



This is an application of 24 tons of biosolids per acre immediately following application.



A geographical positioning system is used (GAS) to document attributes of farmland where City of Fremont biosolids are applied

### Demand for Biosolids

The demand for biosolids has grown so interested farmers may not be able to obtain all the material desired. Crop producers who have flexible schedules and are willing to conduct on-farm research with Cooperative Extension are likely to receive more material. Typically, many farmers adopt a wait-and-see attitude toward the use of this material. Eventually, because of proven enhanced yields and improved soil structure that this material provides, demand grows rapidly.

### Three-Year Nutrient Management Plan

Most of the nitrogen in biosolids is tied up as organic N and is not available immediately for plant uptake, but becomes available over time. This process is called *mineralization*. Farmers who are in the Biosolids Land Application Program are given rates, which will meet the nitrogen needs of the next crop, but there will be some nitrogen available the second and third years after application. Farmers are given application rates of commercial nitrogen fertilizers for successive crops to prevent over application of nitrogen fertilizers.

### Tracking Biosolids with Satellites

With support from the City of Fremont, Cooperative Extension has acquired a Global Positioning System (GPS) receiver to map Fremont biosolid application areas, storage sites, research boundaries as well as environmental setbacks from wells, ponds and streams. The receiver picks up signals from four or more satellites in orbit above the earth, and an internal computer calculates where the receiver is on the face of the earth. It is accurate to within a meter. By using this receiver, even terraced and irregular fields can be accurately mapped and their acreage determined.

The use of GPS offers a consistent and highly accurate way of documenting field attributes and required setbacks. The GPS data is then integrated with Geographical Information System (GIS) maps that have been developed by Cooperative Extension.

### Successful Program

Overall, the Biosolids Land Application Program has been very successful and a good example of using a waste material in such a way that it becomes a valuable resource. University of Nebraska Cooperative Extension on-farm research results consistently show that biosolids match or exceed commercial fertilizers. Biosolids are particularly beneficial to soils that have low phosphorous levels and add organic matter content to the soil. The nutrient value of nitrogen and phosphorous alone are worth nearly \$250 per acre to Dodge County farmers. Additional crop nutrients provided by biosolids can double its value to area farmland. Contact the University of Nebraska Cooperative Extension Division in Dodge County to view on-farm results of biosolids utilization on area farmland.

**For additional information regarding the use of biosolids on farmland please contact:**

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*Helping People To Put Knowledge To Work*

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# Cooperative Extension Program Highlight

## Farmland Application of Biosolids

A Partnership Among

- ◆ The City of Fremont
- ◆ Cooperative Extension in Dodge County
- ◆ City of Omaha Biosolids Management Program
- ◆ Area Crop Producers

The widespread collection, treatment and disposal of wastewater effluent evolved in the mid-to late 19th century. Before this time, wastes were often discharged into surface waters and polluted streams and rivers. As the technology of waste systems has improved, the threat to our environment has been reduced because wastewater effluent has become cleaner and cleaner. However, in the process of producing clean effluent, the process itself accumulates residues or solids. The older, commonly used term for these solids is sewage sludge.

The word biosolids is a new term used to more accurately describe processed municipal treatment plant solids, which are tested and determined to be safe for land application. There is still some interchange of these two words.

### Fremont and Omaha Biosolids: What's In It?

Biosolids are the solids separated from the water portion in the wastewater treatment plant. These solids are largely dead microorganisms used to consume and stabilize the wastewater solids. Biosolids from a specific city wastewater treatment facility are somewhat unique because the content is based on the complement of industries that contribute to the wastestream.

In the final stages of biosolids production through the treatment plant, a polymer is added to the wastewater,



City of Fremont Waste Water Treatment Facility where biosolids are processed.

which causes the solids suspended in the water to precipitate. This allows water to be removed by pressing the liquid through a centrifuge or a series of belts. Fremont biosolids are then blended in a 2:1 ratio (2 parts biosolids:1 part screened yard and garden compost). The final product is about 35% solid. Omaha biosolids are about 25% solids and are not mixed with compost. Both biosolid products are dry enough to be applied with a conventional manure spreader.

Biosolids are high in organic nitrogen, phosphorus and have significant levels of potassium and sulfate. Iron, copper, manganese, molybdenum and zinc, essential elements necessary for plant growth are also found in this material.

**Cooperative Extension in Dodge County**

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## University of Nebraska Cooperative Extension

### What We Do

Extension helps Nebraskans put knowledge to work. It provides a variety of educational opportunities, delivered via a variety of ways, so participants have knowledge they can use to make sound decisions to better their lives. Extension educators and specialists teach, facilitate and collaborate in providing research-based information to approximately 400,000 urban and rural Nebraska residents annually. A Nebraska mainstay since 1915, extension carries forward the land-grant university mission of taking the resources of the university to the state. As a trusted source of factual information today, extension is just as vital as ever, and perhaps even more so, because of the diverse, complex—and often confusing—issues people encounter.



Soil samples are taken to determine crop nutrient requirements.



Yard and garden compost is screened to remove debris prior to mixing with biosolids.



Fremont biosolids are mixed with yard and garden compost.

## Regulations for Safe Use of Biosolids

Technological advances in processing wastewater and the careful application of biosolids allow the beneficial use of biosolids while minimizing the risk of human health problems and environmental contamination. In 1993, the U.S. Environmental Protection Agency (EPA) established specific wastewater processes and application procedures required to permit the land application of biosolids. These regulations were the culmination of 30 years of carefully designed studies conducted at many land grant universities throughout the U.S. These regulations, known as Standards for the Disposal and Utilization of Sewage Sludge, Part 503, are also referred to as the Part 503 rule.

The Part 503 rule addresses wastewater operational standards (to reduce pathogens and control vector attraction), pollutant limits (heavy metals), management practices, monitoring, recordkeeping and reporting.

## Pathogens

All biosolids that are land-applied must be processed to reduce the amounts of pathogens to safe levels. Biosolids that are suitable for horticultural or lawn application (Milorganite®, for example) are called “Class A” biosolids. Because Class A biosolids are processed with some type of heat treatment, they can be applied safely to food crops or to areas of frequent human contact.

Biosolids produced by the City of Fremont and Omaha are applied to crop fields or areas where direct human exposure is infrequent. These biosolids are classified by the EPA as “Class B” biosolids. At the Fremont and Omaha wastewater treatment facilities, time and temperature processing in anaerobic digesters significantly reduces pathogens, but all of the pathogens are not completely destroyed. Class B requirements for land application also include site restrictions that prevent crop harvesting and restrict animal grazing for certain periods of time until environmental conditions have further reduced pathogens. Pathogen levels in class “B” biosolids are far lower than that of fresh animal manures.

## Heavy metals

The EPA 503 Regulations established ceiling concentrations for 10 metals that are usually found in municipal wastewater. The concentrations were determined using a sophisticated risk analysis based on experiments that examined potential health hazards to humans and animals. Fourteen pathways, each examining a possible route of exposure, were carefully studied. Some of these pathways were very complicated. For example, one pathway examined the effect of applying metal-contaminated biosolids to soil grown to forage plants that were fed to livestock that ultimately ended up as human food. To understand this pathway better, scientists studied the uptake of metal-contaminated soil by different crops that might be fed to livestock. In other experiments, scientists fed contaminated feed directly to animals and examined the meat, milk, and body organs of the livestock. Results of these and many other experiments were used to determine the maximum concentrations of metals that can be safely present in sludge and soil. Even though these elements in high concentration can be undesirable, some of these regulated substances, like like copper, molybdenum and zinc are micronutrients, actually required by plants in small quantities. Zinc, usually found in the upper soil layers, is often deficient in soils that have been eroded or excavated. Other elements, like arsenic, lead and cadmium are not needed by plants for plant growth, but at the low levels specified in the Part 503 rule, these elements will not harm plants or animals. These elements often occur naturally in many Dodge County soils.

## Environmental protection

The second aspect of the Part 503 rules involves careful application to prevent environmental contamination. The Part 503 rules include the following application restrictions:

—Biosolids must be applied at agronomic rates, based on the nitrogen requirements of the next crop. The purpose of this regulation is to prevent over-application, which could result in nitrates leaching into ground water. Compliance with this regulation requires soil tests to determine crop fertilizer needs of each field and frequent analysis of the nitrogen concentration in biosolids. This form of determining application rates should be used for all fertilizers.



Biosolids are hauled in trucks with sealed end gates and covered boxes.



Biosolids being loaded into applicator's spreader.



A commercial applicator spreads biosolids on Dodge County farmland.

—Setback distances restrict the application of biosolids near rivers, streams and other waterways to prevent contamination of surface waters from nutrient overloading.  
—Municipalities must monitor application rates and field locations, keep records and submit annual reports detailing field applications.

## Local regulations

The Dodge County Planning Commission has regulations in place that meet or exceed EPA regulations. These regulations may concern proximity to housing developments, acreages, schools and/or the timely incorporation of biosolids. All new proposed biosolid application sites must be approved by the Planning Commission and the Dodge County Board of Supervisors. Because municipal biosolids contains human waste, there is a natural tendency for the public to be concerned about its use. Part 503 rule were developed to ensure safe and beneficial use of this material.

## Biosolids Land Application Program

### Program Overview

In February, 2002 the first truckload of biosolids from the Fremont Wastewater Treatment Facility was delivered to farmland in Dodge County. In the last year, over 3000 tons of biosolids have been used as a source of fertilizer and organic matter to cropland in Dodge County. The value of biosolids, based on the nutrient value alone, is over \$25,000 annually to the cooperating farmers in our program. This program also saves Fremont citizens \$125,000 annually in hauling and disposal fees.

The City of Omaha has been providing biosolids to farmers for more than twenty-five years. Omaha's program delivers approximately 60,000 tons of biosolids to farmers in nine counties on an annual basis. Due to the proven benefits of the biosolids, demand for the material is so high that there is usually a waiting period of one year or more to get enrolled in Omaha's program.

## Advantages

The nitrogen in this organic fertilizer is primarily organic N, which is released slowly over time so it is available when the crop needs it and minimizes potential for nitrate leaching. Biosolids also have many other essential elements needed for plant growth. Many area farmers use it for its phosphorus and zinc because these two elements are deficient on many area soils. It is especially beneficial when applied to soils that have been subject to soil erosion, excavated or have phosphorous deficiencies. The biosolids improve soil water infiltration, which helps minimize soil erosion.

## Disadvantages

Cooperators who use biosolids from the Fremont facility must be patient and willing to work with commercial applicators who have been contracted by the City of Fremont to spread biosolids on area farmland. Contracted spreaders have a proven history of calibrating equipment accurately and spreading biosolids in a timely matter. Soil around storage sites may become compacted; these areas may need to be disked/subsoiled later to loosen the soil. Like many other field operations, application is dependent on suitable weather conditions.

The City of Omaha supplies spreading equipment for the farm operator to use when spreading the biosolids. City personnel set-up and calibrate the equipment and monitor the activity through all stages until completion. The main disadvantage to this type of operation is the time requirement this places on the farmer. Typically, an operator can spread approximately ten to fifteen acres per day.

Occasionally there have been odor complaints after application. Odor seems to be worse during rainy, humid weather, but is not very predictable. When application sites are close to residences, we do our best to prevent problems by taking into account prevailing winds and asking the farmer to incorporate the material. Within a short period of time, there is usually little odor.

