardeners and particularly to commercial growers, while texture and physical appearance are more important to landscapers and land developers. Lack of objectionable odor and contamination are deciding characteristics for all compost consumers in the area.

5.5.2 Compost Pricing

The price of compost varies widely on both a national and local level. Product quality and competition usually determine price, however consumer education and product preference also have a significant impact. Depending on the end user, bulk compost is typically purchased by the cubic yard or ton. High volume customers and brokers who purchase compost for resale ordinarily pay lower prices, while higher prices are paid by retailers who purchase smaller amounts. Retail bulk prices range from around $12.00 to $35.00 per cubic yard, while wholesale prices range from about $6.00 to $27.50 per cubic yard. There is usually an additional charge for delivery.

Bagged compost is sold in one to three cubic foot bags at prices ranging from $0.80 to $3.00 wholesale and $0.99 to $7.00 retail. Mass merchandisers offer the lowest prices for bagged compost. They use compost and related products as a "loss leaders" to attract potential customers, and generate little if any profit from the sale of the products. Garden centers and retail nurseries tend to specialize in locally manufactured products that sell for higher prices. These products are often higher in quality and are packaged and marketed to appeal to local preferences.

5.5.3 Competing Products

Various products compete with manure-based composts; however, the three primary competitors are other compost, bark fines, and peat-based products. The main competitor within the agricultural industry is raw or aged manure. Other products such as bagged topsoil, potting soil and mulch are also potential competing products.

Other Composts

A wide range of composts is sold throughout the region. The most popular are produced from agricultural by-products, primarily animal manure and crop residues. Dairy, cattle, sheep, turkey and poultry are the most common manure-based composts available and are generally the lowest in price. Retail nurseries, garden centers and department stores often use composted dairy manure as a "loss leader". Composts produced from cotton crop residues are probably the most popular and successful products on the market.

Peat

Various types of peat products are available that are suitable for horticultural applications. Peat products are manufactured from the partially decomposed remnants of plants that grow in bogs in the United States and Canada. Peat products are attractive because they are well-decomposed, contain high levels of organic matter, and have an excellent water holding capacity. They are also lower in bulk density than compost, and compress easily which greatly facilitates handling and transportation. Peat products are essentially void of nutrients and possess a low pH. These characteristics can be considered an advantage or disadvantage depending on the end user. For nurserymen, who are the greatest users of peat products, they are considered to be benefits. Most nursery and greenhouses prefer a growing media with a pH below neutral and a low nutrient content, which makes peat an ideal product.[6] Peat humus and sedge peat is often comparable in price to various composts. Sphagnum peat moss is consistently higher in price because of its proven consistency and perceived value. Throughout the region, peat humus is the only type available in bulk form. Bagged Sphagnum or Canadian peat are readily available in retail outlets, but generally are not sold in bulk form. Tables 5.5-1 and 5.5-2 summarize the regional pricing structure for compost and potential competing products.

Table 5.5-1
Comparison of Compost and Competing Product
Bulk Price Throughout Texas

Product	***Retail (cubic yard)***	***Wholesale (cubic yard)***
Manure Compost	$12.50 - $35.00	$6.00 - $27.50
Compost (Various)	$12.50 - $35.00	$5.00 - $27.50
Top Soil and Soil Blends	$10.00 - $40.00	$5.00 - $31.00
Peat Humus	$12.00 - $23.00	$10.00 - $26.50
Bark Fines	$13.00 - $21.00	$16.00 - $24.00

6 Growing media with low levels of intrinsic nutrients allow growers to carefully control fertilization requirements.

Table 5.5-2
Comparison of Compost and Competing Bagged Product Prices Throughout Texas

Product	***Regional Retail***	***Regional Wholesale***	***Unit***
Manure Compost	$0.99 - $2.99	$0.80 - $1.20	(40 lb)
Compost (Various)	$2.15 - $7.00	$0.99 - $3.00	(40 lb)
Top Soil and Soil Blends	$1.95 - $3.95	$0.65 - $2.00	(40 lb)
Potting Soil	$1.00 - $8.99	$0.65 - $3.00	(40 lb)
Peat Moss	$2.33 - $3.75	NA	(1 cubic ft)
Bark Fines	$2.33 - $3.75	$1.10 - $2.00	(2 cubic ft)

Bark Fines

Several types of bark products are marketed in the region. Bark fines manufactured from softwood pine grown in Texas and elsewhere are the main competitor to bulk compost within the landscape and nursery industry. Bark fines improve the physical characteristics of soils and soil media. They provide porosity, drainage and possess a cation exchange capacity that improves with age, and they are also an excellent source of beneficial soil microbes. Because they are low in cellulose and high in lignin, softwood bark fines can be applied either fresh or composted and do not decompose rapidly.

Manure

In most agricultural applications, the most prevalent competing organic product is raw or aged animal manure. Manure from a variety of livestock, including cows, chicken, turkey and horse is used as a source of nutrients and organic matter. Extensive use of manure is limited to areas where there is an abundant supply and crops are in close proximity. The benefits and physical characteristics of composted manure and raw manure are similar in many respects, however there are some significant differences. Raw manure is typically more odorous than composted manure, and may contain pathogens and weed seeds. In addition, some manure contains relatively high concentrations of ammonium and much of this is quickly nitrified and subject to leaching. Also, because raw manure is not stabilized or decomposed when incorporated into the soil, much of the nitrogen already present in the soil will be "tied up" or immobilized by microorganisms that support the decomposition process. Stabilized composts have little decomposable substance remaining, which increases the amount of plant available soil nitrogen. Also, the physical condition of manure, particularly that of cattle and cows, often makes it difficult to spread in a uniform manner. High quality compost offers a much finer consistency that makes it more suitable for high-volume land application. Overall, compost is better suited for agricultural applications. However, it costs significantly more than raw manure, which is often provided free of charge or for the cost of hauling and spreading. In some areas, particularly where poor or sandy soils exist, manure is compost's greatest competitor.

5.5.4 Estimated Compost Demand in Regional Market

Regional demand estimates are based on survey data obtained from producers and consumers of compost in north central Texas, personal interviews with compost producers, on site tours and evaluations of composting facilities, and a review of relevant literature. Appendix G presents the results of surveys conducted and site reports are included in Appendix H. Groups identified through these efforts as existing and potential users include:

1. Landscape contractors
2. Landscape and bulk material suppliers
3. Retail hardware outlets (Ace Hardware, etc.)
4. Department Stores (Wal-Mart and K-Mart)
5. Home Centers (Home Depot)
6. Field and container nurseries
7. Garden centers and retail nurseries
8. Golf courses
9. Parks and recreation departments
10. Public Agencies
11. Agriculture (horticultural and row crops)

For each group, estimates for average annual consumption were derived and were compared with the number of users in each market area in order to assess current market demand. User group counts are those of American Business Information Systems and are based on Standard Industrial Classification (S.I.C) codes. Parks and recreation facilities, field and container nurseries and public agencies are not included in final demand estimates. It appears that compost consumption by these groups is insignificant relative to the other groups included. Table 5.5-3 presents estimates for current quantity demanded for each user group. It should be noted that these figures are not intended to be definitive, but rather they serve to illustrate the comparative size and strength of each subregional market. In addition, the amount of compost blended with soil and marketed as other products such as organic topsoil and potting soil is difficult to assess. Thus, estimates presented are most likely understated.

Table 5.5-3
Regional Market Demand Summary
(Estimated current demand in cubic yards per year)

Markets ***User Groups***	***Austin Area***	***DFW***	***Waco Area***	***Erath Co. Area***	***Abilene Area***	***Wichita Falls***	***TOTAL***
Landscape Contractors and Bulk Material Suppliers	130,000	285,000	20,000	6,000	4,000	3,500	**448,500**
Hardware Retail (Ace Hardware, etc.)	1,000	3,000	500	1,000	250	250	**6,000**
Department Stores (Wal-Mart, K-Mart)	7,000	16,000	2,500	2,000	1,000	1,250	**29,750**
Home Centers (Home Depot)	2,000	10,500	1,000	0	1,500	500	**15,500**
Garden Centers and Nurseries	21,000	40,000	6,500	6,500	3,000	1,500	**78,500**
Field and Container Nurseries	minimal	minimal	minimal	minimal	minimal	minimal	**NA**
Parks and Recreation	minimal	minimal	minimal	minimal	minimal	minimal	**NA**
Public Agencies (TxDOT)	minimal	minimal	minimal	minimal	minimal	minimal	**NA**
Golf Courses	500	500	500	minimal	minimal	minimal	**1,500**
Agriculture	1000	1000	1000	1000	minimal	minimal	**4,000**
Total	**162,500**	**356,000**	**31,500**	**16,000**	**9,750**	**7,000**	**583,750**
Percentage bulk	**85%**	**84%**	**64%**	**40%**	**46%**	**50%**	**71%**
Percentage bagged	**15%**	**14%**	**36%**	**60%**	**54%**	**50%**	**29%**
Current market population	**908,000**	**3,728,420**	**511,010**	**474,970**	**181,340**	**159,200**	**5,055,850**
Compost demand per capita (cu.ft.)	**4.5**	**2.6**	**1.7**	**0.9**	**1.5**	**1.2**	**NA**
Percentage of total estimated demand for regional market	**28%**	**61%**	**5%**	**3%**	**2%**	**1%**	**100**

The above estimates can provide some insight into the variation in compost use among the region's markets and, potentially, indicate markets with the greatest growth potential. Table 5.5-3 compares the populations of each market area with its estimated compost demand. As shown in the table, Austinites use far more compost than any other market segment, with an estimated 4.5 cubic feet per capita. In some respects, this relatively high usage can be credited to strong residential growth.

However, vigorous and successful public education campaigns for the City's Dillo Dirt compost must be credited as well, as they raised public awareness of the benefits of compost use. The campaigns "opened the door" for other composts that are now produced and marketed in the region. In short, compost demand in Austin is a strong testament to the importance of public education to successful compost marketing. Strong public education efforts in other market areas that exhibit a lower per capita compost use could conceivably increase compost demands in those areas significantly.

5.5.5 Compost End Users and Resellers Survey

As noted earlier, TIAER surveyed potential users of an Erath County compost as the basis for determining target markets. The surveys are included as Appendix E and summarized below. Based upon the survey results, this section also describes the potential role of individual user segments as target markets for an Erath County product.

Landscape Contractors and Bulk Material Suppliers

Landscapers use compost extensively in garden and turf establishment, renovation, and maintenance on residential and commercial property. Of the landscape contractors surveyed, seventy-five percent use at least thirty cubic yards of compost per year, and some of the larger firms use more than several thousand cubic yards per year. For example, AAA Grass and Landscape of Austin uses and distributes approximately 4,000 cubic yards each year. Compost demand by landscapers is particularly robust in the Austin and DFW areas. Estimated annual consumption in Austin and surrounding communities is at least 130,000 cubic yards and at least 285,000 cubic yards in the DFW area. These estimates would probably increase considerably if all of the compost contained in manufactured topsoil were included. In the remaining subregional markets, demand is considerably lower. The end user population is much smaller and less concentrated making bulk delivery more difficult and costly.

The majority of landscapers contacted prefer a product with a uniform consistency and free of seed contamination and objectionable odors. The product must also be well cured and rich in nutrients and organic matter. Landscapers obtain compost and topsoil from bulk material suppliers and garden centers. Bulk material suppliers produce, market and distribute a variety of composts, mulches, pine barks, and soil blends. Living Earth Technologies of Dallas is a good example. The firm manufactures and sells approximately 150,000 to 200,000 cubic yards of compost and other organic soil amendments each year and caters primarily to landscaping companies and high-volume retail nurseries and garden centers. Bulk material suppliers use considerable amounts of compost in the production of topsoil blends, which are used extensively in landscape and construction projects.[7] Garden centers also provide wholesale bulk and bagged compost to contractors with smaller operations.

Overall, it is estimated that landscapers and bulk material suppliers account for around seventy to seventy-five percent of annual compost consumption throughout the regional market. The landscaping industry is a primary target market, however transportation costs will be a limiting factor. Without back haul, market penetration in the DFW and Austin areas will be difficult, and competition from well-established compost producers in these areas will be significant. It might be possible to provide composted manure to bulk material suppliers in and around DFW as a raw material that could be processed at their facilities, however most of the firms agreed that transportation costs would be prohibitive.

Retail Nurseries, Garden Centers, Department Stores, Retail Hardware and Home Centers

Homeowners generally purchase compost and other soil amendments is in bagged form at garden centers and large retail outlets such as Wal-Mart and Home Depot. Professional end-users, particularly small-scale landscapers, also purchase bagged compost usually at discounted prices from local vendors. Most bagged composts are sold during the spring. Sales are generally lower during summer and fall, and decrease dramatically in the winter. Various size bags are available. By far, the most popular is the forty pound size, although some compost is distributed in three cubic foot bags.

Approximately 80 percent of retail outlets surveyed sold some form of compost. Annual sales ranged from approximately 20 cubic yards for small retail nurseries to 2,500 cubic yards for large mass merchandisers such as Wal-Mart. The largest nurseries and garden centers are located in the DFW and Austin areas. For example, Calloway's Nursery currently has fifteen retail stores located throughout DFW and marketed approximately 67,000 forty-pound bags of compost in 1997. The Nicholson-Hardie Nursery of Dallas sold over 5,000 one cubic foot bags in 1997, sales of which were more than double that of bagged peat moss or pine bark mulch. The managers at both stores acknowledged that demand for compost in DFW is brisk and has grown in recent years due to an increase in environmental awareness on the part of the public. The most popular bagged composts are produced from a variety of different feedstocks and are marketed as organic soil amendments. Compost manufactured from cotton burrs are probably the most successful. These products have a consistent fine texture, weigh less than other composts, and are generally free of objectionable odors. A number of bagged dairy manure products are sold in the region, and most are marketed as "cow manure" rather than compost. These

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[7] In many parts of Texas, raw soil contains very little organic matter. Many topsoil dealers blend soil with compost. This greatly increases organic matter content and improves the physical and aesthetic characteristics of the soil making it more attractive to potential customers.

products are generally lower in price than other composts and some are of questionable quality.

Overall, it is estimated that the bagged retail market accounts for approximately twenty-five to thirty percent of annual compost consumption in the regional market and should be considered a primary target market. In order to penetrate this market on a large scale, it is important to differentiate the Erath County compost from lower quality manure products (marketing the product as composted manure may lower its market value by placing it in direct competition with lower priced products of marginal quality). Toward this end, the Erath County product bags (and name brand) should emphasize the compost benefits (rather than the compost's derivation). Alternately, the product could be blended with other organic by-products and marketed as an environmentally friendly soil amendment rather than "composted cow manure".

Field and Container Nurseries

There are several types of nurseries in the region including greenhouse, container, and field nurseries. Greenhouse and container nurseries generally use a combination of pine barks, peat moss, and soil-less mixes for growing media. Field nurseries use pine bark and peat moss to improve the soil in which trees and shrubs are grown. Only high quality composts that are well-stabilized and low in soluble salts are acceptable in nursery applications. For this reason, animal manure composts are not used extensively by nursery growers.

Several container and field nurseries were contacted during the market survey, and none currently use compost as a potting soil or growing medium. Nursery managers and owners stressed that compost alone is too high in salt content and cannot be used as a potting soil.[8] Most of the growers contacted use commercial soil-less mixes as potting soil and prefer pine bark mulches for use in their field operation. For example, Green Creek Nursery is a high volume field and container operation in Stephenville, Texas. The company currently uses as much as 3,000 cubic yards of pine bark mulch per year. The owner stated that he is very skeptical of plant and manure-based composts because of potential weed and disease contamination, which can be very difficult and costly to eradicate. As a rule, this segment of the market is difficult to penetrate on a large-scale as it requires more research and demonstration, as well as a need to work closely with individual customers. The current market for compost use among field and container nurseries is minimal and they should not be identified as a target market.

8 Bulk material suppliers who use compost in the production of potting soils blend it with other ingredients such as peat humus, peat moss, perlite, and rock powders. This is done according to the consumer's specific needs.

Parks and Recreation

Compost applications by this market segment include turf establishment and maintenance, the amendment of plant bed soil, and back-fill for shrub and tree plantings. Throughout the region a number of municipal parks and recreation departments were contacted. The degree of use varied from city to city. For example, the city of Abilene uses small amounts, 50 cubic yards per year, of Back to Earth cotton burr compost on flowerbeds and shrubs; however, for athletic fields and turf the parks department uses chemical fertilizers only. The parks and recreation department in Wichita currently uses a biosolids compost produced at the Wichita Municipal Recycling Facility. The compost is blended with topsoil and applied on turf within the city's parks. The park superintendent is pleased with the performance of the compost and hopes to eventually reduce or eliminate the need for commercial chemical fertilizers.

In general, compost consumption by this market segment is limited, and the growing availability of compost generated by municipal recycling facilities will make this market difficult to penetrate on a large scale. Municipal parks and recreation departments will find it hard to justify expenditures on commercial products when in-house products are readily available at little or no expense. This segment is not seen as a primary target market in Erath County.

Public Agencies

The public agency category includes state and federal agencies and facilities. In recent years, an increase in environmental awareness on the part of the public has urged many federal and state agencies to adopt mandates promoting the use of environmentally friendly products and services. The Texas Recycling Law HB 1340 and Clean Texas 2000 sponsored by the Texas Natural Resource Conservation Commission (TNRCC) prompted the Texas Department of Transportation (TxDOT) to conduct a study assessing the use of compost as an erosion control material.[9] The prevention of erosion allows TxDOT to comply with the National Pollutant Discharge Elimination System regulations issued by the Environmental Protection Agency in 1990.

According to the study, prompt vegetation establishment following roadway construction is crucial for effective erosion control. If grasses fail to grow, soil washes away during heavy rainfall and erosion can damage roadway pavement. In addition, eroded soil can wash downstream and adversely affect water quality and aquatic habitats. However, the establishment of proper vegetation is difficult due to poor soil quality along many roadsides in Texas. The addition of compost to marginal soils not only provides plant nutrients, but in clay soils it reduces soil compaction and allows the soil to retain moisture. In sandy soils, compost acts as a sponge that helps retain water that would otherwise drain below the reach of plant

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[9] Storey, B., McFalls, J. and Godfrey, S. "The Use of Compost and Shredded Brush on Rights-of-Way for Erosion Control: Final Report". Research Report 1352-2F. Texas Transportation Institute, College Station, Texas. November 1995.

roots. Overall, the study demonstrated that the use of compost is as effective as other erosion control materials currently used by the agency and surpasses others in terms of cost effectiveness. Encouraged by the results of the research, TxDOT drafted "Specification Item 1009: Furnishing and Placing Compost".[10] The specification defines the three types of compost products acceptable for use in roadway construction and maintenance, "Compost Manufactured Topsoil", "Erosion Control Compost" and "General Use Compost".

Although current use of compost by TxDOT is limited, this market segment has significant potential for development. The proven success of compost as an erosion control material combined with regulatory pressures will likely encourage TxDOT to utilize compost on a much wider basis in future projects. Engineers and maintenance representatives from regional TxDOT offices have expressed considerable interest in the employment of compost for local roadway construction and maintenance activities. However, composted dairy manure produced at the facility will most likely be too high in salt content in order to qualify as "general use compost" under current specifications (TxDOT requires that compost in this category have a soluble salt content lower than 4 mmhos, a limit that most compost marketers and users believe is unreasonably low for the intended application). An alternative would be to blend the material with soil in order to reduce salinity and market the product as a "compost manufactured topsoil". If developed, this market segment could provide a high volume outlet for material processed at the proposed facility.

Golf Courses

Potential uses of compost on golf courses include the establishment and maintenance of gardens and turf areas such as roughs, fairways, tees and greens. Greens are typically constructed out of sand that contains only small amounts of organic matter. Lack of organic matter provides little buffer against turf stresses and diseases that can damage root structures.

Throughout the region, compost use on golf courses is sporadic and limited. The superintendent of The Tennison Municipal Golf Course of Dallas estimates that the city allocates only around five percent of its grounds maintenance budget to organic soil amendments and fertilizers. He noted that the majority of this is used to purchase peat moss, which is required by the United States Golf Association in the construction and maintenance of fairways. The Grover C. Keaton Golf Course of Dallas uses compost produced on-site with yard wastes. The groundskeeper applies the compost to portions of the fairways and is pleased with the overall results. He also purchases approximately two tons of Milorganite per year for use on greens and tees. The superintendent stated that they are in the process of having the course certified as a bird sanctuary by the National Audubon Society. In order to obtain the certification, the course must be classified as "organic", which entails using a certain percentage of organic soil amendments and fertilizers. He also noted that golf courses typically apply excessive amounts of pesticides, which can significantly

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10 See Appendix C.

reduce the microbial activity responsible for organic matter decay. The result is that much of the organic matter is un-decomposed "thatch" that is of little or no value to the soil. Overall, the superintendent stated that he likes the organic approach and is interested in the possibility of using more compost, preferably on a trial basis. He did note however that the majority of golf courses in the area are skeptical of the organic approach, and rely primarily on slow release chemical fertilizers, which are considered cost effective, reliable and easy to apply.

Although current demand by golf courses is limited in the region, the market has potential for development due to the increasing availability and quality of compost products, and a recognition of composts many benefits. However, the majority of golf courses in the region are located near large metropolitan areas such as DFW and Austin, and any increase in demand by this market segment will likely be met by established compost producers.

Agriculture

Agriculture is probably the largest potential market for compost from Erath County. If developed, this market alone would ensure the long-term sustainability of a large-scale composting operation. On a national basis, organic farmers are the primary agricultural consumers of compost. The majority of traditional farmers do not perceive compost use as economically viable. However, in some areas of the country compost is gaining popularity as a means to reduce chemical applications and growers are increasingly realizing the benefits compost use.

The main value of compost with respect to crop production is its ability to enhance the physical and chemical properties of soil.[11] Repeated applications over a period of several growing seasons can result in less compacted soils with greater water and nutrient retention capability, or in essence, a soil highly suitable for agriculture. Well-made compost is very similar to naturally occurring humus. Applying compost to a marginal soil can have lasting positive effects, although applications over many growing seasons are sometimes required to optimize soil enhancement.

When compared to inorganic fertilizers, compost is low in nutrient value. Synthetic sources range between ten and one hundred times higher. For example, in order to meet a crop requirement of 200 pounds of nitrogen per acre, a grower would need

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[11] Soil organic matter consists of humus, plant roots, fungi, bacteria, and other organisms such as earthworks and insects; however, only about one-tenth of the total organic matter is actually alive. The remainder is composed of dead, decaying, or decayed organic matter that provides nutrients for the myriad of microorganisms in the soil. As microorganisms consume this material, many of the nutrients present in organic compounds of dead cells are converted to an inorganic ionic form that is readily available to plants. Decayed matter is also converted into a relatively stable form known as humus, which, when present in sufficient volumes, increases soil interstitial water and air. The result is a less compacted soil with greater water and nutrient retention capability, or in essence, a soil highly suitable for agriculture. See Tietjen, C. and Hart, S., "Compost for Agricultural Land". Journal of the Sanitary Engineering Division: Proceedings of the American Society of Civil Engineers, 1969.

435 pounds of urea (46 percent nitrogen) compared with 20,000 pounds of compost. Nutrients in compost must also be released from their organic substrates before they are available to crops. This process may take anywhere from several days to several months to complete. In general, the nutrient release patterns of compost are a function of many different biological and environmental factors, and the use of compost as a primary source of nutrients requires a great deal of experience and knowledge.

In north central Texas, compost utilization in row crop production and horticulture is currently limited, however in the High Plains region of Texas, there is an exception worthy of review. The Birkenfeld brothers (Keith, Bob and Greg) began producing compost and applying the product to their farm acreage located west of Tulia in the Texas Panhandle five years ago. Originally, the composting operation was an initiative to reduce the amount of chemicals used by the Birkenfelds. According to Bob, "Farming the conventional way just wasn't fun anymore, and it wasn't particularly profitable either. The soil was getting so compacted that the ripper (chisel) was leaving clods the size of big boulders on top of the ground. We were using lots of chemicals in a vain effort to control insects like the Russian wheat aphid, and lots of fertilizers to keep yields up. There had to be a better way." The better way included adopting integrated pest management practices and using compost as a substitute for chemical fertilizers and as a means of increasing the quality and health of the soil.

After realizing the benefits of sustained compost use, the Birkenfelds decided to market the material to area cotton and peanut farmers. [12]

Convincing growers to adopt a more organic approach to farming presented challenges. Compost producers and consistent users are well aware of the long-term agronomic benefits of compost, however farmers who have traditionally relied solely on chemical inputs are often skeptical. As Bob pointed out, most farmers today grew up in an environment where chemical intensive cultivation practices were heralded as the most effective and efficient means of production. Farmers tend to follow the status quo, and given the narrow profit margin many face, they are risk averse and resistant to change. In addition, the benefits of compost are not widely promoted by agricultural institutions such as university extension services and commercial fertilizer companies. Efforts to promote organic or sustainable agriculture are often viewed as politicized propaganda, and in general, organic farming is not considered economical. Therefore, the Birkenfelds must compete with well-established fertilizer and chemical companies and promote the nutritional value of their product rather

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[12] The Birkenfelds produce compost with cattle manure and crop residue from nearby feedlots and cotton gins. Price per ton is $13.00 freight on-board. Transportation costs about 10 to 12 cents per mile per loaded ton and the application fee is $5.00 per ton. Grain trucks haul the compost to the field where a front-end loader transfers the material into spreader trucks for land application. The spreaders require a significant investment on the part of the Birkenfelds. Prices for spreader trucks range from around $20,000 to $80,000, but they are necessary in order to effectively apply compost in the field. Each truck is equipped with a radar-sensing device under the front bumper that detects changes in ground contour and elevation. This information is relayed to an on-board computer that adjusts the rate of application if necessary.

than its ability to increase soil health and productivity. Rather than compete with the fertilizer industry, the Birkenfelds stressed the need to establish cooperative relationships with local fertilizer distributors. Compost generally does not contain sufficient levels of plant nutrients, and farmers who use compost often do so in conjunction with inorganic fertilizers. In other areas of country, alliances with fertilizer companies are proving successful. For example, Compost West Inc. of Jerome, Idaho currently markets approximately 50,000 tons of dairy manure compost to row crop farmers. To facilitate market development, Compost West established a partnership with a regional fertilizer distributor. Both companies encourage growers to apply a combination of compost and inorganic fertilizers with the logic that compost will reduce leaching and increase fertilizer efficiency. The fertilizer distributor also provides transportation and application services for both compost and fertilizer.

Companies in Texas and elsewhere have successfully established agricultural markets for compost. In order to prosper, entrepreneurs such the Birkenfelds have devoted many years to market development through research and the establishment of ongoing relationships with farmers. The time and knowledge needed to develop agricultural markets relative to the economic return does not provide an adequate incentive for most investors. The beneficial effects of compost are long-term and not widely understood, and selling in this market requires a significant educational and promotional effort in order to bridge the inherent skepticism of many growers.

The agricultural sector in the region could provide a high volume outlet for compost. Crop production in surrounding counties is extensive and varied. Table 5.5-4 lists significant crop acreage within approximately a 50-70 mile radius of the proposed Erath County facility(ies).[13] One of the marketable benefits of compost to regional growers is its ability to enhance the physical and chemical characteristics of soils. The soil in Erath and surrounding counties is of marginal quality. Referred to as Caliche or Nimrod, the soil is often void of nutrients, very low in organic matter and lacks water retention capability. Repeated applications of compost over a period of two or three growing seasons could significantly improve the adsorption capacity of the soil, thereby reducing irrigation and fertilizer costs. In addition, as levels of organic matter increase, soils would retain nutrients more effectively. The potential to market compost to area peanut, watermelon, pecan, wheat and cotton growers is substantial. Peanuts are particularly attractive because they require fewer nutrients than most crops, particularly nitrogen, which makes compost ideal.[14] At an application rate of two tons per acre, five percent of current peanut, watermelon, wheat,

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13 Organic farming is currently very limited in the immediate area. Only one certified organic producer is located within 50 miles of the proposed facility, and only 11 are located near the Dallas/Fort Worth area. The majority of organic producers, over 75 percent, are concentrated in the southern portions of the State, particularly in the Rio Grande Valley.

14 Peanut production in the area has declined in recent years. Many growers have relocated to west Texas where the soil is of better quality. In addition, the 1996 farm allowed the limited sale, lease and transfer of quota across county lines. The extent to which the industry will decline is difficult to predict, but may affect marketing strategies in the future.

cotton and pecan acreage would require approximately 51,000 cubic yards of compost each growing season. As markets are developed, this amount could increase considerably. In addition, as soil fertility and productivity increased, different types and varieties of crops such as alfalfa could be introduced to the area. It is also conceivable that organic farming be established in the county. The agricultural market has strong potential. If developed successfully, this market segment would consume substantial quantities of compost produced at the proposed facility.

Table 5.5-4
Significant Crop Acreage (approximate)
Within a 50-70 Mile Radius of Stephenville, Texas

Crop	*Acreage*
Corn	3,900
Wheat	157,000
Hay, Forage and Silage	440,000
Upland Cotton	4,000
Peanuts	74,200
Watermelons	2,500
Pecans	22,000

SOURCES: Texas Agricultural Statistics Service, 1996
U.S. Census of Agriculture, 1992

5.6 Regional Markets for Heat-Dried Manure

Compost is the dominant form of processed dairy manure marketed in the region, however, there are some manure and municipal biosolids heat-dried or pelletized products available. Dehydrated manure products cost significantly more than compost, but guarantee a higher nutrient analysis. In addition, the dry granular form makes these products ideal for application with a manual or mechanical fertilizer spreader.

In the Dallas/Fort Worth Area, two companies that market heat-dried products as organic fertilizer were contacted. Greensmiths Inc. produces and distributes an organic fertilizer manufactured from municipal sewage sludge with a nutrient content of 6-3-2 (NPK). Primary end users are home gardeners and golf courses. The company delivers the product in bagged or bulk form. Wholesale bagged prices are around $6.50 per fifty-pound bag. Wholesale bulk prices are approximately $150 per ton (freight on board) and $180 per ton delivered anywhere within about a 50-mile radius of the Dallas/Fort Worth Area. Rhodes Nursery of Dallas markets heat dried dairy manure under the label *Greensense Organic Fertilizer*. The product is blended with humate and has a nutrient rating of 5-2-4 (NPK). Cargill Feed of Dallas manufactures the material on a contractual basis, and Rhodes is responsible for marketing and distribution. Homeowners are the primary consumers. The product sells for $13.99 per forty-pound bag retail and around $7.00 per bag wholesale. The owner commented that his company is in the process of developing bulk markets for the product. However, he stressed the difficulty given that his product is considerably more expensive than other organic soil products such as compost and he faces strong competition from traditional inorganic fertilizers.

Some end users surveyed expressed mild interest in an organic fertilizer product. However, potential bulk customers such as landscapers and golf courses stressed that the product must be cost competitive with traditional inorganic fertilizers in order to compete effectively. In addition, processed organic fertilizers are generally too expensive and low in nutrients for use in traditional row crop agriculture. Enhancement of the product with supplemental nutrients would likely be required to compete with fertilizers in the agricultural market. Unenhanced heat-dried manure could potentially be used as an organic filler in fertilizer blends, but it is unlikely that this outlet would provide a revenue stream according to a broker of heat-dried products. Organic farming is often cited as a potential market, however there are few organic producers in the region, and in general, organic growers rely on compost and other more cost-effective sources of organic nutrients. The retail bagged market (home gardeners and lawn maintenance) is probably the market segment that offers the greatest potential for cost recovery.

5.7 Existing Market Potential

Existing market potential for a processed Erath County manure was explored in depth only for compost, as composting is the only proven technology that has been proven on a large scale for manure processing. This section summarizes existing market potential for a compost product, but also discusses in a more limited fashion potential markets for heat-dried and N-Viro products.

5.7.1 Compost

As indicated in previous sections, existing markets for compost products appear to be relatively robust, particularly in large urban areas with concentrated populations such as the DFW and Austin areas. Additionally, many compost producers and distributors expect growth in the market over the next five or ten years as environmental awareness on the part of consumers increases.

Penetration of those markets by a compost generated in Erath County, however, will take a considerable effort. Factors to overcome to establish an Erath County product in existing markets include:

- *High Transportation Costs* – The proposed composting facility will be at least seventy miles from a major market. Without the use of back-haul, the bulk market in DFW and Austin will be difficult to penetrate. A compounding factor is the presence of numerous well-established and efficient producers in and around the major market areas. These firms manufacture high quality products and have well-developed infrastructures and strategies to satisfy existing demand.

- *Low Initial Revenues* – The perceived value of manure compost is low at this time, and retail outlets often use the products as a "loss leader". Composts produced from crop residues such as cotton burrs have a higher perceived value. Lack of industry standards or product regulation contributes to the production and sale of low quality composts. Much of the dairy manure compost available in retail outlets is priced very low and is of questionable quality. Low quality or improperly manufactured products can potentially decrease demand and lower market price.

- *Competing Products* – In and around major market areas, there are numerous well-established and efficient producers. As result, there is no shortage of supply of compost available to any category of user or re-seller in this market.

- *Lack of Public Familiarity With the Product* – An information barrier concerning the benefits of compost and its proper use seems to exist between producers, research institutions and the general population. There is a plethora of university and extension research documenting potential benefits and applications of compost, but little of this information appears to be reaching the general public and the agricultural community.

Each of these market barriers can be overcome with infrastructure development and a creative marketing strategy. The process will be slow, however, and the County should not expect a significant penetration of market for at least several years after composting begins.

Several undeveloped markets, including agriculture and TxDOT, are proximate and potentially high volume market segments that offer greater short-term promise as outlets for an Erath County product.

Section 5.8 presents marketing strategies to develop these untapped markets, as well as a strategy to enter established markets.

5.7.2 Heat-Dried Manure

Demand for heat-dried product is hard to estimate, largely because of the vast array of competing products - which includes the strongly established inorganic fertilizers. An advantage of heat-drying from a marketing perspective, however, is that it improves product handling characteristics and facilitates transportation to distant markets. Rather than the 150 mile radius assumed for compost products, a much larger marketing area is feasible for heat-dried product. For example, Milorganite (manufactured in Milwaukee, WI) is marketed across the nation. Additionally, bulk product from the northeastern seaboard is regularly marketed in Florida.

In order to generate a revenue stream, it appears that a heat-dried manure would need to be enhanced to increase its nutrient content. Exactly how much supplemental nutrients should be added is in question, however. The types and amounts of supplements will be largely determined by target markets (some fertilizer blenders even create "custom blends" for their clients' specific needs). Should heat-drying be deemed feasible from a technological perspective (through pilot studies), then a more detailed study should be performed to determine the level of enhancement required to effectively compete with other fertilizers.

5.7.3 N-Viro Processing

N-Viro Soil generated from biosolids is not traditionally marketed — it is generally given away to nearby agricultural users. Because the new N-Viro process has not been applied at a full-scale to manure management (and specific descriptions of the process are unavailable) it is difficult to predict market size, but we can draw parallels between N-Viro biosolids and N-Viro manure products that might establish marketing boundaries.

First, because the process increases raw material volume, transportation opportunities are limited — at this time, we envision that the product would have to be used in or around Erath County. The immobilization of nutrients by the process makes it possible to meet water quality goals, however, without physically removing manure from the County.

Secondly, the primary use of N-Viro biosolids has historically been in the agricultural sectors, which is not generally a lucrative market for biosolid-type products. The N-Viro product, in fact, is generally given away. Because Erath County has a strong agricultural base, a potentially large market for an N-Viro manure product exists in close proximity to a proposed management facility. We assume, however, that an Erath County N-Viro manure (like biosolids) would be given away, and would therefore generate no revenue.

5.8 Market Clearing Strategies

The following discussion of market clearing strategies focuses on compost — strategies for marketing heat-dried and N-Viro products are not included. Market clearing strategies for a heat-dried manure are not presented because the technical feasibility of this option for Erath County manures has not yet been proven. If and when it is determined (through pilot studies) that the process is feasible, then market potential can be assessed based upon the characteristics of the product generated during piloting. For N-Viro manure products, distribution of product to the local agricultural sector may be required, but as other N-Viro products have not been sold in the past, we assume that distribution of the product will not generate revenue. Pilot studies may be used to test this assumption should N-Viro appear to be a cost-effective management strategy for Erath County manures.

Given the current status of markets for compost and related products, it is unlikely that revenue from sales of processed dairy manure will support a large regional processing facility in the short-term. Based on an estimated market demand of about 600,000 cubic yards per year, and assuming an annual compost production of 116,300 cubic yards, a market penetration of almost 20% would be required to distribute all product generated at a regional facility. It is improbable that an Erath County product could replace 20% of the competing products on the market in the immediate future and, even if it could, transportation costs to the relatively distant existing markets would severely undermine revenues from product sale. It is more reasonable to begin composting on a smaller scale, expanding operations only as markets mature.

The market research team identified two options that, if pursued, can not only increase sales revenues, but will also help ensure that dairy manure is exported from Erath County on a scale that will have a positive impact on water quality, including:

- The development of untapped, potential high volume markets in close proximity to the proposed facility.
- The expansion and development of private sector manure processing activity in the county.

We recommend that both approaches be pursued to maximize revenues and minimize costs to local dairy operators. Specific strategies to develop markets and encourage private sector participation are described below.

5.8.1 Market Development

The two market segments that appear to have the greatest potential for development are agricultural growers and the Texas Department of Transportation (TxDOT). Both markets are essentially undeveloped and are attractive because of their size and proximity, as well as a perceived need for a compost product.

Together, these high volume, bulk markets could quickly support a subregional composting operation generating 20,000 cubic yards annually, but revenues from markets are expected to be lower than revenues from retail bagged markets. As noted in Section 5.5.3, bulk manure product prices range from $6.00 to $27.50 per cubic yard in regional markets. Agricultural markets tend to support the low end of that price range, and the sale price supported by TxDOT is unclear. Nonetheless, these market serve an important role as outlets for an Erath County product and, most importantly, provide a mechanism to remove manure from the County.

Agricultural Growers

Based on market research and experiences of compost producers and agricultural users, there appear to be significant opportunities to develop agricultural markets for compost in the areas surrounding Erath County. Expected uses in this market segment would include broad application to crops such as peanuts and watermelons.

Other area applications could include fruit and pecan orchards. The product would be marketed as a nutritional soil amendment with the ability to rejuvenate soil fertility and productivity, thereby increasing crop yield and expanding production.

To develop this market, bulk compost should be provided to agricultural growers in the region. Application services for the product should be provided as well. Conventional manure spreading and fertilizer application equipment is not generally suitable for the application of compost, resulting in unsatisfactory results from its application to the soil. The additional service would improve performance and ultimately user satisfaction from compost application. This translates over time to greater perceived value for the product. Providing application services would also eliminate the need for individual growers to purchase or lease equipment suitable for product transport and application. The lack of proper application equipment would be a strong disincentive to agricultural growers, and the purchase of a compost-spreader as part of the composting program is viewed as a critical to the successful development of agricultural markets.

Advantages of this approach are as follows:

- Incentives for product use greatly increased by providing both delivery and application services;
- Regional product identity;
- Opportunities for economic development and impact; and
- Opportunities for agricultural revitalization and redevelopment.

Disadvantages of the approach are:

- Lack of support from some local agencies;
- Lack of cooperation between growers;
- Additional transportation and capital costs associated with delivery and application services;
- Financial risks and seasonal factors; and
- Potentially low revenues compared to retail markets.

To generate wide-based acceptance and use of compost in the agricultural community, it will be necessary to employ a combination of several strategies. These approaches all assume that the product can be provided at a price that is competitive with other products intended for similar use.

- *Cooperation with Agricultural Producers* – It is imperative that compost producers work closely with various agricultural growers to meet the grower's specific needs and requirements in terms of product quality, volume, price and related services.

- *Product Trial* – It is necessary to convince agricultural producers to consume the product on a trial basis, even on a small scale, in order to prove its benefits and applications on a wide variety of crops and types of soils.

- *Demonstration Projects and Research Support* – It is important to involve other agricultural agencies in sponsoring a wide variety of demonstration projects designed to teach appropriate application techniques, explain product benefits. Agricultural agencies could also assist with research designed to develop new and improved application techniques and product uses.

- *Producer Incentive Programs* – It is important to work with public and private agencies and groups to develop incentives for agricultural use by offering developmental grants, low interest land improvement and reclamation loans, or tax breaks based on new or expanded use and application of compost for agricultural development.

- *Establishment of Cooperative Agreements with Area Fertilizer Distributors* – The creation of coops with local fertilizer distributors could be designed to promote benefits of compost application in combination with inorganic fertilizers. The fertilizer distributor could also possibly perform delivery and application services.

Texas Department of Transportation

Due to some of the unique qualities and benefits of compost application related to erosion control, TxDOT recognizes the value of compost for use in roadway construction and maintenance. Since there are widespread compost suppliers throughout the state, target markets for an Erath County product are within a 50-mile boundary east and south, a 100-mile range to the north, and a 150-mile range to the west. Unlike agricultural markets, transportation costs should not be a limiting factor due to TxDOT's capability of transporting the product. TxDOT is continually engaged in construction and improvement projects across the State and in the regional market. Poor soil quality to the north and west of Erath County contribute to significant erosion problems. These are primary areas where TxDOT may find compost application beneficial.

Advantages of this market include:

- Continuous outlet for compost product throughout the year;
- Relatively high volume usage; and
- Knowledge of product use and benefits.

Disadvantages are as follows:

- Lack of experience in using the product on a broad basis;
- Difficulty in meeting product specifications/requirements;
- Funding for projects may affect level of demand; and
- May be subject to bidding by competing suppliers.

To facilitate the usage of bulk compost by TxDOT it may be necessary to employ a number of strategic activities designed to stimulate and encourage increased use of the product. It is likely that these will be employed in some combined form on a fairly continuous basis.

- *Product Trial* – This would involve working with local TxDOT officials to initiate product use on a small scale as a trial in order to prove that the product does perform as expected before large-scale applications are attempted.

- *Demonstration Projects* – These would include cooperatively designed projects to publicly demonstrate the multiple benefits of compost usage to other agencies and to the general public. This would include special signage and publicity to draw attention to the demonstration areas.

- *Product Research Support* – Cooperatively funded research on new applications and benefits of compost use in various area of TxDOT responsibility (including roadside parks and problem areas requiring soil remediation due to chemical spills, etc.) could be used to promote growth of this market.

- *Extended Use by Counties and Cities* – This approach calls for cooperative training and education of county and city transportation right-of-way maintenance staff on the benefits and proper application of compost in their road maintenance and improvement projects.

5.8.2 Development of Private Sector Composting Activity

As noted earlier in this section, existing markets identified in the survey are strong, but are largely unattainable to Erath County at this time. Two of the major constraints in penetrating those markets — lack of familiarity by the public and the lack of an established distribution network — could be overcome by an experienced private sector producer and marketer. This option is explored in detail in Section 7.2.

5.9 Marketing Summary

In summary, the marketing strategy recommended for an Erath County product is as follows:

- *Construct a subregional facility to test manure processing technologies and perform research to support market development.* As indicated by the results of the marketing assessment, there is no "silver bullet", no lucrative market in-waiting for a processed manure. Over time, it appears that market for a compost product could be developed, but a slowly emerging market will not address the critical need to remove significant phosphorus from the watershed or provide adequate revenues (in initial years of operation) to support manure processing activities.

  In the absence of a single, definitive solution to the County's manure crisis, a multi-pronged approach is recommended. This approach will likely include composting, as it is the only proven technology considered in this study, but it might also include the innovative N-Viro process and/or heat-drying. At this time, we envision that a subregional facility would be built that would include one or more of these technologies. For composting, the facility would serve as a market development center. For the N-Viro and heat-drying processes, the facility would first provide demonstration-scale testing to assure technological feasibility, followed by market development activities should those tests be successful.

- *Focus initial market efforts on proximate, high-volume (agriculture, TxDOT) markets.* Although these markets were explored for compost only, they may also serve as outlets for an N-Viro or heat-dried product. These markets will likely offer relatively low revenues, but address the overriding basis for this project — improving water quality.

- *Encourage and solicit private sector composting in Erath County.* This approach offers multiple benefits including: knowledge of market needs, potentially established distribution networks, and the ability to effectively tap into existing markets. Overall, private sector operations offer the greatest revenue potential for Erath County product(s).

- *Construct additional facilities as markets for the product(s) mature.* It is anticipated that the private sector would likely be partly or totally responsible for additional facility construction.

Finally, regardless of the market segment targeted or processing technology used, funding assistance will likely be required to help establish a sustainable market for Erath County product(s). Potential funding mechanisms, as well as an implementation plan for manure processing in the County, are presented in Section 7 of this report.

6 Section Six

Section 6
Alternatives Cost Assessment

6.1 Approach

This section presents a cost assessment of the manure management alternatives being considered. For each alternative, manure collection, facility and equipment (capital), operating, and life-cycle costs are addressed. The goal of this effort is to identify the most cost-effective management strategy (exclusive of potential revenues from product sale and/or tipping fees and subsidies — these issues are addressed in Section 7).

6.2 Cost Assumptions

Capital costs presented in this section are based upon quotes from vendors and on CDM experience with similar facilities. Base costs for each capital item required are increased by a factor of 25% to account for facility engineering costs and contingencies. An additional 20% is added to base capital costs to cover construction contractor overhead and profit. All costs are in 1998 dollars.

The costs associated with manure collection are included in facility operating costs. Collection costs used in this analysis are based upon values presented in a 1991 report prepared for Erath County by the Texas Agricultural Experiment Station and Extension Service. Discussions with other haulers to existing composting operations indicated that the costs used in this study ($3.50/ton and $6.00/ton for transportation to a sub-regional and regional facility, respectively) were appropriate.

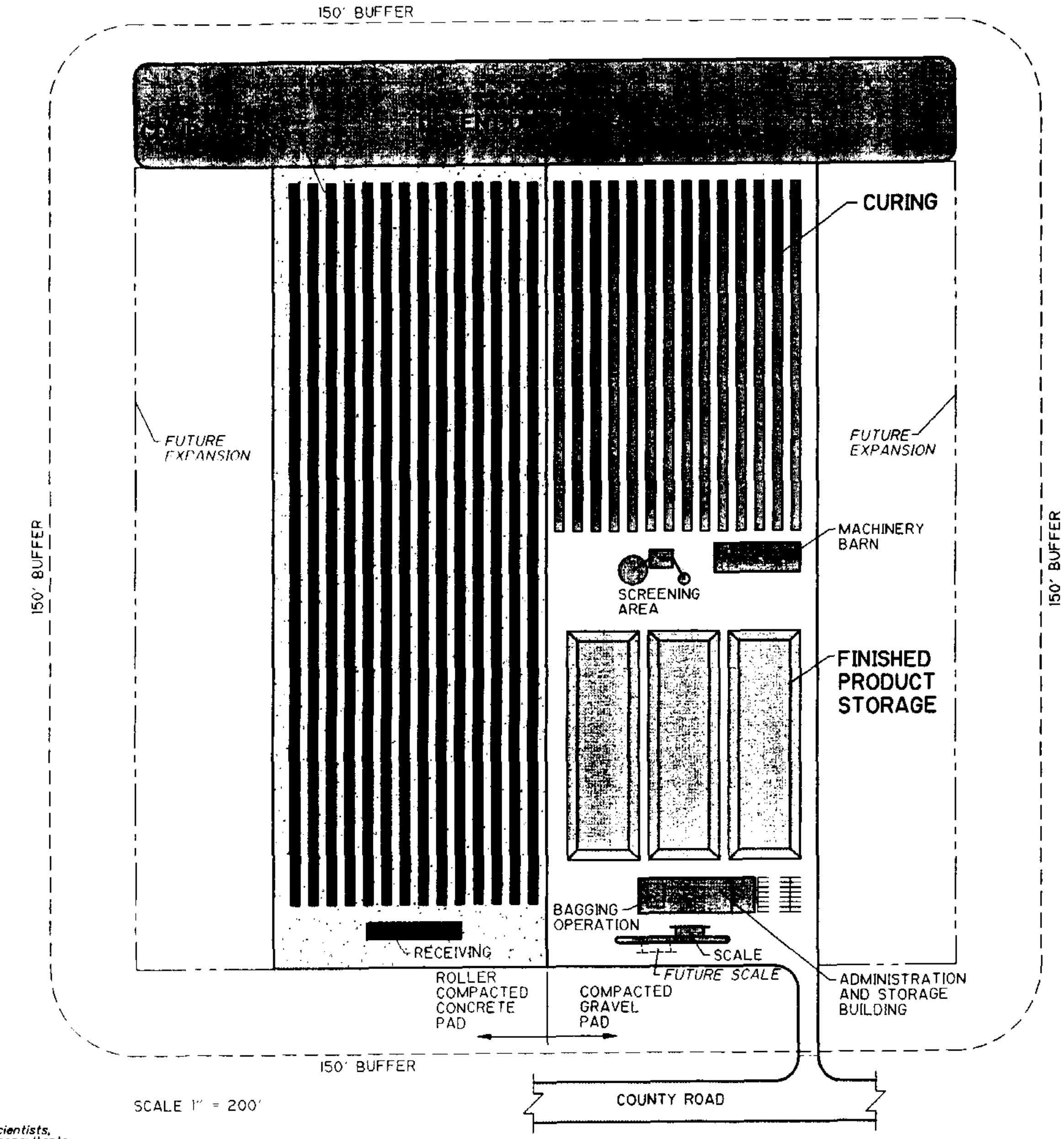
For heat-dried compost options, facility operating costs could be offset somewhat by product sales and by an annual fee assessed to participating dairy operators. Potential revenues and their impact on economic feasibility are addressed in Section 7.

In order to assess the total annual cost of the manure processing operations, estimated capital costs were converted to annual costs and added to operating costs and potential facility revenues. The conversion of building and site improvement capital costs to annual costs assumed that capital costs would be financed over a period of 20 years at an interest rate of 5%. Machinery and office supply life-cycle costs were computed using a shorter lifespan.

6.3 Composting Facility Costs

6.3.1 Regional Facility

Figure 6.3-1 illustrates a conceptual layout of a regional composting facility. For this analysis, we have assumed that the regional facility would include: a paved pad



SCALE 1" = 200'

DEVELOPED AREA: 45 ACRES
TOTAL SITE AREA: 60 ACRES

CDM
environmental engineers, scientists, planners, & management consultants

BRAZOS RIVER AUTHORITY
ERATH COUNTY ANIMAL WASTE MANAGEMENT FEASIBILITY STUDY

REGIONAL COMPOSTING FACILITY
CONCEPTUAL LAYOUT

FIGURE No 6.3-1

(roller compacted concrete) for active composting; an administration building; a machinery barn; storage building for bagging equipment and compost; truck scales to determine the quantity of incoming manure and outgoing compost; and, a stormwater detention facility.

At this time, we assume that stormwater would be evaporated from the pond. Additional calculations will need to be performed to confirm required pond size. The pond will, at a minimum, be able to accommodate a 25-year storm but will be oversized (by increasing freeboard and pond area) to ensure that evaporation can effectively remove water from the pond. The extra pond volume provided will also provide additional storage if multiple large storms occur in a short time frame. On occasion, it may be necessary to dewater the pond and haul its contents for disposal. We envision that such instances will be rare, however, and costs are not included for dewatering and hauling in this report.

Equipment to support the composting operation would include: a single self-propelled compost turner; front end loaders to construct and take down windrows; a screen to eliminate rocks and gravel from the finished product; dump trucks for on-site materials handling; and, pick-up trucks for site staff to monitor operations on the 60 acre site. In addition to the above items, facility development would require the drilling of a water supply well and the construction of a water distribution system. The purchase of a compost hauler/spreader is also recommended to promote growth in agricultural markets (see Section 5.9).

Total capital costs for a regional facility incorporating the above elements are presented in Table 6.3-1, along with estimated operating costs and projected facility revenues.

As shown in the Table, the overall annualized cost for a (non-subsidized) regional composting facility (not accounting for potential revenues) is estimated to be about $1,835,600. If government funding covered construction (capital) costs, then this cost would be reduced to $1,195,700.

6.3.2 Subregional Facility

In addition to being smaller than a regional composting facility, the components and operating practices of each subregional facility will be somewhat different than a regional facility. Differences between the two types of facilities are as follows:

- *Paving* – For the subregional facilities, it is assumed that the composting surface will not be paved, as providing a paved surface for multiple sites would be prohibitively expensive.

- *Turning Equipment* – Windrows at the sub-regional facility will be smaller than those at the regional facility, and so smaller, less costly turning equipment can be effectively used. For this study, it is assumed that a turner that can be pulled behind a tractor can be used, rather than the large self-propelled unit planned for the regional operation.

Table 6.3-1
Estimated Cost for Regional Composting Facility

Item	Size/No.	Unit	Unit Cost	Estimated Cost	Life of Equipment	Annual Cost
I. Capital Costs						
Site Aquisition	60	acres	$3,000	$180,000	20	$14,400
Site Development*	45	acres	$6,000	$270,000	20	$21,700
Water Well & Distribution	1	LS	$50,000	$50,000	20	$4,000
Paved Composting Pad	13	acres	$140,000	$1,820,000	20	$146,000
Admin Building	2,400	SF	$70	$168,000	20	$13,500
Storage Building	10,000	SF	$30	$300,000	20	$24,100
Front End Loader	4	ea	$91,000	$364,000	7	$62,900
Dump Truck	1	ea	$73,000	$73,000	7	$12,600
Pick Up Truck	2	ea	$30,000	$60,000	7	$10,400
Large Composting Turner	1	ea	$250,000	$250,000	7	$43,200
Compost Watering Tank	1	ea	$10,000	$10,000	7	$1,700
Compost Screen	1	ea	$175,000	$175,000	7	$30,200
Machinery Barn	7,500	SF	$20	$150,000	20	$12,000
Compost Hauler/Spreader	1	ea	$80,000	$80,000	7	$13,800
Bagging Equipment	1	ea	$85,000	$85,000	7	$14,700
Fork Lift	1	ea	$45,000	$45,000	7	$7,800
Office Furnishings/Supplies	1	LS	$15,000	$15,000	5	$3,500
Scales	1	LS	$50,000	$50,000	20	$4,000
Roads/Parking	500	SY	$20	$10,000	20	$800
			Subtotal	$4,155,000		$441,300
			Overhead (20%)	$831,000		$88,300
			Contingencies (25%)	$1,038,800		$110,300
			Total Capital Cost	$6,024,800		**$639,900**
II. Operation Costs						
Power	12	month	$600	$7,200	annual	$7,200
Maintenance	1	LS	$35,000	$35,000	annual	$35,000
Personnel (supervisor)**	1	per.	$50,000	$50,000	annual	$50,000
Personnel (operators, admin.)**	8	per	$30,000	$240,000	annual	$240,000
Analytical Testing	1	LS	$4,000	$4,000	annual	$4,000
Hauling Costs to Site	139,250	ton	$6	$835,500	annual	$835,500
Fuel	1	LS	$12,000	$12,000	annual	$12,000
Miscellaneous	1	LS	$12,000	$12,000	annual	$12,000
			Total Operational Cost			**$1,195,700**
III. Total Annual Cost						**$1,835,600**
Annual Compost Production, CY						**116,300**
Cost per Cubic Yard of Compost						**$15.78**

* Includes Costs for Detention Pond

** Includes Fringe Benefits

- *Shared Equipment* – At the smaller subregional facilities, it is unlikely that all facility equipment will see full-time use. Accordingly, it is assumed that such equipment will be shared by two or more facilities. This equipment (which includes the turner, tractor, and screen) can be hauled or driven between proximate sites. Bagging equipment would also be shared by multiple facilities (a single unit would serve the entire region) but would be stationary at one of the subregional sites.

In all other respects, size is the only difference between the individual subregional facilities and the regional operation. As shown in Figure 6.3-2, the conceptual layout for the subregional facility is similar to the layout for the larger regional operation.

Table 6.3-2 presents the estimated costs to construct and operate a total of six (non-subsidized) subregional sites. As shown in the table, the annualized cost for six subregional composting facilities (excluding potential revenue) is estimated to be about $1,751,300. With a full capital subsidy, this cost would be reduced to $1,042,800 per year.

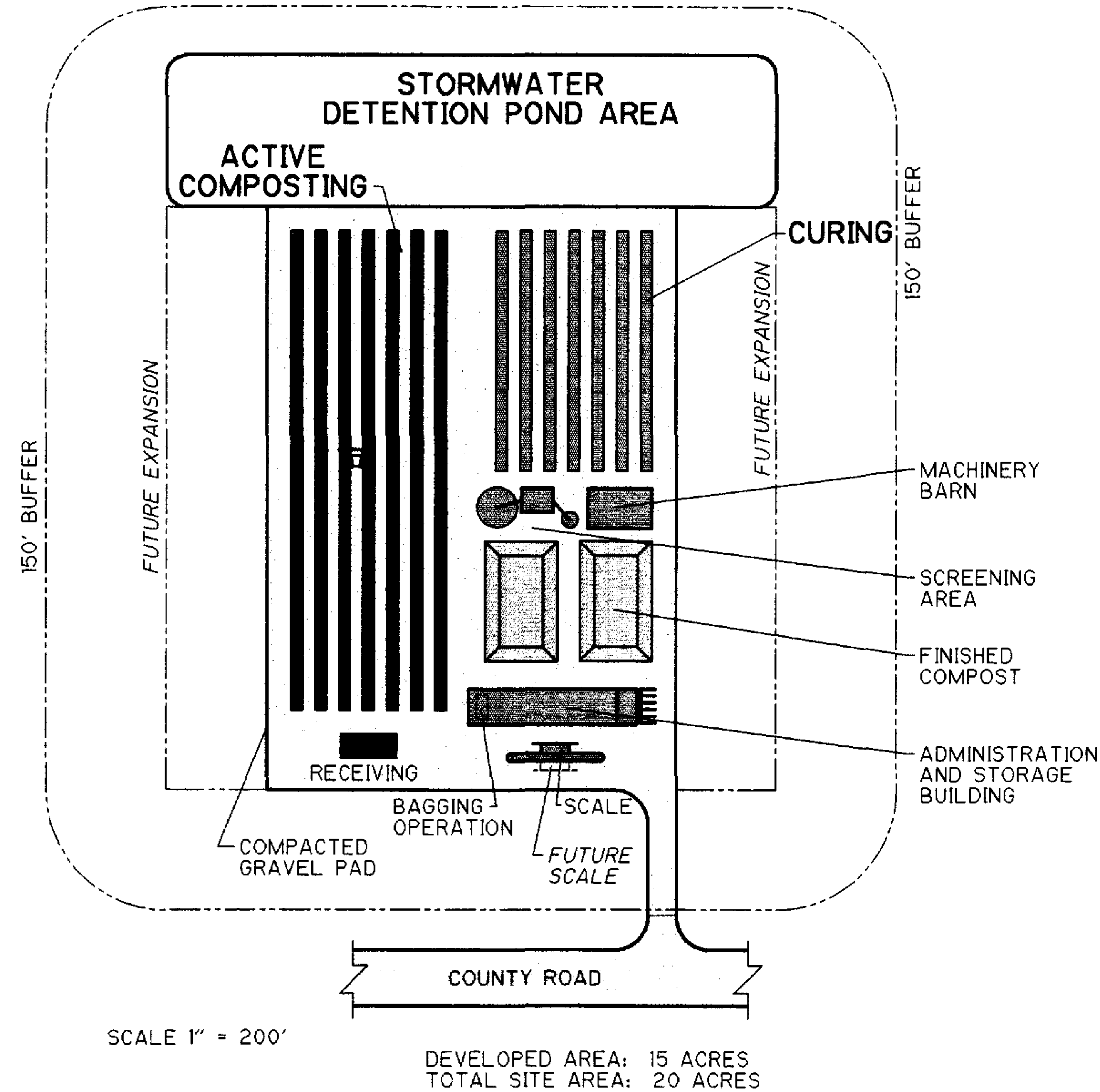
6.4 Heat-Drying Costs

As will be shown below, heat-drying is a capitally intensive process. Because construction costs are very high, and because economics of scale would strongly favor a regional facility (when capital costs are high), subregional alternatives are not investigated for this process.

For this project, we have based heat-drying cost estimates on a drying system similar to the system already installed for the BRA in Waco. A major difference between the existing BRA dryer (for sewage sludge) and a dryer for manure in Erath County is the need for pre-processing manure. Pre-processing steps recommended in this section focus on the removal of rocks from the manure. However, it is possible that the manure might need to be digested prior to drying if target markets for the product include homeowners, golf courses, or other "odor-sensitive" markets. Under this scenario, a complex system including manure slurrying, screening, digestion, and dewatering would be required prior to drying. Although we have not developed costs for such a complex, similarly sized anaerobic digestion and dewatering complexes for municipal sludge can cost in excess of $100,000,000 to construct. The inclusion of digestion therefore renders the heat-drying alternative unfeasible.

Figures 6.4-1 and 6.4-2 present a schematic and layout for a manure drying operation. Proposed facilities and equipment are described below.

Pre-processing for the facility would essentially consist of two steps - air-drying and subsequent screening. Air drying of manure would take place on a large roller compacted concrete pad. The pad would be partially covered to protect drying manure from precipitation. The air drying step would serve primarily to dry the raw manure sufficiently for effective screening, but a secondary benefit of this step is a reduction in required dryer size and operating costs (since dryer sizing is usually



BRAZOS RIVER AUTHORITY
ERATH COUNTY ANIMAL WASTE MANAGEMENT FEASIBILITY STUDY

SUBREGIONAL COMPOSTING FACILITY
CONCEPTUAL LAYOUT

CDM
environmental engineers, scientists, planners, & management consultants

FIGURE No 6.3-2

Table 6.3-2
Estimated Cost for Six Subregional Composting Facilities

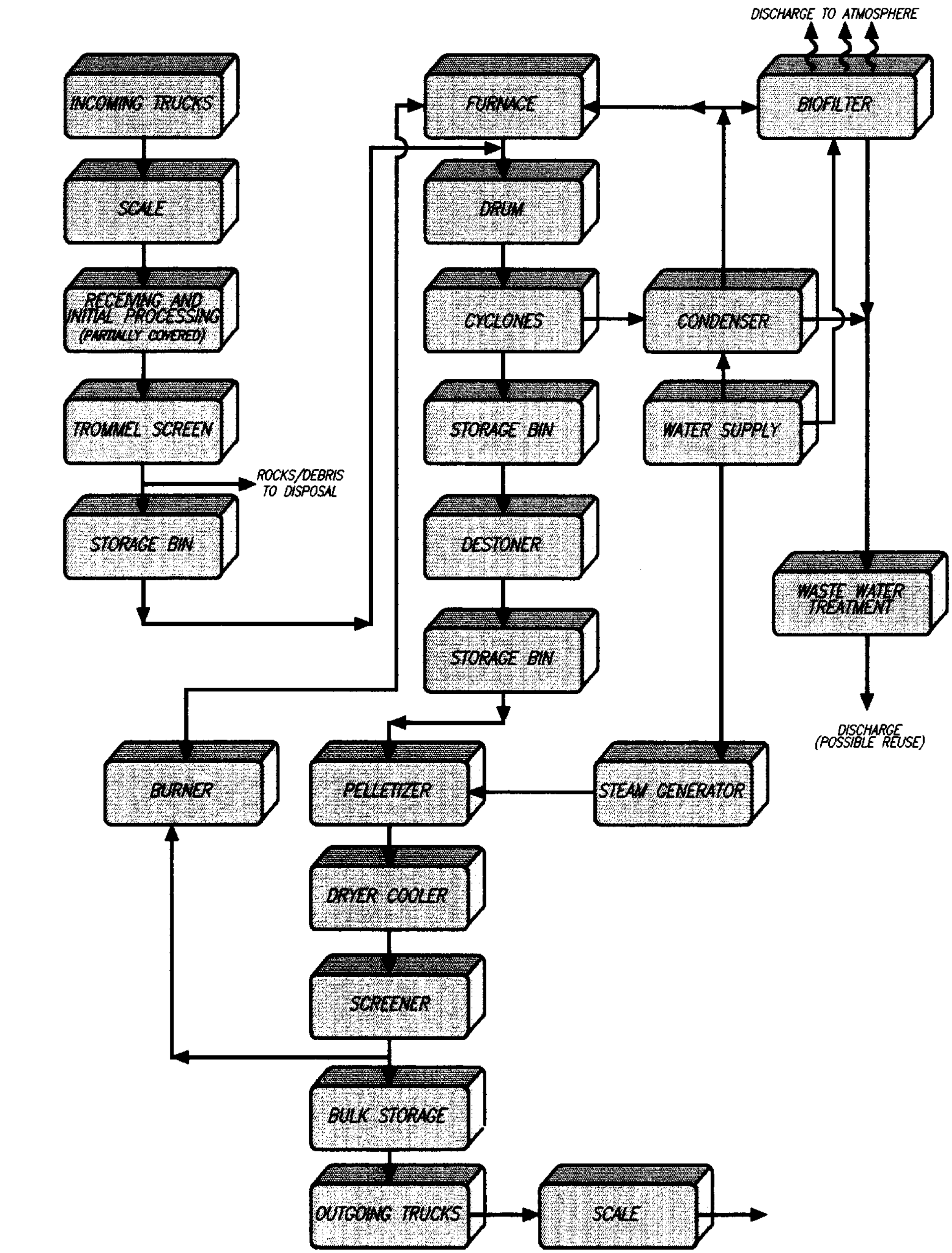
Item	Size/No.	Unit	Unit Cost	Estimated Cost	Life of Equipment	Annual Cost
I. Capital Costs						
Site Aquisition	120	acres	$3,000	$360,000	20	$28,900
Site Development*	90	acres	$6,000	$540,000	20	$43,300
Water Well & Distribution	6	ea	$30,000	$180,000	20	$14,400
Admin Building	2,400	SF	$70	$168,000	20	$13,500
Storage Building****	10,000	SF	$30	$300,000	20	$24,100
Front End Loaders	6	ea	$91,000	$546,000	7	$94,400
Tractors	3	LS	$62,000	$186,000	7	$32,100
Dump Truck	3	ea	$73,000	$219,000	7	$37,800
Pick Up Truck	3	ea	$30,000	$90,000	7	$15,600
Small Compost Turners	3	ea	$36,000	$108,000	7	$18,700
Compost Watering Tanks	6	ea	$5,000	$30,000	7	$5,200
Mobile Compost Screens	2	ea	$150,000	$300,000	7	$52,000
Machinery Barn	24,000	SF	$20	$480,000	20	$38,500
Compost Hauler/Spreader	1	ea	$80,000	$80,000	7	$13,800
Bagging Equipment****	1	ea	$85,000	$85,000	7	$14,700
Fork Lift****	1	ea	$45,000	$45,000	7	$7,800
Office Furnishings/Supplies	6	ea	$3,500	$21,000	5	$4,900
Scales	6	ea	$50,000	$300,000	20	$24,100
Roads/Parking	3,000	SY	$20	$60,000	20	$4,800
			Subtotal	$4,098,000		$488,600
			Overhead (20 %)	$819,600		$97,700
			Contingencies (25%)	$1,024,500		$122,200
			Total Capital Cost	$5,942,100		**$708,500**
II. Operation Costs						
Power	12	month	$200	$2,400	annual	$2,400
Maintenance	1	LS	$35,000	$35,000	annual	$35,000
Personnel	2	per.	$50,000	$100,000	annual	$100,000
Personnel (operators, admin.)	13	per.	$30,000	$390,000	annual	$390,000
Analytical Testing	1	LS	$4,000	$4,000	annual	$4,000
Hauling Costs to Site	139,250	ton	$3.5	$487,400	annual	$487,400
Fuel	1	LS	$12,000	$12,000	annual	$12,000
Miscellaneous	1	LS	$12,000	$12,000	annual	$12,000
			Total Operational Cost			**$1,042,800**
IV. Total Annual Cost						**$1,751,300**
Annual Compost Production, CY						**116,300**
Cost per Cubic Yard of Compost						**$15.06**

* Includes costs for detention pond

** Equipment to be shared between 2 subregional sites

*** Equipment to be shared between 3 subregional sites

**** Services all subregional facilities

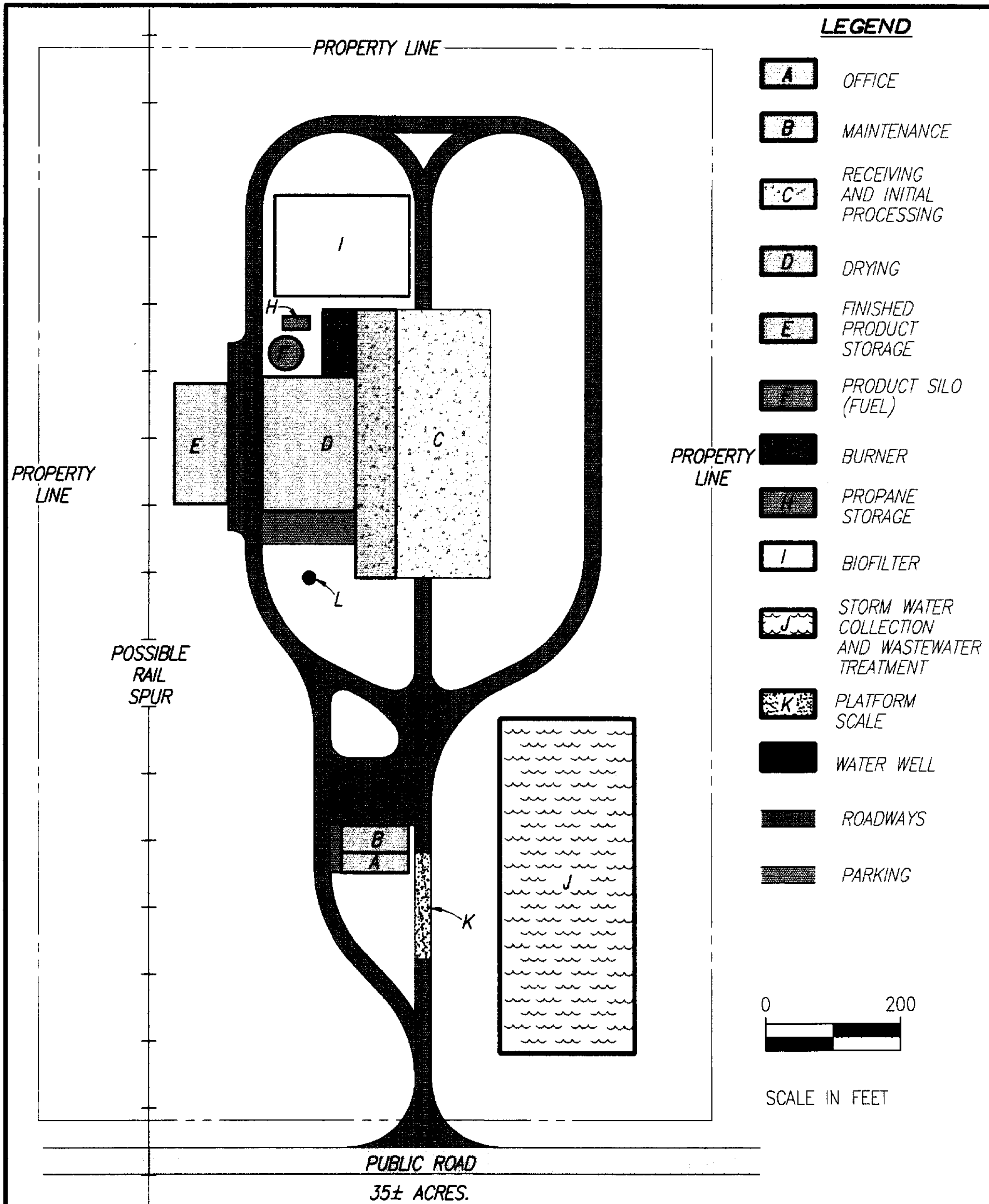


BRAZOS RIVER AUTHORITY
ERATH COUNTY ANIMAL WASTE MANAGEMENT FEASIBILITY STUDY

DRYER INSTALLATION PROCESS SCHEMATIC

PREPARED BY:
ROMING-PARKER ASSOCIATES, L.L.P.

FIGURE No 6.4-1



BRAZOS RIVER AUTHORITY
ERATH COUNTY ANIMAL WASTE MANAGEMENT FEASIBILITY STUDY

DRYER INSTALLATION TYPICAL SITE PLAN

PREPARED BY:
ROMING-PARKER ASSOCIATES, L.L.P.

FIGURE No 6.4-2

\97119\EXHIBIT.DWG Plotted: 3-3-98 By: BVB © 1998 Roming-Parker Associates, L.L.P.

based on the amount of water that must be removed). Air-dried manure would then be put through a trommel screen to remove as many stones and other large objects from the manure as possible. Screened manure would be moved by front-end loader to the drying system.

Once in the drying facility, the manure would first be blended in a mixer with already dried material to facilitate the drying process. The resulting mixture, at up to 70% solids content, would then be fed directly to a drum dryer. The temperature in the drum is maintained to ensure that the drying material itself would not exceed 90°F. Dried manure would then be conveyed from the drum, along with evaporated moisture, by a high-speed airstream. A particle separator following the drum would remove about 98% of the particles from the airstream. Removed particles would then screened to separate them into final product (generally 1mm to 4mm in diameter), under-sized and over-sized fractions. Over-sized particles are crushed and mixed with undersize particles for used as "recycle" for mixing with the feed sludge to the dryer. Final product can be hauled away directly for use, stored in silos for subsequent transportation to market, or bagged for distribution.

The airstream exiting the dryer contains some particulates, has a high moisture content, and is generally odorous. A saturator/scrubber tower is used to remove excess moisture and remove particulates. Following this device, the airstream is split, with about 90% recirculated back to the dryer. The remaining 10% is sent to an odor control system. For this analysis, a biofilter has been assumed for odor control.

Table 6.4-1 presents the estimated capital and operating costs for a regional manure drying facility. As shown in the table, capital costs for the operation are high, with an annualized capital cost of $2,165,700 and operating costs estimated to be $2,444,000 per year.

6.5 N-Viro Processing Costs

Tables 6.5-1 and 6.5-2 present the estimated costs for regional and subregional processing facilities. As indicated by the table, estimated costs are higher than, but comparable to composting costs.

Components of the facilities include a process building, a portable pug-mill for mixing alkaline additives and manure, a silo for additive storage and materials handling equipment. Like subregional composting, this process could share some equipment with other subregional facilities to reduce overall capital costs. Storage for approximately four months worth of product is included in the required site area.

6.6 Selection of Recommended Plan

Table 6.6-1 presents total capital, annualized capital, operating and total annualized costs for each of the alternatives considered in this section. As shown in the table, composting and the N-Viro process appear to offer the lowest annualized cost for manure management. Many factors can affect the overall cost-effectiveness of a given option, however, not the least of which are the degree of funding available,

Table 6.4-1
Estimated Cost for a Regional Heat-drying Facility

	Item	Size/No.	Unit	Unit Cost	Estimated Cost	Life of Equipment	Annual Cost
I.	***Capital Costs***						
	Site Acquisition	35	Acres	$3,000	$105,000	20	$8,400
	Site Development	35	Acres	$3,000	$105,000	20	$8,400
	Administration Bldg.	2,000	SF	$120	$240,000	20	$19,300
	Maintenance Bldg.	4,000	SF	$60	$240,000	20	$19,300
	Dryer Bldg.	52,000	SF	$40	$2,080,000	20	$166,900
	Product Storage Bldg.	13,600	SF	$65	$884,000	20	$70,900
	Burner Bldg.	5,000	SY	$30	$150,000	20	$12,000
	Receiving Pad	8,900	LS	$30	$267,000	20	$21,400
	Product Silo	1	LS	$300,000	$300,000	20	$24,100
	Propane Storage	1	LS	$75,000	$75,000	20	$6,000
	Biofilter	1	LS	$485,000	$485,000	20	$38,900
	Storm Water Facilities	1	LS	$250,000	$250,000	20	$20,100
	Storm Water Treatment	1	LS	$75,000	$75,000	20	$6,000
	Platform Scale	1	LS	$75,000	$75,000	20	$6,000
	Water Well	1	LS	$225,000	$225,000	20	$18,100
	Water Distribution	1	LS	$75,000	$75,000	20	$6,000
	Roadways	15,500	SY	$30	$465,000	20	$37,300
	Electrical Systems	1	LS	$250,000	$250,000	20	$20,100
	Furniture & Equipment	1	LS	$25,000	$25,000	10	$2,000
	Dump Truck	1	LS	$70,000	$70,000	7	$12,100
	Front End Loader	2	Ea.	$105,000	$210,000	7	$36,300
	Pick-up Truck	1	Ea.	$25,000	$25,000	7	$4,300
	Tractor/Mower	1	Ea.	$25,000	$25,000	7	$4,300
	Misc. Tools, Equipment	1	LS	$15,000	$15,000	7	$2,600
	Drying Equipment	1	LS	$11,500,000	$11,500,000	20	$922,800
		Subtotal			$18,216,000		$1,493,600
		Overhead (20%)			$3,643,200		$298,700
		Contingencies (25%)			$4,554,000		$373,400
		Total Capital Cost			**$26,413,200**		**$2,165,700**
II.	***Operation Costs***						
	Personnel						
	Operators	18	Ea.	$35,000	$630,000	annual	$630,000
	Others	2	Ea.	$32,000	$64,000	annual	$64,000
	Electrical Power	1	LS	$591,300	$591,300	annual	$591,300
	Propane	1	LS	$2,000	$2,000	annual	$2,000
	Vehicle Fuel						
	Diesel	1	LS	$43,400	$43,400	annual	$43,400
	Gasoline	1	LS	$2,400	$2,400	annual	$2,400
	Vehicle Maintenance	1	LS	$20,400	$20,400	annual	$20,400
	Biofilter Maintenance	1	LS	$5,000	$5,000	annual	$5,000
	Equipment Maintenance	1	LS	$250,000	$250,000	annual	$250,000
	Hauling Cost to Site	139,250	ton	$6	$835,500	annual	$835,500
		Total Operational Cost					**$2,444,000**
III.	***Total Annual Cost***						**$4,609,700**
	Annual Pellet Production, cubic yards						**116,300**
	Cost per Cubic Yard of Pellets						**$39.64**

Table 6.5-1
Cost Estimate for Regional N-Viro Manure Processing Facility

	Item	Size/No.	Unit	Unit Cost	Estimated Cost	Life of Equipment	Annual Cost
I.	***Capital Costs***						
	Site Aquisition	20	acres	$3,000	$60,000	20	$4,800
	Site Development*	15	acres	$6,000	$90,000	20	$7,200
	Water Well & Distribution	1	ea	$30,000	$30,000	20	$2,400
	Office Trailer with Lab	1	ea	$40,000	$40,000	20	$3,200
	Process Building Slab (Concrete)	1,000	sf	$10	$10,000	20	$800
	Process Building	1,000	sf	$25	$25,000	20	$2,000
	Equipment Foundations	100	yds	$375	$37,500	20	$3,000
	Install Power	1	ea	$30,000	$30,000	20	$2,400
	Install Lighting and Controls	1	ea	$5,000	$5,000	20	$400
	Install Telephone	1	ea	$1,000	$1,000	20	$100
	Install Storm Sewers	500	lf	$10	$5,000	20	$400
	Mixer (Port-A-Pug II)	1	ea	$260,000	$260,000	20	$20,900
	3200 cu ft. Silo	1	ea	$60,000	$60,000	20	$4,800
	500 cu ft Tank	1	ea	$5,000	$5,000	20	$400
	Transfer Auger	1	ea	$10,700	$10,700	20	$900
	Truck Scale Installed	1	ea	$75,000	$75,000	20	$6,000
	Equipment Freight	1	ls	$4,000	$4,000	20	$300
	Stacking Conveyor	150	lf	$1,000	$150,000	7	$25,900
	Front End Loader	2	ea	$91,000	$182,000	7	$31,500
	Clod Breaker/ Loadout Conveyor(1)	1	ea	$100,000	$100,000	7	$17,300
	Lab Equipment	1	ea	$4,500	$4,500	7	$800
				Subtotal	$1,184,700		$135,500
				Overhead (20%)	$236,900		$27,100
				Contingencies (25%)	$296,200		$33,900
				Total Capital Cost	$1,717,800		**$196,500**
II.	***Operation Costs***						
	Power	12	month	$1,500	$18,000	annual	$18,000
	Maintenance	1	LS	$56,000	$56,000	annual	$56,000
	Personnel (Supervisor)	1	per.	$50,000	$50,000	annual	$50,000
	Personnel (operators, admin)	2	per	$30,000	$60,000	annual	$60,000
	Analytical Testing	1	LS	$6,000	$6,000	annual	$6,000
	Hauling Costs to Site	139,250	Wet ton	$6	$835,500	annual	$835,500
	Alkaline Additives 1 & 2 (15% Dose)	20,888	ton	$15	$313,300	annual	$313,300
	Alkaline Additive 3 (3% Dose/dry ton)	70	ton	$250	$17,400	annual	$17,400
	N-Viro Technical, Prof., Patent Fee	139,250	Wet ton	$2	$278,500	annual	$278,500
	Fuel	1	LS	$29,190	$29,200	annual	$29,200
	Miscellaneous	139,250	LS	$0.50	$69,600	annual	$69,600
				Total Operational Cost			**$1,733,500**
III.	***Total Annual Cost***						**$1,930,000**
	Annual Production, CY						**255,800**
	Cost per Cubic Yard of Product						**$7.54**

* Includes costs for detention pond

Table 6.5-2

Cost Estimate for Six Subregional N-Viro Manure Processing Facilities

Item	Size/No.	Unit	Unit Cost	Estimated Cost	Life of Equipment	Annual Cost
I. Capital Costs						
Site Acquisition***	54	acres	$3,000	$162,000	20	$13,000
Site Development*, ***	18	acres	$6,000	$108,000	20	$8,700
Water Well & Distribution***	6	ea	$30,000	$180,000	20	$14,400
Office with lab***	2	ea	$10,000	$20,000	20	$1,600
Process Building Slab (Concrete)***	6,000	sf	$10	$60,000	20	$4,800
Process Building ***	6,000	sf	$25	$150,000	20	$12,000
Equipment Foundations***	600	yds	$375	$225,000	20	$18,100
Portable Generator***	2	ea	$75,000	$150,000	7	$25,900
Install Lighting and Controls***	6	ea	$1,000	$6,000	20	$500
Mixer (Port-A-Pug II)***	2	ea	$260,000	$520,000	20	$41,700
1200 cu ft. Silo***	2	ea	$25,000	$50,000	20	$4,000
500 cu ft Tank***	2	ea	$5,000	$10,000	20	$800
Truck Scale Installed***	6	ea	$75,000	$450,000	20	$36,100
Equipment Freight	2	ls	$4,000	$8,000	20	$600
Stacking Conveyor***	100	lf	$1,000	$100,000	7	$17,300
Front End Loader****	3	ea	$91,000	$273,000	7	$47,200
Lab Equipment***	2	ea	$4,500	$9,000	7	$1,600
Clog Breaker-Loadout Conveyor***	2	ea	$100,000	$200,000	7	$34,600
Tractor (new)***	2	ea	$62,000	$124,000	7	$21,400
			Subtotal	$2,805,000		$304,300
			Overhead (20 %)	$561,000		$60,900
			Contingencies (25%)	$701,300		$76,100
			Total Capital Cost	$4,067,300		**$441,300**
II. Operation Costs						
Fuel for generator***	12	month	$1,500	$18,000	annual	$18,000
Maintenance***	1	LS	$30,000	$30,000	annual	$30,000
Personnel (Supervisor)****	1	per.	$50,000	$50,000	annual	$50,000
Personnel (operators, admin)***	2	per	$30,000	$60,000	annual	$60,000
Analytical Testing***	1	LS	$3,000	$3,000	annual	$3,000
Hauling Costs to Site***	139,250	Wet ton	$4	$487,400	annual	$487,400
Alkaline Additives 1 & 2 (15% Dose)*	20,888	ton	$15	$313,300	annual	$313,300
Alkaline Additive 3 (3% Dose/dry ton)	70	ton	$250	$17,400	annual	$17,400
N-Viro Technical, Prof., Patent Fee***	139,250	Wet ton	$2	$278,500	annual	$278,500
Fuel***	1	LS	$29,190	$29,200	annual	$29,200
Miscellaneous***	139,250	LS	$0.50	$69,600	annual	$69,600
			Total Operational Cost			**$1,356,400**
III. Total Annual Cost						**$1,797,700**
Annual Production, CY						**255,800**
Cost per Cubic Yard of Product						**$7.03**

* Includes costs for detention pond

** Equipment to be shared between 2 subregional sites

*** Equipment to be shared between 3 subregional sites

**** Services all subregional sites

Table 6.6-1
Comparison of Estimated Manure Processing Costs

Technology	***Capital Cost***	***Annualized Capital Cost***	***Annual Operating Cost***	***Total Annual Cost***
Composting				
Regional	$6,024,800	$639,900	$1,195,700	$1,835,600
Subregional	$5,942,100	$708,500	$1,042,800	$1,751,300
Heat-drying	$26,413,200	$2,165,700	$2,444,000	$4,609,700
N-Viro Processing				
Regional	$1,717,800	$196,500	$1,733,500	$1,930,000
Subregional	$4,067,300	$441,300	$1,356,400	$1,797,700

Notes:
(1) Costs for regional alternatives assume that all collectable manure (estimated to be 232,500 cubic yards annually) will be handled at a single facility. Subregional costs assume that up to six facilities will be constructed, each handling about one sixth of the collectable manure generated (roughly 38,500 cy/year).
(2) Assumes a 20 year life for structures, 7 year life for equipment, 5 year life for office equipment, and an interest rate of 5%.

and revenues from product sale and/or fees charged to dairy operators. These issues are explored in Section 7. Regardless of these impacts, it appears that composting and the N-Viro process offer the greatest opportunity to meet the primary project goal — improving water quality — in the near term and we recommend that both be incorporated into diversified management strategy for the County.

Both share risks, however, that favor the construction of subregional facilities over regional facilities. For composting, the ability and means to develop a sustainable market is in question; for the N-Viro process, the claims regarding process capabilities have yet to be proven. For both technologies, the construction of demonstration facilities seems prudent.

In addition to low costs, the composting and N-Viro technologies offer complementary benefits that support their dual application. Composting is a proven technology for manure management, transforming the manure into a value added product that can be easily handled. The primary disadvantage of composting is the "lag-time" required to build product markets. The N-Viro manure process is as yet unproven on a large scale, but if a USDA-funded demonstration of the process yields expected results, it could provide a mechanism to reduce phosphorus in the Bosque watershed without removing the product from Erath County (and correspondingly, the need to develop external product markets). Like compost, the N-Viro product would offer soil conditioning properties that would enhance soil tilth. Pursuing both of these technologies simultaneously provides a diverse management strategy for the County, and given the uncertainty of success, avoids the pitfall relying on a single — and potentially unsuccessful — solution to the County's manure crisis.

Finally, despite its high cost, it may not be prudent to eliminate heat-drying from consideration at this early planning stage. If heat-drying can be proven to be technically-feasible, it may be possible to generate an enhanced product (i.e. with supplemental nutrients) that could yield revenues high enough to significantly offset revenues. Much testing will be required to make this determination, however.

In summary, uncertainties regarding market feasibility for composting and technical feasibility for both the N-Viro and heat-drying processes demonstrate the need for a research facility to further explore the viability of these options and their potential role in a diversified animal waste management strategy for Erath County.

7 Section Seven

Section 7
Implementation Plan (Phase II)

This section builds upon previous recommendations of this report to develop an implementation plan for animal waste processing in Erath County. Specific issues addressed include financing alternatives for a new facility, permitting requirements and an estimated project completion schedule.

7.1 Plan Description

Based upon the efforts summarized in Sections 3 through 6, CDM recommends a phased and diversified approach to manure management in Erath County. The recommended plan is based upon conventional treatment technologies, but incorporates innovative technologies as well. The cornerstone of the plan is the construction of a research center that will include a subregional composting operation, but may also include innovative processes.

The facility will provide a means to export manure from the Bosque River watershed, perform research to support market development for processed manure products, and provide a "proving" ground for new technologies.

Although additional siting analyses will be required, it appears that either of the Lingleville sites (4A and 4B) may be suitable for facility development.

While the composting aspect of the proposed research center is under development, we recommend further investigations into both the N-Viro process and heat-drying. For the N-Viro process, this effort would include a review of results from the Beltsville, MD demonstration project and, if warranted, a visit to the facility. If the technology appears promising, a subregional demonstration project in Erath County is recommended. If site size allows, the N-Viro operation could be co-located with the composting operation (although co-location is not mandatory, it is recommended to facilitate research activities). For heat-drying, small-scale piloting could also be conducted at the research center. To simplify permitting, we suggest limiting the output from the heat-drying facility to 10 tons per day.

Costs for the N-Viro and heat-drying elements of the proposed research operation are not presented here. These aspects of the management strategy require further investigation to confirm their technical feasibility.

While regional alternatives are being studied, we recommend that Erath County also investigate alternative technologies for "on-farm" applications. Candidate technologies might include anaerobic digestion, the Bion Nutrient Management System, and vermicomposting. As noted in Section 3, we envision that these on-farm management approaches will supplement, rather than replace, regional management strategies for the county. Several will be applicable primarily to dairies that employ hydraulic flushing of manure from milking barns.

Costs to construct and operate the composting portion of the research center are presented in Table 7.1-1. The costs are preliminarily based on a subregional facility sized to handle one sixth of the total collectable manure in the county, as a final site (and the corresponding determination of dairies that might contribute to that site) has not been selected. As shown in the table, capital costs for this initial facility will be higher than the average per facility cost under the subregional composting alternative (estimated to be roughly one sixth of the capital cost for six facilities, or $990,400 per facility). The heavy reliance on shared equipment in the subregional approach is the primary difference for the relatively higher cost of the initial facility. Costs for the second and third facilities constructed in the county (should this technology prove sustainable) are expected be far lower than initial facility costs as many pieces of equipment are to be shared among three facilities and will have already been purchased.

Assuming that public funds can be obtained for construction, it is expected that the composting facility itself would be managed by a public agency and that this agency will be responsible for research to support the development of processed manure markets. Actual operation of the facility end-product and distribution and marketing tasks would be handled by a contracted private party.

If federal funds or other sources of grant money are unavailable, then the above operating scenario may not be economically viable. During Phase II, efforts to secure funding for the facility should be continued. Additionally, private sector participation in the project should be strongly encouraged. Once project funding is established, the operating plan for the facility should be revisited.

In summary, we recommend that the next phase of this project (Phase II) consist of the following eight steps.

1. *Secure financing for the manure processing and research center.* At this time, we suggest that funds for the composting aspect of the center (including monies for market research) be pursued only. If sufficient information is available from the Beltsville, MD project to assure the applicability (and cost-effectiveness) of the N-Viro process in Erath County, then funding should potentially include monies for a demonstration of this process as well.

2. *Site, permit and construct composting facilities for research center.*

3. *Continue investigations of the N-Viro process and heat-drying.* For the N-Viro process, this requires monitoring of progress at Beltsville. For heat-drying, this investigation will potentially include analytical testing of Erath County manures to assess nitrogen content, discussions with vendors regarding product enhancement options and costs, and a pilot study.

Table 7.1-1
Cost Estimate for Single Erath County Subregional Composting Facility

Item	Size/No.	Unit	Unit Cost	Estimated Cost	Life of Equipment	Annual Cost
I. ***Capital Costs***						
Site Aquisition	20	acres	$3,000	$60,000	20	$4,800
Site Development*	15	acres	$6,000	$90,000	20	$7,200
Water Well & Distribution	1	ea	$30,000	$30,000	20	$2,400
Admin Building	400	SF	$70	$28,000	20	$2,200
Front End Loader	1	ea	$91,000	$91,000	7	$15,700
Tractors	1	ea	$62,000	$62,000	7	$10,700
Dump Truck **	1	ea	$73,000	$73,000	7	$12,600
Pick Up Truck	1	ea	$30,000	$30,000	7	$5,200
Small Compost Turners**	1	ea	$36,000	$36,000	7	$6,200
Compost Watering System	1	ea	$5,000	$5,000	7	$900
Mobile Compost Screen***	1	ea	$150,000	$150,000	7	$25,900
Machinery Barn	4,000	SF	$20	$80,000	20	$6,400
Compost Hauler/Spreader	1	ea	$80,000	$80,000	7	$13,800
Bagging Equipment**	1	ea	$85,000	$85,000	7	$14,700
Fork Lift	1	ea	$45,000	$45,000	7	$7,800
Office Furnishings/Supplies	1	ea	$3,500	$3,500	5	$800
Scales	1	LS	$50,000	$50,000	20	$4,000
Roads/Parking	500	SY	$20	$10,000	20	$800
			Subtotal	$1,008,500		$142,100
			Overhead (20 %)	$201,700		$28,400
			Contingencies(25%)	$252,100		$35,500
			Total Capital Cost	$1,462,300		**$206,000**
II. ***Operation Costs***						
Power	12	month	$100	$1,200	annual	$1,200
Maintenance	1	LS	$17,000	$17,000	annual	$17,000
Personnel (Supervisor)	1	per.	$50,000	$50,000	annual	$50,000
Personnel (operators, admin)	1	per	$30,000	$30,000	annual	$30,000
Analytical Testing	1	LS	$1,000	$1,000	annual	$1,000
Hauling Costs to Site	23,208	ton	$3.5	$81,200	annual	$81,200
Fuel	1	LS	$2,000	$2,000	annual	$2,000
Miscellaneous	1	LS	$2,000	$2,000	annual	$2,000
			Total Operational Cost			**$184,400**
III. ***Total Annual Cost***						**$390,400**
Annual Compost Production, CY						**19,400**
Cost per Cubic Yard of Compost						**$20.12**

* Includes costs for detention pond
** Equipment to be shared between 2 subregional sites
*** Equipment to be shared between 3 subregional sites
**** Services all subregional sites

4. *Perform demonstration N-Viro and/or heat-drying projects if investigations warrant.*

5. *Investigate on-farm approaches to animal waste management.* Although on-farm approaches such as digestion are not expected to provide a regional waste management solution, they may supplement regional approaches and enhance management diversity.

6. *Conduct activities to support market development for an Erath County manure compost* (as outlined in Section 5) through the research center.

7. *Complete technical assessments of the N-Viro and heat-drying processes.*

8. *Finalize long-term sustainable animal waste management plan for Erath County.*

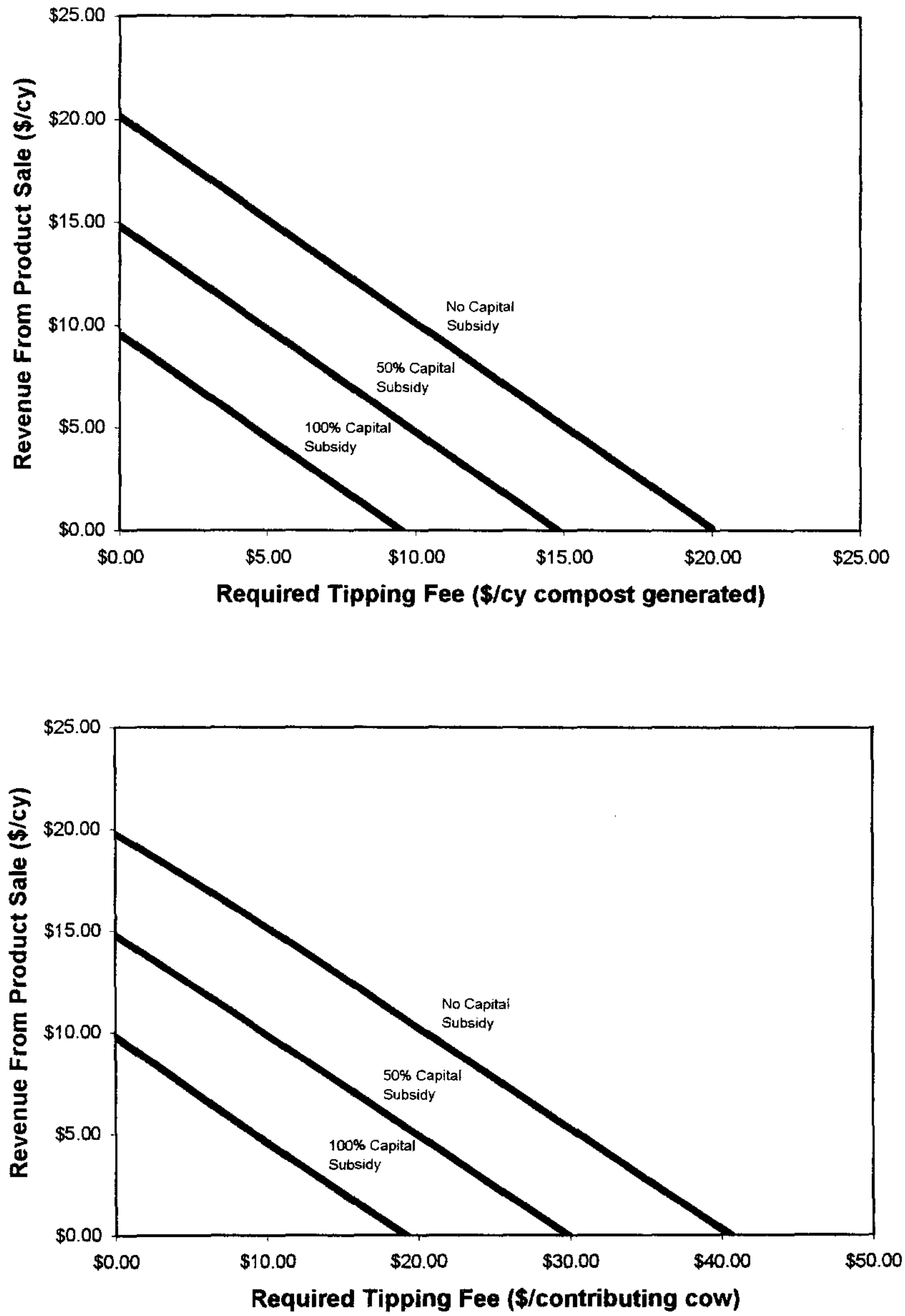
7.2 Funding Mechanisms

Establishing manure processing operations in Erath County will require financial assistance. Figure 7.2-1, which is based on the costs to develop and operate the subregional composting facility for the proposed research center, illustrates the need for external funding. The figure shows the tip fee (a fee levied for waste management) required to offset total facility annualized costs as a function of the amount of capital subsidized and potential revenues (expressed as $/cy). Tip fee requirements are shown as both $/cubic yard of product generated and $/cow. Curves on the table are based upon facility costs presented in Table 7.1-1. As shown on the figure, a 50% subsidy of capital costs would reduce the required tip fee by about $5/cy and a complete subsidy of construction costs would offset the required tip fee by a total of about $10/cy (regardless of revenues from product sale). Revenues from product sale further reduce the tip fee. For example, if revenues of $6/cy could be obtained for an Erath County compost, the tip fee would be reduced from about $9/cy to about $4/cy for a facility constructed under a complete subsidy. As indicated by the lower graph, a tip fee of $4/cy (of compost generated) equates to about $8/cow.

At this time, it is envisioned that dairy operators would be asked to contribute a voluntary tip fee to utilize the waste processing facilities in order to partially offset facility costs. Currently, there are no contractual obligations on the part of dairy producers in the county to contribute funds to the proposed facility. However, there is a possibility that dairies would be willing to contribute an amount approximately equal to what they currently pay for manure management.

Research by TIAER (see Appendix I) indicates that on average dairy producers in Erath County pay about $9.10 to $15.40 per cow annually to transfer manure from the dairy to adjacent fields (i.e. "on-farm" handling costs are not included). For example, producers typically apply cow manure to forage and pasture land. Manure contains plant nutrients and can improve soil conditions, thus the producer gains some utility from its use.

Figure 7.2-1 Impact of Subsidies and Revenues on Required Tipping Fee



The validity of the assumption that dairies would pay a voluntary tip fee rests in the notion that they may be motivated to participate in a voluntary manure processing program as a means to delay the implementation of regulations restricting land application or other mandatory water quality protection measures. Whether or not concerns regarding future regulations provide sufficient incentive among dairy operators to support voluntary manure processing remains to be seen.

The concern regarding the level of dairy participation leads once again to the need for external funding — the lower the tip fee, the higher the likelihood that dairy operators will participate in a manure processing program.

Several traditional and non-traditional funding mechanisms might be explored to reduce tipping fees for the research center, none of which are mutually exclusive.

7.2.1 Traditional

Traditional funding sources include bond-financing, grants and loans from government-sponsored programs, and government subsidy programs. At this time, it appears that the bond-financing approach will not be feasible, as County voters would be required to approve such a measure and the certainty of their support cannot be guaranteed. A variety of grants and loans are available from programs sponsored by the USDA, EPA, the State of Texas and other agencies interested in protecting the environment. The EPA has a catalog [*Watershed Protection: Catalog of Federal Programs (EPA 841-B-93-002)*] which lists water-related EPA sponsored funding programs and their objectives. Every effort should be made to pursue funding from EPA (or other) programs with objectives which match those of this manure management project. One of the most promising sources of funding for the proposed research center — the Environmental Quality Incentives Program (EQIP) — falls into this category.

Established under the 1996 Farm Bill, the Environmental Quality Incentives Program (EQIP) provides a voluntary conservation program for agricultural producers to address soil, water and related natural resource concerns. The Federal Commodity Credit Corporation provides funding for EQIP. The authorized budget of $1.3 billion is prorated at $200 million per year of which Texas receives $20,000,000 through the year 2002. Total cost share and incentive payments are limited to $10,000 per person per year and $50,000 for the length of the contract. Cost-share may pay up to 75 percent of costs of certain conservation practices including manure management facilities. Incentives of up to 100 percent may be paid to encourage producers to use sound land management practices such as manure management, nutrient management, grassed waterways, filter strips, as well as other conservation related practices. Incentives may be allocated for up to three years.

Eligibility is limited to persons engaged in livestock or agricultural production. Qualified land includes cropland, pastures, and other farm or ranch lands. Owners of large livestock operations are not eligible for cost share assistance for animal waste storage or treatment facilities. However, the definition of "large" is subject to determination by the National Resources Conservation Service in each state.

Producers may obtain applications from the USDA Service Center. The possibility exists that dairy operators could be reimbursed for transportation costs associated with delivery of solid waste to a composting facility. In addition, farmers who purchase compost from the facility for agricultural applications might receive incentive payments. Small-scale dairy operators may be eligible for receive EQIP grants to construct on farm waste treatment facilities including composting equipment. The use of EQIP may diminish short-term tipping fees paid by dairy producers, but cannot be depended on in the long-term.

7.2.2 Non-Traditional

A variety of non-traditional programs might be explored to fund the proposed facility, including a "Green Milk" program and direct federal appropriations. Each of these options are described below.

Milk Stewardship Program ("Green Milk")

Sharing the cost of environmental compliance with consumers of dairy products is an alternative to burdening dairy operators and government agencies with manure management costs. A Milk Stewardship Program (MSP) would provide a mechanism through which milk producers recover costs of environmental compliance. An MSP would pay a premium to dairy operators who satisfactorily participate in a manure processing program. Payments to dairy operators would require an increase in prices paid by purchasers of unprocessed milk. Referred to as a milk price premium, it is the amount farm level prices must rise to allow producers to recoup costs of properly processing the manure. The required premium varies according to each dairy's level of production, however, the average daily milk yield in Erath County is approximately 55 lbs. per cow or 200 cwt. per year. Using the county average, the price premium per cwt. would be about 13 cents. Assuming a gallon of milk weighs 8 pounds, and all 200 cwt. go toward fluid milk production, the necessary retail price increase is about one cent per gallon.

Direct Appropriations

The BRA, Erath County, TIAER and other interested parties may petition legislative representatives to appropriate funding for the proposed facility. As shown in Figure 7.2-1, the impact of even partial funding of project capital requirements could be profound, significantly offsetting estimated annualized cost of $20.12/cy (of compost generated).

Private Sector Funding

As noted in Section 5, existing markets for a composted manure are strong, but at present are unattainable for an Erath County product due to such factors as high transportation costs and the public's lack of familiarity. Experienced entrepreneurs with established distribution networks and marketing programs could overcome these barriers more effectively than uninitiated producers. The general advantages that an experienced marketer would bring to compost distribution would also apply to other marketable manure products, such as dried manure.

To date, entrepreneurial activity (with respect to manure processing) has been limited in Erath County to composting. Private sector operators have been attracted to the area because of the large and concentrated supply of raw material, but very few have been successful. Factors that influence the success of these operations — and ways to improve opportunities for success — are described below.

Private sector producers that operate in the county will likely target low volume, high return markets. The goal of the entrepreneur is profit, not water quality. Centralized composting is currently not an option. Without adequate profit incentive, the private sector requires either public subsidies or regulatory mandates that force dairy operators to provide raw material at economically feasible rates. For example, under current regulations dairy operators apply cow manure to forage and pasture land. In the event that regulations severely restrict or prohibit land application, dairy operators may be willing to contribute greater amounts of money for regionalized processing facilities.

The majority of compost producers interviewed by TIAER and the BRA conclude that market-driven regionalized composting is not feasible under existing market and regulatory conditions. Mrs. Jane Witheridge, CEO of Organics Management Company (OMC), stated:

> *"There is a gap in the product value and cost to process manure for distribution outside the generation zone [Erath County]. Absent implementation of incentives or enforcement action against the generators [dairy operators], the free market will take its course. OMC is committed to managing organics application to commercial and agricultural lands in Texas, and we remain interested in Erath County. Without more security, it will take us longer to implement the necessary protection in our investment. My best estimate for when this would occur is within the next three to five years."*

Private sector efforts in Erath County are not expected to expand rapidly in the near future. Currently, there is little economic incentive for entrepreneurs to market processed animal wastes from the County on a scale that may impact water quality.

To encourage private sector activity — and provide the foundation for a sustainable manure management strategy — financial incentives and infrastructure support are required. Compost producers interviewed identified the following items that would improve their opportunities for success:

Financial Incentives

- Purchase of land for a composting facility
- Lending capital at a low rate with favorable terms

- Pre-payment for work.
- Performance of engineering and/or construction work.
- Grants to dairies to offset cost of manure removal.

Infrastructure Support

- Establishing contracts with dairies to provide adequate amounts of appropriate feedstock
- Providing access to property
- Providing assistance with zoning, permitting, and public opinion and support
- Providing research and market development assistance

7.2.3 Summary

Use of one or more of the alternative financing mechanisms presented above will be necessary to construct and operate a processing facility. The selection of funding mechanisms is left to policy makers. All funding alternatives sources should be evaluated according to a single set of appropriate criteria, however. The following criteria are suggested:

- *Equity* refers to the distribution of mechanism's financial burden among individuals.

- *Legislative acceptability* reflects the political will to levy fees or taxes on citizens or sectors of the economy.

- *Public acceptability* reflects the willingness of tax or fee recipients to pay.

- *Feasibility* relates to the legal authority to impose a fee or tax and factors that affect workability of a mechanism.

- *Administrative requirement* is the effort needed to implement financing mechanisms, including costs of implementation, collection and fund management.

7.3 Permitting Requirements

Based upon the information presented in Section 4.3, it appears that permitting requirements for a subregional manure composting facility will be few. Assuming that development of Site 4A or 4B will not impact wetlands, then no permits are required for facility siting. Permitting requirements for a heat-drying or N-Viro facility would need to be determined on a case-by-case basis by TNRCC staff.

Regardless of the technology selected, approvals for construction will be required from the U.S. Fish & Wildlife Service and the Texas Historical Commission if the facility is publicly funded. The U.S. Fish & Wildlife Service approval is required to verify that no endangered species are present on the site. Although the preliminary siting analysis discussed in Section 4 indicated that this should not be an issue at Site 4A or 4B, a more detailed assessment must confirm that finding once a definitive site has been selected. Similarly, an archaeologist must be retained to demonstrate to the Texas Historical Commission that the site does not contain areas of historical significance (although the preliminary siting assessment indicated that the probability that Sites 4A and 4B contained cultural resource sites was low). Researching and obtaining these approvals is expected to take about 4 months.

Additionally, a standard air quality permit will be required from the TNRCC for the composting operation. For composting, an "exempt" status facility is entitled to this permit if the following conditions are met:

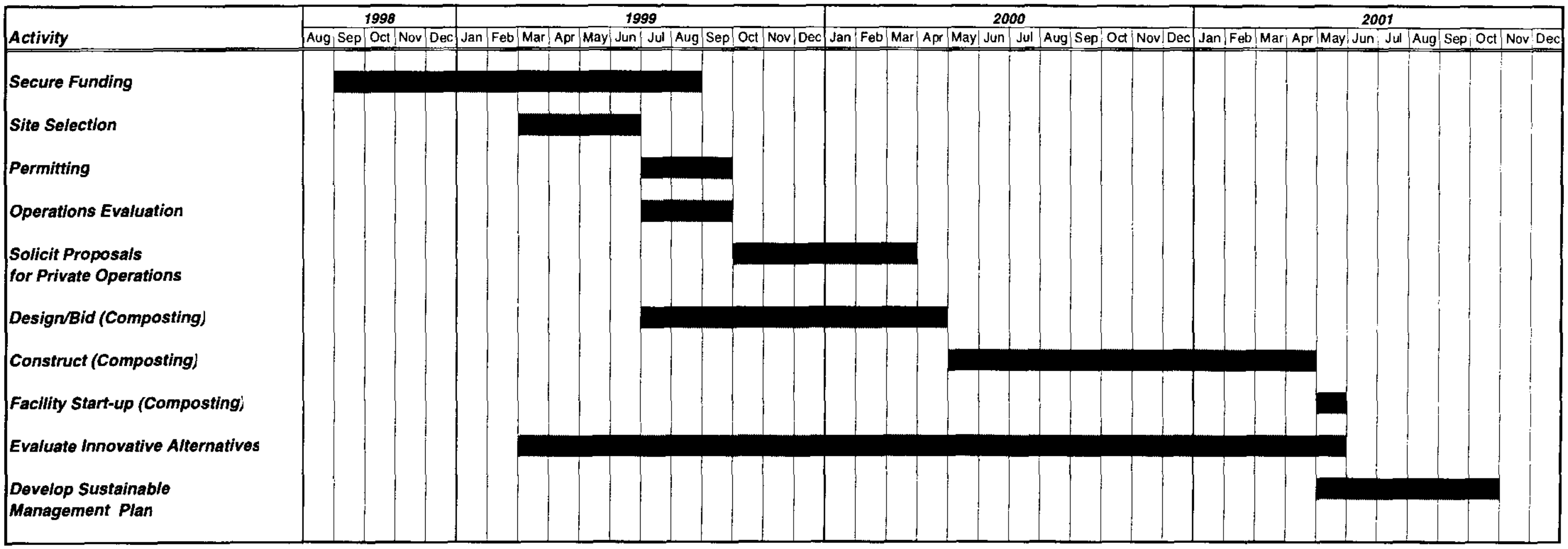
- If the total volume of materials to be composted, including in-process and processed materials, is greater than 2000 cubic yards, the setback distance from the property edge to the receiving areas must be at least 50 feet.
- All permanent in-plant roads shall be regularly watered, paved, cleaned, or treated with dust suppressant to reduce dust emissions.
- Except for initial start-up and shutdown, the receiving chambers on all grinders must be adequately filled to minimize emissions from the receiving chamber, or grinding operations must occur in an enclosed structure. All grinders not enclosed inside a building must be equipped with low velocity fog nozzles spaced to create a continuous fog curtain, or portable watering equipment must be available to control dust when stockpiling material.
- All conveyors off-loading materials from grinders at a point not inside a building must have a water or mechanical dust suppression system to control dust when stockpiling ground material.

The proposed operation would be subject only to the first two requirements above, as grinders are not required at the proposed facility. The proposed screening operation may be a source of dust, however, (if the curing piles become too dry) and we would recommend using the portable watering devices provided for the windrows to minimize dust on the site.

7.4 Schedule

Figure 7.4-1 presents a preliminary schedule for Phase II of this project. Phase II development activities include siting, permitting, design, and facility construction. An allowance for soliciting proposals to privately operate the facility is included as well. As shown in the figure, CDM estimates that Phase II activities can be completed in less than three years.

Figure 7.4-1
Phase II Implementation Schedule



Appendix A

Appendix A

TAC Meeting Minutes

Erath County Animal Waste Management Facility Plan
Technical Advisory Committee Meeting

Student Development Center
Tarleton State University

December 5, 1997

Welcome & Opening Remarks — ***Judge Tab Thompson***

— Discussed agenda. Purpose of meeting is to bring everyone up to speed on the project.

— Please ask your questions - don't leave without asking the questions that are on your mind.

— Have an industry in Erath County that we are proud of and we are doing everything to take care of it and help it grow; but we must be environmentally sound not to affect the waters of the Bosque River.

— Let us look at some of the problems, solve them and then we can scratch Erath County off of the problem list.

— The judge wants information that he can be personally proud of when it is done. He does not want to end up with just a report but a plan to solve a problem.

History & Objective of Project — ***Mr. Mike Meadows***

— First part of 1996 articles stated money would be available in EQIP funding through USDA. BRA visited with Erath County to gage interest. Clean water studies showed impact on Bosque River.

— The objective of the BRA is to protect the water quality of Bosque River.

— Developed scope of work and met with everyone affected by the project. If BRA could find funding would they support the efforts - everyone sent letters supporting the project. Several met in Washington D.C. and got a commitment of funding from USDA, TWDB, a legislative line item, and some from the City of Waco.

— The objective of the project is to look at how to collect, transport, treat and market the product outside the basin. There are no preconceived notions about what the answer is.

— Non-regulatory approach - must keep dairy industry in a growth mode and environmentally sound.

— They will give a document to the County - here is how you do it, here is where you do it, here is where you market it and how much will it cost.

— Small operators are in the county operating composting facilities. The county facility will be operated as directed by the County. Could be private, could be County. BRA is not interested in operating a plant in Erath County.

Project Overview — ***Mr. Allen Woelke, P.E.***

— Discussed project scope of work and individual tasks included.

— Discussed consulting team consisting of CDM, TIAER, Hicks & Co., GSG, Booth Ahrens & Werkenthin, and Roming-Parker Associates.

— Discussed responsibilities of each team member.

— Discussed schedule for completing project.

— Discussed additional Technical Advisory Committee meeting dates in February, April and June of 1998.

Marketing Overview **_Mr. Larry Beran_**

— If composting is highly profitable then private enterprise would have already been composting in Erath County.

— If there was a transparent government solution then it would already been done.

— There is not a simple solution to the problem in Erath County.

— Two million tons of manure are produced annually.

— Where the product gets taken is an important issue.

— Discussed existing manure handling costs ($10.00/cow).

— Discussed alternatives to existing handling methods.

— CDM will be providing costs for construction and operation.

— Discussed Central Composting model.

National Challenge **_Mr. Ron Alexander_**

— Discussed potential uses of compost. Agriculture has been considered the most likely user of compost, but the economics don't work out.

— We will look at high volume/low value, low value/high value products.

— Nine major markets will be looked at. 400,000 possible end users in the country.

— Discussed benefits to compost use and the benefits of compost for soil.

— Different end users have different uses for compost.

— Discussed compost characteristics.

— Discussed manure compost pricing. In Texas the value of compost is on the high side. Discussed competing products with compost.

— We do not know if compost is the answer. There are options of fertilizer, fuel product, etc.

— Discussed the difference between using compost and manure. Fixing nitrogen. Organics are stabilized.

Conventional Market Analysis **_Dr. Jerry DeHay_**

— We are not working in a quick fix arena.

— Need to look at competing products and the form of the products.

— Will define existing markets. Will survey companies throughout the country to find out the markets they are selling to.

— Will define typical product user. Who is using it, how much are they using, is the use seasonal. Need to find markets that can use the volume and yet pay enough to keep operation solvent. This may require producing multiple products. Will have to deal with perceived value of the product.

— We need to know about market demand and price elasticity.

— We need to understand the growth potential of the market. Can use of product by existing users be increased. Can new users be converted from other products.

— We will look at constraints to market entry.

— We need to define competitive products. How can we position our product to take market share away from competitors.

— Are there ways to mix or modify product to increase demand.

— Can packaging increase value and demand.

— One of the big costs that we are concerned with is transportation.

— Discussed Cost/Benefit Analysis. The project has to be self sufficient. Need to recognize enough revenue to operate the facility without subsidies. Would like this to be an entrepreneurial venture.

— Our approach will be pragmatic to make this thing work.

— Discussed market strategy.

— Discussed the Market Clearing Strategy. If all work is done and there is still a shortfall, then what has to be done to keep the facility operating? Hopefully any shortfall will be a short term problem.

Market Clearing Strategy — ***Mr. Ron Jones***

— There are no simple solutions to the cow manure in Erath County.

— Transportation is the biggest issue.

— Just taking care of the large dairies is not going to solve all of the problems. Small watersheds will require taking care of small dairies also.

— The impact of the dairies on Lake Waco is not defined - the study is underway. To take care of small watersheds in Erath County small dairies will have to be addressed.

— Most composting operations are subsidized with tipping fees. We do not believe that we can have a tipping fee without affecting the dairy industry.

— The large dairy can do on-farm composting as cheaply as any other way. On-farm composting on large dairies is viable.

— In case composting is not a profitable venture then how do you keep facility operating?

— Problem with composting in dairy business is it is difficult to apply "polluter pays" philosophy because dairy farmers are price takers.

— Do we care if we take out the small dairy farmers because of increased environmental costs? This is a political question that has to be answered by policy makers.

— Discussed Market Strategy - if prices do not support facility - is there a government subsidy that will keep the facility operating?

— This issue is all over the country with chicken and swine producers as well. It is likely that more compost will be coming on the market tending to push prices down just when we are trying to drive prices up.

— We do not think that consumers understand the value of compost. May consider a test program in the metroplex.

— We could easily clear the market if we could just raise the price of milk 4¢/gallon.

— EPA is now taking the position that the integrators are responsible for the waste (from article in the Washington Post).

— Hypothetically if compost producers cannot move product out of Erath County and there is government money to support the construction, then we need to know if it can help us.

— Maximize revenue of biosolids.

— Talked about Chino Basin facility and its problem moving product.

— If free market economics don't work then will look at government support.

— Discussed the 3-phase approach.

Summary ***Mr. Mike Meadows***

— The problem is complex. That is why you do not see a lot of private enterprise already composting here.

— Discussed the Chino Basin facility. They did not develop markets before they built the facility.

— Transportation is certainly important. But on-farm composting may not be the answer.

— U.S. Government is willing to support environmental programs, e.g., Chesapeake Bay.

— Will not be able to build a facility to capture 100% of manure. Will work to increase percent captured over time.

— Discussed economics of dairy farming on Erath County and environmental impact on the Bosque River.

— Encouraged committee to participate in the planning process.

— Asked for questions.

James Trayweek - Texas has lost 27% of dairy producers over the past 2½ years. Major problem is keeping dairies in business. Texas is losing more production than any other state. He is behind project. He is not opposed to government subsidy.

Dar Anderson - Have we tried adding nutrients to compost to improve its value.

Willard Howle - Excited about doing anything to improve the environment. They are interested in Waco having clean water but also interested in clean water in Erath County. They are losing dairies and cows in the county because of economics. Where did waste numbers come from? Has seen the land in the county go from worn out due to cotton farming, but manure application has improved its conditions.

Jim Wimberly - Need to go back to the basics. The objective is not to remove all the material out of the county. We need to know how much to remove to bring the environment back into balance. There are a lot of composters and there is a lot of data that we can learn from.

Beade Northcut - Intrigued by marketing study of how to raise milk to pay for the environmental aspects. We do not have to take all the manure out.

Brad Lamb - NPS program (not regulatory yet). Sensing that the voluntary program may be coming to an end. Discussed CAFO meetings. Tremendous amount of public interest in Erath County. Interest from EPA to solve situation without regulating. Hopes to be able to provide guidance.

Jim Wimberly - We should want to complement not compete with existing composters. This process may enable private composters to do better through the marketing analysis. The current problem is moving the compost into markets.

Dr. Self - Could be overfeeding phosphorus in feed. Minerals in feed could cause a problem with land application building up minerals in the soil. Should be tradeoff where people producing siteage should take compost as part of the deal.

Ned Meister - Have come a long way in the past few years - even being able to discuss this would not have been possible only a few years ago. Disposal of manure must have the least impact on the dairy producers. Want the most practical approach.

Jack White - From soil samples some fields are high in nutrients, and composting will give an option to dairy producers to land application of manure. Most people don't know the benefits of compost. Education would be beneficial.

Dr. Self - We need to talk to soil chemists who send out recommendations about amount and form of P to be applied to land.

John Hatchel - Concerned about water quality in Lake Waco. Have never presumed that the dairies are the problem. Composting works - the City composts yard waste. We do not want regulations to solve the problems. Waco is now sampling the S. Bosque as well.

Jay Wilson -	Good business is a result of decisions. Glad we are looking at Chino Basin and what is not working there.
John Hatchel -	Need to keep public and press informed. Ned to share information so public does not scream "regulation".
Joe Huddleston -	Interested because he finances dairies. Thinks it is great because of regulation that is sure to come if a solution is not developed. Might be markets for compost in adjoining counties.
Clyde Bohmfalk -	Had 3 meetings about 10 years ago. After adoption of rule relating to disposal of agricultural waste someone came into his office and said "We may have a problem with some of the dairies because we do not know how many dairies will be impacted by this rule." In meeting with Rep. Stenholm there was a great deal of hostility between dairy producers and regulators. Have come a great distance. We are dealing with difficult issues and there are no easy answers. This is about the only alternative to land application.
Don Starr -	Talked about meeting with Rep. Stenholm. Communication is much better now. The closer we get to solutions the more the Representative can help. Boll weevil program is paid 25-30% by U.S. Government.
Clyde Bohmfalk -	This is not a dairy problem - but deals with all CAFOs.
Don Starr -	Will have effects all over the U.S.
James Trayweek -	Everything is getting to WalMart size thinking. Some of the dairy producers cannot get bigger.
Don Starr -	It is not best for everyone to be big.
Dr. DeHay -	Bigger is not necessarily better. He does not see this being solved by something big.
Mike Meadows -	Have to keep focused on the objective for Erath County. Be open and honest for the good of the project.
Judge Thompson -	Thanked participants for their time and interest.

Copies of the slides used during the presentation are attached to these minutes.

A copy of the sign-in sheet is attached to these minutes.

AWFP Technical Review Committee Meeting

December 5, 1997

Name	Agency Name	Work Phone	Work Fax	E-Mail Address	Business Address
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Erath County Animal Waste Management Facility Plan
Technical Advisory Committee Meeting
City of Waco Water Utility Office Training Facility

February 17, 1998

John Hatchel:

— Opening Remarks and Welcome
— Introduced Mike Jones, Ricky Garrett, Wiley Stem

Market Analysis:

— Just looked at compost so far (just basic - no value added-products)
— Next stage is to look at value added products. Presented physical characteristics of compost, presented the benefits of compost use. A lot of people are not familiar with benefits of compost and are confused about differences between compost and manure.
— Discussed marketing regulations - manure compost is not regulated unless claims of its nutrient value. If compost is blended with fertilizer, then nutrient value must be labeled.
— Prices of compost range considerably:

Bulk:	\$12.00 to \$33.50/cy for manure compost regional retail
	\$12.00 to \$27.50/cy for manure compost regional wholesale
	\$10.00 to \$40.00/cy for soil blend
Bagged:	\$.99 to \$2.99/40 lb bag for manure compost
	\$1.95 to \$3.95/40 lb bag for topsoil
	\$1.00 to \$8.99/40 lb bag for potting soil.

— Presented market demand of compost.
— Interviewed over 100 users to develop market demand, landscapers, and landscape suppliers (127,100 cy/yr)
— Hardware, home centers usually sell bagged products.
— Presented regional quantities demanded:

DFW	350,000 cy/yr
Austin	150,000 cy/yr
Waco	30,000 cy/yr

— Estimated transportation cost:

120 mi	\$3.96/cy (bulk)
	\$0.15/bag
60 mi	\$1.98/cy

— Presented survey of producers
— Discussed market definition - This is what the actual market is - not potential market.

— Local markets are being met by local producers. Producers could produce more if there were greater demands.
— Preliminary marketing strategy:

- Provide bulk material to commercial companies
- Provide bulk material to regional outlets
- Provide bulk material to agricultural growers
- Provide bulk materials plus application services to agricultural services
- Provide bulk and bagged material to wholesale outlet.

— Preference is blended product with higher nutrient value - there are established producers in these markets.
— May be a back haul to cotton growing area that is bringing in cottonseed for cattle feeds.
— Peanut growing may be a potential market to improve existing fields.
— Application services assure proper application of product and happier end users.
— No shortage of compost.
— Current price does not offer potential for cost recovery.
— Next time marketing will discuss new markets and strategies.
— Are small dairies causing a problem in Erath County?
— The number of dairies are decreasing, but the number of cows have gone up indicating that there are fewer small dairies.
— Our goal is <u>not</u> to compost all the manure in Erath County but to remove enough to improve water quality.
— We need to keep small dairies in mind because of potential of water quality problems from these dairies.
— Bottom line is small dairies are going out of business and may not be a concern.
— We do not want to create environmental costs that will hasten the loss of the small dairies.
— Presented slides form Chino Basin.

<u>Scott McCoy, TNRCC</u>:

— Worked with TxDOT to develop technical specifications for use of compost on TxDOT ROWs.
— Specifications were approved in December and are now with all TxDOT Districts so they can all use compost.
— TxDOT has an interest in using compost.
— Three categories:

1. Compost manufactured topsoil.
2. Erosion control compost.
3. General use compost (for maintenance work).

— Average price last year for topsoil was $28.00/cy.
— EQUIP will give money to TNRCC for education (on year to year basis).

David Moore:

— Shipping bagged compost manure to DFW from Florida.
— Want to put bagging operation in Erath County to serve the DFW market. They believe they can sell 25,000 tons or 100,000 cy/yr.
— They provide spreading services for farmers.
— Interested in TxDOT specifications. Erath County compost is not meeting specifications.
— No rules and regulations for bagging - there is no control over what goes into the bag.

Scott McCoy:

— Compost Advisory Council is looking into what it will take to provide quality in bagged products.
— May be a stamp of approval.
— Reevaluating test procedures in TxDOT specifications.

Dar Anderson:

— There are a lot of acres that could use compost.
— There are crops that could be grown to support the dairy industry.
— The farmers need to be educated about benefits of compost.
— There is a large potential market west of Stephenville.

David Moore:

— Agricultural interests are better customers and use large amounts.
— The private interests are going to "pick the plums".

Ned Meister:

— Felt things were coming together - beginning to see some progress to address the problems.
— There is an initiative to deal with animal waste rules coming from EPA year 2000 to address poultry and swine, year 2002 to address cattle.
— Waste management plans in the future may include a requirement for composting or conversion to a usable product.

Jim Wimberly:

— Use term "compost production facility" in lieu of "biosolids treatment facility".
— Agricultural market is the big market for compost products.

— Chemical use is not sustainable.
— Soil quality is the important factor.
— Public sector needs to step in to develop agricultural markets.
— Takes 3 years for benefits from compost to show up.

Dar Anderson:

— Should be university studies that show the benefits of the use of compost.

Jim Wimberly:

— Need to bring along agricultural advisors who historically have pushed the use of chemical fertilizers.

Jack White:

— Map with red rings are interesting.
— Hoping Comanche County could be merged with Erath County map.
— Some soil testing in Goose Branch watershed indicates that producers only have enough land for the waste water from dairies, not for the solids from the dairies.
— A composting facility should reach out to other waste streams to look at co composting.

David Moore:

— Why is the public getting involved when private enterprise is already working in Erath County?

Judge Thompson:

— We're looking at this because not all of the dairies can be composted by private industries.
— The County is interested in keeping the dairy business in Erath County.
— Envisions mixture of all thoughts that have been discussed to allow dairies to be profitable and improve water quality.

David Moore:

— Frustrated because he has not been able to locate bagging facility.
— Vision is to develop agricultural market to compete with bagged market.

Clyde Bohmfalk:

— The change in land application rates is what is driving the look at alternative treatment methods.

Judge Thompson:

— Made closing remarks.

Erath County Animal Waste Management Facility Plan
Technical Advisory Committee Meeting
Attendees

February 17, 1998

Name	Affiliation
Allen Woelke	Camp Dresser & McKee Inc.
Larry Beran	TIAER Tarleton State University
Stuart Norvell	TIAER Tarleton State University
Jerry DeHay	JMD Consulting
Beade O. Northcut	TSSWCB
Dar Anderson	Dairy
Michael Jones	City of Waco
Calvin Cowan	Congressman Chet Edwards
Ned Meister	Texas Farm Bureau
Jack White	USDA-NRCS
Brad Lamb	U.S. EPA
Judge Tab Thompson	Erath County
Wiley Stem	City of Waco
Jay Wilson	FMC - Stephenville
Clyde Bohmfalk	TNRCC
David Moore	Compost Performance Systems
John Hatchel	City of Waco

Erath County Animal Waste Management Facility Plan
Technical Advisory Committee Meeting

June 18, 1998

Allen Woelke:

— Opening Remarks and Welcome.
— Summary of siting assessment and traffic assessment.
— Presentation of site development costs for regional and subregional sites.

Dr. DeHay:

Market Assessment Summary

— Who uses manure and in what quantity in area near Erath County.
— JMD and TIAER performed regional market demand study.
— There is a market that currently exists, but there are also compost producers who are adequately meeting the demand.
— Suppliers include Gardenville and small producers including yard waste and municipal composters.
— Current reported production within regional market is approximately 365,000 c.y.
— Current supply of compostable manure in Erath County is approximately 200,000 c.y.
— Over 600,000 c.y./yr. supply available to satisfy demand of less than 600,000 c.y./yr.
— Discussed regional markets.
— Discussed transportation costs to major market area based on $0.12 per loaded mile per c.y. Costs varied between $12 to $18/c.y.
— Presented cost breakdown of product to get to market (did not include capital costs):

  – came to total gross loss of $376,000/yr.
  – not an optimistic cost analysis.

Dr. Self:

— Need to balance negative cost to negative environmental impact of doing nothing.

Dr. Larry Beran:

— Discussed importance of marketing study.
— Presented revised central composting numbers.

$37.90/cow

Capital cost	**O&M**	
$19.11	$18.79	
	-10.00	(tipping fee)
	$8.79	
	$12.09	(sales ($6/c.y.)
The Gap $15.81	$3.30	

— 2 c.y./cow/yr. - Where will the additional funding come from?

- Larger tipping fee.
- Higher prices for product.

— Discussed Private Sector and competition of public agencies with private sector. Met with established groups. Looked at putting compost on agricultural land - needs to be short delivery distances to be cost effective. TxDOT has potential to be big market for new construction and maintenance.

— Based on private sector meetings (especially Black Gold) presented cost curve:

$37.90/cow		
Capital cost	**O&M**	
$19.11	$18.79	
	$10.00	(tipping fee)
	$8.79	
Profit $26.52	$54.42	(sales)
	$45.63	

– Clients include:
  - Lowe's, 50,000 c.y./yr.
  - Home Depot ($3.47 retail, $1.75 wholesale = $1.00/ft^3)

Organics Management

$37.90/cow		
Capital cost	**O&M**	
$19.11	$18.79	
	-10.00	(tipping fee)
	$8.79	
	$27.21	(sales)
The Gap $0.69	$18.42	

– Tipping fee required.
– 5-6 years for market development.
– Potential for agricultural markets in the Rio Grande Valley.

Scotts Hyponex

$37.90/cow	
Capital cost	**O&M**
$19.11	$18.79
	-10.00 (tipping fee)
	$8.79
	$27.21 (sales)
The Gap	$18.42
$0.69	

- Tipping fee necessary to change their product mix.
- Currently turn dairy manure away.

Agriculture

$18.79/cow	
Capital cost	**O&M**
$0	$18.79
	-10.00 (tipping fee)
	$8.79
	$12.09
The Gap	$3.30
$24.80	$27.80 (transportation)

- Product revenue is the lowest.
- Transportation is the largest factor, volume is the greatest.

Brad Lamb:

— Sales people at most home centers do not understand product, what it can do for you and where you should do it.

TxDOT

$37.90/cow	
Capital cost	**O&M**
$19.11	$18.79
	-10.00 (tipping fee)
	$8.79
	$42.33
Profit $14.43	$33.54

- Current specifications allow the use of compost in highway construction and maintenance.
- Concern for salts.
- No widespread acceptance (decisions are made locally).
- Needs a jump start much like recycled paper.

Brad Lamb:

— New BMP standards for roadways will include compost as a way to limit erosion.

— Preliminary Marketing Strategy

Established	50,000 c.y.
Ag	25,000 c.y.
TxDOT	75,000 c.y.
Total produced	200,000 c.y.

— Preliminary Recommendations

- Build public financed facility.
- Public/private partnership for operation and marketing.

Mike Meadows:

— You cannot move large quantities of compost out of Erath County - you have to do other processes. Pellets are easier to use. Ned to find different end products.

Tab Thompson:

— Pleased with findings of the study, disappointed that we did not find a silver bullet. The project was worthwhile. Water quality is still the issue and that is more important than the local dairies. Dairy industries will change dramatically in five years. There is a local mindset that there is not an environmental problem. Had a meeting in D.C. to speak with

Edwards and Stenholm. The project is insignificant to EPA and USDA and we are ahead of where these agencies are. Study will help some dairies. We need something quickly and we will probably not be able to provide that quick answer. Eventually we will have a valuable product from the manure. Federal money is not a dead issue, but will not be in this year's budget. Will have to develop a local solution.

Mike Meadows:

— Will finalize report and send it out. Looking at the State of Texas for funding. If there is no funding, the project will not proceed.

Brad Lamb:

— EPA folks took the presentation as a proposal to build a compost facility. Was not viewed as a research project.

John Hatchell:

— Waco appreciates work and study. Need to clean up watershed. Looking at wetlands and other options. Hope that Waco and Erath County can continue to work together to solve the water quality problems.

Scott McCoy:

— July 20 compost summit in Texas. Product and product quality - Recycling Coalition of Texas has compost advisory board that is proposing compost standards. Trying to keep regulators out of the business. On August 13th, there is an alternative waste management through composting seminar.

AWFP Technical Review Committee Meeting

December 5, 1997

Name	Agency Name	Work Phone	Work Fax	E-Mail Address	Business Address
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Erath County Animal Waste Management Facility Plan
Technical Advisory Committee Meeting
Attendees

June 18, 1998

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Jerry Dehay	TIAER Tarleton State University
Stuart Norvell	TIAER Tarleton State University
Lynne Moss	Camp Dresser & McKee Inc.
Mike Meadows	Brazos River Authority
Scott McCoy	TNRCC
Calvin Cowan	Congressman Chet Edward's office
Dr. H.L. Self	
Brad Lamb	U.S. EPA
Judge Tab Thompson	Erath County
Beade Northcut	TSSWC
Jay Wilson	Erath County
John Hatchel	City of Waco

Appendix B

Appendix B

Dairy Distribution Data

COMPOSTING SITE DAIRY GROUPINGS

Erath County Animal Waste Management Facility Feasibility Study

1 Mt. Pleasant Site

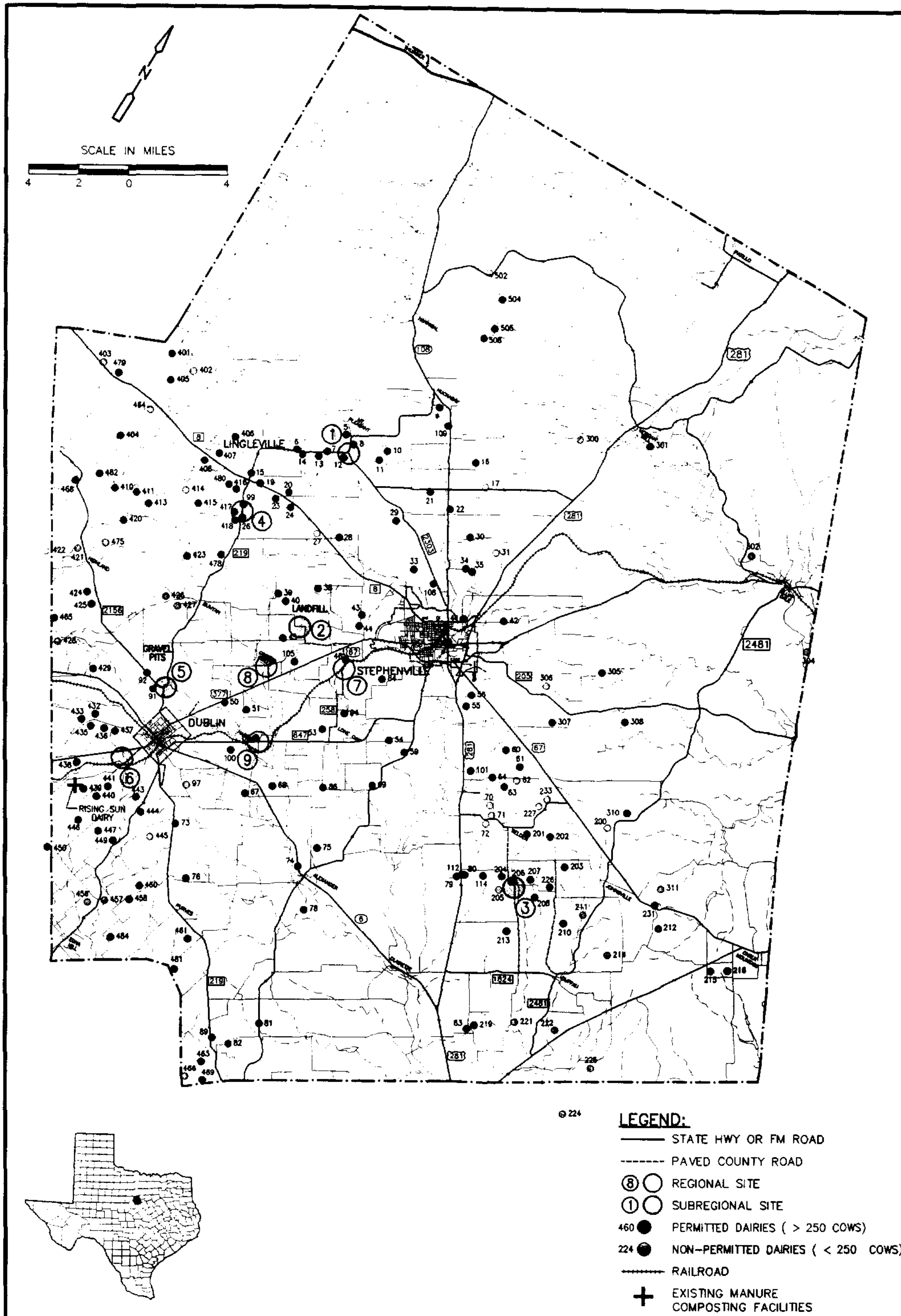
Dairy No.	Owner / Operator	Cow Capacity
4	D & L Dairy	250
5	DeVries, Don	1100
6	Hicks Dairy	400
7	Philips, Kenny	249
8	Kranenburg (leasee)	700
10	Vandenburg, S (leasee)	500
11	Carpenter Dairy	750
12	Beyer G R "Jack" Dairy # 1	990
13	Philips Dairy	125
14	Brand Harmon Dairy	249
16	Dewit , Harry	500
17	Tate, Johnny	249
21	Watson Dairy	400
22	Fanning, Brent	250
29	Beltman, Tony Dairy	840
30	Williamson, Sherman	800
31	Pack, Benjamin	80
33	Great Southern Dairy	250
34	Elston, Randal	250
35	Elston, Edwin and Randall	400
41	Tarleton State University	250
42	VandenBerge, Jack	500
108	Wallace Leland Dairy	150
109	Schouten, Dennis	250
300	Dawson, Delbert	249
301	VanLoon, Ted	375
502	Liberty Valley Dairy	249
504	Triple M Dairy	250
505	Lowe & Sons Dairy	400
508	Lowe, Randy	250
Total Cows		12,255
Total Dairies		30

2 Landfill Site

Dairy No.	Owner / Operator	Cow Capacity
38	Howle, J.M. Jr.	750
39	Kelso, Eloy	300
40	DeVries, George	1250
43	Vanderlei, Peter	500
44	Green Valley Dairy	500
45	Sunrise Farms In	250
46	Pittman, Brian	199
50	Sweetwater Dairy	280
51	Lewis, Jim	188
53	Cooper Milky Way Dairy	1225
54	Bluebonnet Dairy	500
59	Pack, Harold & Sons Dairy	650
69	Postma Dairy	250
84	Rocky Hill Dairy	250
86	My Three Sons Dairy	500
94	Calcium Deposit Dairy	950
105	Beyer's Sell Barn	1838
Total Cows		10,380
Total Dairies		17

3 Selden Site

Dairy No.	Owner / Operator	Cow Capacity
55	DeBruin Dairy	275
56	Nauta, Gerrit	249
60	Boren, Clyde Estate	450
61	Lonesome Dove Dairy	400
62	Lingle, Robert	249
63	Allen Dairy	750
64	Triple S Dairy	650
70	Brown, Steve Dairy	249
71	Moncrief Dairy	249
72	Micheal Moncrief	249
79	Schouten, M.D. Dairy	990
80	Feedlot for Schouten Dairy	900
83	Zwart, Durk	500
101	Vanderhorst & Sons Dairy	750
112	Udder Place	850
114	John Leyendekker	750
200	Riggs Dairy	249
201	Open Spaces Dairy	325
202	Wyly Dairy	700
203	Wyly Brothers	249
204	P & L Dairy	580
205	P & L Dairy # 2 (leasing)	249
206	Moncrief, Leonard #3	249
207	Sta-Lyn Dairy	250
208	Talsma, Klaas	1400
210	Vandermeer Dairy	750
211	Morrison, Carol	249
212	Hankins, D.L.	249
213	Cedarwood Dairy	1500
214	Shannon Dairy	249
215	Rojo Dairy	249
216	Deridder Dairy	650
219	Rocky Top Dairy	175
221	Rainwater, Alton	249
222	J & R Dairy Farm Inc	249
224	Arendt, Chas	249
225	Vosburg, E.R .& N.R.	249
226	Penn-Cal	1280
227	Hoelscher Dairy	249
231	Mountain Road Dairy	995
233	Ned-Tex Dairy	249
305	McCoy, Steven Dale	400
306	Purvis, E. C.	249
307	Heavyside Dairy	275
308	Van Dam	600
310	C & S Dairy	650
311	Mountain Side Dairy	249
Total Cows		22,050
Total Dairies		47



CDM

ERATH COUNTY, TEXAS

DAIRY LOCATIONS

FIGURE No B-1

4 Lingleville Site

Dairy No.	Owner / Operator	Cow Capacity
15	Griffin, Joe	249
19	Parks View	500
20	Pack, Doyle	600
23	Lingleville Dairy	700
24	Jam-Dot Holsteins	995
26	Triple Dutch Dairy	900
27	Overside Dairy	249
28	J & L Dairy	450
99	Lueck Dairies Lingleville	990
401	Staude, Joey	500
402	Bliss Dairy	249
403	Iley, Wayne	249
404	Moon, Ricky	249
405	Dempsey, Gary	249
406	Staude, Joey	400
407	Parks, James	350
408	Whitefield, Lex & Jerry	249
414	Moo View Dairy	249
415	Mayfield, Harvey	500
416	Pecan Grove Dairy	450
417	Sunset Dairy	650
418	Rocky Ledge Dairy	249
423	Crouch, J.L. Jr.	400
464	Ten Cent Dairy	249
478	Double V Dairy	990
479	JM Dairy	990
480	James Traweek #2	995
Total Cows		13,850
Total Dairies		27

5 Gravel Pits

Dairy No.	Owner / Operator	Cow Capacity
91	Aztex Dairy	1200
92	Crouch, Bob	990
410	Armstrong, Glen	500
411	Dos Amigos	700
413	Ray, Clayton W.	250
420	Buena Vista Dairy	250
421	Tony Vera Dairy	249
422	Keith, Don Ray	249
424	Highland Cattle Company	1500
425	Reese, Jack D	250
426	Turley, Curtis	249
427	Turley, Doug	249
428	Cow Creek Farm	249
429	Ricks, Larry	800
465	Hurricane Ridge Dairy	700
468	Armstrong, Charles	500
475	VanBeek Dairy	249
482	Joe Schouten	500
Total Cows		9,634
Total Dairies		18

6 Dublin Site

Dairy No.	Owner / Operator	Cow Capacity
57	Lazy D Dairy	189
67	Gibson, Larry	490
68	Hidden Valley Dairy	1500
73	Estrella Dairy	1320
74	Cal-Tex Dairy	500
75	Greenway Dairy	500
76	Grand Canyon Dairy	1950
78	Hakes Holstein Heaven	600
81	Dutch Cowboy Dairy	700
82	Leyendekker, Gerben	700
89	Vanderlaan, Peter	850
97	Ricks Dairy	249
100	Liedroc Farms West	960
432	Rio Leche Dairy #1	800
433	Shady Lane Dairy	250
435	Remington-Tanner Dairy	2500
436	Aurora Dairy Farm Inc	3000
437	Rio Leche Dairy	700
438	Fine Meadow Farm Inc.	250
439	Rising Sun Dairy	1900
440	Roberson, Mike	500
441	Blue Tulip Dairy	480
443	Kings X Dairy	500
444	TexAz Dairy	990
445	Aviles, Juan Dairy	249
446	Lanting, Bruce & Kari	500
447	Rose Hill Dairy	250
449	McNutt Brother	190
450	Bradley, Bill	250
456	Damstra, Gosse & Aafke	249
457	Haringa, Bruce	249
458	Joost Smulder (leasee)	249
460	Dutch-Tex Holstein	700
461	Thompson, Clayton	249
463	Harbour-Crest Dairy	250
466	D & D Dairy	249
469	Four H Dairy	250
481	Hen Lyn Dairy	1200
484	Sun Valley Dairy	1100
Total Cows		28,562
Total Dairies		39

		Total Dairies	Total Cows
7	**CR 258 Regional Site**	178	96731
8	**Greens Creek Regional Site**	178	96731
9	**Harbin Regional Site**	178	96731

Note: Missing dairy numbers are inactive dairies.

Appendix C

Appendix C

Transportation Impact Analysis

TRANSPORTATION IMPACT ANALYSIS

Proposed Erath County
Animal Waste Management Facility

INTERIM STATUS REPORT

Prepared for

Camp Dresser & McKee, Inc.

Prepared by

GSG, Inc. & Bledsoe Consultants, Inc.

February 1998

GSG, Inc. Engineers, Planners & Regulatory Consultants

511 West 7th Street
Austin, Texas 78701

TRANSPORTATION IMPACT ANALYSIS

Proposed Erath County Animal Waste Management Facility

INTERIM STATUS REPORT

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ANIMAL WASTE MANAGEMENT FACILITY
TRANSPORTATION IMPACT ANALYSIS

INTERIM STATUS REPORT

EXECUTIVE SUMMARY

Camp Dresser & McKee (CDM) was retained by the Brazos River Authority to determine the feasibility of developing an Animal Waste Management Facility in Erath County, Texas. CDM has retained GSG, Inc., Engineers, Planners, and Regulatory Consultants, and Bledsoe Consultants, Inc. (BCI), a Transportation Systems Planning firm, to prepare the Transportation Impact Analysis for the facility.

This Interim Status Report is presented as the first step in developing the Transportation Impact Analysis. Its purpose is to provide a "fatal flaw transportation analysis" of the three (3)Regional and six (6) Subregional sites, and rank them within their category. After Camp Dresser & McKee selects the final site candidates for in-depth analysis, GSG/BCI will proceed with the final Transportation Impact Analysis, which will determine the traffic impacts on roads accessing the proposed facility, and identify improvements which would be required on those roads to maintain adequate traffic flow and safe traffic conditions for both Waste Facility transport and for the motoring public.

The GSG/BCI team spent January 14 and 15, 1998 in Erath County conducting field investigations of the candidate sites. They used Field Sheets to codify data gathered in the field and in the office (refer to Attachment I), including information such as access route, pavement width and number of lanes, 1996 Average Daily Traffic Volumes (if available), pavement condition, and to record notes and the photographic information for each site.

GSG inventoried all of the bridges which would be impacted within the catchment area of each site. Bridges in the Study Area were divided into those which were in the influence area of the Regional sites, and those which fell in the area of Subregional sites. Within these two major categories, bridges were further separated into on-system (State Highway bridges) and off-system (County and Local bridges) classifications. An initial bridge assessment of the potential impacts that a waste treatment facility might have on surrounding bridge structures was performed based on information acquired from the TxDOT Fort Worth District. They were then ranked based on their adequacy in the following areas: load restrictions, clear travel width, and loading type/frequency. The bridge adequacy ranking was included as a variable in the final ranking exercise.

Evaluation of the potential sites in each group for overall transportation access was made using the variables of accessibility, roadway geometrics and surface condition, safety factors, and the amount of remedial action that would be needed. The Variables were given a rating of good, fair, or poor, and are presented in the Working Evaluation Matrices, showing the overall transportation desirability of each site. The sites were then ranked within the Subregional and Regional categories. Subregional Site number 1 was deemed most desirable, and Subregional Site number 2 as least desirable from a transportation access, safety and remedial action basis. For Regional sites, Site number 8 was found to be most adequate, and Site number 7 least adequate.

ANIMAL WASTE MANAGEMENT FACILITY
TRANSPORTATION IMPACT ANALYSIS

INTERIM STATUS REPORT

TABLE OF CONTENTS

ANIMAL WASTE MANAGEMENT FACILITY
TRANSPORTATION IMPACT ANALYSIS

INTERIM STATUS REPORT

I. BACKGROUND

Camp Dresser & McKee has been retained by the Brazos River Authority to determine the feasibility of developing an Animal Waste Management Facility in Erath County, Texas. Part of their charge in selecting potential sites for the facility was to conduct a Transportation Impact Analysis, to determine the amount of site-related traffic which would be generated by the site (whether Regional or Subregional) and the waste generation sources, and to determine the traffic impacts on roads and bridges accessing the proposed facility. The Transportation Impact Analysis would then rank the sites based on magnitude of the traffic impacts associated with each potential site, and identify improvements which would be required on those roads and bridges to maintain adequate traffic flow and safe traffic conditions for both Waste Facility transport and for the motoring public.

Camp Dresser & McKee has retained GSG, Inc. to prepare the Animal Waste Management Facility Transportation Impact Analysis. GSG, Inc., Engineers, Planners, and Regulatory Consultants, is developing the Transportation Impact Analysis with Bledsoe Consultants, Inc. (BCI), a Transportation Systems Planning firm.

II. PURPOSE OF INTERIM STATUS REPORT

This Interim Status Report is presented as the first step in developing the Transportation Impact Analysis. Its purpose is to provide a "fatal flaw transportation analysis" of the three (3)Regional and six (6) Subregional sites, and rank them within their category. This report should be considered a "working document;" it presents our initial findings and assessments - and preliminary ranking of the sites - with the understanding that we will receive feedback from Camp Dresser & McKee, the members of the Brazos River Authority, and affected Erath County officials as input to our final analyses and final report.

III. METHODOLOGY

The following section describes the methodology GSG/BCI used to conduct the fatal flaw analysis for this Interim Status Report.

III.1 Roadway Inventory

In preparation for their site investigation of the nine candidate sites in Erath County, GSG and BCI developed a set of Field Sheets on which information gathered in the field and in the office could be codified. These sheets were used to gather information such as access route, pavement width and number of lanes, 1996 Average Daily Traffic volumes (if available), pavement condition, and to record notes and the photographic information for each site. The GSG/BCI team spent January 14 and 15, 1998 in Erath County conducting field investigations of the candidate sites. Attachment I contains a draft copy of the working Field Sheets.

It should be noted that some items on the working Field Sheets are still not completed. Some items, such as the 1996 Average Daily Traffic (ADT), were available from the Texas Department of Transportation (TxDOT) Planning and Programming Division, or the TxDOT Fort Worth District or TxDOT Stephenville Area Engineer's Office. This information is available for all roads on the State System (*e.g.*, RM and FM roads; US Highways), and we have compiled historical ADT information for the last ten years for all the State System roads in the Study Area. For County Roads, such information is not available.

The information on the Field Sheets for the *final candidate sites* will be completed as input for the in-depth analyses provided in the final Transportation Impact Analysis. This will include taking traffic counts on the affected County Roads accessing the *final candidate sites*, and determining capacities and Levels of Service.

III.2 Initial Bridge Assessment

Based on the bridge information acquired from TxDOT [refer to Section III.3.c, below], an initial assessment was made on the potential impacts that any waste treatment facility might have on surrounding bridge structures. For this initial assessment, the impacts were categorized as follows.

Bridges in the Study Area were divided into those which were in the influence areas of the Regional and Subregional sites. Within these two major categories, bridges were further separated into on-system (State Highway bridges) and off-system (County and Local bridges) classifications. They were then assessed on the following criteria:

1. Load Restrictions,
2. Clear Travel Width,
3. Loading Type/Frequency,
    a. Localized Hauls (H-20 sized vehicles), and
    b. Post-Processing Hauls (HS-20 vehicles)

Localized hauls were defined as vehicles having loadings similar to those of H-20 sized trucks making collections from individual farms, and subsequently delivering the waste to the local or regional facility.

Post-processing hauls were defined as HS-20 (semi-class) vehicles making hauls out of either Regional or Subregional facilities.

Bridges were given ratings of Adequate (A), Marginal (M), or Restricted (R), which are defined as follows:

Adequate (A) - No load restrictions; sufficient clear width to maintain two-way traffic of at least H-20 sized vehicles.

Marginal (M) - No load restrictions, one-way traffic when a H-20 or larger sized vehicle passes over bridge.

Restricted (R) - Load posting restricting H-20 or larger sized vehicle.

PLEASE NOTE: Frequency of loadings was not evaluated as part of this initial assessment. This variable will be incorporated into the final Transportation Impact Analysis once the final candidate sites have been selected.

III.2.a Identification of Bridges

Attachment II of this report indicates the specific off-system and on-system bridges which could be impacted by development of a Regional site, Subregional site, or both. Based on this, each bridge was assigned an appropriate site number, or numbers, to or from which hauls could be made.

Although six separate impact boundaries have been outlined, and the appropriate bridges within these regions were identified, consideration was given to possible hauls made from certain farms across adjacent boundaries assuming one site was selected and the other was not. Both off-system and on-system bridges were selected and reviewed in the same manner. Based upon this initial review, there appear to be *no limitations for any on-system bridges* within the Study Area.

The following matrices numerate the distribution of bridges (on- and off-system) over each proposed site, based on accessibility limitations as described earlier in this section.

BRIDGE IMPACT MATRIX 1
SUBREGIONAL SITES

VARIABLES	SITE NUMBER					
	1	2	3	4	5	6
Number of Off-System Bridges						
Adequate	0	0	0	0	0	0
Marginal	4	1	1	2	1	5
Restricted	3	5	5	1	2	5
Number of On-System Bridges						
Adequate	12	12	24	5	3	8
Marginal	0	0	0	0	0	0
Restricted	0	0	0	0	0	0

BRIDGE IMPACT MATRIX 2
REGIONAL SITES

VARIABLES	SITE NUMBER		
	7	8	9
Number of Off-System Bridges			
Adequate	0	0	0
Marginal	0	2	4
Restricted	2	4	6
Number of On-System Bridges			
Adequate	62	62	62
Marginal	0	0	0
Restricted	0	0	0

III.2.b Bridge Assessment Summary

Based on the distribution presented in the above matrices, the sites have been ranked for preference from most to least adequate for each of the Regional and Subregional categories. Based on input received from Camp Dresser & McKee, the Brazos River Authority, and Erath County, as well as subsequent analysis, these rankings could change. However, this information has been incorporated into the final site ranking found in Section IV of this report.

TABLE 1
RANKING OF SITES
BY ADEQUACY OF BRIDGES

ADEQUACY	SUB-REGIONAL SITE #	REGIONAL SITE #
MOST	4	7
	5	8
	1	9
	6	
	2	
LEAST	3	

III.3 Contacts with Local Officials

During the January 14-15 trip to Erath County, the GSG/BCI team contacted the following officials to discuss the transportation network in the Study Area.

III.3.a Meeting with Erath County Commissioner Jerry Martin, Precinct 1 - Ms. Bledsoe met with Commissioner Jerry Martin on January 15, 1998. Commissioner Martin was very helpful in giving a general summary of the condition of the County Roads, the accessibility of these roads, and the County's maintenance procedure. As a former dairyman, he also provided us with information about the primary dairy locations in the County, dairy transport characteristics, and potential problems to watch for in our analysis. The following is a list of the salient items discussed. After the fatal flaw analysis is complete - and the final site candidates have been chosen by Camp Dresser & McKee - we will be contacting Mr. Martin again for particulars about road conditions around those sites.

- There is a County project in process to improve CR 258; it will be completed by time the Animal Waste Management Facility begins construction.

- From his contact with County citizens, their main concern is manure spilling from back of open spreader trucks. The manure spills create a traffic safety and aesthetic problem.

- When we discussed the potential impact of heavy trucks on the roads in the County, he stated that many of these heavy trucks are already servicing the dairies - as feed and materials delivery trucks, manure transport trucks, and, sometimes, as compost transport trucks. In the case of some of the potential sites, the traffic "generated" by a Waste Management Facility would really be traffic which is already there, but traveling a different route, or having different load or time of day characteristics.

- Commissioner Martin stated that records on on-State System or off-State System bridges are kept by TxDOT.

- Commissioner Martin noted that the roads in the County were in considerably worse shape than usual due to the continual rain in the past few weeks. The road crews were not able to maintain the roads as well as usual during rainy conditions.

III.3.b Meeting with Bill Nelson, P.E., TxDOT Assistant Area Engineer (Stephenville) - In our meeting on January 15, 1998, Ms. Bledsoe requested information from Mr. Nelson for all of the State System roads in the Study Area as input for the final analyses. This information is available from the TxDOT Fort Worth District (*via* the Area Engineer's Office) "RI1 Log," and includes pavement sections, pavement design characteristics, ADT, etc. for all state-maintained roads. Mr. Nelson is in the process of compiling this information for the roads shown on Table 2.

TABLE 2
INFORMATION FROM RI1 LOG

STATE/FED ROAD	INTERSECTS WITH	SITE #
US 67/377	CR 380	8
	CR 258	7
	CR 351 (CR 580)	2
	CR 336	6
FM 847	CR 520	9
	CR 250	9
FM 219	CR 375	5
	FM 2303	1
	CR 391	4
	FM 2156	5
FM 1824	CR 229	3

Mr. Nelson indicated to us that TxDOT will be upgrading US 67/377 in the summer of 1998.

III.3.c Meeting with Shiraz H. Dhanani,P.E., Senior BRINSAP Engineer, TxDOT Fort Worth District - On January 15, 1998, Mr. Manore met with Mr. Dhanani. In that meeting Mr. Manore outlined the scope of the Animal Waste Management Facility project, and explained the need for on-system and off-system bridge information in Erath County.

Mr. Dhanani supplied the on- and off-system bridge maps of Erath County along with further information detailing each structure, as indicated below:

1. Bridge Identification Numbers,
2. Bridge Geometrics (# spans, length, width, etc.),
3. Maintenance Responsibilities,
4. Load Restrictions,
5. Load Ratings,
6. Date Last Inspected,
7. On-system bridge location map, and
8. Off-system location map.

This information was compiled to determine the key locations of structures which may prove unsuitable to carry the associated vehicle loadings which could be generated by any Regional or Subregional waste facility in Erath County.

III.3.d Future Meetings with Officials - As the final Transportation Impact Analysis is developed, we will be contacting the County Commissioners for the other Precincts in which the final site candidates are situated, and working with TxDOT as necessary to complete the analysis.

IV. RANKING POTENTIAL SITES

IV.1. Evaluation Variables and Criteria

For evaluation and ranking purposes, the nine sites were divided into those which were being considered as Regional facilities (Sites 7, 8, and 9), and those being considered for Subregional facilities (Sites 1 through 6). Evaluation of the potential sites in each group for overall transportation access was made using the following Variables:

1. Accessibility,
2. Roadway Geometrics and Surface Condition,
3. Safety Factors, and
4. Magnitude of Remedial Action.

The criteria for each Variable was considered in the total ranking for the Variable. The Variables have been given a rating of Good, Fair, or Poor. The Weighted Variables are presented in Working Evaluation Matrix 3 (Subregional Sites) and Working Evaluation Matrix 4 (Regional Sites) [see below]. The "Weighted Totals" row at the bottom of each matrix indicates the overall transportation desirability of that site. The sites are then ranked within each category or matrix (Subregional and Regional) on the last row of the matrix.

Sections V.1.a through V.1.d discuss the evaluation criteria associated with each variable.

IV.1.a Accessibility

Accessibility is defined as "ease of access" to the site. The Accessibility Variable consists of a number of criteria which influence accessibility, which are listed below.

1. Accessibility to all-weather State-maintained roadway,
2. Number of intervening roadways or driveways,
3. Other intervening traffic generators (schools, businesses, etc.),
4. Intervening (substandard) bridge structures,
5. Proximity to uncontrolled railroad crossings, and
6. Average Daily Traffic Volumes (ADTs) & Levels of Service.

IV.1.b Roadway Geometrics and Surface Condition

The adequacy of the roadway geometrics and surface condition for routes to the various sites is a factor of the design of the roadway, condition of the pavement, and general terrain features. The following criteria were considered.

1. Geometric design of roadway, including horizontal and vertical curves,
2. Compacted dirt/gravel or bituminous pavement
   - for each of above, condition of surface (level or not, cracked or bumpy, pot holes, etc.),
   - drainage adequacy, and
3. Smoothness of ride.

IV.1.c Safety Factors

Safe traffic access for both the motoring public and for Animal Waste Management Facility transport is an important consideration in ranking and selecting sites.

1. Sight distance restrictions (reverse curves or other factors limiting adequate sight distance),
2. Railroad crossings
   - controlled or uncontrolled; caution lights or bars, etc.,
3. Schools or school zones; school bus routes, and
4. Residences.

IV.1.d Magnitude of Remedial Action

For this variable, the rankings were "good" if little remedial action was necessary in the following criteria; "fair" if a medium amount of remedial action was needed, and "poor" if major improvements to intersections, roadway geometrics, bridge structures, or railroad crossing would be required.

1. Upgrading X miles of roadway from site back to good State-maintained roadway,
2. Magnitude of intersection upgrades (main routes only), and
3. Modification of structures (bridges; on- and off-system).

WORKING EVALUATION MATRIX 3
SUBREGIONAL SITES

VARIABLES	SITE NUMBER					
	1	2	3	4	5	6
Accessibility	G	F	P	G	G	F
Pavement Condition & Ride	G	G	G	F	G	F
Safety	G	F	G	G	P	F
Magnitude of Remedial Action	G	P	P	G	F	F
WEIGHTED TOTALS	G	F	F	G	F	F
RANKING	1	6	5	2	3	4

WORKING EVALUATION MATRIX 4
REGIONAL SITES

VARIABLES	SITE #		
	7	8	9
Accessibility	F	G	G
Pavement Condition & Ride	P	F	G
Safety	P	G	F
Magnitude of Remedial Action	P	F	F
WEIGHTED TOTALS	P	G	G-
RANKING	3	1	2

V. SUMMARY OF INTERIM FINDINGS

As shown in Matrices 4 and 5, the interim transportation analysis ranks Subregional Site number 1 as most desirable, and Subregional Site number 2 as least desirable from a transportation access, safety and remedial action basis. For Regional sites, Site number 8 was found to be most adequate, and Site number 7 was deemed least adequate from a transportation standpoint.

Once again, we will be taking into account the feedback received about this Interim Status Report from Camp Dresser & McKee, the local officials, and the Brazos River Authority when making the final analyses for the full Transportation Impact Analysis. As that report is developed, we will be focusing in greater depth upon some of the variables and criteria employed in the ranking system in this document, and refining our analyses of the final candidate sites.

VI. ITEMS TO BE INCLUDED IN FINAL TRANSPORTATION IMPACT ANALYSIS

When feedback is received from Camp Dresser & McKee, the members of the Brazos River Authority, and affected Erath County officials, the rankings of this analysis may be modified. Once the top candidate Regional and Subregional sites are selected, the GSG/BCI team will continue with in-depth analysis for these sites. The following general outline lists topics which will be covered in the final report.

Refinement of Ranking Analysis

1. Review and refinement of Variables and Criteria
2. Completion of Bridge analysis

Transportation Analysis Methodology

1. Existing Levels of Service
    a. Average Daily Traffic/Capacity
2. Background Traffic Growth Analysis
    a. Using TxDOT AADT maps for last 10 years
    b. Factoring current ADTs up to projected site opening date
3. Site Generated Traffic Analysis
    a. Using CDM's Manure Calculations and Truck Loading Factors
        - for both Regional and Subregional sites

4. Trip Distribution Analysis
    a. Employ Gravity Model Techniques

5. Projected Level of Service Analysis
    a. Identify capacity constraints
    b. Identify geometric constraints
    c. Identify safety issues

Design Recommendations

1. Generic Entrance Treatments (Regional and Subregional facilities)
    - will include signs, markings, warning lights & other treatments, channelization, curb radii, luminaires, etc.
2. Roadway Upgrades (AASHTO standards)
3. Intersection Upgrades (AASHTO standards)
4. Potential Costs

ATTACHMENT I
WORKING FIELD SHEETS

SITE 7 - CR 258 SITE
BY RR, ~ 3 MI. W/STEPHENVILLE

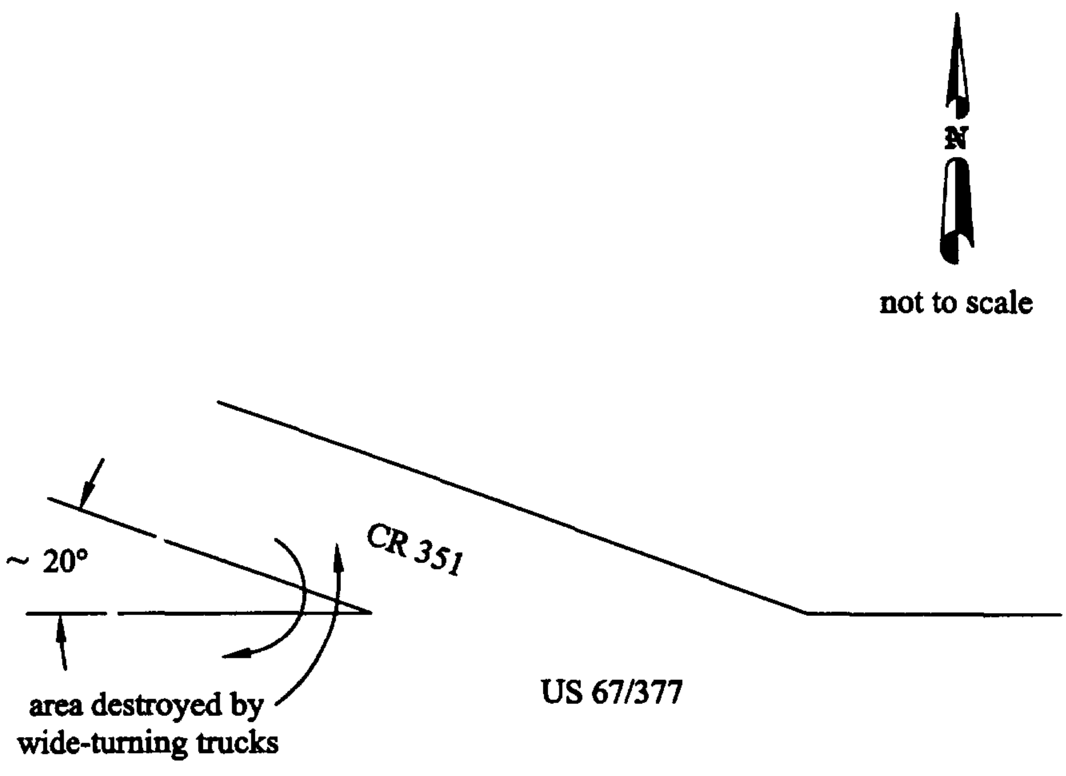
ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
CR 258	28'	2				bituminous pavement no shoulders fair-poor condition some pot holes poor drainage **should improve CR 258** to NW all way back to US 67/377; **Jerry Martin says its an improvement proj.** to be done by time site is under construction	**1.** SE- 258 **2.** Nwon 258 w/**RR Xng** **3.** road (mud)(258) **4.** SE, .5 mi from site on 258 - **road improves**	1. standing water 2. uncontrolled RR crossing adjacent to site on NW (see photo 2) 3. sight distance problem both SE and NW (reverse curves) 4. consider rail siding for loading compost 5. problems with large trux turning in & out **@ US 67/377 - improve intersection**
US 67/377				11,500				

TIAs\AWMF-Erath\field sheets

DRAFT

SITE 2 - LANDFILL
CR 385 - SOUTH OF US 67

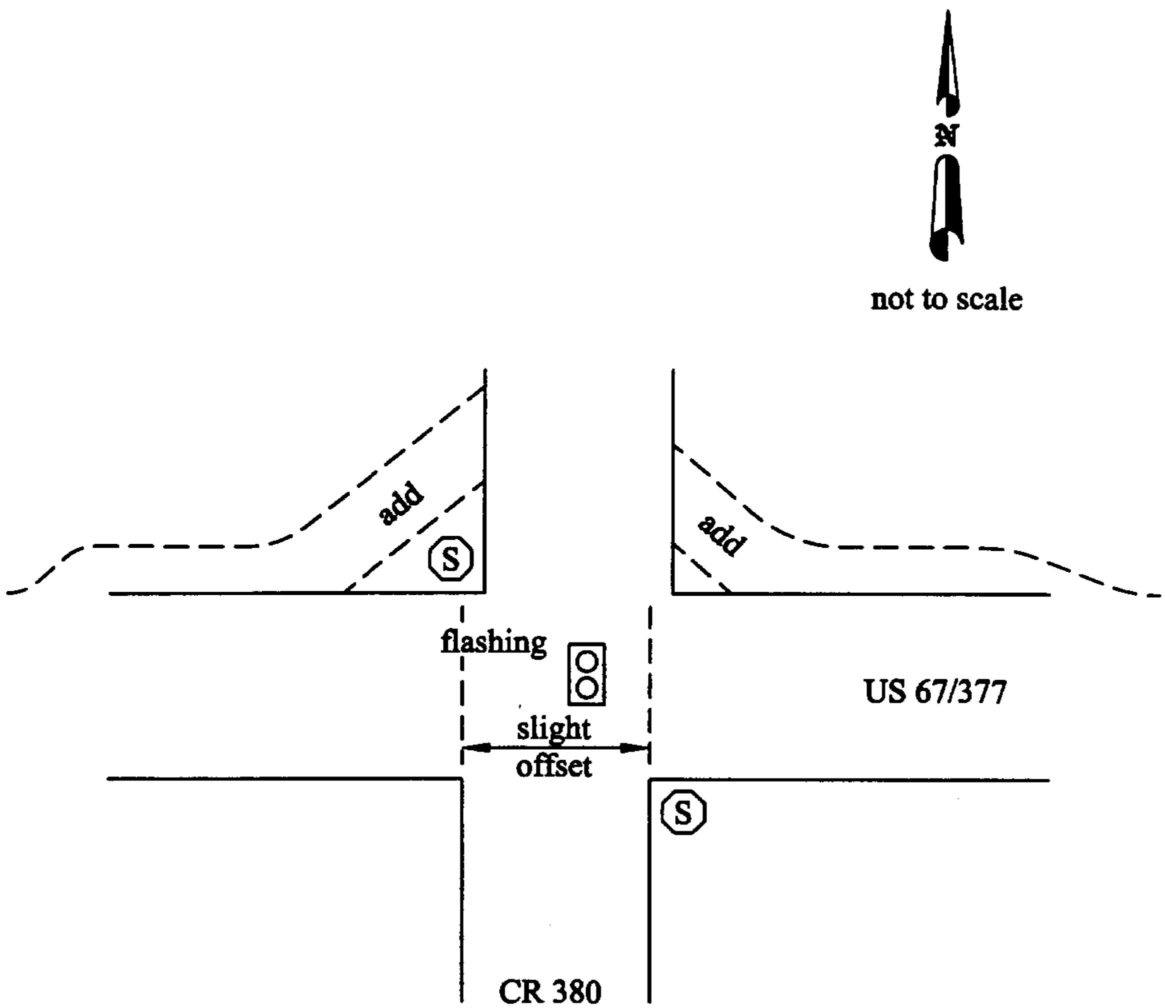
ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
CR 378 **note:** ***not the logical way to site***		2				compacted dirt/gravel no shoulders fair to poor condition full of potholes	**5.** CR 378 **6.** NW on 378 **7.** NE on ?378 - bridge	
CR 351						bituminous pavement no shoulders fair-good condition	**8.** SW on CR 351 at **bridge # AA0351-004** **10. culvert** on 351 (new; no limit sign-ok)	**one-lane bridge on CR 351 just east of its intersection with CR 378** (14/19' clear width'; load limit 15,000 axle or tandem) school on CR 351 **problem with trux turning right from CR 351 onto US 67/377** (EB right) - see sketch; note the mud left by unchannelized right turns
CR 385	18'	2				bituminous pavement no shoulders fair-good condition	**9.** SE on CR 385 in front of site	**SEE PAGE 2b FOR SKETCH OF THE US 67/377-CR 351 INTERSECTION**
US 67/377		2 12'-13' lanes		11,500		8' shoulders		



EXISTING
CR 351 @ US 67/377 INTERSECTION

SITE 8 - GREEN'S CREEK
CR 380 - ~ .5 MI N/US 67

ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
CR 380	20'	2				bituminous pavement no shoulders fair-poor condition alligator cracking near shoulders bumpy ride	**11.** SE on CR 380 **12.**NW on 380	**intersection w/US 67** has flashing light; slightly offset NB & SB legs of 380; **EB & WB stop signs** on 380 **consider center turn lane on US 67**; add SB and WB right turn lanes for 380 access **excellent access from US 67** - straight in-out; nothing between site & US 67
US 67				8,500		bituminous pavement no shoulders rough condition **scheduled for recon-struction in summer 1998 (Bill Nelson)**		
CR 351 ***n/a - not good access to site***						this section of CR 351 is **dirt** (all the way back to CR 385) **no good access back to CR 351**	**13.** CR 380/351 int.- taken on 351 looking NE	
US 67/CR 380 INT.							**14 & 15.** SE on CR 380 (at US 67/377) **16.** SW on US 67 looking at 380 int.	**SEE PAGE 3b FOR SKETCH OF US 67/377-CR 380 INTERSECTION2**



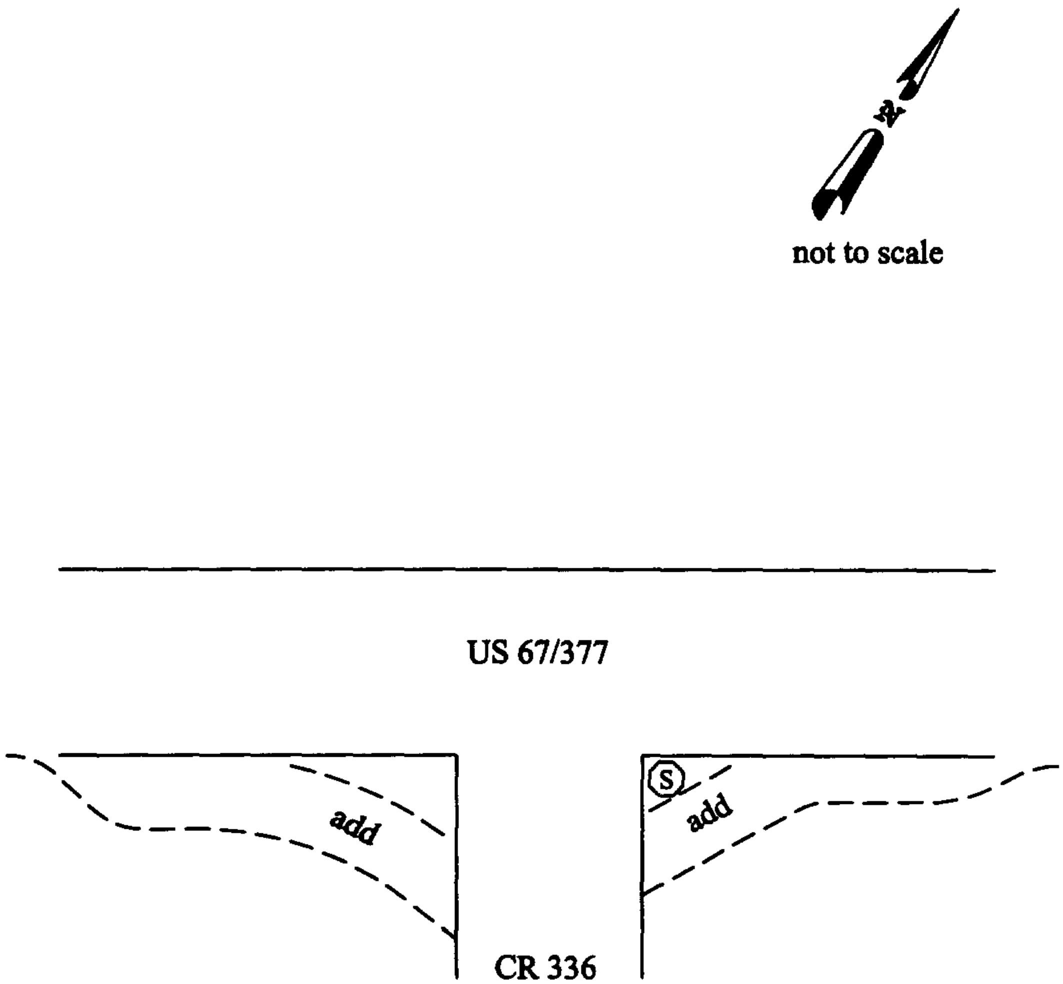
POSSIBLE IMPROVEMENTS FOR
US 67/377 @ CR 380 INTERSECTION

SITE 5 - GRAVEL PITS
FM 219, ~ 1MI. N/DUBLIN, JUST NORTH OF FM 2156

ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
FM 219	20'	2		890		bituminous pavement no shoulders ditch drainage good condition	**17.** South on FM 219 **18.** North on FM 219	potential **sight distance** problem bec of speed on FM 219 & lack of luminaires; **we noted several speeders while in the field**
US 67/FN 219 INT.				10,600				at int: signal on guy wire; US 67 2 lanes

SITE 6 - DUBLIN
BETWEEN RR & CR 336, ~ .25 MI S/US 67 (OUTSKIRTS OF DUBLIN)

ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
CR 336	22'	2				bituminous pavement no shoulders fair condition *bumpy ride*	**19.** North on CR 336 **20.** South on CR 336 **22. bridge # AA0336-001** on CR 336 ~1 mile south of site	Bridge is 14', but clearance width is 17' about 1.5 miles south of site on CR 336, **railroad crossing**
US 67/CR 336 intersection ON US 67/377				 4,200			**21.** looking north on 336 (to US 67 int.)	stop sign on NB approach (on CR 336) **improve int. with NB and EB right turn lanes** **maybe signalize intersection** **SEE PAGE 5b FOR SKETCH OF US 67/377-CR 336 INTERSECTION**



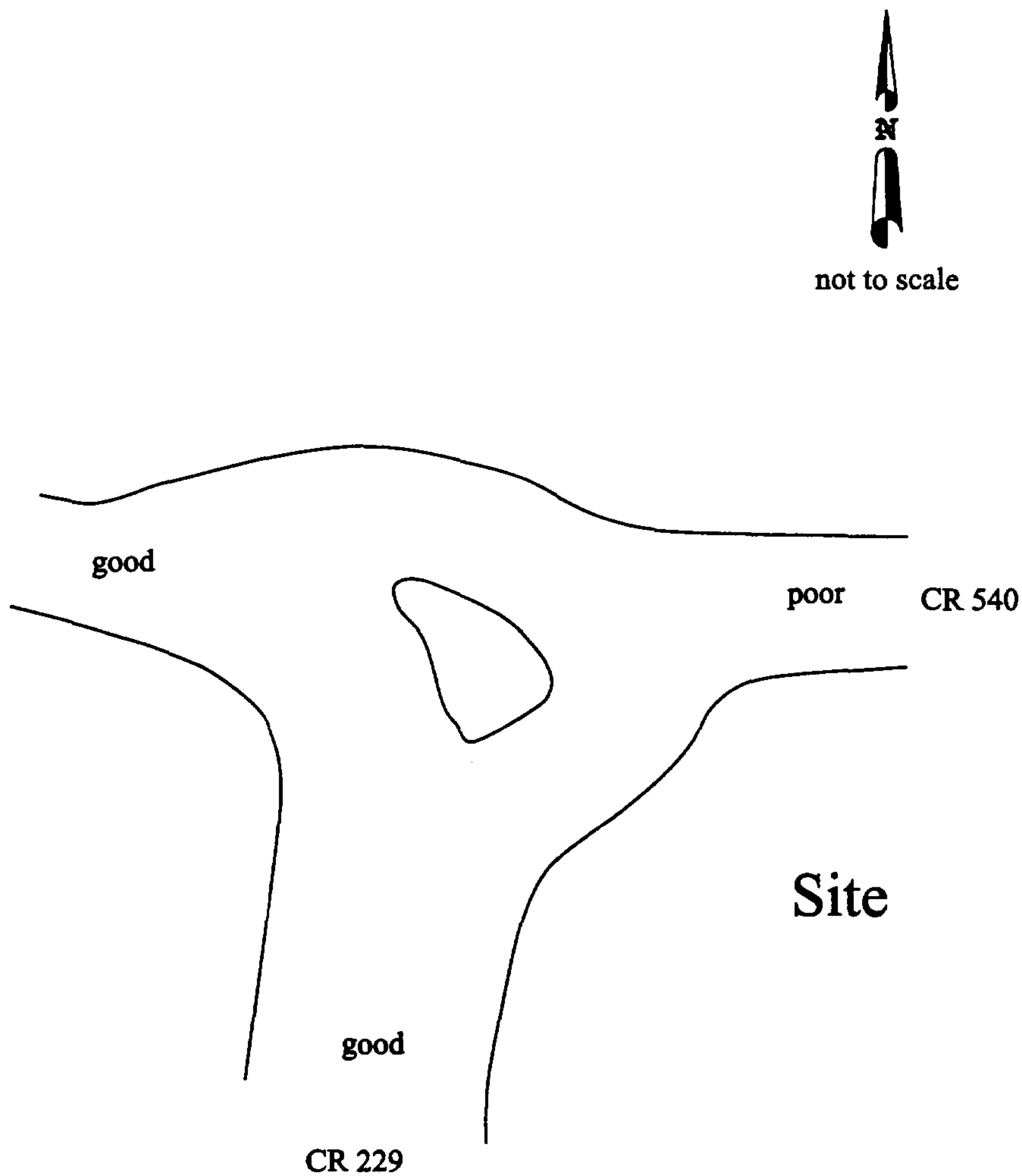
POSSIBLE IMPROVEMENTS FOR
US 67/377 @ CR 336 INTERSECTION

SITE 9 - HARBIN
IN TRIANGULAR TRACT BETWEEN **FM 847 & RR & CR 520 - ~ 3 MI E/DUBLIN**

ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
FM 847	20'	2		730		bituminous pavement no shoulders rural section; ditch drainage good condition smooth ride	**23.** east on FM 847 **24.** west on FM 847 to **RR Xng**	site is quite accessible from the Dublin area **railroad crossing on south side of property** (crossing FM 847) - **controlled with lights - but NO bars** -could impede traffic flow straight as an arrow - no s-d problems
CR 520						compacted dirt/gravel no shoulders fair condition level; some shallow potholes	**25.** north on CR 520 to FM 847 **26.** south on CR 520	on east side of site - away from Dublin **if entrance taken on CR 520,** it would need to be improved back to FM 847, plus **int. improved**

SITE 3 - SELDEN
SOUTHEAST SIDE OF INT. OF CR 229 (PAVED) & CR 540

ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
CR 229	20'	2				bituminous pavement no shoulders good condition	**29.** looking north from 229 to 540 **30.** NW on 229 **31.** SE on 229	**improve completely substandard intersection of CR 540 & CR 229**
CR 540	14'	2				compacted dirt/gravel no shoulders poor condition pot holes	**27.** SW on CR 520 **28.** NE on CR 520	**improve CR 540 if entrance on this side** **SEE PAGE 7b FOR SKETCH OF CR 229 @ CR 540 INTERSECTION**



EXISTING
CR 229 @ CR 540 INTERSECTION

SITE 4 - LINGLEVILLE
EITHER SIDE OF FM 219, ~1 MI. S/LINGLEVILLE

ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
FM 219	18'	2		750		bituminous pavement no shoulders good condition smooth ride	**32**. NW on FM 219 **33**. SE on FM 219	
CR 392						compacted dirt no shoulders poor condition		

SITE 1 - MT. PLEASANT
FM 219 - JUST SOUTH OF FM 2303

ACCESS ROUTE	PVT WIDTH	# LNS	CAP	1996 ADT	LOS	PVT CONDITION (shoulders, base, etc.)	PHOTOS	NOTES
FM 219	20'	2		550		bituminous pavement no shoulders good condition smooth ride	**34.** NW on 219 **35**. SE on 219 **37**. SE on 219 at int. **38**. NW on 219 looking at int. **39**. east on 219 looking down on 2303 **40**. FM 219 - looking NW	
FM 2303				530		good	**36**. NW on 2303 at int.	**intersection has very wide turning radii** **intersection excellent for heavy trux**

ATTACHMENT II
POTENTIAL BRIDGE IMPACT LISTING
OFF-SYSTEM & ON-SYSTEM

Animal Waste Management Facility   *ATTACHMENT II*

Potential Bridge Impact Listing: OFF-SYSTEM*

Facility Number		Bridge Number	Posted Restrictions (lbs)	Restriction Type		Clear Travel Width (ft-in)	Accessibility
3		AA0179-001	10000	SA/TA		14-0	R
3		AA0208-001	12000	SA/TA		13-3	R
3		AA0211-001	5000	SA/TA		14-1	R
3		AA0213-001	NONE			12-1	M
3		AA0226-001	16000	SA/TA		15-0	R
3		AA0230-001	6000	GR/SA/TA		11-8	R
6,9		AA0246-001	21000	TA		12-6	R
6,9		AA0249-001	NONE			20-0	M?
6,9		AA0249-002	6000	GR/SA/TA		11-3	R
6,9		AA0249-003	NONE			??	M?
2,7,8,9		AA0259-001	15000	SA/TA		18-1	R
6,9		AA0275-001	NONE			18-0	M
6,9		AA0277-001	21000	TA		12-0	R
2,7,8		AA0279-001	17000	SA/TA		18-4	R
6,9		AA0300-001	5000	SA/TA		13-5	R
6,9		AA0303-001	16000	GR/SA/TA		11-4	R
6,9		AA0303-002	28000	TA		13-0	M
6		AA0336-001	NONE			19-0	M
2,5,8		AA0351-001	15000	SA/TA		19-0	R
2,5,8		AA0351-002	12000	SA/TA		15-6	R
2,5,8		AA0351-003	NONE			19-0	M
2		AA0351-004	15000	GR/SA/TA		19-0	R
4,7,8		AA0392-001	NONE			15-9	M
1,4		AA0396-001	28000	GR/SA/TA		12-0	M
1,4		AA0397-001	NONE			16-0	M
1,4		AA0398-001	5000	SA/TA		12-0	R
1		AA0407-001	21000	TA		11-7	M
1		AA0423-001	7000	SA/TA		13-5	R
1		AA0424-001	NONE			13-1	M
1		AA0429-001	7000	SA/TA		11-8	R

*** Based on TXDOT-Ft. Worth Bridge Data (Both Off and On-System)**

Key:

Restriction Type
GR = Gross Vehicle Weight
SA = Single Axle Loads
TA = Tandem Axle Loads

Accessability
A = Adequate
M = Marginal
R = Restricted

? = Insufficient Data

Animal Waste Management Facility

Potential Bridge Impact Listing: ON-SYSTEM

ATTACHMENT II

Facility Number		Bridge Number	Posted Restrictions (lbs)	Restriction Type		Clear Travel Width (ft-in)	Accessibility
7,8,9		0079-04-015	None	N/A		???	A?
7,8,9		0079-04-027	None	N/A		???	A?
7,8,9		0079-05-021	None	N/A		???	A?
7,8,9		0079-05-022	None	N/A		44-0	A
7,8,9		0079-05-023	None	N/A		44-0	A
7,8,9		0079-05-024	None	N/A		44-0	A
7,8,9		0079-05-039	None	N/A		68-0	A
7,8,9		0079-05-040	None	N/A		68-0	A
7,8,9		0080-01-001	None	N/A		???	A?
7,8,9		0250-03-022	None	N/A		60-0	A
7,8,9		0250-03-010	None	N/A		???	A?
7,8,9		0250-04-005	None	N/A		44-0	A
7,8,9		0250-04-006	None	N/A		44-0	A
7,8,9		0250-04-007	None	N/A		44-0	A
7,8,9		0250-04-008	None	N/A		44-0	A
7,8,9		0250-04-009	None	N/A		44-0	A
7,8,9		0250-07-011	None	N/A		33-0	A
7,8,9		0257-06-023	None	N/A		41-9	A
7,8,9		0258-02-005	None	N/A		47-3	A
7,8,9		0258-02-001	None	N/A		21-7	A
7,8,9		0258-02-002	None	N/A		34-0	A
7,8,9		0258-02-004	None	N/A		34-0	A
7,8,9		0259-01-053	None	N/A		???	A?
7,8,9		0259-01-054	None	N/A		???	A?
7,8,9		0259-01-055	None	N/A		28-6	A
7,8,9		0259-01-056	None	N/A		???	A?
7,8,9		0259-01-057	None	N/A		38-0	A
7,8,9		0259-01-058	None	N/A		???	A?
7,8,9		0343-04-020	None	N/A		24-0	A
7,8,9		0343-04-021	None	N/A		24-0	A
7,8,9		0343-04-022	None	N/A		???	A?
7,8,9		0343-04-023	None	N/A		???	A?
7,8,9		0343-04-028	None	N/A		???	A?

Key:

Restriction Type

GR = Gross Vehicle Weight

SA = Single Axle Loads

TA = Tandem Axle Loads

Accessability

A = Adequate

M = Marginal

R = Restricted

? = Insufficient Data

Animal Waste Management Facility **ATTACHMENT II**

Potential Bridge Impact Listing: ON-SYSTEM

Facility Number		Bridge Number	Posted Restrictions (lbs)	Restriction Type		Clear Travel Width (ft-in)	Accessibility
7,8,9		0467-02-002	None	N/A		42-0	A
7,8,9		0467-02-003	None	N/A		25-8	A
7,8,9		0467-02-004	None	N/A		42-0	A
7,8,9		0467-02-005	None	N/A		42-6	A
7,8,9		0550-02-001	None	N/A		40-0	A
7,8,9		0550-02-002	None	N/A		40-0	A
7,8,9		0550-02-003	None	N/A		40-0	A
7,8,9		0550-02-009	None	N/A		24-0	A
7,8,9		0550-02-010	None	N/A		32-0	A
7,8,9		0550-02-027	None	N/A		40-0	A
7,8,9		0550-02-031	None	N/A		58-0	A
7,8,9		0550-03-017	None	N/A		22-3	A
7,8,9		0550-03-025	None	N/A		24-0	A
7,8,9		0550-04-026	None	N/A		23-0	A
7,8,9		1597-02-006	None	N/A		32-0	A
7,8,9		1597-02-007	None	N/A		22-7	A
7,8,9		1597-02-008	None	N/A		32-0	A
7,8,9		1963-02-001	None	N/A		33-0	A
7,8,9		1963-02-003	None	N/A		23-0	A
7,8,9		1963-02-004	None	N/A		???	A?
7,8,9		1990-01-002	None	N/A		???	A?
7,8,9		1990-01-003	None	N/A		36-0	A
7,8,9		1991-02-001	None	N/A		24-0	A
7,8,9		1991-02-002	None	N/A		24-0	A
7,8,9		1991-02-003	None	N/A		24-0	A
7,8,9		2578-02-001	None	N/A		24-2	A
7,8,9		2578-02-002	None	N/A		33-8	A
7,8,9		2578-02-003	None	N/A		24-4	A
7,8,9		0550-02-007	None	N/A		???	A?
7,8,9		0550-02-008	None	N/A		24-0	A
7,8,9		1990-01-001	None	N/A		34-0	A

Key:

Restriction Type
GR = Gross Vehicle Weight
SA = Single Axle Loads
TA = Tandem Axle Loads

Accessability
A = Adequate
M = Marginal
R = Restricted

? = Insufficient Data

Appendix D

Appendix D

Environmental Assessment

Hicks & Company

Environmental/Archeological Consulting

BRAZOS RIVER AUTHORITY
ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY
FEASIBILITY STUDY FOR SITE SELECTION
POTENTIAL ENVIRONMENTAL CONSTRAINTS REPORT

Prepared for:

Brazos River Authority

Prepared by:

Hicks & Company

Camp, Dresser & McKee, Inc.

March 1998

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BRAZOS RIVER AUTHORITY
ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY
FEASIBILITY STUDY FOR SITE SELECTION
POTENTIAL ENVIRONMENTAL CONSTRAINTS REPORT

INTRODUCTION

The purpose of this study is to determine potential environmental constraints on thirteen sites selected for consideration for the location of one regional or more than one sub-regional animal waste management facilities in Erath County, Texas. The following environmental constraints analysis evaluates the potential for federally listed threatened/endangered species habitat, wetlands or other waters of the U.S., cultural resource sites, and areas within the 100-year floodplain. The potential constraints of the potential animal waste management facilities were evaluated using available data, maps, aerial photography, and site visits by a Hicks & Company biologist and an archeologist. Due to lack of landowner-approved access to the sites, field evaluation consisted of observing the tracts from public road right-of-ways adjacent to the sites.

This report provides a brief regional description of Erath County, followed by a section describing general environmental conditions for each site and a potential environmental constraints matrix that includes an explanation of the methods and criteria used to evaluate the potential sites for the environmental constraints mentioned above. Attached to this report is a separate report summarizing cultural resources information within the project area and the proposed animal waste management facility sites. Finally, the attached **Maps 1 through 9** provide a delineation of 100-year floodplains and potential jurisdictional wetlands and other waters of the U.S. (streams and stock ponds hydrologically connected to jurisdictional streams). Potential cultural resource areas are not mapped within each site, as the potential for cultural resource sites within each tract is fairly homogeneous (i.e., due to the relatively small size of the tracts, a tract considered to have a high probability for cultural resource sites is considered to have a high probability throughout the tract). No potential threatened/endangered species habitat was identified on any of the proposed sites.

REGIONAL SETTING

The topography of the study area ranges from rolling hills to fairly level terrain along large stream systems. Dominant soils in the region include thin stony and gravelly soils on ridges, deep loamy soils on rolling hills, and deep clayey soils on gently sloping areas in the Dublin area (Wagner, et al., 1973). The entire study area is underlain by cretaceous limestone bedrock.

Erath County occurs within the Cross Timbers and Prairies Vegetational Area of Texas as described by Gould (1975). About 75 percent of this vegetational region is used as range and pasture. The native state of rangeland in the region is mid- to tall-grass prairie. Cultivation has resulted in replacement of prairie species by oaks, honey mesquite (*Prosopis glandulosa*), and Ashe juniper (*Juniperus ashei*), with mid- and shortgrass understories. Prairie climax vegetation is composed primarily of big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium* var. *frequens*), indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), and Canada wildrye (*Elymus canadensis*), with minor amounts of sideoats grama (*Bouteloua hirsuta*), blue grama (*B. gracilis*), hairy grama (*B. hirsuta*), Texas wintergrass (*Stipa leucotricha*), and buffalograss (*Buchloe dactyloides*). Much of the land within the project area is used for dairy operations, although cow-calf operations are also common in the area. To enhance grazing value, many pasture areas are planted in bermudagrass (*Cynodon dactylon*), oats (*Avena fatua* var. *sativa*), and wheat (*Triticum aestivum*).

Riparian tree species found along rivers and streams include oaks (*Quercus fusiformis* and *Q. texana*), pecan (*Carya illinoiensis*), and elms (*Ulmus crassifolia* and *U. americana*), with honey mesquite as an invader and black willow (*Salix nigra*) occurring in disturbed areas.

Federally-listed threatened and endangered species of potential occurrence in Erath County include the golden-cheeked warbler (*Dendroica chrysoparia*), the black-capped vireo (*Vireo atricapillus*), the bald eagle (*Haliaeetus leucocephalus*), the interior least tern (Sterna antillarum athalassos), and the peregrine falcons (*Falco peregrinus anatum* and *F.p. tundrius*). Potential habitat for the bald eagle and the interior least tern is absent from the proposed project area. Both of these species rely on habitat associated with large river systems and lakes/reservoirs. The peregrine falcons may occur as passing migrants through north Texas during the spring and fall seasons. Habitat for the golden-cheeked warbler and the black-capped vireo is found in Erath County.

Golden-Cheeked Warbler

The golden-cheeked warbler is a small insectivorous neotropical migratory songbird which nests only in the mixed mature juniper-oak woodlands of the Balconian and southern Cross Timbers and

Prairies Biotic Provinces. This species, which winters in southern Mexico and the Central American countries of Guatemala, Honduras, and Nicaragua, is the only Texas species whose breeding range is entirely confined to the state's boundaries. The known breeding range of the golden-cheeked warbler includes 37 Texas counties within the Lampasas Cut Plain, Edwards Plateau and Llano Uplift regions of the state.

Black-Capped Vireo

The black-capped vireo is a small insectivorous songbird which winters in Mexico, and nests in parts of Texas and Oklahoma. In Texas, the majority of populations occur on the Edwards Plateau, typically along steep slopes covered by dense brush.

SITE-SPECIFIC BASELINE CONDITIONS

This section provides a general description of the environmental conditions for the proposed animal waste management facility sites. These descriptions focus on the baseline conditions of vegetation. The presence of 100-year floodplains, potential for wetlands and other waters of the U.S., and the potential for federally-listed species habitat is presented in the *Environmental Constraints Matrix* section below. Information summarizing the potential for cultural resources within the proposed animal waste management facility sites is provided in the *Environmental Constraints Matrix* below and attached to this document as a separate report.

Site 1 - Mt. Pleasant Sites

Site 1A - The eastern corner of this tract is a pasture dominated by bermudagrass and bahiagrass. The remaining, majority of the property is planted in winter wheat and/or oats.

Site 1B - The majority of this tract is dominated by winter wheat and/or oats. Scattered post oak are associated with a drainage that transverses the western corner of the tract.

Site 2 - **Landfill Site** - This tract is a landfill site for the City of Stephenville. Stabilizing vegetation occurs on the completed portion of the tract while areas of active landfill operations are highly disturbed.

Site 3 - **Selden Site** - This site consists of a bermudagrass pasture, with a stream bordering the northeastern edge of the tract.

Site 4 - **Lingleville Sites**

Site 4A - This tract is a bermudagrass pasture with scattered post oaks.

Site 4B - This tract is surrounded by privately-owned land with no opportunity for viewing from a public access point. Analysis of aerial photography indicates that this site is a used as bermudagrass pasture and exhibits a drainage pattern that may include jurisdictional waters of the U.S..

Site 5 - **Gravel Pits** - The vegetation of this tract is characterized as oldfield on thin soils overlaying a caliche substrate. The dominant grasses on this site are Texas wintergrass, grama grasses, and little bluestem, with western ragweed (*Ambrosia psilostachya*), *Yucca* sp., and horsemint (*Monarda citriodora*) as common forbs. An abandoned caliche borrow pit is present in the northwest corner of the tract, and may be considered a jurisdictional water of the U.S.

Site 6 - **Dublin Sites**

Site 6A - The majority of this tract is dominated by winter wheat and/or oats. A few scattered clumps of Ashe juniper are present in the western portion of the site.

Site 6B - This tract is a bermudagrass pasture with scattered post oaks.

Site 7 - **CR 258 Site** - This tract is a plowed bermudagrass hayfield.

Site 8 - **Greens Creek Sites**

Site 8A - This tract is rangeland dominated by heavily grazed grasses and broomweed, with scattered live oaks and post oaks. An eroded drainage transverses the southeast portion of the site.

Site 8B - The southern portion of this tract is a pasture dominated by bermudagrass. The northern half of the site is bermudagrass pasture that surrounds a post oak/blackjack oak woodland on sandy soils. A stream with in-channel impoundments occurs in the western-center portion of the tract.

Site 9 - **Harbin Site** - The western half of this tract is a mesquite grassland dominated by bermudagrass, Texas wintergrass, threeawns (*Aristida* spp.), and grama grasses, with broomweed and western ragweed as common forbs. The western tip of the site consists of a creek bottom with mature cedar elm, Texas oak, live oak, pecan, and American elm. The eastern half of the site is planted in bermudagrass.

ENVIRONMENTAL CONSTRAINTS MATRIX

The following section describes the methods used for the analysis of potential environmental constraints evaluated for the site selection process. Additionally, an explanation is provided for the evaluation criteria of potential environmental constraints (i.e., High, Medium, and Low Potential) for each environmental issue.

100-Year Floodplain

Methods: 100-year floodplain information was derived from Flood Hazard Boundary Maps for Erath County developed by the U.S. Department of Housing and Urban Development, Federal Insurance Administration.

Evaluation Criteria: Low - No 100-year floodplain mapped for the tract.

Medium - Small avoidable area in the 100-year floodplain, usually at the edge or corner of a tract.

High - Extensive areas (over 30 percent of tract) in the 100-year floodplain.

Wetlands and Other Waters of the U.S.

Methods: Wetlands and other waters of the U.S. (stream channels) information was derived from U.S. Fish and Wildlife Service, National Wetlands Inventory Maps, analysis of aerial photography (USGS NAPP B&W 1995), USGS 7.5 Minute Topographic maps, and limited field observation from the perimeter of the tract.

Evaluation Criteria: Low - Probably no jurisdictional wetlands or other waters of the U.S.

Medium - Small, avoidable areas of potential jurisdictional wetlands or other waters of the U.S., usually at the edge or corner of a tract. These areas are of a size that may be covered under a Section 404 Nationwide Permit.

High - Extensive areas (over 30 percent of tract) with high potential for jurisdictional wetlands or other waters of the U.S.

Cultural Resources

Methods: The potential for cultural resource sites was evaluated using several factors. These included the location and condition of previously recorded sites in the area, presence of topographic highs with proximity to substantial streams, the condition of such locations in terms of exhibiting intact soils or sediments (as opposed to exposed bedrock on surface), and current use of the landscape. Several locations exhibited some of these characteristics, however, these tracts appeared to exhibit very thin surface soils that would tend to preclude the potential for intact sites.

Evaluation Criteria:

Low - Areas with thin surface soils on uplands and slopes, shallow floodplains, and disturbed areas.

Medium - Areas exhibiting topographic highs near substantial drainages. These areas exhibit fairly thin surface soils, however, there is a potential for buried or partially intact sites.

High - Tracts that exhibit elevated areas that provide substantial viewshed, and are above the floodplain and yet have good proximity to water. Additionally, these areas exhibit intact soils/sediments, even on ridge tops, suggesting the potential for intact, possibly buried cultural materials.

Threatened/Endangered Species

Methods: A list of potential threatened and endangered species occurring in Erath County was obtained from Texas Parks and Wildlife, Texas Biological Conservation Data System. The main species of concern in the project area are the black-capped vireo and the golden-cheeked warbler, both federally listed endangered species. Potential habitat for the species was evaluated by analysis of aerial photography and limited field observation from the perimeter of the tract. No potential habitat for either species occurs on any of the proposed sites.

Evaluation Criteria:

Low - No potential threatened/endangered species habitat.

Medium - Possible potential threatened/endangered species habitat. Habitat assessment recommended.

High - High potential for threatened/endangered species habitat. Habitat assessment recommended.

BRAZOS RIVER AUTHORITY
ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY
POTENTIAL ENVIRONMENTAL CONSTRAINTS MATRIX

SITE NAME & NUMBER	POTENTIAL CONSTRAINT			
	100-Year Floodplain	Wetlands and Other Waters of the U.S.	Potential for Cultural Resource Sites	Threatened/Endangered Species
Site 1A	Low	Low	High	Low
Site 1B	Low	Generally Low Medium - West Corner of Tract	High	Low
Site 2	Low	Low	Low	Low
Site 3	Low	Low	Medium - Especially Western ½ of Tract	Low
Site 4A	Low	Low	Low	Low
Site 4B	Low	Generally Low Medium - Northeast Corner of Tract	Low	Low
Site 5	Low	Medium - Abandoned Borrow Pits are Subject to Section 404 Evaluation	Low	Low
Site 6A	Low	Low	Low	Low
Site 6B	Generally Low Medium - Northeast Corner of Tract	Generally Low Medium - Northeast Corner of Tract	Medium	Low
Site 7	Low	Low	Low	Low
Site 8A	Generally Low Medium - Southwest Corner of Tract	Generally Low Medium - Stream Channel Bisects Southern 1/3 of Tract	Low	Low
Site 8B	Low	Medium - Stream and In-Stream Pond in West-Central Portion of Tract	Low	Low
Site 9	Generally Low Medium - Extreme Southwest Corner of the Tract	Generally Low Medium - Extreme Southwest Corner of Tract	Generally Low Medium - Northeast 1/4 of Tract	Low

BRAZOS RIVER AUTHORITY
ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY
POTENTIAL CULTURAL RESOURCES ASSESSMENT

A preliminary assessment of the potential for cultural resources within the proposed animal waste management facility sites has been completed. Background research, conducted at the Texas Archeological Research Laboratory (TARL) and the Texas Historical Commission (THC), focused on identifying extant archeological sites, historic and prehistoric, and also determining the locations of previous archeological surveys. In addition, the project area has been examined for the presence of National Register sites and/or State Archeological Landmarks as well as Historical Markers. Subsequent to this background research, a field visit was performed to evaluate the potential for cultural resources in all 13 proposed tracts.

RESULTS

Results of the background investigations indicate that no National Register sites, State Archeological Landmarks, Historical Markers, or known prehistoric sites exist within the project areas. A number of recorded sites, primarily prehistoric, do exist in the vicinity of project areas, however, none are in close enough proximity to warrant concern. These sites have been described as small surfacial artifact scatters which have yielded numerous time diagnostic artifacts. Diagnostic artifacts from these sites suggest that the area has been occupied by humans from the Paleoindian period (ca 9200-6000 BC) through the Archaic period (ca 6000 BC-AD 800) and up to the Late Prehistoric period (ca AD 800-1600).

FIELD VISIT

A field visit for the potential animal waste management facility sites was conducted during the period February 11-13, 1998, to evaluate the potential for cultural resources. Due to the lack of landowner access to the sites, field evaluation consisted of observing the tracts from public road right-of-ways adjacent to the sites.

The potential for cultural resources at the proposed facility locations was evaluated based on the topographic and environmental settings of the known recorded sites in the area (i.e., topographic highs, out of the flood plain, with proximity to substantial streams), as well as the condition of such locations in terms exhibiting intact soils or sediments (as opposed to exposed bedrock on surface), and current use of the landscape which can facilitate either the preservation or degradation of surface soils or sediments. Several locations exhibited some of these characteristics, however, these tracts appeared to exhibit very thin surface soils that would tend to preclude the potential for intact sites.

All tracts were evaluated using a low, medium, and high probability for the presence of cultural resources. Tracts with low probability ratings included those exhibiting thin surface soils on both uplands and slopes, shallow floodplains with the limited potential for buried sites, and areas that appeared to be disturbed mechanically.

Tracts with medium probability ratings included those where topographic highs (i.e., ridges, knolls, or hills) were in proximity to fairly substantial drainages as well as areas where floodplain deposits might contain buried cultural material. These tracts exhibit fairly thin surface soils, however, there is a potential for buried or partially intact sites.

Tracts with high probability ratings included those where elevated areas provided adequate viewshed, are above the floodplain and have good proximity to water. Additionally, these areas exhibit intact soils/sediments, even on ridge tops, suggesting the potential for intact, possibly buried cultural materials.

Sites 1A and 1B were the only tracts assigned a high probability rating given the aforementioned factors used for evaluation. Site 6B was given a medium probability rating while sites 3 and 9 were given medium ratings on specific portions of the tracts (see constraints matrix above). All remaining tracts were assigned low probability ratings.

SUMMARY

In summary, it must be stated that any tracts chosen, regardless of the probability rating, should be evaluated both through pedestrian survey and shovel testing. Given the lengthy occupation of the area by prehistoric peoples, it is possible that some sites could be buried, within floodplain deposits of both smaller and larger drainages as well as on elevated areas still exhibiting intact surface sediments. Furthermore, even surficial artifact scatters could be partially intact and contain useful information relating to the prehistoric utilization of the area.

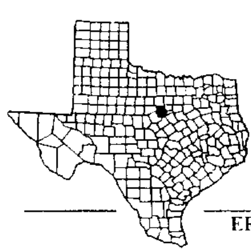
REFERENCES CITED

Gould 1975. Texas Plants: A Checklist and Ecological Summary. Texas A&M University Press. College Station, Texas. 106 pp.

Wagner, B.J., J.R. Thomas, E.R. Harris, E. DeLeon, C.G. Ford and J.D. Kelley. 1973. *Soil Survey of Erath County, Texas*. U.S. Department of Agriculture - Natural Resources Conservation Service (formerly Soil Conservation Service) January 1973.

MAP 1

SITE 1 - MT. PLEASANT SITES

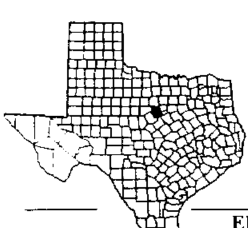


Potential Wetlands/Waters of the U.S.

Approx. Scale: 1 in. = 650 ft.

ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY FEASIBILITY STUDY

MAP 2



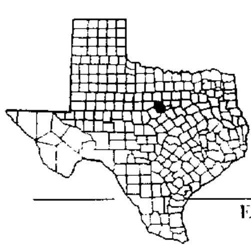
SITE 2 - LANDFILL SITE

Approx. Scale: 1 in. = 650 ft

ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY FEASIBILITY STUDY

MAP 3

SITE 3 - SELDEN SITE

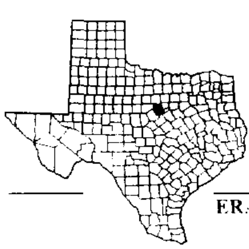


Approx. Scale: 1 in. = 650 ft.

ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY FEASIBILITY STUDY

MAP 4

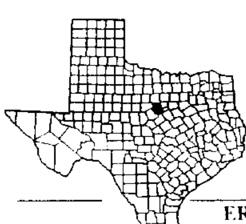
SITE 4 - LINGLEVILLE SITES



Potential Wetlands/Waters of the U.S.

Approx. Scale: 1 in. = 650 ft.

MAP 5



SITE 5 - GRAVEL PITS

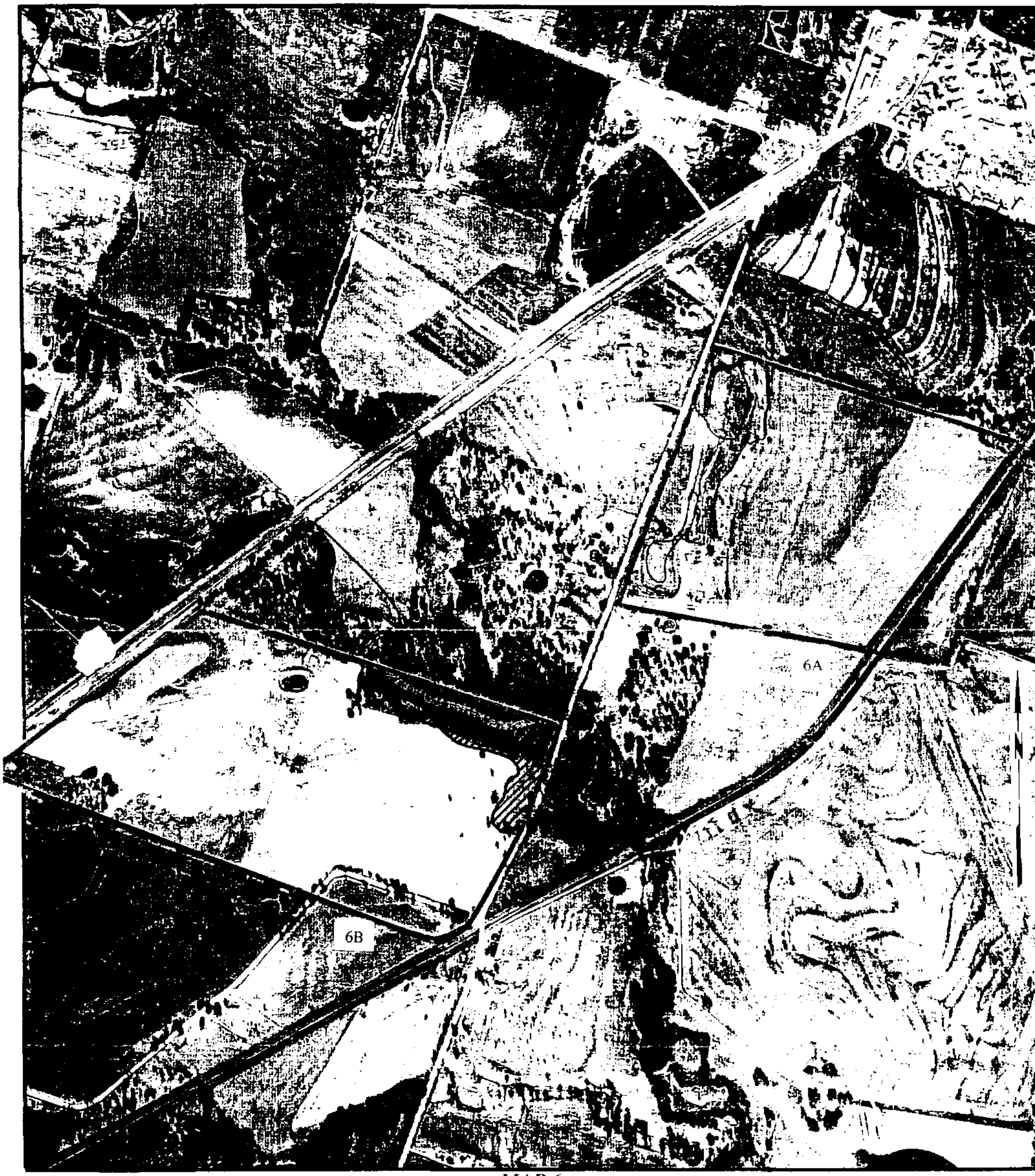
Potential Wetlands/Waters of the U.S.

Approx. Scale: 1 in. = 650 ft.

ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY FEASIBILITY STUDY

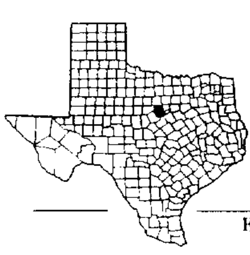
Brazos River Authority

Camp Dresser & McKee, Inc.
Hicks & Company, Inc.



MAP 6

SITE 6 -DUBLIN SITES



Potential Wetlands/Waters of the U.S. 100-year Floodplain

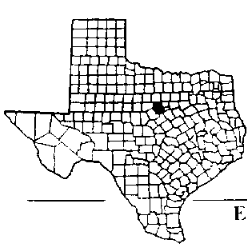
Approx. Scale: 1 in. = 650 ft.

ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY FEASIBILITY STUDY

Camp Dresser & McKee, Inc.
Brazos River Authority/Hicks & Company, Inc.

MAP 7

SITE 7 - CR 258 SITE



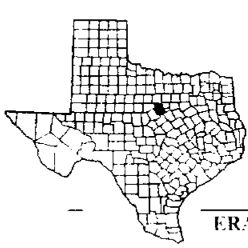
Approx. Scale: 1 in. = 650 ft.

ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY FEASIBILITY STUDY

Camp Dresser & McKee, Inc.
Brazos River AuthorityHicks & Company, Inc.

MAP 8

SITE 8 - GREENS CREEK SITES

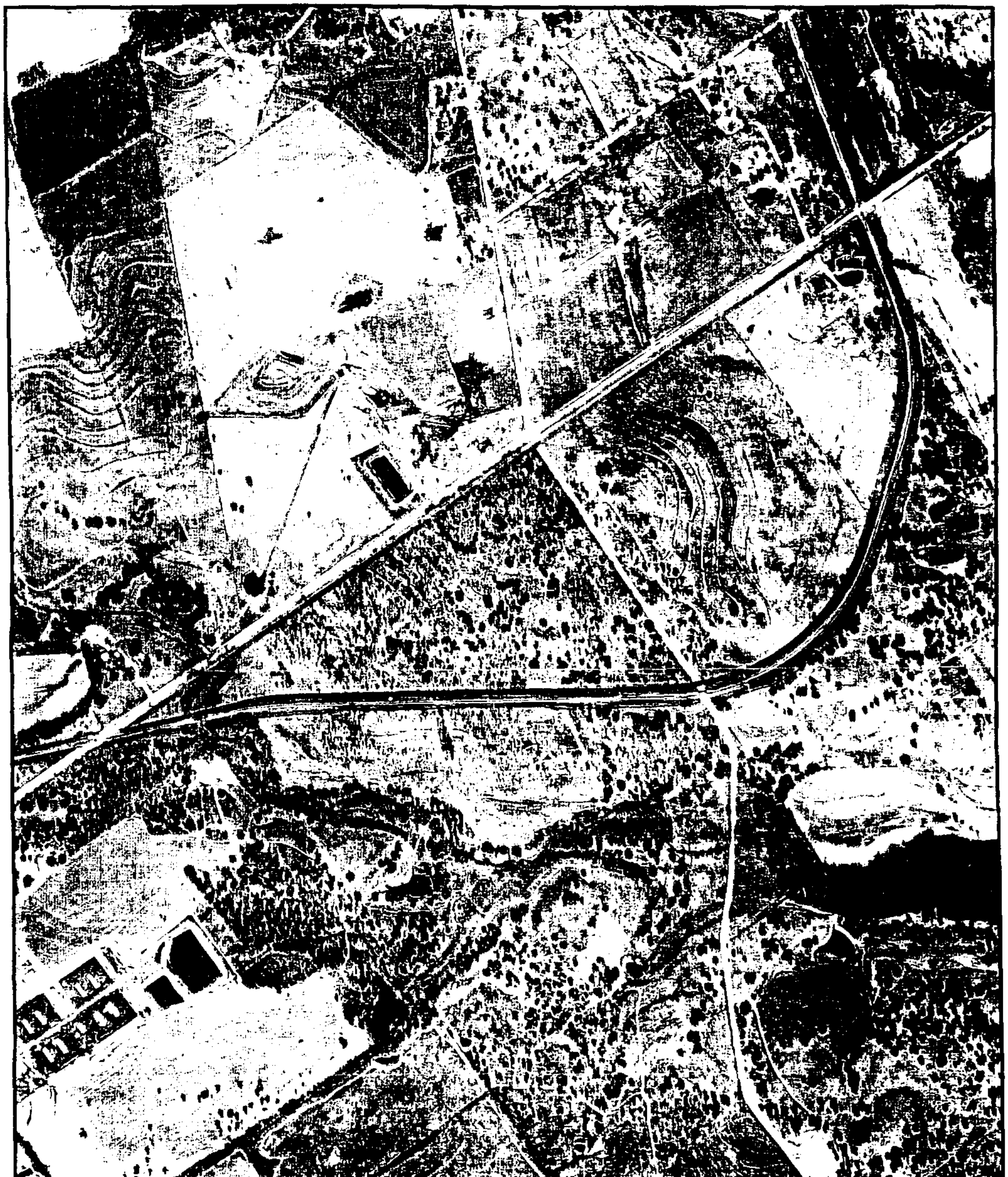


Potential Wetlands/Waters of the U.S. 100-year Floodplain

Approx. Scale: 1 in. = 650 ft.

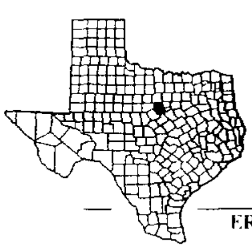
ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY FEASIBILITY STUDY

Camp Dresser & McKee, Inc.
Brazos River Authority/Hicks & Company, Inc.



MAP 9

SITE 9 - HARBIN SITE



Potential Wetlands/Waters of the U.S.   100-year Floodplain

Approx. Scale: 1 in. = 650 ft.

ERATH COUNTY ANIMAL WASTE MANAGEMENT FACILITY FEASIBILITY STUDY

Camp Dresser & McKee, Inc.
Brazos River Authority/Hicks & Company, Inc.

Appendix E

Appendix E

Composting Regulatory Considerations Report

LAW OFFICES OF
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MICHAEL J. BOOTH
CAROLYN AHRENS
FRED B. WERKENTHIN, JR.
TODD K. SELLARS

June 5, 1998

BY FACSIMILE 345-1483

Mr. Allen Woelke
Camp Dresser & McKee Inc.
9111 Jollyville Road
Austin, Texas 78759

RE: Opinion Letter Regarding Applicable Permitting Requirements for Manure Composting Plant

Dear Allen:

Pursuant to your request, we have researched the applicable permitting requirements for a manure composting plant.

I. FACTS

The Brazos River Authority wishes to develop a manure composing facility in Erath County to compost manure from dairy farms. At some point, other organic materials may be composted at the facility. The plant may be constructed in a floodplain or near a wetlands area.

II. QUESTIONS PRESENTED

1. What permitting is necessary to operate a facility for composting manure?

2. What other materials can be composted at a manure composting facility without requiring additional permits?

3. What permits are necessary to build a facility in a floodplain or in a wetlands area?

III. BRIEF ANSWER

Under Texas law, manure is a solid waste. Most solid waste processing and disposal facilities must obtain solid waste permits from the Texas Natural Resource

Conservation Commission ("TNRCC"). However, a plant that composts only manure which has been set apart from other waste by the owners of the farms sending the manure to the plant is generally exempt from the notification, registration, and permit requirements set forth in the TNRCC rules governing composting facilities. Such a facility may also compost yard trimmings, clean wood material, vegetative material, and paper without losing its exempt status. Such a facility also qualifies for an air quality standard permit if certain design and operational criteria are met.

There are no federal permits required to build in a floodplain, though local regulations are applicable. A plant must obtain a permit from the Army Corps of Engineers before beginning construction in wetlands.

IV. DISCUSSION

A. State and Federal Statutory Standards for Solid Waste

The Texas Solid Waste Disposal Act ("TSWDA") requires the TNRCC to manage and monitor industrial solid waste. TEX. HEALTH & SAFETY CODE ANN. § 361.017 (Vernon 1992). The TSWDA defines "industrial solid waste" as solid waste resulting from or incidental to agricultural operations and "solid waste" as garbage, refuse, and other discarded materials. *Id.* § 361.003(16), (34)-(35) (Vernon Supp. 1998). While materials that are reclaimed and recycled are generally not "wastes," the TSWDA specifies that recycled materials which are used to produce products that are applied to the land are solid wastes. *See* 30 TEX. ADMIN. CODE § 335.1 (West 1997) (definition of "solid waste" at (F)-(G)(i)). The TSWDA grants TNRCC the power to require and issue permits for the construction, operation, and maintenance of facilities used to store, process, or dispose of solid waste. TEX. HEALTH & SAFETY CODE ANN § 361.061 (Vernon Supp. 1998).

The federal Resource and Recovery Act ("RCRA") definition of "solid waste" is identical to the TSWDA definition. 42 U.S.C.A. § 6903(27) (West 1995). However, RCRA sets forth only general guidelines for states to address solid waste management and Environmental Protection Agency ("EPA") does not administer a permitting program for non-hazardous solid waste. *See* 42 U.S.C.A. §§ 6941-6947 (West 1995 and Supp. 1996). Therefore, a composting plant need not obtain a solid waste permit from the EPA.

The TSWDA and RCRA definitions for "hazardous waste" are also identical. TEX. HEALTH & SAFETY CODE ANN. § 361.003(12) (Vernon Supp. 1998). The RCRA defines "hazardous waste" as solid waste which may cause mortality or incapacitating injury, or pose a substantial threat to human health. 42 U.S.C.A. § 6903(5) (West 1995) (definition of hazardous health); 42 U.S.C.A. § 6925 (hazardous waste permit requirements). While it is questionable that manure meets this definition in the first place, the EPA specifically excepts manure and other agricultural wastes which are returned to the soil as fertilizer from the hazardous waste regulations in the RCRA. 40 CFR § 261.4(b)(2)(i)-(ii) (1997). Therefore, a manure composting plant need not obtain hazardous waste permits from either the TNRCC or EPA.

B. State Regulatory Requirements for Composting

The TNRCC rules implementing TSWDA prohibit storing, processing, or disposing of industrial solid waste without an authorized permit. 30 TEX. ADMIN. CODE § 335.2(a) (West 1997). However, the TNRCC has promulgated specific rules for composting facilities.

The TNRCC composting rules follow a three-tiered regulatory scheme, depending on the potential environmental threat from the materials to be composted. For composting materials with the highest degree of threat, such as mixed municipal solid waste, an individual permit is required. 30 TEX. ADMIN. CODE § 332.3(a)(1)-(2) (West 1997). Registration is required for composting intermediate level materials, such as municipal sewage sludge, grease trap waste, and disposable diapers. *Id.* § 332.3(b)(1)-(7). Notification is required for composting less-threatening materials, such as meat, fish, animal carcasses, and greases. *Id.* § 332.3(c)(1)-(2). For the lowest level of threat, none of these are required. *Id.* §332.3(d)(1)-(6).

Composting manure fits into the lowest level, provided that certain restrictions are followed. *Id.* § 332.3(d). A plant that composts only source-separated manure is generally exempt from notification, registration, and permit requirements. *Id.* § 332.3(d)(1)(A)-(B). Such a facility may also compost yard trimmings, clean wood material, vegetative material, and paper without losing its exempt status. "Source-separated" means that the manure being sent to the plant has been set apart from other waste by the owners of the farms. *Id.* § 332.2. In other words, it has not come into contact with any materials that result in more stringent regulation. "Yard trimmings" are leaves, grass, clippings, yard and garden debris, and brush, including clean woody vegetative material no more than six inches in diameter, which result from landscaping maintenance and land-clearing operations. *Id.* "Clean wood material" is wood or wood materials, including stumps, roots, vegetation with intact root ball, sawdust, pallets, and manufacturing rejects, but does not include wood that has been treated, coated, or painted, or demolition material contaminated by paint, chemicals, glass, wiring, metal, or sheetrock. *Id.* "Vegetative material" is raw, processed, liquid, solid, or cooked fruit, vegetable, or grain material but does not include oils or greases derived from these materials. *Id.*

To qualify for the § 332.3(d)(1)(A)-(B) exemption, a facility need not compost only one of the listed materials. A plant may compost and mix manure with yard trimmings, clean wood material, vegetative material, or paper and remain exempt from the TNRCC notification, registration, and permit requirements. *Id.* § 332.3(d)(1)(A)-(B). However, the plant may lose its exempt status if it composts manure with other materials such as municipal sewage sludge, mixed municipal solid waste, grease, or animal carcasses. *Id.* § 332.3(a)-(c). This letter will not address the TNRCC registration and notification requirements for composting facilities which process materials other than those allowed under § 332.3(d)(1)(A)-(B), because it is our understanding that the facility will only compost materials allowed under the exempt facility criteria.

It is important to note that the TNRCC rules do impose some requirements on composting facilities which are otherwise exempt from the rules. Exempt facilities must follow the general requirements for composting found in TNRCC Rule 332.4. *Id.* § 332.3(d). Rule 332.4 generally requires composting facilities to comply with the Texas Water Code provisions prohibiting pollution of surface water and groundwater, Health and Safety Code provisions prohibiting nuisance conditions, and all other applicable federal and state laws, among other things. *Id.* § 332.4(1)-(11).

From our conversations with TNRCC staff, we understand that exempt plants are not required to build facilities to prevent precipitation from running off the grounds of the plant into nearby surface water bodies or into groundwater tables. However, plants that are not exempt from the permit and registration requirements must be constructed, operated, and maintained to protect surface water by managing the precipitation runoff which would result from a 25-year, 24-hour rainfall event and must have liner systems to prevent groundwater contamination. *Id.* § 332.37(1)-(2) (registration plants); *Id.* § 332.45(1)-(2) (permitted plants). Such plants must also be located at least 500 feet from all public water wells, 150 feet from private water wells, and at least 100 feet from surface water bodies such as lakes, creeks, rivers, and intermittent streams. *Id.* §§ 332.36(4)-(5), 332.44(4)-(5). The TNRCC staff recommends that exempt facilities have these precautions as well, but the Administrative Code does not require them.

C. State Air Emissions Statutes and Regulations

The Texas Clean Air Act ("TCAA") directs the TNRCC to monitor air quality levels and control air pollution. TEX. HEALTH & SAFETY CODE ANN. § 382.011 (Vernon Supp. 1998). TCAA and TNRCC rules require persons constructing new facilities that may issue air contaminants to obtain permits from the TNRCC. *Id.* § 382.0518(a) (Vernon Supp. 1998); 30 TEX. ADMIN. CODE § 116.1 *et seq.* (West 1997).

A facility that is exempt from the TNRCC manure composting facility requirements for permits, notification, and registration is entitled to an air quality standard permit if the following requirements are met:

1. If the total volume of materials to be composted, including in-process and processed materials, is greater than 2,000 cubic yards, the setback

distance from the property edge to the receiving and processing area must be at least 50 feet.

2. All permanent in-plant roads shall be regularly watered, paved, cleaned, or treated with dust suppressant to reduce dust emissions. Vehicle speeds on non-paved roads are not to exceed 10 MPH.

3. Except for initial start-up and shutdown, the receiving chambers on all grinders must be adequately filled to minimize emissions from the receiving chamber, or grinding operations must occur in an enclosed structure. All grinders not enclosed inside a building must be equipped with low velocity fog nozzles spaced to create a continuous fog curtain, or portable watering equipment must be available to control dust when stockpiling ground material.

4. All conveyors off-loading materials from grinders at a point not inside a building must have a water or mechanical dust suppression system to control dust when stockpiling ground material.

Id. § 332.8(b)(1)-(4). If an air quality standard permit is issued under the composting plant rules, the facility need not obtain any other permits. *Id.* § 332.8(a)(5). If a facility's operations change such that it is no longer exempt, the facility must obtain an air quality standard permit for a registered, notification, or permitted facility. *Id.* § 332.8(b)(5). Because the facts do not indicate that the facility's operations will be non-exempt, this letter does not address the requirements necessary for such permits.

D. Permit Requirements for Constructing in Floodplain

TNRCC rules provide that composting facilities, which must comply with the registration and permit requirements, must be constructed outside a 100-year flood plain. *Id.* § 332.36(1) (registration facilities); *Id.* § 332.44(1) (permitted facilities). The rules do not limit the location of exempt composting facilities.

While there is no state permit required to construct a composting plant in a floodplain, building permits in such areas are usually issued by city and county governments. Like the TNRCC rules for nonexempt composting facilities, these regulations generally require new construction in floodplains to be elevated above the 100-year frequency flood level.[1] The facts do not indicate that the facility will be constructed within the limits of any city. To determine the applicable county regulations, we talked to the Erath County judge, who is familiar with the project. Our discussions indicate that there are no county regulations or restrictions which would

[1] *See* Regulatory Requirements (http://www.usace.army.mil/inet/functions/cw/cecwpfpsys/ace9-o4.htm).

apply. However, the TNRCC rules generally prohibit exempt facilities from conducting activities that would result in the pollution of surface water or groundwater. *Id.* § 332.4(1). This dictates that the plant not be built in an area prone to flooding.

There also do not appear to be any federal regulations that require a permit for constructing in a floodplain. Executive Order 11988, issued by President Carter in 1977, discourages federal agencies from conducting or supporting activities to be conducted in floodplains unless there are no practical alternatives. However, where such construction is allowed by state or local authorities, the Army Corps of Engineers' Flood Plain Management Services program will provide guidance on a variety of topics. Flood Plain Management Services will provide the following information for free to state and local governments and nonfederal public agencies, and for a fee to private organizations: copies of maps, flood elevation data for specific sites, HEC-2 computer models, pamphlets, studies, and other assistance.[2]

E. Permit Requirements for Constructing in Wetlands

TNRCC rules prohibit the construction of composting plants in wetlands when the plants must comply with the agency's rules for permitting and registration. *Id.* § 332.36(3) (registration facilities); *Id.* § 332.44(3) (permitted facilities). The rules do not limit the location of exempt facilities. Therefore, no permit is needed from the TNRCC to construct a composting plant in a wetlands area.

Executive Order 11990, also issued by President Carter in 1977, discourages federal agencies from taking actions that might destroy or degrade wetlands. This is an extension of the Clean Water Act which requires permits from the Army Corps of Engineers in order to discharge dredge or fill material into wetlands and other waters of the United States. 33 U.S.C.A. § 1344 (West 1986). These permits, commonly known as "Section 404" permits, must be obtained to construct a composting facility in a wetlands area.

The Clean Water Act defines "dredged material" as material excavated or dredged from navigable waters. 33 C.F.R. § 323.2(c). "Fill material" is material used primarily for replacing an aquatic area with dry land or changing the bottom elevation of a river body. *Id.* § 323.2(e). "Wetlands" usually includes swamps, marshes, bogs, and similar areas. *Id.* § 328.3(b). The Corps presently defines "waters of the United States" to include waters used presently or in the past for commerce, interstate waters, intrastate lakes, rivers and streams (including intermittent streams) and their tributaries, adjacent wetlands, and isolated wetlands, such as prairie potholes. *Id.* § 328.3(a)(1)-(8). Therefore, to the extent that constructing the composting plant

[2] *See* Flood Plain Management Services (http://www.nppwm1.npp.usace.army.mil/fpm/fpm_overview.html).

would require filling in wetlands or streams, a Section 404 permit is required. 33 U.S.C.A. § 1344.

It is important to note that the Corps may refuse to issue a Section 404 permit if the benefits of the proposed action outweigh the damage to the wetlands, or if the subject wetlands has significant environmental value. 33 CFR § 320.4(4). Discharges may also be disallowed if there are practical alternatives that would have less impact on the aquatic ecosystem, as long as the alternatives would not have other significant adverse environmental consequences. 40 CFR § 230.10(a)-(d). As well, the TNRCC must issue a water quality certification that the Section 404 permit discharge will comply with the Clean Water Act. 33 U.S.C.A. § 1341(a)(1) (West 1986). The TNRCC will not certify Section 404 permit discharges if it determines that there are alternatives available, appropriate and practical steps have not been taken to minimize potential adverse effects to the aquatic ecosystem, or the project's impacts are significant, even if proposed steps to mitigate unavoidable adverse impacts are followed. 30 TEX. ADMIN. CODE § 279.11(c)(1)-(4) (West 1997). Therefore, if the Corps or TNRCC determines that the composting plant would adversely affect the environment as planned or that there are viable alternative locations, a Section 404 permit and state certification may be denied.

V. CONCLUSION

The plant does not need to obtain a composting facility permit from the TNRCC or follow the agency's rules for notification and registration as long as the plant composts only manure with yard trimmings or certain other materials. The plant must, however, follow the composting facility rules' general requirements. The plant does not need to obtain a separate solid waste disposal permit under the TSWDA. Though the plant must obtain an air quality standard permit under the composting rules, it also does not need a separate permit under the TCAA. There are no federal, state, or local permits required to build in a floodplain, but the plant must obtain a permit from the Army Corps of Engineers before beginning construction in wetlands.

This letter reflects our current opinion on the legal and factual issues addressed and is based upon current legal authorities. Future court decisions, legislation, and other developments can change the law. Before applying this opinion in the future, it is essential to determine whether the law has changed in any respect that would necessitate a revision of the opinion. This opinion is supplied solely for your information and use in connection with the matter described in your request and should not be quoted or otherwise referred to in any document, in whole or in part, and should not be furnished to any other person or agency without our prior written consent. The opinions in this letter are limited to the matters expressly stated. No opinion is implied, and none should be inferred, beyond the opinions expressly stated.

If you have any additional questions, do not hesitate to call us.

Very truly yours,

Fred B. Werkenthin, Jr.

FBW:TKS:kwb
287.980605.manure.Woelke.opin.ltr

Appendix F

Appendix F

Regional Market Tabulations

Appendix F

Description of Sub-regional Markets

Table F-1: Austin Area Market

Counties and Selected Statistics	Population	Property Value (billions of dollars)	Land Area (sq. miles)
Williamson	190,190	10.559	1,124.0
Burnett	27,040	1.640	545.8
Travis	678,500	34.763	989.4
Llano	12,755	1.375	934.0
Total	**908,485**	**48.337**	**3,593.2**

* Source: Texas Statistical Almanac (1996)

Table F-2: Dallas/Fort Worth Area Market

Counties and Selected Statistics	Population	Property Value (billions of dollars)	Land Area (sq. miles)
Tarrant	1,288,261	54.124	863.0
Dallas	1,989,156	108.664	879.0
Denton	343,137	15.356	888.5
Johnson	107,916	3.329	729.0
Total	**3,728,470**	**181.473**	**3,360.5**

* Source: Texas Statistical Almanac (1996)

Table F-3: Waco Area Market

Counties and Selected Statistics	Population	Property Value (billions of dollars)	Land Area (sq. miles)
Mclennan	202,137	5.505	1,041
Bell	217,379	5.752	1,059
Coryell	73,321	1.157	1,051
Falls	18,176	0.596	769
Total	**511,013**	13.010	**3,920**

* Source: Texas Statistical Almanac (1996)

Table F-4: Abilene Area Market

Counties and Selected Statistics	Population	Property Value (billions of dollars)	Land Area (sq. miles)
Shackleford	3,445	0.268	914
Nolan	17,017	0.783	912
Taylor	126,805	3.710	915
Runnels	11,699	0.448	1,054
Callahan	12,446	0.558	898
Coleman	9,926	0.448	1,272
Total	**181,338**	**6.215**	**5,965**

* Source: Texas Statistical Almanac (1996)

Table F-5 Wichita Falls Area Market

Counties and Selected Statistics	Population	Property Value (billions of dollars)	Land Area (sq. miles)
Wichita Falls	127,789	3.922	627
Archer	8,439	0.474	909
Baylor	4,467	0.244	870
Foard	1,870	0.111	706
Throck Morton	1,952	0.209	912
Knox	4,752	0.197	854
Coleman	9,926	0.448	1,272
Total	**159,195**	**5.605**	**6,150**

* Source: Texas Statistical Almanac (1996)

Table F-6: Erath County Area Market

Counties and Selected Statistics	Population	Property Value (billions of dollars)	Land Area (sq. miles)
Erath	31,344	1.309	1,086
Hood	32,051	1.412	421
Parker	72,373	2.673	903
Jack	7,274	0.595	917
Wise	39,550	1.563	904
Palo Pinto	25,119	1.063	953
Eastland	19,547	0.656	926
Stephens	9,764	0.514	894
Young	17,932	0.707	922
Comanche	13,975	0.623	937
Hamilton	8,217	0.495	835
Mills	5,076	0.312	748
Bosque	16,456	0.846	989
Young	17,932	1.477	799
Hill	29,429	1.056	962
Brown	36,899	1.186	945
Ellis	92,027	3.846	940
Total	**474,965**	**20.333**	**15,081**

* Source: Texas Statistical Almanac (1996)

Table F-7: Estimated number of potential product re-sellers and end users in regional markets.

Type of business or institution	Austin	Waco	DFW	Erath	Abilene	Wichita Falls	Totals
Landscape Contractors and Bulk Material Suppliers	159	38	540	36	22	18	813
Garden Centers and Retail Nurseries	67	27	154	31	16	6	301
Retail Hardware (Ace Hardware, True Value etc.)	51	34	128	66	8	12	299
Department Stores (Wal-Mart and K-Mart)	12	5	23	5	1	3	49
Home Centers (Home Depot and Lowe's)	4	1	15	0	3	1	24
Municipal Parks	26	20	106	18	10	6	186
Golf Courses	23	12	52	23	5	4	122

* Does not include agricultural growers. Data are based on Standard Industrial Classification Codes.

Appendix G

Appendix G

Market Surveys

Appendix G

The following table contains a tabular list of potential resellers and end users of a processed dairy manure product. Each business or institution listed provided information during marketing research for the "Erath County Animal Waste Management Study." The purpose of the survey was to obtain information regarding items such as the resale and/or consumption of organic fertilizers and compost, information on consumer preferences, seasonal sales patterns etc. Information presented in the following table focuses on annual consumption of organic fertilizers and compost. Data facilitated estimation of compost consumption in north central Texas. (See Section 5 of this report) Table G-1 does not contain all information gathered during interviews.

Table G-1: Summary of potential resellers and end users surveyed during market research.

business / institution	type of user group	market area	annual use or re-sale	summary of respondent comments
Miller's Nursery Dublin Hwy, 377 S. Stephenville, TX 76401 254-968-2387	Field and Container Nursery	Erath	Uses 1200 cubic yards of pine bark mulch (bulk only).	Some on site composting of yard waste. Primarily uses soil-less mixes for container operation. Compost use is relatively low.
Green Creek Nursery PO Box 957 Stephenville, TX 76401 254-968-2227	Field and Container Nursery	Erath	Uses 3000 cubic yards of pine bark mulch ? of soil-less mixes ? of slow release chemical fertilizers	Strongly prefers soil-less mixes and pine bark mulch blended with sand at a ratio of 6:1. Respondent is very skeptical of plant and manure based composts because of potential weed contamination. Weed infestation is very difficult and costly to eradicate. Also stated that most compost is too "hot" (i.e. high nitrogen content). Estimated that most container nurseries use only soil-less mixes and bark/pine mulches.
Peters Wholesale Nursery C.R 2710, Walnut Springs, TX 76690 254-797-4154	Field Nursery	Erath	Uses only soil-less mixes, mostly peat and perlite mixtures 100 cubic yards	
Willow Lake Farm and Nursery 3400 Mineral Wells Weatherford, TX 76088 817-599-3407	Field and container Nursery	Earth	Use soil less mixes and pine Bark Mulch 180 cubic yards	
Stuart Nursery 2317 Fort Worth Hwy Weatherford, TX 76087 817-596-0003	Container Nursery and Landscaper	Erath	Sells 10 cubic yards of cotton burr compost and 20 cubic yards of "landscapers mix" (bagged only)	Sells some cow manure compost, but only small volumes. Most popular product is cotton burr compost.
Granbury Nursery 2410 East Hwy 377 Granbury, TX, 76409 817-573-1251	Retail Nursery Primarily supplies	Erath	NA	No organic fertilizers or compost, only small volumes of synthetic chemical fertilizers.

Weakly Watson True Value Hardware 100 CC Woodson Rd. Brownwood, TX 76801 915-646-0536	Hardware	Erath	NA	Sells some peat moss but only small volumes. Might sell cow manure compost on a trial basis, but does not sell many soil amendments.
Dowell Ace Hardware 377 N. Business 377 E. Stephenville, TX, 76401 254-965-5152	Hardware	Erath	Sells 9 cubic yards of various composts (bagged only)	Does not sell large volumes of compost. Wal-Mart is the main retailer of bagged organic soil amendments and compost.
Ace Hardware 2901 US Hwy. 180 E. Mineral Wells, TX 76967 940-325-5952	Hardware	Erath	Sells 18.5 cubic yards of cow manure compost and, 31.0 cubic yards of various compost (bagged only)	
Handyman Hardware 625 Palo Pinto St. Weatherford, T X 76086 817-599-8155	Hardware	Erath	Sells 11 cubic yards of cow manure compost (bagged only)	Has nine other stores, all stock composted cow manure and average sales range from 6-9 pallets a year (50 bags per pallet).
Arch Landscape Design 3320 Fall Creek Hwy. Granbury, TX 76409 817-326-3236	Landscape	Erath	Uses various compost-200 cubic yards (bulk only)	Could probably use about 100-200 cubic yards a year if price was right and delivery services were available on a regular basis. Reported problems with delivery now.
Environmental Design Group, CR 265 Priddy, TX 915-966-3365	Landscape	Erath	Uses various compost 55.5 cubic yards (bagged only)	
Country Gardens RR5 box 147BB Dublin, TX 76446	Landscape	Erath	Uses some bark mulch, and yard waste and about 50 cubic yards of cow manure compost (bulk only)	Could use 50 cubic yards of quality compost or more a year, but requires delivery to job sites. Currently buys composted dairy manure from Earth Perfect in Dublin, TX. Texture and appearance are important in terms of compost quality.
Lowell Lawn and Landscaping 1776 N. Braham St. Stephenville, TX 254-968-4288	Landscape	Erath	70 cubic yards of bark mulch 30 cubic yards of cow manure compost (bulk only)	Currently purchases cow manure compost from Earth Perfect.
Legends Country Club 137 Ben Hogan Dr. Stephenville, TX 254-968-2200	Golf	Erath	NA	Recently purchased some cow manure compost from Earth Perfect for use on a trial basis. Groundskeeper will apply compost to fairways and greens. Uses mostly synthetic chemical fertilizers for grounds maintenance.

Wal-Mart 755 E. Hwy 377 Granbury, TX 817-573-3791	Department Store	Erath	Sells cow manure compost 90 cubic yards other composts and soil amendments 880 cubic yards. (bagged only)	
Wal-Mart 2765 W. Washington St. Stephenville, TX 76402 254-965-7766	Department Store	Erath	cow manure compost ? cubic yards sheep manure compost ? cubic yards ? other products (organic topsoil, peat moss) (bagged only)	Did not have specific sales data. Wal-Mart would provide invoice information, but only at the end of the year. Cow manure compost is purchased from Hope Agri-Grow (Jemasco Mulch) in Paris, Texas. Hope Agri-Grow delivers peat, topsoil and manure composts in bulk loads with a minimum of 15 pallets per load. Wal-Mart retails cow manure for $1.27 per 40-lb. bag. Sheep manure retails for $2.12 per 40 lb. bag. The topsoil product costs sells for $1.27 per bag.
AAA Grass and Landscape 5910 W. HW 290, Austin ,TX 78735 512-892-3636	Landscape	Austin	Sells and uses about 3000 cubic yards of "Dillo Dirt" and 1000 cubic yards of various compost (bulk only)	Compost includes cotton burr, manure based and a mushroom farm bedding by-product compost.
Advance Landscape Design 9702 Gray Blvd. Austin, TX 78758 512-832-8009	Landscape	Austin	NA	Do not use compost or organic products.
Arbor Tex Landscape and Maintenance 402 Havenside Dr., Austin, TX 78704 512-462-3032	Landscape	Austin	NA	Use minimal amounts of compost. They are a small operation, primarily yard maintenance.
Absolute Lawn Care Austin, TX 78704 512-218-1954	Landscape	Austin	NA	Use minimal amounts of compost. They are a small-scale operation, primarily yard maintenance.
AT Masonry and Supply 300 Palm Valley Rd. Austin, TX 78703 512-388-0300	Hardware	Austin	NA	Sells minimal amounts of mulch.
Dole and Associates	Landscape	Austin	NA	Uses minimal amounts of compost.

5719 Misty Cove, Austin, TX 78759 512-418-8844				
Bolton Works 15724 Fitzhugh Rd. Austin, TX 78736 512-264-0155	Landscape and Nursery	Austin	Uses 1000 cubic yards various compost (bagged and bulk)	
Evergreen Landscape 4402 Nixon Lane Austin, TX 78736 512-926-9513	Landscape	Austin	Uses 1000 cubic yards of various compost (bulk only)	
Great Hills Garden Center 6914 Mc Neil Dr., Austin, TX 78729 512-835-8093	Garden Center	Austin	Sells 23 cubic yards of various compost (bagged only)	Most popular product is a cotton burr compost, marketed under by Back to Earth Inc.
Gardens 1818 W. 35th St. Austin, TX 78703 512-407-5490	Nursery and Landscape	Austin	Sells and uses 1500 cubic yards of compost/blend (bulk) Sells 59 cubic yards compost (bagged)	Buys bulk soil amendment from Omanhouse for landscaping contracts. Product is a blend made with cow manure, plant material and granite. Sells bagged cotton burr compost retail. Uses various types of synthetic chemical fertilizers for landscape jobs.
Great Outdoor Landscapes 2730 S. Congress Ave. Austin, TX 78704 512-448-2992	Landscape	Austin	Uses 74 cubic yards (bagged)	Currently uses cotton burr compost.
Murferys Landscaping 901 Sam Bars Rd. Austin, TX 78704 512-255-3353	Nursery	Austin	Sells 116 cubic yards of various compost (bagged)	Satisfied with organic soil amendments currently available.
Waltons Florist and Nursery Inc. 5604 Bee Caves Rd. Austin, TX 78746 512-327-1206	Container Nursery	Austin	NA	Uses some chemical fertilizers, but generally uses soil-less mixes only. Composts are not porous enough. Chemical fertilizers and fish oils are better suited for high-quality ornamental plants.
Duffy's Ace Hardware 3447 Altamera, Fort Worth, TX 76133 817-370-8899	Hardware	DFW	NA	Duffy's does not carry composts or organic fertilizers. They do sell some chemical fertilizers and potting soils.
Archies Garden Land	Nursery	DFW	Sell 10 cubic yards of	

6700 Camp Bowie Blvd. Fort Worth, TX 817-737-6614			cow manure compost and 37 cubic yards of various compost. (bagged only)	
Azle Nursery and Landscape 139 W. Main St. Azle, TX, 76020 817-444-4769	Nursery and Landscape	DFW	Sells 200 cubic yards of various compost 11.9 of cow manure compost (bagged and bulk)	Sells wholesale/discount to small landscaping operations and sells bags at retail prices to home gardeners.
Bill Dunlop Lawn Services 6926 Maple Ave. Dallas, TX 75235 214-352-9833	Landscape	DFW	NA	Uses only pine-bark mulches (500 cubic yards) and chemical fertilizers (1000 lbs.). Interested in an organic fertilizer product if it was price competitive on nutrient per nutrient basis with synthetic chemical fertilizers.
Brokers Quality Grass 1856 I-35 N. Carrolton, TX 972-466-0410	Sod Broker	DFW	NA	Unaware of any sod farms that use compost. Most Texas sod is grown in the southern portion of the state.
Busby's Nursery 7925 Jacksonboro Hwy Fort Worth, TX 817-237-4884	Nursery	DFW	Sells 1.8 cubic yards of cow manure compost 2.8 cubic yards of various compost (bagged only)	Very small nursery. Sell small volumes of cotton burr compost.
Calloways Nursery 4200 Airport Freeway #200 Fort Worth, TX 76117 817-222-1122	Nursery	DFW	Sells 2,488 cubic yards of various composts (bagged only)	Calloways has 15 retail outlets in the Metroplex area. They have a private label. About 95 percent of sales are their own product. The remaining 5 percent are primarily Back to Earth cotton burr compost. The general manager, Sam Winger, reported that demand for compost and organic soil amendments are strong and increasing. *Note: the volume reported is for all 15 stores.*
Department of Parks and Recreation 4200 S. Freeway Dr. #2200 Fort Worth, TX 817-871-5700	Parks	DFW	?	The Department currently uses compost generated by the Fort Worth Municipal Recycling Facility (primarily composted yard waste). They use compost for flower and shrub bedding in local parks. For athletic fields, they use only slow release chemical fertilizers. Erath County compost would be too costly to justify given the availability of the municipal compost.
Foliage Factory 10700 White Settlement Rd Fort Worth, TX 76117 817-246-0731	Landscape	DFW	Use and sell 600 cubic yards of various compost and 700 cubic yards of "hard mulch" (bulk and bagged)	The Foliage Factory purchases bulk compost from Vital Earth Technologies. The product is labeled as "landscapers special" and delivered in 60 cubic yard truckloads and priced at $15.00 per cubic yard.

Four Seasons Nursery and Landscaping 3383 E. University Dr, Denton, TX 76208 940-566-2172	Retail Nursery	DFW	110 cubic yards of various compost 7 cubic yards of cow manure compost (bagged)	Four Seasons primary market is homeowners and gardeners. They would retail a processed manure product, if they had test samples and chemical analysis. The product must also be price competitive with others.
Fowlkes Norman and Associates 4802 Hwy. 377 South Fort Worth, T X 817-244-3822	Landscape	DFW	Use 580 cubic yards of various compost (bulk)	Buys from Vital Earth Technologies.
Grover C. Keaton Golf Course 2322 N Jim Miller Rd. Dallas, TX 75227 214-670-8784	Golf	DFW	See comments	Uses some compost produced on-site with yard wastes (maybe 10 cubic yards). They apply compost on some portions of the fairways and are pleased thus far. They use about 2 tons of milorganite on greens and tees as well as a considerable amount of slow release synthetic fertilizers. The superintendent would like to have the course certified as a bird sanctuary by the National Audubon Society. "Organic." certification requires the approval of the Audubon Society. He likes the organic approach to grounds maintenance and is interested the possibility of using organic fertilizers as an alternative to chemicals. He also noted that the USGA currently requires that fairways be constructed and maintained with 10% peat moss. He thinks compost would work better and be more cost effective.
Handyman Hardware 3147 Denton Hwy. Fort Worth, TX 76117 817-834-9041	Hardware	DFW	NA	No compost, only peat moss.
Herman Tree and Landscape 1105 Hughes Ave. Fort Worth, TX 76103 817-536-9531	Tree Farm and Landscape	DFW	NA	Use granular chemical fertilizers, 12-12-12. Does not think organic fertilizers would be as effective as the chemical fertilizers. Organic fertilizers are too low in nutrient content. He might try some on a trial basis if it was free.
Home Depot 6501 NE Loop 820 North Richland Hills, TX 76180 817-485-4400	Home Center	DFW	NA	Said market for compost is very strong, but could not release any sales information due to corporate policy.
Into the Garden 1612 S. University Dr. # 406, Fort Worth, TX 76107	Nursery	DFW	NA	Sell minimal amounts. They primarily specialize is ornamental garden sculpture and exotic plants.

817-336-4686				
Lamberts Landscape Co. 6333 Denton Dr. Dallas, TX 75235 214-350-8350	Landscape	DFW	Use 2000 cubic yard of various composts (bulk only)	Lamberts purchases wholesale form Gardenville and Vital Earth.
Mc Clendon Nursery 2505 Hall Johnson Rd. Colleyville, TX 76034	Nursery	DFW	107 cubic yards of various compost (bagged)	
Metro Hydro Mulch & Landscape 4802 HW 372 S. Fort Worth, TX 76102	Landscape	DFW	5000 cubic yards of mulches and various composts (bulk)	Silver Creek Materials is their supplier
Nicholoson Hardie Nurseries 5725 W. Lovers Lane Dallas, TX 75209 214-357-4348	Nursery	DFW	188 cubic yards of various composts (bagged)	1997 annual sales: 5076 bags of compost, 1 cu. ft. 568 bags of peat, 3.8 cu ft. 1606 bags of pine bark, 2 cu. ft.
Quality Scape Inc. 3759 McCart Avenue, Fort Worth, TX 817-923-5296	Landscape	DFW	30 cubic yards of various compost	Quality Scape uses compost purchased from Silver Creek Material for flowerbeds and shrubs, and use chemical fertilizer on lawns. Would like to buy more compost, but lacks adequate storage facilities. Would be interested in an organic fertilizer if the product price competitive.
Berend Brothers Farm and Garden 4313 Seymour Hwy., Wichita Falls, TX 76309 940-691-1141	Farm and Garden Center	WF	minimal sales of compost 10-20 bags per year	Berend Brothers is mostly a farm supplier and noted that the agricultural industry uses very little if any compost in the area. Claims that retail market for organic fertilizers and soil amendments has not developed in the area as it has in DFW.
Harris Nursery and Landscaping 3209 Lawrence Rd., Wichita. Falls, TX 76308	Nursery and Landscape	WF	Sells 33 cubic yards of various composts 19 cubic yards of cow manure compost (bagged only)	Most popular product is Back to Earth cotton burr compost
Holt Nursery and Landscaping 3913 Kell Blvd., Wichita Falls, TX 76308 940-691-4757	Landscape and Nursery	WF	Sells 111 cubic yards of various compost 4 cubic yards of manure compost. (bagged)	The majority of the bagged compost is a cotton burr product used primarily by landscapers. About 25 percent is sold retail to home gardeners. Landscapers generally do not buy manure compost.
Smith Garden Town 4100 Kemp Blvd. Wichita. Falls, TX 76308 940-692-7100	Garden Center	WF	Sell 144 cubic yards of various composts (bagged)	The majority of compost sold a "Landscapers Mix" manufactured by Hope-Agri. The remainder is a Back to Earth Inc. product.

Wichita Valley Landscape Services 5314 SW Pkwy, Wichita Falls, TX 76310 940-538-6311	Landscape and Garden Center	WF	Sell 55 cubic yards of various composts and 4 cubic yards of cow manure compost Use 30 cubic yards of compost produced by the City of Wichita.	Compost is made by Back to Earth Inc. and is sold retail as cow manure compost. They use bulk compost from the City of Wichita in landscaping jobs because of its availability and low cost.
Wichita Falls Parks and Wildlife Dept. 1300 7th St. Wichita Falls, TX 76301 940-761-7490	Parks	WF	See comments	Grounds manager uses compost from the city recycling facility. The park groundskeeper is experimenting with compost applied on selected plots within city parks. He is pleased with the performance of the material. He blends compost with topsoil. Eventually the parks department hopes to replace all commercial chemical fertilizers. Respondent stressed that compost produced by the city is very low cost and increasingly available.
Abiline Lawn and Grass Company 2618 E. Hwy. 80 Abilene, TX 79601 915-677-8928	Landscape	Abilene	NA	Hydro-mulch.
Abilene Parks Division 633 Walnut St., Abilene, TX 79601 915-676-6217	Parks	Abilene	Sells 6 cubic yards of various composts (bagged)	Use minimal amounts of composts (cotton burr) on flowerbeds and shrubs. On grasses and athletic fields, they use chemical fertilizers (32-10-10). Says compost is relatively expensive as compared to chemical fertilizers.
Baack Florists and Greenhouse 1842 Matador St., Abilene TX, 79605 915-692-7763	Florist and Nursery	Abilene	NA	Use some peat moss but not more than 20 to 30 cubic yards.
Garden Place 4002 N. 1st St. Abilene, TX 79605 915-676-0086	Garden Center	Abilene	Sells 1200 cubic yards of various compost and 185 cubic yards of cow manure compost (bagged and bulk)	Sells high volumes of "Landscapers Mix" and cotton burr compost. Says cow manure compost sales are good. Could probably market 50 to 100 pallets per year if product was of good quality and price competitive.
Mankin Landscaping 1449 Roanoak Dr. Abilene, TX 79603 915-673-3871	Landscape	Abilene	NA	Uses some mulch and pine fines, but only small amounts, 5 to 6 tons a year. They use mostly chemical fertilizers for lawn care (15-5-10) which retails for about 6.50 a bag.
Wolfe Nursery 2850 South Clack St. Abilene, TX 76906 915-698-2401	Garden Center	Abilene	1300 cubic yards of various composts 100 cubic yards of cow manure compost	Sells wholesale to landscapers and retail to home gardeners. Most of the product marketed is cotton burr compost produced by Nature Life Inc.

			(bagged and bulk)	
Ackers Sunrise Nursery 3489 Speegleville Rd. Woodway, Texas 76712 254-848-5898	Nursery	Waco	20 cubic yards of compost	Ackers purchases a biosolids product from the City of Waco (BRA in Temple) for $5.00 per cubic yard. They blend the biosolids product with potting soil and for use in plant beds.
Alamo Hydro Mulch and Landscaping Box 816, Waco, TX 76719 254-666-3260	Landscape and Hydro Mulch	Waco	12 cubic yards of yard waste compost	Alamo produces compost from yard wastes and some animal manure. They use it for landscape applications.
Bogey's Golf Course 5500 Old Steinbeck Rd. Waco, TX 76708 254-754-4401	Golf	Waco	NA	Bogey's strictly uses bagged commercial fertilizers, about 2520 lbs. per year. Interested in compost and organic fertilizers, if the products were effective and adequately priced.
Greenville Garden Center 1312 N. New Rd. Waco, TX 76710 254-776-2400	Garden Center and nursery	Waco	28 cubic yards of various compost 92 cubic yards of cow manure compost (bagged)	Cow manure compost sales are brisk. This is the only retail outlet surveyed where cow manure compost sales exceeded those of cotton burr and other composts.
Organic Nursery 6898 W. Hwy. 88 Woodway, TX 76112 254-776-6069	Garden Center	Waco	400 cubic yards of various compost (bagged), 10 cubic yards of sheep manure compost (bagged)	Sells to landscapers wholesale and retail to homeowners.
J and J Landscape Management 613 E Ward Drive, Waco, TX, 76706 254-662-4545	Landscape	Waco	NA	Use some peat moss, but no compost or organic fertilizers. Relatively small-scale operation.
Radles Nursery Lady Bird Rd. Woodway, TX 76712 254-848-5300	Nursery and Landscape	Waco	Uses about 288 cubic yards of compost	Uses compost sold by Cambell's Fresh Mushroom Farm. The product is a blend of turkey and chicken manure and bedding. Buys it bulk for landscaping operations and for application in plant beds. Noted that many of the nurseries and landscapers in the area use this product because it is low cost and effective.

				They obtain the product free of nominal charge, and pay only transportation costs.
Waco Parks Maintenance 311 Concord Dr. Waco, TX 76707 254 -750- 8080	Parks	Waco		Uses compost generated by the City of Waco. Unsure of how much.
Westview Nursery and Landscape 1000 Woodway Dr. Waco, TX 254-776-2334	Nursery and Landscape	Waco	19 cubic yards compost 28 of cow manure compost (bagged)	
Westview Nursery and Landscape 1136 N.W Drive Waco, TX, 76710 254-772-7890	Nursery and Landscape	Waco	33 cubic yards of various compost 11 cubic yards of cow manure compost 11 cubic yards of sheep manure compost. (bagged)	

Appendix H

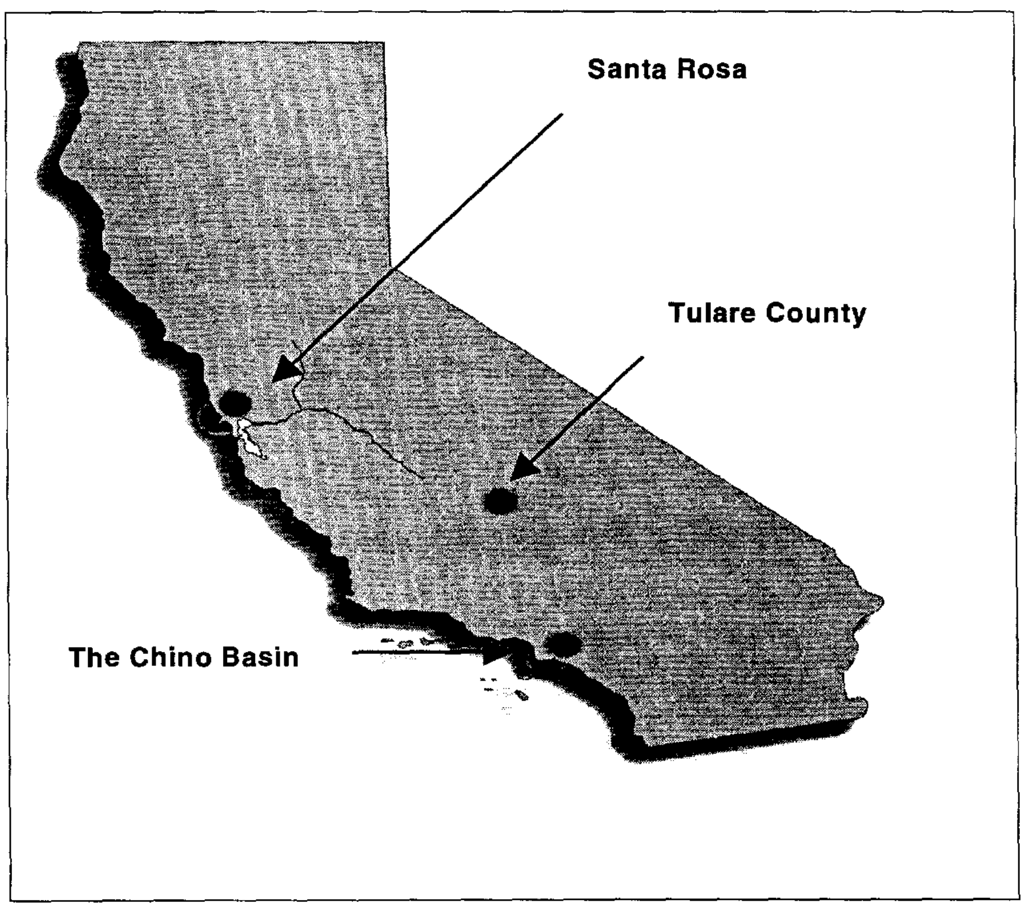
Appendix H

Site Visit Report

Introduction

The dairy industry has changed dramatically over the past twenty years. Technologically advanced production facilities are rapidly replacing small-scale traditional dairy farms, which typically number two to three hundred animals. Often referred to as Concentrated Animal Feeding Operations (CAFOs), these operations house thousands of animals enclosed in confined areas. Particular regions of the United States have extremely high concentrations of livestock. In areas with large concentrations of dairies, elevated levels of phosphorous and nitrogen from cow manure and effluent run-off have been detected in ground and surface waters. Livestock induced run-off is a source of water pollution in the United States. Federal and state agencies have established regulatory policies to help improve water quality. In some instances, implementation of such policies has created a necessary partnership between the public sector and the dairy industry that emphasizes creative solutions to the problem. Regulatory pressure has also encouraged the growth of companies that specialize in processing dairy manure into marketable commodities such as organic fertilizers or soil amendments.

This report summarizes information obtained on a tour of selected dairy waste management facilities throughout California, whose dairy industry has grown to be the largest in the United States. Sites visited are currently processing manure for sale in retail and agricultural markets, or have developed programs that encourage environmentally sound dairy management. Areas visited include the Chino Basin, Tulare County and the city of Santa Rosa in Sonoma County.



The Chino Basin Water District, Dairy Preserve and Composting Facility

The Chino Basin Municipal Water District (CBMWD) is a water management agency that provides distribution of imported water and water resource management services within the Chino groundwater basin. According to CBMWD, The district provides services to the cities of Chino, Chino Hills, Fontana, Montclair, Ontario and Upland as well as the Cucamonga County Water District and the Monte Vista Water District. Approximately 600,000 people reside in the District. CBMWD has six major service responsibilities: domestic water collection, waste water treatment and disposal, distribution of supplemental water supply, groundwater management, industrial waste or non-reclaimable waste disposal, water conservation and reclamation, and co-composting. According to CBMWD, water demand within the district is met from a number of sources including: groundwater from the Chino and adjoining groundwater basins, surface flows from the San Antonio, Cucamonga and Day Creek Canyons, imported water supplies from the Metropolitan Water District of Los Angeles (MWDLA), and recycled water from the District's wastewater and reclamation facilities. CBMWD obtains an average of 70 percent of the water from local groundwater and canyon sources, and 30 percent is purchased from MWDLA. 35 percent of local groundwater supports agricultural and 65 percent sustains municipalities and industry.

The CBMWD is situated adjacent to the Chino Basin Dairy Preserve which is one of largest in the nation with an estimated 475,000 cows. Growth in the region's dairy industry mushroomed in the late 1960's, when ranchers from the Los Angeles area relocated to the Chino Basin to take advantage of relatively cheap land and low urban population pressure. The Williamson Act of 1968 established the preserve. Similar legislation in 1971 and 1973 facilitated expansion to its current level. The Williamson Act bars any non-agricultural development on the preserve and requires dairies to remain on the preserve for a minimum of ten years. The preserve comprises 15,000 acres and contains approximately 220 dairies. An average dairy in the preserve houses around 880 cows, although some have herds of more than 5,000. Due to the large concentration of cows, roughly 32 per acre, manure production is enormous. Disposal of dairy waste became a major concern when surface and ground water in the Chino Basin became contaminated with high levels of manure nutrients such as nitrogen.

In order to address the problem, CBMWD constructed and opened a composting facility in June, 1995.[1] According to CBMWD, the mission of the facility is to "provide a reliable, economically feasible method for processing and disposing of municipal biosolids generated at the Chino Basin waste water facilities and dairy manure derived from dairies overlying the Chino Groundwater Basin." Based on the District's estimates, at full capacity the facility can compost all of CBMWD's municipal biosolids and approximately one-third of manure generated annually by local dairies. CBMWD produces two types of composts, a blend of municipal biosolids and dairy manure (co-compost), and compost containing only dairy manure.

CBMWD owns and maintains the facility on unincorporated land located in the southern corner of the preserve. CBMWD's composting facility covers 97 acres of land and cost 12.5 million dollars to construct. Approximately one-half of construction monies were allocated to land expenses. To begin construction, CBMWD obtained over 70 permits from a variety of regulatory agencies. Two large bays make up the facility, each 2,300 feet long and 600 feet wide. One bay serves to process co-compost, while the other processes only dairy manure compost. The co-compost area is sealed with 9.6 inches of compacted soil cement and capped with two inches of asphalt. The dairy manure area is sealed with 13.2 inches of soil cement with no asphalt cap. Regulatory agencies required both

[1] According to Parivash Dezham, Manager of Technical Services for CBMWD, other processing methods were considered including heat-drying or incineration. However, CBMWD ruled out the construction of an incineration or heat drying facility due to stringent air quality regulations in San Bernardino and adjacent counties. Mrs. Dezham also noted that the facility has faced numerous law suits filed by adjacent dairies who claim that dust from compost generated at the facility harbored pathogenic organisms and was a threat to human and livestock. None of the litigation has been successful.

specifications to prevent nitrates from seeping into groundwater. Run-off protection is also contained by perimeter berms and a 216-foot by 1,240 foot catch basin with an estimated capacity of 12 million gallons.

CBMWD produces compost using standard windrow technology. Dairy manure and sludge are placed in windrows approximately ten feet wide and four feet high. As solid material decomposes, windrow volumes decrease and workers combine two or more piles to form a larger windrow. Water trucks maintain windrow moisture, which increases temperatures within the piles. Composting destroys pathogenic bacteria in manure and sludge. The final product contains approximately 60-percent solids, composting requires 45 to 60 days for completion.

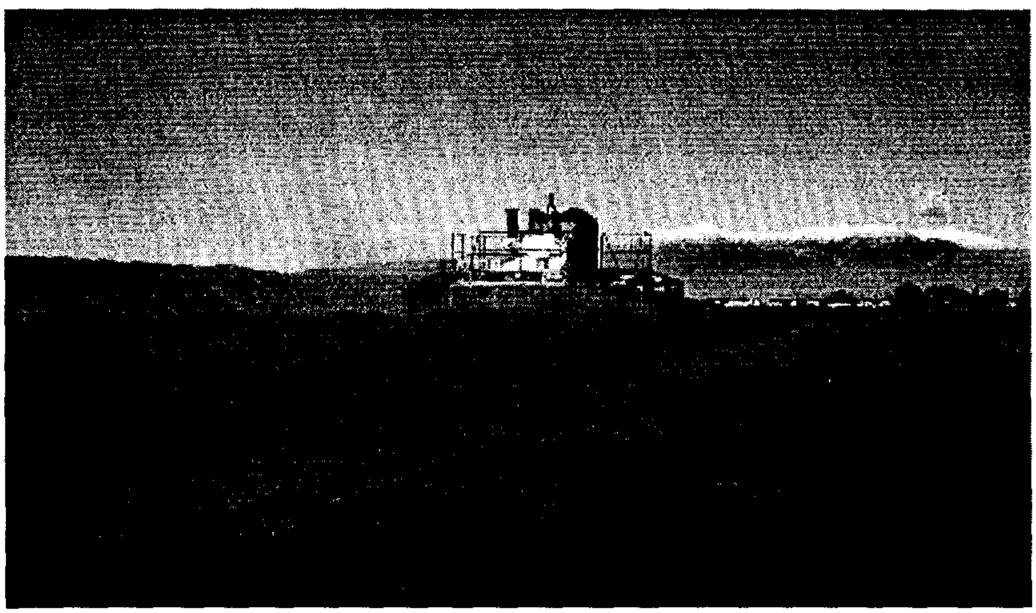
At full capacity, the Chino Composting facility processes an average of 1,100 tons of dairy manure per day.

Operation of the facility is carried out under contract by two companies: EKO Compost of Riverside, California who produce co-compost, and Western Green Cycle Inc. (WGC) who produce dairy manure compost. According to CBMWD, the facility treats an average of 1,100 tons of per day during the dry season and about 400 to 600 during the rainy season. CBMWD weighs dairy manure brought to the facility and generates a manifest that allows facility managers to record amounts of manure exported from each dairy. Dairy producers are responsible for transporting cow manure to the facility.

Dairy operators typically hire private contractors to transport manure. Private haulers charge anywhere from $3.00 to $5.00 dollars a ton depending on the distance. In addition, CBMWD charges dairies a $.65 per ton tipping fee that generates $50,000 to $60,000 dollars in annual revenue. Tipping fees do not cover the facility's operation and maintenance costs. CBMWD plans to increase fees to $2.50 a ton. A CBMWD representative stated that dairy operators would likely resist any fee increases.

According to EKO, production costs are approximately $2.90 per ton. EKO markets co-compost for around $4.00 per ton to local distributors who re-sell it for $18.00 to $22.00. Primary consumers are fruit and cotton growers in the San Joaquin Valley 80 to 300 miles away. Transportation costs to the valley range from $12.00 to $16.00 a ton. WGC sells the manure-only compost for $5.00 dollars a ton to farmers. WGC recently decided not to renew their contract with CBMWD. A WGC representative stated that tipping fees are not large enough to make the venture profitable. He also stated that, "The biosolids market has gone to hell, because people are scared of it." Apparently, consumers are fearful of potential heavy metal contamination in municipal sewage sludge. The WGC spokesman also stated that many growers and landscapers would not purchase compost generated at the facility, because of its high salt content. The company representative did acknowledge that some grape and cotton producers purchase dairy manure compost.

CBMWD produces compost using standard windrow technology. Dairy manure and sludge are placed in windrows approximately ten feet wide and four feet high. As solid material decomposes, Windrow volume decreases and workers combine two or more piles to form a larger windrow.



CBMWD's facility is relatively effective from a supply perspective. It is well designed, constructed, and is operated efficiently from a logistical standpoint. However, the barrier to the facility's overall success is rooted in marketing. Local markets need to be further researched and developed, and compost should be specifically tailored to meet the needs of individual consumers. Efforts at market development may also include reducing excessive levels of salt in the compost, and implementing a public awareness campaign aimed at mitigating the public's negative perceptions of biosolids compost.

Tulare County and New Era Farm Services Incorporated

Tulare County leads the United States in total milk production and total number of cows. The county is home to approximately 585,000 cows, heifers and calves that produce approximately 21 percent of California's annual milk production. Tulare County's dairy industry is growing rapidly as dairy operators relocate from the Los Angeles area. Incentives include good weather, relatively cheap land, ample sources of feed, water and labor, and nearby processing and service enterprises. In addition, Tulare County has a rural population that is generally receptive to the industry. Experts expect continued expansion of the Tulare County's dairy industry. [2]

The industry's rapid growth has fueled concerns about water quality in Tulare County. In response to increasing regulatory pressures, most dairies in the county have adopted "best management practices" (BMPs) and have upgraded their facilities. Many dairies are equipped with modern free-stall flush systems. A typical 1000-cow dairy has a one million cubic foot waste water storage lagoon for recycling and land application. Manure solids separators allow dairy operators to recycle undigested fiber for use as corral bedding. Some on-farm composting is taking place, however, most dairy operators export manure to private sector compost producers such New Era Farm Services Inc. (NEFS).

NEFS lies in the heart of Tulare County's dairy country. Ralph Jurgens established NEFS in 1973, and over the years he has developed the firm into a very successful and highly sophisticated composting operation. The company markets itself as an agronomic service corporation specializing in "organic matter management and crop nutritional support systems." NEFS's main soil amendment is "New Era Compost," a selected mix of composted dairy manure inoculated with a microbial stimulant and blended with topsoil. The final mix is around two-thirds compost and one-third topsoil. Depending on consumer's specific needs, NEFS can blend basic compost with gypsum, sugar beet limestone, dolomite, sulfur, and other trace elements. Additional minerals adjust soil characteristics such as alkalinity and porosity. To determine the right mix, NEFS provides soil analysis upon request.

Compost sales average 100,000 tons per year. Primary consumers are cotton and fruit growers, and prices range from $17.00 to $25.00 dollars a ton depending on the blend. NEFS also markets a "Compost Tea" which is a soluble extract derived from composted manure that has undergone a thermophillic controlled oxidative process that takes approximately twenty-one days to complete. Farmers can apply the product through irrigation systems or can spray it on foliage. "Compost Tea" is relatively easy, fast and cheap to produce and there is a high demand for it. NEFS currently sells about 300,000 thousand gallons a year.

NEFS produces compost using windrow technology. Compost requires 30 to 60 days for completion. NEFS pays dairy operators $2.00 to $4.00 a ton depending on manure quality (i.e. type of feed ration used), and on how far away the dairy is from NEFS's composting facility. NEFS delivers compost within a 200-mile radius of their facility. The average hauling distance is 160 miles. Transportation fees are around $10.00 per 100 miles. Land application of compost is the responsibility of farmers, who generally hire an independent contractor. NEFS also offers on-site consultation services to dairy operators who wish to compost on-farm. Consultation includes guidance on the use of state of the art techniques including compost inoculation, proper use of machinery for turning windrows, and the mixing and evaluation of raw material and final product.

NEFS has been significantly more successful in the production and marketing of processed dairy manure than CBMWD. NEFS has a greater scientific knowledge of the product, and a clearer understanding of current and potential markets. They have created a high-quality product that works well and meets the specific needs of individual consumers. In general, NEFS is an excellent

[2] Schultz, T. "The Dairy Industry in Tulare County," University of California Extension Service, 1997.

example of how the private sector can form a symbiotic relationship with the dairy industry that contributes greatly in the effort to improve environmental quality.

The City of Santa Rosa and Sonoma County

The dairy industry in Sonoma County is considerably smaller than in Chino or Tulare County, however it has experienced significant growth in recent years. In 1997, there were approximately 100,000 dairy cows in Sonoma County. Average herd size is 500 cows, although some operations contain several thousand cows. Like Chino and Tulare, citizens of Sonoma County recognized excessive levels of nutrients, primarily nitrogen, in local surface and groundwater. Environmental studies funded by the city of Santa Rosa, the county capital, concluded that the primary source of the nitrogen are dairy farms in the watershed and residential septic tanks in and around the city of Santa Rosa.

The city of Santa Rosa acted to reduce nitrogen run-off from septic tanks, and worked with dairies to reduce cow manure and effluent run-off. The city estimates that a 60-percent reduction in nitrogen originating from dairy run-off will reduce nutrient loads to acceptable levels. Dairymen and scientists determined that the best way to achieve the reduction was to construct confinement facilities for dry cows and heifers. Unlike milking cows, dairy operators typically keep dry cows and heifers unconfined in fields adjacent to barns during the rainy season (winter). Heavy rains wash manure nutrients into ground and surface waters. Confinement facilities allow dairy operators to control and store most of the cow manure generated during the rainy season. Dairy operators then land apply manure and effluent during the dry season when crops require irrigation. Dairy operators apply manure and effluent at agronomic rates, and thus there is much less nutrient run-off.

To finance construction of the facilities, the city approved two million dollars in seed money to create an interest-free loan fund for dairy operators.[3] Approximately 10 percent of dairies in the county take part in the program. Facilities constructed are modern freestall barns equipped with hydraulic flushing systems. Representatives from CDM and TIAER conducted a tour of a 400-cow free-stall barn recently constructed with funds from the city's loan program. The flush system is driven by a 40 horse power pump installed in a lagoon. Dairy operators activate the pump two or three times a day. The pump siphons roughly 2200 gallons of water each minute for five minutes through two outside lanes and for ten minutes through two center lanes. Cows reside on an elevated platform with hay bedding. Effluent and manure flow to a lagoon, and water is recycled during the next flush. A timer incorporated into the pump automates the system. During summer months, dairy operators irrigate hay and row crops with manure-laden water, and apply it at agronomic rates developed for each dairy participating in the program.

[3] The agricultural extension service in Sonoma County proposed a 10 cent per gallon surcharge on retail milk in order to finance dairy waste management, but the proposal was shelved until the results of the city's efforts can be evaluated.

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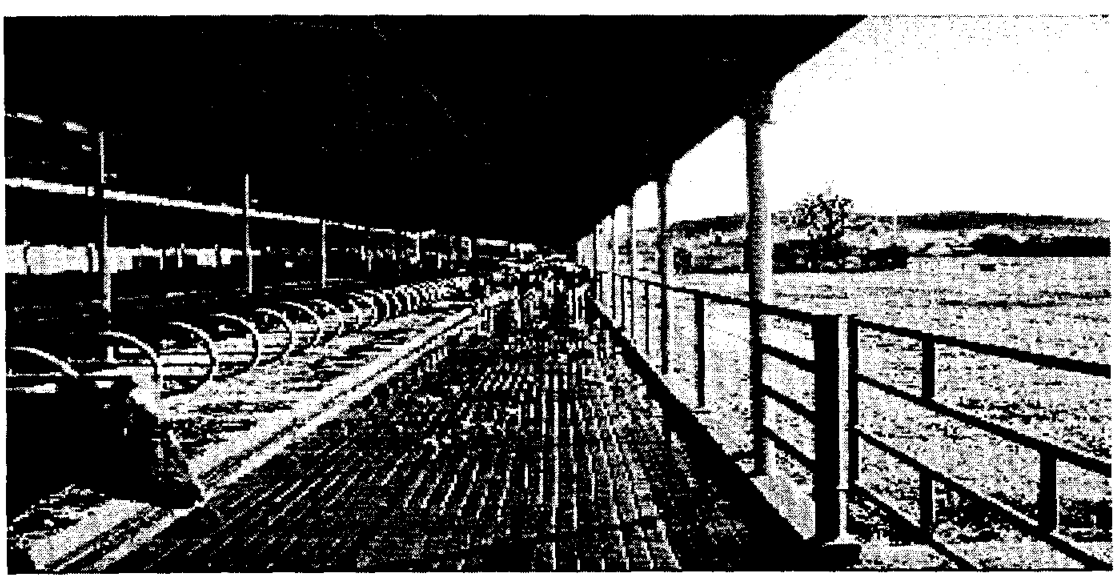

Some dairies participating in the program lack sufficient amounts of land to absorb manure and effluent at estimated agronomic rates. Individual dairies must export approximately 265 to 1,380 cubic yards of manure. Export of manure is common. Opportunities for export include:[4]

- **General Agricultural Use:** Transporting excess manure to other farms for application as fertilizer and on-farm composting for sale in local retail markets.

- **Vermiculture**: Growing worms in the manure that transforms the manure into worm castings that are in demand by local landscapers for use as a soil amendment.

- **Off-Farm Composting**: The city is currently conducting a feasibility study of composting dairy manure at its composting facility at the Laguna treatment plant.

Most dairies export excess manure to other farms. On-farm composting is taking place on a relatively small scale but is gaining popularity. For example, the Terri Linda Dairy in Santa Rosa composts manure in large piles that are turned periodically. The owner sells compost at bulk rates for $5.00 a ton to landscapers and home gardeners. He acknowledged that compost demand is brisk and driven by a strong desire on the part of consumers to be environmentally conscience. The Terri Linda Dairy recently received an offer from a statewide home and gardening retail chain to buy its compost for $13.00 a ton. Centralized dairy manure composting in Sonoma County is still in the experimental stages. The city of Santa Rosa has an in-vessel composting facility for municipal sludge. Facility operators purchase wood chips as a bulking agent for sludge. However, dairy manure is cheaper than wood chips and readily available. The facility is testing composted dairy manure for use as a potential bulking agent. If proved successful, the city estimates they could use fifteen percent of the county's dairy manure.

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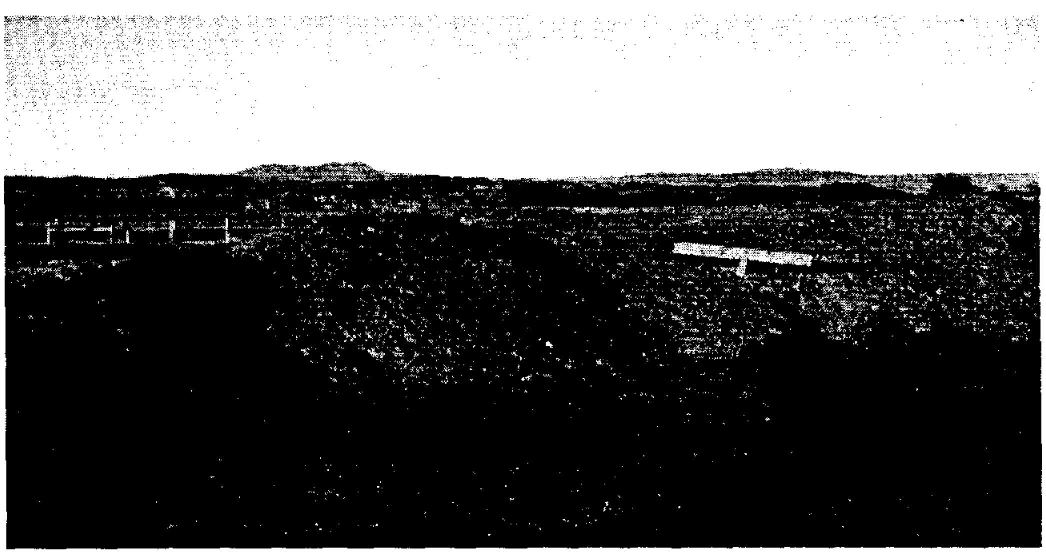

[4] Fox, D. R. "Nitrogen Balance for Certain Dairies on the Subregional Reclamation System." A Report Prepared for the City of Santa Rosa Utilities Department." March, 1997.

Sonoma County and the City of Santa Rosa have taken a more holistic approach that entails the implementation of BMPs and possibly centralized composting. The approach is a good one, but is costly. Sonoma County can afford it as they have a thriving economy and a large tax base. In addition, local taxpayers are receptive to projects that enhance or preserve environmental quality in the bucolic region. In areas with less tax revenue and a public less amiable to environmental issues, the approach may not be feasible. Lastly, Santa Rosa has focused on the reduction of nitrogen levels in surface and ground waters, but apparently has not addressed potential problems with phosphorous.

Conclusion

Environmental compliance in California has encouraged and in many cases forced the dairy industry to work closely with the public and private sector to address water quality issues. Each site visited in California provides an example of this relationship and each displayed varying degrees of success in dealing with the problem. Regardless, all provide valuable insight on how other areas in the United States, including Erath County, can address the issue surrounding the dairy industry and the integrity of our water resources.

Appendix I

Appendix I

Estimated Current Manure Management Costs

Economic Costs of Solid Waste Management: Erath County Dairy Industry

Introduction

The following report accomplishes two tasks. Primarily it provides a brief description of solid waste management for dairies in Erath County, Texas. Secondly, the report presents cost estimates associated with solid waste management. The author presents various estimates; each formulated under different sets of assumptions. Analysis is based on information and data from a variety of secondary sources including research conducted by Texas A & M University and the Texas Institute for Applied Environmental Research. Estimates presented are not intended to be definitive, but rather serve as a guide in the formulation of economic and public policy analysis.

Standard Waste Management Practices in Erath County

The majority of dairies in Erath County have solid waste management systems. Few are free-stall facilities, however many dairy operators are currently considering this option. Texas State laws require dairies to be equipped with a lagoon system designed to capture liquid waste run-off from open lots and corrals during heavy rainfall. Practices used to collect, stockpile and transport dairy manure are relatively homogenous with respect to technique and machinery. Manure management activities characteristic of Erath County include the following (Outlaw et al., 1995):

- **Scraping of corrals and alleyways.** Dairy operators typically scrape corrals with a 60 to 100 horsepower tractor equipped with a pull type box scraper or a box scraper connected to a three-point hitch on the tractor. Scraping is usually done every two weeks.

- **Stockpiling manure.** After scraping, dairy operators dump manure in large piles or "in-pen mounds." A front-end loader or tractor equipped with front-end loader stacks manure.

- **Export of manure to farmland for application.** Dairy operators transport stockpiled manure to nearby fields for land application approximately every six months. Manure is applied to both row crops and pastures.

Manure Generation per Cow

According to the ASAE Standards (1993), freshly deposited dairy manure has a moisture content of around 87 percent, and fresh manure generation per cow is 23.6 tons per year. This report assumes that open lot dairy manure has moisture content of 50 percent. Annual manure generation per cow at 50 percent moisture is 6.14 tons. A further reduction of 23 percent is assumed on the basis that this portion is flushed from milking parlors and feed lanes into containment lagoons as liquid waste. Thus, each year dairy operators must manage 4.72 tons of solid waste per cow.

Manure Management Cost Estimates

Cost estimates are adapted from a number of sources including Outlaw et al. (1995) and Masud et al. (1992). Outlaw et al. conducted focus groups with small and large-scale dairy operators from the Cross Timbers region of Texas, which comprises Erath, Comanche, Hamilton, Bosque and Mills counties. Outlaw et al. developed estimates for small and large-scale dairies. Small-scale dairies are defined as having an average of 250 cows, and large-scale dairies are defined as having an average of 1000 cows. Differences exist for large and small dairies with respect to machinery used to collect and stockpile manure, amount of land owned, and the amount and type of labor utilized.[1] Outlaw et al. assume dairy operators do not employ contractors who specialize in dairy manure management.

Table 1 contains dairy manure management costs for small, medium and large-scale dairies.[2] "On-dairy" capital and variable costs include annual expenditures on machinery, and labor used to collect and stockpile manure. "Off-dairy" costs refer to equivalent expenditures on transportation and manure land application. Manure management costs for small and medium-scale dairies do not include the cost of land where manure is applied. Dairy operators typically grow livestock forage on this land. It is assumed that the reduction in feed costs achieved from forage cultivation offsets the costs of land. However, large-scale dairies regularly lease additional land solely for manure management. According to Pratt et al. (1997), large-scale dairies require approximately 50 additional acres for solid waste management. Cost estimates in Table 1 include leasing costs of 50 additional acres for large dairies.

Table 1. Annual Solid Manure Management Costs Per Cow

Dairy size	On-dairy capital costs	Off-dairy capital costs	On-dairy variable costs	Off-dairy variable costs	Total cost
small (250 cows)	$27.60	$13.80	$13.20	$8.00	$62.70
medium (500 cows)	$12.70	$6.90	$13.20	$9.10	$41.90
large (1000 cow)	$6.60	$4.50	$13.20	$9.10	$33.30
Average total cost for all dairies	**$11.30**	**$6.50**	**$13.20**	**$8.90**	**$39.90**

* Costs are rounded to the nearest tenth of a dollar.

Outlaw et al. assume dairy operators perform hauling and spreading themselves. However according to Pagano et al. (1995), Erath County dairy operators regularly hire custom manure haulers. Several vendors in the county collect and haul dairy manure to surrounding pastures or cropland (Masud et. al, 1991). Charges vary according to the level of service. For example, Vendor A charges a standard fee of $18.00 per eighteen cubic yard load to haul and spread. Vendor A charges an additional $3.00 per load to transport manure to fields not adjacent to dairy lots. Vendor B charges $15.00 per fifteen cubic yard load, and has two classifications, short haul and long haul. Short haul rates apply only if Vendor B applies manure within a one-mile radius of the dairy. Loads beyond a one mile radius classify as long haul and require an

1. The Appendix of this report contains solid waste management costs for small, medium and large-scale dairies. Figures are adapted from Outlaw et al. who estimated costs for "small" and "large dairies" only. To account for medium sized dairies (500 cows) variable costs of "large" dairies (1000 cows) were reduced by 50 percent. With the exception of the additional land requirement, capital costs for medium dairies the same as those of large dairies.

additional $1.25 per load. Vendor C has a pricing structure similar to Vendor B. Short haul rates apply if manure is piled and ready to load. Manure must also be applied within a one-mile radius of the dairy. Long haul rates are an additional $3.00 per fifteen cubic yard load for every extra mile. Price per ton for all vendors is approximately $1.70.[3] On average, each additional mile, cost $.25 per ton.

Table 2. Average Price Per Ton Charged by Custom Manure Haulers

	Price per ton	Annual cost per cow
Hauling and spreading (within 1 mile radius of dairies)	**$1.70**	**$7.90**

*Costs are rounded to the nearest tenth of a dollar.

Table 3 contains cost estimates assuming dairy operators hire custom haulers. Dairy operators who hire custom haulers have lower variable costs. In addition, dairy operators do not incur the capital cost of a manure spreader. The author assumes that large dairies must distribute manure outside a one mile radius of the dairy and pay an additional fee of $.25 per ton. Off dairy capital costs for large dairies include 50 acres of land leased at $20.00 an acre.

Table 3. Annual Costs Per Cow Assuming Contracted Hauling and Spreading.

Dairy size	On-dairy capital costs	Off-dairy capital costs	On-dairy variable costs	Off-dairy variable costs	Total cost
small (250 cows)	$27.60	$0.00	$13.20	$7.90	$48.70
medium (500 cows)	$12.70	$0.00	$13.20	$7.90	$33.80
large (1000 cow)	$6.60	$1.00	$13.20	$9.00	$29.80
Average total cost for all dairies	**$11.30**	**$0.60**	**$13.20**	**$8.50**	**$33.60**

*Costs are rounded to the nearest tenth of a dollar.

Comparisons of calculations in Table 3 and Table 1 demonstrate that dairy operators who hire custom haulers save an average of $6.30 per cow each year.

4. Cost per ton is calculated according to the following formula: cost per ton = [cost per load / (no. of cubic yards per load × (1,200/2,000)]. For example, vendor A's cost per ton is: [$18 /(18 *(1,200/2,000)] or $1.67. Assuming manure from lots and corrals has a final moisture content of 50 percent, manure weight in cubic yards is 1,200 lbs. (ASAE, 1993).

Potential Economic Value of Dairy Manure

Preceding cost estimates do not account for the potential economic value of livestock manure. Dairy operators may perceive manure as simply a liability that must be disposed of, however they may also perceive it as a beneficial economic input. Perceptions that dairy manure is useful are justifiable considering that farmers use livestock manure as a fertilizer supplement and soil amendment. Animal manure contains valuable plant nutrients such as nitrogen, potassium and phosphorous. In addition manure may improve soil aeration and tilth, and increase levels of organic matter in the soil. However, excess applications of manure can harm crops, contaminate surface and ground water, and may result in weed propagation.

Potential costs and benefits associated with land application of dairy manure are difficult to factor into an economic analysis. They are variable and dependent upon manure condition, environmental factors such as soil type and climate, and agronomic characteristics of crops receiving manure. Biophysical processes such as volatilization, denitrification, and mineralization will affect nitrogen availability. Estimates for nitrogen losses due to nitrification and volatilization range from 10 to 50 percent depending on environmental conditions and methods of application (Moore et al., 1993). Mineralization also affects nutrient availability. Mineralization is the biological process where microorganisms convert nutrients from an organic form to an inorganic form readily available for plant uptake. The entire mineralization process may take up to two years to complete. Depending on environmental conditions, only 10 to 50 percent of manure nitrogen converts to an inorganic form in the six months following land application (Hue, 1997). Most manure phosphorous and potassium are available, unless excess levels are already present in soil, or if manure is applied in conjunction with synthetic phosphorous or potassium sources. If high levels of phosphorous and potassium are present in the soil prior to manure application, plants may not absorb all of the nutrients. Many or all may be lost to leaching and run-off. Biophysical and environmental factors will reduce the monetary value of manure considerably, however such factors are difficult to quantify precisely. Another method of assigning economic value to livestock manure is to assess what farmers or other users are willing to pay.

Unfortunately, there is not a plethora of research that captures the monetary value of cow manure, however some sources are available. A survey of the Texas Panhandle completed by Bonner and Harman (1992) reveals that almost 65 percent of respondent farmers were willing to purchase cattle manure at $2.00 per ton. Quantity demanded decreases to 45 percent at $3.00 per ton. Glover et al. (1994) estimated demand for cattle manure in the High Plains of Texas. Prices paid per ton range from $1.60 to $3.20 with a median of $2.40.[4] Outlaw et al. (1995) reported that during the spring planting season of 1995, some non-dairy farmers in Erath County were willing to pay $1.10 per ton of dairy manure. In some areas, compost producers pay dairy operators for cow manure. For example, a large-scale compost producer in Tulia County, California purchases dairy manure for $2.00 to $4.00 a ton depending on quality and nutrient content (Norvell, 1998). Some compost producers incur a portion of manure management costs. For example, in the High Plains region of Texas, compost producers often clean and haul manure from cattle feedlots, which costs around $2.00 a ton in machinery and labor.[5] Based on the preceding examples, willingness to pay ranges from $1.10 per ton to $4.00 per ton. If one assumes a median of $2.00 per ton, the monetary value of cow manure is $9.40 per cow.

For sake of comparison, Table 4 presents estimated monetary value of dairy manure based on the following criteria: 1.) nutrient content at the time of land application, 2.) nutrient content following land application, and 3.) willingness to pay on the part of agricultural growers and

4. Cattle manure may differ from dairy manure in terms of nutrient content, consistency and moisture levels etc., and may be of higher or lower quality depending on the end-user's needs and perspective.

5. In many instances, dairy operators will pay to transport and dispose of animal manure. This is particularly the case in regions where environmental regulations place stringent limits on land application of manure.

other users. Nutrient content at the time of land application is based on estimates of Osei et al. (1995).[6] Osei et al. estimated the nutritional composition of dairy manure after accounting for losses due to waste management practices characteristic of open-lot dairies. Manure nutrient values in Table 4 are based on the current price of commercial nitrogen, phosphorous and potassium. According to an Erath County fertilizer distributor, prices per pound average around $.12 for nitrogen, $.12 for phosphorous and $.08 potassium. Post land application value assumes a nitrogen loss of 50 percent.

Table 4. Potential Economic Value of Dairy Manure

	Value based on nutrient content at time of land application	Value based on nutrient following land application (50 % loss of N)	Value based on willingness to pay
Annual potential value per cow	$27.90	$20.40	$9.40

*Costs are rounded to the nearest tenth of a dollar.

Numerous variables affect livestock manure value; however, many are difficult to quantify in a realistic manner. In actuality, value can range anywhere from $0 to $27.90 dollars or so depending on demand for manure, perceptions of end-users, current regulations regarding manure management, environmental conditions, and farm managerial practices. As long as it is acceptable for dairy operators to land apply manure, the potential economic benefit should be incorporated into manure management costs. Manure provides some level of utility for dairy operators in the form of crop or forage nutrition and soil productivity. Valuation based on willingness to pay is probably more realistic, as it captures the uncertainty regarding nutrient availability following land application, and possible negative impacts such as weed propagation. It should be noted however, that the benefit of dairy manure assumes dairy operators apply manure at the nitrogen agronomic rate. Environmental legislation may eventually require all dairy operators to apply manure at the phosphorous agronomic rate. Such a scenario would severely restrict land application, and livestock manure would likely become a liability rather than a potential asset.[7]

6. Osei et al. (1997) estimate that an Erath County dairy cow produces 125 lbs. of nitrogen, 54 lbs. of phosphorous, and 79 lbs. of potassium per year. Moore et al. (1993) calculate that an average dairy cow produces 138, 42, 96 lbs. of NPK respectively. Both estimates account for nutrient losses prior to land application. Nutrient values in Table 4 are based on estimates of Osei et al

8. See Pratt et al. (1997).

Conclusion

Table 5 contains total average costs as presented in Table 1 and Table 3.[8] Estimates in Table 1 assume that dairies, regardless of size, incur all fixed and variable costs associated with manure handling, transport and land application. Estimates in Table 3 assume that dairies incur only the fixed and variable costs associated with on farm manure management (scraping, piling and loading), and hire contractors for transport and land application. Net costs in Table 5 subtract the potential value of dairy manure based on what farmers and other users have been willing to pay.

Table 5. Average Manure Management Costs for Erath County Dairies (per cow)

Cost for dairy operators who perform all manure management tasks	On-dairy capital costs	Off-dairy capital costs	On-dairy variable costs	Off dairy variable costs	**Total Costs**	**Net Costs**
Small (250 cows)	$27.60	$13.80	$13.20	$8.00	**$62.70**	**$53.30**
Medium (500 cows)	$12.70	$6.90	$13.20	$9.10	**$41.90**	**$32.50**
Large (1000 cows)	$6.60	$4.50	$13.20	$9.10	**$33.30**	**$23.90**
Average cost all dairies	**$11.30**	**$6.50**	**$13.20**	**$8.90**	**$39.90**	**$30.50**
Cost with contracted hauling and spreading						
Small (250 cows)	$27.60	$0.00	$13.20	$7.90	**$48.70**	**$39.30**
Medium (500 cows)	$12.70	$0.00	$13.20	$7.90	**$33.80**	**$24.40**
Large (1000 cows)	$6.60	$1.00	$13.20	$9.00	**$28.90**	**$19.50**
Average cost all dairies	**$11.30**	**$0.60**	**$13.20**	**$8.50**	**$33.60**	**$24.20**

If dairy operators apply manure to crop and forage fields and perceive it as beneficial, net costs range from $24.20 to $30.50 per cow, depending upon whether or not the dairy in question hires a custom hauler. However, if future environmental legislation prohibited manure land application, manure may have little economic value. Costs of manure management will likely be altered. "On-dairy" costs will likely remain the same, however "off-dairy" variable costs may significantly increase, particularly if dairy operators are required to remove solid waste from Earth County.

[8] Costs presented do not incorporate expenses associated with soil testing as required by regulatory agencies in Texas. According to state environmental regulations, once per year dairies are required to perform tests measuring levels of soil nutrients such as phosphorous. The percentage of dairies that regulatory perform soil testing, is not available. However, it is unlikely that associated costs are significant relative to total manure management expenditures.

Appendix

Dairy Manure Management Cost Estimates for Dairies as Adapted from Outlaw et. al

Table A: Cost Estimates For Small Dairies

Average No. Cows	**No.**	**250**			
Total Land Available for Application	Acres	300			
Average Cow Weight	lbs.	1,400			
Per Cow Manure Production	lbs./day	129	tons/year	23.6	
Total Manure Production (87% moisture)	lbs./day	32,329	tons/year	5,900	
Total Manure Production (50% moisture)	lbs./day	8,411	tons/year	1,535	
Capital Items	**Percent of Annual Use**	**Investment**	**Amortized Costs (15 years)**	**O and M**	**Annual**
100 h.p tractor	50	$44,000	$2,892.42	$770	$3,662.42
80 h.p with loader	50	$34,000	$2,235.05	$595	$2830.05
box blade	100	$2,500	$328.68	$88	$417.68
Manure spreader	100	$20,000	$2,629.48	$700	$3,329.48
12 ft. disc	35	$2,250	$103.54	$28	$131.54
				Total	**$10,370.17**
				Per cow	**$41.44**
Labor Costs (opportunity cost of labor)					
Average Annual full-time Salary	$18,500.00				
Average Work Week	40				
Average Hourly Wage Rate	$8.89				
In Corral Variable Costs	**Hours Annually**	**Cost**			
Labor Activities					
Scraping	260	$2311.40			
Loading	34	$302.26			
Fuel and Lubrication Costs (In corral)		$679.00			
Total In Corral Variable Costs		**$3292.66**			
Per Cow		**$13.17**			
Post Corral Variable Costs	**Hours Annually**	**Cost**			
Transporting (25 minutes per load)	167	$1,484.63			
Land Application	12	$106.68			
Fuel and maintenance costs (Post corral)		$413.19			
Total post corral variable costs		**$2,004.50**			
Per cow		**$8.02**			
Total Costs:		**$15,667.33**			
Per cow		**$62.67**			

*Amortized costs assume a financing period of 15 years at interest rate of 10 percent.

Table B: Cost Estimates for Medium Dairies

Average No. Cows	**No.**	**500**			
Total Land Available for Application	Acres	450			
Average Cow Weight	lbs	1,400			
Per Cow Manure Production	lbs/day	129	tons/year	23.6	
Total Manure Production (87% moisture)	lbs/day	64,656	tons/year	11,800	
Total Manure Production (50% moisture)	lbs./day	16,822	tons/year	3,070	
Capital Items	**Percent of Annual Use**	**Investment**	**Amortized Costs (15 years)**	**O and M**	**Annual**
100 h.p. tractor	50	$44,000	$2,892.42	$770.00	$3,662.42
articulated loader	50	$27,000	$1,774.90	$473.00	$2247.90
box blade	100	$2,500	$328.68	$88.00	$416.68
manure spreader	100	$20,000	$2,629.48	$700.00	$3,329.48
12 ft. disc	35	$2,250	$103.54	$28.00	$131.54
				Total	**$9,788.01**
				Per cow	**$19.58**
Labor Costs (hired hands)					
Average Annual Full-Time Salary	$18,500.00				
Average Work Week	40				
Average Hourly Wage Rate	$8.89				
In Corral Variable Costs	**Hours Annually**	**Costs**			
Scraping (2 hours per week)	520	$4,622.80			
Loading (5 minutes per load)	68.5	$608.97			
Fuel and Lubrication Costs (In corral)		$1,359.11			
Total		**$6,590.88**			
Per cow		**$13.18**			
Post Corral Variable Costs					
Transporting (25 minutes per load)	333.5	$2,964.82			
Land Application	18	$160.02			
Rock Removal	120	$600.00			
Fuel and maintenance costs		$812.50			
Total		**$4537.34**			
Per cow		**$9.07**			
Total Costs		**$22,416.22**			
Per cow		**$41.86**			

*Amortized costs assume a financing period of 15 years at interest rate of 10 percent.

Table C: Cost Estimates for Large Dairies

Average No. Cows	No.	1000			
Total Land Available for Application	Acres	750			
Average Cow Weight	lbs	1,400			
Per Cow Manure Production (87% moisture)	lbs./day	129	tons/year	23.6	
Total Manure Production	lbs./day	129,315	tons/year	23,600	
Total Manure Production (50% moisture)	lbs./day	33,644	tons/year	6,140	
Capital Items	**Percent of Annual Use**	**Investment**	**Amortized Costs (15 years)**	**O and M**	**Annual**
100 h.p. tractor	50	$44,000	$2,892.42	$1,001.00	$3,893.42
articulated loader	50	$27,000	$1,774.90	$473.00	$2247.90
box blade	100	$2,500	$328.68	$88.00	$416.68
manure spreader	100	$20,000	$2,629.50	$700.00	$3,329.48
12 ft. disc	35	$2,250	$103.54	$28.00	$131.54
50 acres additional acres for manure management	100				$1000.00
				Total	**$11019.01**
				Per cow	**$11.01**
Labor Costs (hired hands)					
Average Annual Full-Time Salary	$18,500.00				
Average Work Week	40				
Average Hourly Wage Rate	$8.89				
In corral Variable Costs	**Hours Annually**	**Costs**			
Scraping (2 hours per week)	1040	$9,250.00			
Loading (5 minutes per load)	137	$1,215.00			
Fuel and Lubrication Costs (In corral)		$2,718.21			
Total		**$13,183.21**			
Per cow		**$13.18**			
Post Corral Variable Costs					
Transporting (25 minutes per load)	667	$5,936.00			
Land Application	36	$320.19			
Rock Removal	240	$1,200.00			
Fuel and Lubrication costs		$1,625.05			
Total		**$9,081.24**			
Per cow		**$9.08**			
Total Costs		**$33,283.46**			
Per Cow		**$33.28**			

*Amortized costs assume a financing period of 15 years at interest rate of 10 percent.

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