

# Wastewater Treatment Facilities

Lincoln, Nebraska, like every other city in the United States, has the continuing responsibility to treat residential and industrial wastewater along with handling solid waste. Wastewater treatment, solid waste disposal and recycling are expensive processes and programs which often get overlooked by residents. As long as water goes down the drain or trash containers are emptied, the average person doesn't worry too much about what happens to the water or refuse that is generated. That's good – because that means there are no problems with the sanitary sewer system and solid waste is being managed effectively. Behind the scenes however, there are about 114 employees that work for the Lincoln Wastewater and Solid Waste Division who are constantly testing, operating, maintaining, and improving Lincoln's wastewater treatment and solid waste handling facilities to protect public health and the aquatic environment.

## Mission Statement

The Wastewater and Solid Waste Division's mission is to provide vital wastewater and solid waste services to all citizens,



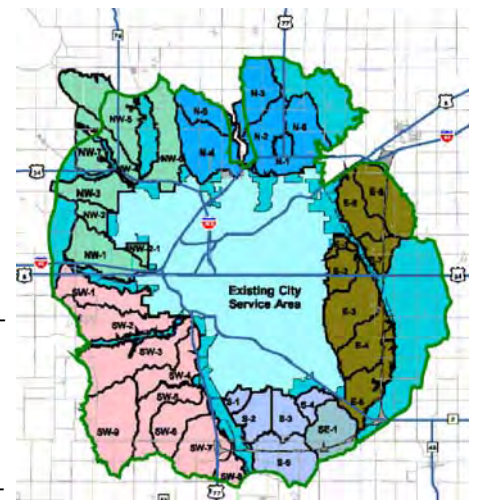
Odor Control Facilities



Theresa Street Treatment Facility

ensuring the highest possible levels of public health, economic growth, environmental quality, and fiscal responsibility for the community.

Underneath and throughout Lincoln are over 1,000 miles of sanitary sewer lines and 16 pumping stations that keep the wastewater flowing to two municipal wastewater treatment facilities. The Theresa Street facility sits on 51 acres along Salt Creek in the north central section of the City. As Lincoln expanded to the east, the Northeast Wastewater Treatment facility was constructed just south of Interstate 80 and east of Highway 77. The Theresa Street facility has a maximum capacity of treating 28 million gallons per day and on an average day presently treats about 20 million gallons of wastewater. The Northeast facility currently treats about five million gallons per day. That adds up to 25 million gallons of water per day running through the treatment facilities – enough to fill Holmes Lake in three and one-half days. Operations and maintenance staff operate and maintain over 3,500 pieces of equipment between the treatment facilities and



Existing & Future Service Areas

Wastewater treatment in Lincoln, Nebraska can be categorized into eight components. Each component contributes to the overall treatment and final quality of the treated wastewater before it is discharged to Salt Creek. These components are:

1. Screening, Pumping, and Grit Removal
2. Primary Clarification
3. Biological Treatment
4. Secondary Clarification
5. Disinfection
6. Solids Digestion
7. Solids Dewatering
8. Land Application



Northeast Treatment Facility

## 1. Screening, Pumping, & Grit Removal

Raw sewage enters the treatment facilities through influent pumping stations. At the raw wastewater pumping stations large mechanically cleaned screens with vertically placed bars remove larger debris like sticks, paper, and hygienic products. After being screened, the wastewater is pumped to the grit basins. Grit basins are designed to remove heavy particles, like sand, gravel, vegetable seeds, and egg shells. Material collected from the bar screens and the grit basins are hauled to the sanitary landfill (Bluff Road).

## 2. Primary Clarification

After wastewater passes the grit basins, it goes to the primary clarifiers. Primary clarifiers are designed to remove settleable solids which tend to be more organic in nature and settle at a much slower rate. In addition, primary clarifiers have skimmer arms which collect floating materials, like grease. It takes approximately two-to-four hours for wastewater to travel through the primary clarifiers.



Aeration Basin

## 3. Biological Treatment

Once the settleable solids have been removed, the wastewater enters a biological reactor or aeration basin, which is called the biological treatment phase. This treatment phase removes dissolved pollutants within the wastewater, utilizing a diverse population of micro-



organisms like bacteria, protozoa, stalked ciliates, and rotifers that live within these biological reactors.

In order for these organisms to live and reproduce, they must have adequate oxygen and an adequate food supply. These small organisms, which can only be seen through a microscope, use the wastewater as their food source. They feed on the organic matter found in wastewater. There are numerous methods of aerating wastewater for the organisms use. Treatment facilities use blowers and submerged diffusers, surface mixers, or cascade the wastewater over rock, plastic, or wood media. The by-product of their metabolism is carbon dioxide, nitrogen, and water, which leads to a purified and treated effluent. To optimize the metabolism of these

Primary Clarifier

microorganisms in treating wastewater, the aeration basins must have adequate oxygen and mixing so that these organisms are in constant contact with their organic food source. Wastewater is typically held within the biological reactors for four-to-eight hours.



## 4. Secondary Clarification

After wastewater leaves the biological reactors, it is sent to the secondary clarifiers. Secondary clarifiers look just like the primary clarifiers but serve a different



**Secondary Clarifier**

purpose. Due to the feeding requirements of the microorganisms, the wastewater now has a much smaller fraction of organic waste but a significant volume of the wastewater now contains the

suspended microorganisms themselves. This combination of treated wastewater and suspended microorganisms is called “mixed liquor”. Once the mixed liquor reaches the secondary clarifiers, the microorganisms settle to the bottom of the tank. The secondary clarifier is designed to separate the treated wastewater from the microorganism population and return most of the microorganisms back to the biological reactor.

## 5. Disinfection

After the treated wastewater leaves the secondary clarifiers the final treatment step, prior to discharging to Salt Creek, is disinfection. Some viruses and bacteria can pass through the treatment process and remain viable. To prevent



**Ultraviolet Disinfection Channel**

these organisms from harming human beings, they must be destroyed. In the disinfection process the treated

wastewater passes

through two effluent channels with lamps that emit ultraviolet light. As the water is subjected to the disinfecting properties of the ultraviolet light, the harmful organisms are destroyed. Just a few seconds of intense ultraviolet light is effective in disinfecting the wastewater.

## 6. Solids Digestion

Organic solids collected from the primary clarifiers and waste solids from the secondary clarifiers are pumped to large tanks called anaerobic digesters where microorganisms break down

the solids into a more stable form. The anaerobic digestion process is used at both treatment facilities to stabilize organic solids. One beneficial by-product of the digestion process is



**Anaerobic Digesters**

methane gas. At the Theresa Street facility this gas is used by two engines as fuel to generate electrical power and provide heat for the digestion process. The engines can produce as much as 900 kilowatts of power while maintaining a temperature of 98 degrees Fahrenheit within the three egg-shaped digesters. This benefits the environment by reducing the need for electricity produced from fossil fuels and utilizes the methane gas which would otherwise be wasted.



## 7. Solids Dewatering

Following 18-22 days of digestion at the Theresa Street facility (25-30 at the Northeast facility), the treated solids are suitable for dewatering and eventual agricultural land application as a soil amendment and fertilizer. Dewatering is a

process that removes excess water and reduces the total volume of biosolid waste that must be transported to the land application area. Digested solids from the anaerobic digesters are fed into three belt filter presses which squeeze out excess water between



**Belt Filter Press Dewatering**

porous belts at the Theresa Street facility. Once the excess water is removed, the biosolids, a “cake”, is loaded into large trucks which haul the dewatered solids to local farm ground in Lancaster County for land application. The Northeast facility does not perform dewatering.

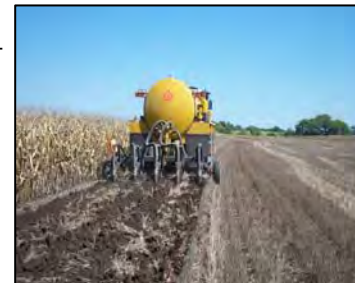
<b>Facility Loadings and Operational Data*</b>		
<b>Theresa Street Wastewater Treatment Facility</b>		
<i>Influent</i>		
BOD	290 mg/l	46,074 lbs/day
TSS	237 mg/l	37,654 lbs/day
NH3N	23.2 mg/l	3,686 lbs/day
<i>Effluent</i>		
CBOD	3.4 mg/l	540 lbs/day
TSS	5.9 mg/l	937 lbs/day
NH3N	0.13 mg/l	20.7 lbs/day
Avg. Daily Flow	19.05 million gallons per day	
Biosolids Produced	6,000 dry tons per year	
Electricity Produced	5.45 million kw-hrs per year	
<b>Northeast Wastewater Treatment Facility</b>		
<i>Influent</i>		
BOD	270 mg/l	12,137 lbs/day
TSS	269 mg/l	12,092 lbs/day
NH3N	20.8 mg/l	935 lbs/day
<i>Effluent</i>		
CBOD	2.4 mg/l	108 lbs/day
TSS	3.5 mg/l	157 lbs/day
NH3N	0.25 mg/l	11.24 lbs/day
Avg. Daily Flow	5.39 million gallons per day	
Biosolids Produced	1,128 dry tons per year	
<b>* Averages for 2009</b>		

## 8. Land Application

Following digestion and dewatering the treated solids are suitable for agricultural land application as a soil amendment and fertilizer. From the Theresa Street facility the digested solids are hauled to local farmers who apply the material with their spreading equipment.



At the Northeast treatment facility the digested sludge, which is in liquid form, is injected beneath the ground surface on agricultural land owned and farmed by the City of Lincoln. Crops grown on this site, located near I-80 and North 70<sup>th</sup> Street, are sold and the revenue is used to offset the costs of wastewater treatment.



**Subsurface Biosolids Injection**

Test plots and on-going crop research using the digested sludge (biosolids) has been helpful in demonstrating the beneficial uses of biosolids materials on cropland. The City of Lincoln is working with the [University of Nebraska-Lincoln Extension in Lancaster County to promote the biosolids program](#) to local farming interests.

## Other Services and Information

The Lincoln Wastewater System provides 24-hour service to City of Lincoln customers. Employees are on-call to respond to citizen's service problems or questions throughout the year. If you experience sewer service problems you should call 402-441-7961. A field crew will investigate the nature of the problem as soon as possible.



The wastewater staff is also available to provide wastewater treatment facility tours or presentations to interested groups and students. Facility tours can be arranged by contacting Brad Barber, at 402-441-7965 (bbarber@lincoln.ne.gov).



If you have additional questions or comments regarding the Lincoln Wastewater System, please refer to the contact listing below.

- Gary Brandt, Utilities Coordinator, 402-441-7968 (gbrandt@lincoln.ne.gov)
- Steve Crisler, Wastewater Treatment, 402-441-7970 (scrisler@lincoln.ne.gov)
- Karla Welding, Solid Waste, 402-441-7867 (kwelding@lincoln.ne.gov)
- Gene Hanlon, Recycling Hotline, 402-441-8215 (ghanlon@lincoln.ne.gov)
- Gary Thalken, Industrial Pretreatment and Sampling, 402-441-7967 (gthalken@lincoln.ne.gov)
- Brian Kramer, Sanitary Sewer Service, 402-441-7987 (bakramer@lincoln.ne.gov)

**Wastewater Website: [www.lincoln.ne.gov/city/pworks/waste](http://www.lincoln.ne.gov/city/pworks/waste)**

