

Appleton Wastewater Treatment Plant Biosolids Management Program



CITY OF APPLETON

Appleton Wastewater Treatment

AWWTP Biosolids Program Objectives

The City of Appleton, Wastewater Treatment Plant (AWWTP) produces approximately 20,000 wet tons of biosolids per year. The AWWTP Biosolids Management Program is committed to effectively manage and utilize 100% of the biosolids produced through beneficial use alternatives like agricultural land application while maintaining maximum standards of human and environmental health.

Biosolids application by the City of Appleton on farm fields has been a long standing practice that is consistent with the "green" philosophy that is being emphasized now more than ever. Biosolids application, incorporation, and site monitoring have traditionally been provided to landowners or tenants at no charge. This beneficial use partnership has provided farmers with an alternative to costly chemical fertilizers while providing the AWWTP a reliable outlet for its biosolids.

The Wisconsin Department of Natural Resources (WDNR) recognizes the AWWTP Biosolids Management Program as a leader among statewide Publicly Operated Treatment Works (POTWs). WDNR Wastewater Engineer Mark Corbett stated that the AWWTP "facility operates an exceptional Biosolids Management Program, focused on the beneficial use of biosolids, and predicated on the protection of public health and the environment. The stellar implementation of this program, including land owner and contract hauler involvement, is a model among local and statewide POTW's."



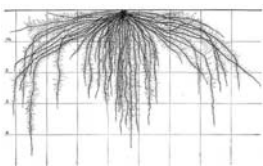
Special points of interest:

- IMPROVE CROP PRODUCTION
- IMPROVE SOIL TILTH
- REDUCE CHEMICAL FERTILIZER COSTS
- REDUCE SOIL EROSION AND PROTECT WATER QUALITY
- CONSERVE LANDFILL SPACE

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Depiction of healthy corn root structure and photo of silty clay loam soil profile to 30-inch depth.

“Biosolids application, incorporation, and site monitoring have traditionally been provided to landowners or tenants at no charge.”



Field soil testing using hand auger.

Nutrient Benefits

AWWTP Biosolids Management Program participants Martin Lisowe Farms, Inc. of Stockbridge, Wisconsin and Dan Ostrowski of Amherst Junction, Wisconsin have observed positive crop response to biosolids applications compared to chemical fertilizer applications alone while significantly offsetting chemical fertilizer, lime, and/or tillage costs.

Biosolids are the nutrient-rich organic materials produced from the treatment of domestic sewage. Specific sewage treatment processes can differ depending upon the facility, its age, local waste streams, treatment standards, and specific treatment needs. The AWWTP utilizes two biological processes, aerobic aeration and anaerobic digestion to break down waste matter and remove nutrients from incoming wastewater streams. The anaerobic process reduces pathogens and minimizes odors, forming a safe and natural agricultural product.

Appleton biosolids are rich in plant essential nutrients such as nitrogen (N), phosphorus (P), and potassium (K) and also contain other essential nutrients like calcium, copper, boron, manganese, molybdenum, sulfur, zinc and iron. Replenishing farm topsoil with biosolids can promote long-term productivity. The largest components of AWWTP biosolids is calcium followed by nutrient rich organic matter. The calcium in AWWTP biosolids originates from the drinking water treatment processes at the Appleton Water Treatment Plant. Lime used in drinking water purification processes to floc or settling out solids is in the form of pure lime or quicklime. This form of lime is introduced or combined into the total sanitary wastewater stream where it resembles a form comparable to a 60-69 lime.

In addition to organic matter, the lime in AWWTP biosolids makes it a valuable soil conditioner or amendment, particularly for use in agriculture. Application rates are based upon soil test results, crop recommendations, and soil buffering capacity considerations. Managed lime applications not only raise soil pH but can also improve soil structure, enhance availability of some nutrients, and promote beneficial bacterial activity. Increasing soil organic matter has positive effects similar to that of lime, moreover by improving the consistency of sandy soils while providing nutrients used by plants. Improving soil structure and/or tillage promotes dense, healthy root growth, enhancing a plant's ability for nutrient uptake and water absorption. This leads, in turn, to higher crop productivity than is possible with the use of chemical fertilizers alone.

Regulatory Site Permitting and Monitoring

The Biosolids Management Program follows the guidelines and regulations as described in the United States Environmental Protection Agency's Code of Federal Register (CFR) 40 part 503 and the State of Wisconsin Department of Natural Resources (WDNR) Code 204. Soil testing is conducted prior to land application of biosolids as part of the permitting process. Appleton's Biosolids Management Coordinators possess the educational background, professional certifications, and experience that has allowed the Program to "self-approve" sites for land application. This privilege granted by the WDNR expedites the regulatory permitting processes and provides more control of the City's Biosolids Management Program.

Records are kept for each site in the Biosolids Management Program. These record files contain property legal descriptions, soil properties, soil test results, maps, and nutrient management sheets. The WDNR requires that sites be tested at least once (1) every four (4) years or prior to subsequent biosolids applications. Global Positioning System software or GPS is utilized in conjunction with aerial and topographic maps to accurately depict soil test grids, area or acreage, physical features (i.e. surface water, homes, ditches, etc.), setbacks, and application restrictions (i.e. hydric soils). An example of the aerial and topographic site maps generated the approval or permitting process are included in this letter as Attachment 1. Records generated for the approval or permitting process are shared with regulators and Biosolids Management Program participants.

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Biosolids Application and Nutrient Tracking

N, P, K, and lime application rates are closely managed by the Biosolids Management Program. Biosolids applications rates are calculated and nutrient loading monitored by use of a nutrient management worksheet (see Attachment 2). The nutrient management worksheet is also a tool that is used to calculate equivalent cost values relative to N, P, K, and lime. The attached worksheet contains an example of biosolids analysis data from a recent hauling event. Primary macronutrients, secondary macronutrients, micronutrients, as well as trace metals are tested on a bi-monthly basis and closely monitored. Additional information contained the worksheet includes the date biosolids were applied to the site, how much was applied, crop(s) grown, nutrient credits, and the pounds of nutrients and metals applied per acre. Nutrient management worksheets are created following every biosolids application and are shared with regulators and Program participants.

N and P are plant essential nutrients that are required to be managed for the protection of surface and ground water quality. Management of N and P loading and good soil management practices can protect watershed quality. Watershed quality concerns have surfaced in recent years as both surface and groundwater quality issues associated with nutrient management have brought forth by regulators. The N and P nutrient data contained on the worksheet is provided to assess site owners or farmers crop and soil/plant nutrient needs. The application rate used in the AWWTP Biosolids Management Program is not only based upon crop N need but liming needs and soil buffering capacity. Often the rate applied is less than recommended nutrient values allowed by the WDNR. The actual rate used on any specific field is dependent upon the soil analysis data, soil type, crop nutrient or soil management needs, and site topography. The landowner is asked for input on nutrient rates prior to biosolids application. This methodology helps prevent diminished water quality while still providing organic matter to the soil and nutrients necessary for crop growth.

Nutrient Management Practice Considerations

There is a wide range of adsorption and precipitation mechanisms in soils with no one consensus as to the relative magnitude of their individual contributions. Total P and water extractable P do not parallel each other in terms of plant available or soluble P. Water extractable P in AWWTP biosolids typically represents only 3% of the total P. The majority of P in the AWWTP biosolids is fixed or in relatively insoluble form (calcium and iron phosphates). These forms of P are the result of liming residuals received from specific waste streams and iron treatments used as part of AWWTP processes. These forms of P do mineralize over time and eventually become plant available. Therefore, total P should still be managed for or considered in nutrient management planning. There are steps being taken by the WDNR and US Department of Agriculture to recognize and manage P in the water extractable form as well as the total form. Nutrient uptake by plants and subsequent removal of a particular crop residue by harvesting is also a consideration when performing annual nutrient planning.

Subsequent applications of AWWTP biosolids are based on soil pH and lime need and generally occur every third to fourth year. This management strategy gives farmers greater flexibility with manure management under their NRCS 590 plans. Biosolids or sludge that do not possess the same characteristics are often applied to fields on a more frequent basis based on recommended crop N rates. Therefore, the potential for excessive nutrient and/or metals loading is greatly reduced compared to loading that can occur from more frequent applications. Furthermore, biosolids are incorporated into the soil following application. Incorporation is generally performed by offset disc or chisel plow. Incorporation reduces potential surface water impacts or excessive nutrient loading in low-lying areas due to erosion. Proper setbacks from water supply wells, steep slopes, shallow groundwater, and surface water further minimize excessive nutrient loading. Your own fertilizer application and tillage Best Management Practices (BMPs) will also significantly reduce excessive nutrient loadings to soil and water.



Contractor tractor and spreader.



Contractor delivery of biosolids to permitted field.

“...applications of AWWTP biosolids are based on soil pH and lime need and occur every third to fourth year.”



Famer fall spreading dairy manure.

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Conclusion

The City of Appleton, Department of Utilities, Wastewater Treatment Division, is committed to a program of beneficial use through land application for the biosolids. Biosolids contain plant essential nutrients and provide valuable soil pH buffering capability. Replenishing farm topsoil with biosolids can promote long-term crop productivity, improves soil tilth, restores soil organic matter, and decreases chemical fertilizer costs. In addition to chemical fertilizer costs being offset, biosolids application, incorporation, and site monitoring are provided by the AWWTP at no charge to the landowner or tenant as part of this beneficial use partnership.

We hope this information provides some insight into the AWWTP Biosolids Management Program. Please contact Chris Stempa, Pretreatment and Biosolids Manager, at (920) 832-5945 with any questions or comments regarding this letter or attachments.

Best Regards,

Appleton Wastewater Treatment Plant



AWWTP egg-shaped anaerobic digesters.

Attachments

Attachment 1 – Topographic and Aerial Site Maps

Attachment 2 – Nutrient Management Worksheet



.... grow with us

CITY OF APPLETON

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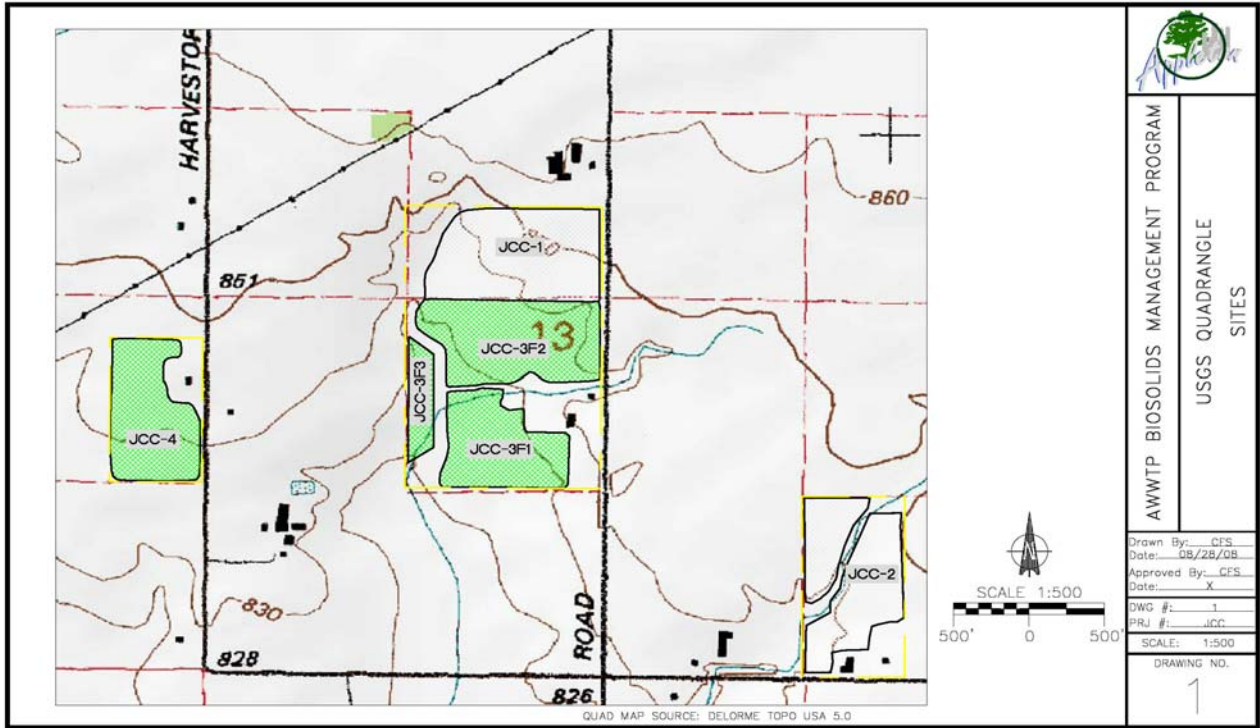
City of Appleton Biosolids Program Website:
<http://www.appleton.org/departments/utilities/wastewater/biosolids/>



AWWTP Mission Statement

“The City of Appleton’s Wastewater Treatment Plant provides the community with essential wastewater treatment services. Our technically skilled and highly motivated staff strive to maintain maximum standards of community health and safety while protecting and preserving the environment. It is our goal to achieve these objectives in a manner that demonstrates integrity responsibility, and economically sound practices.”

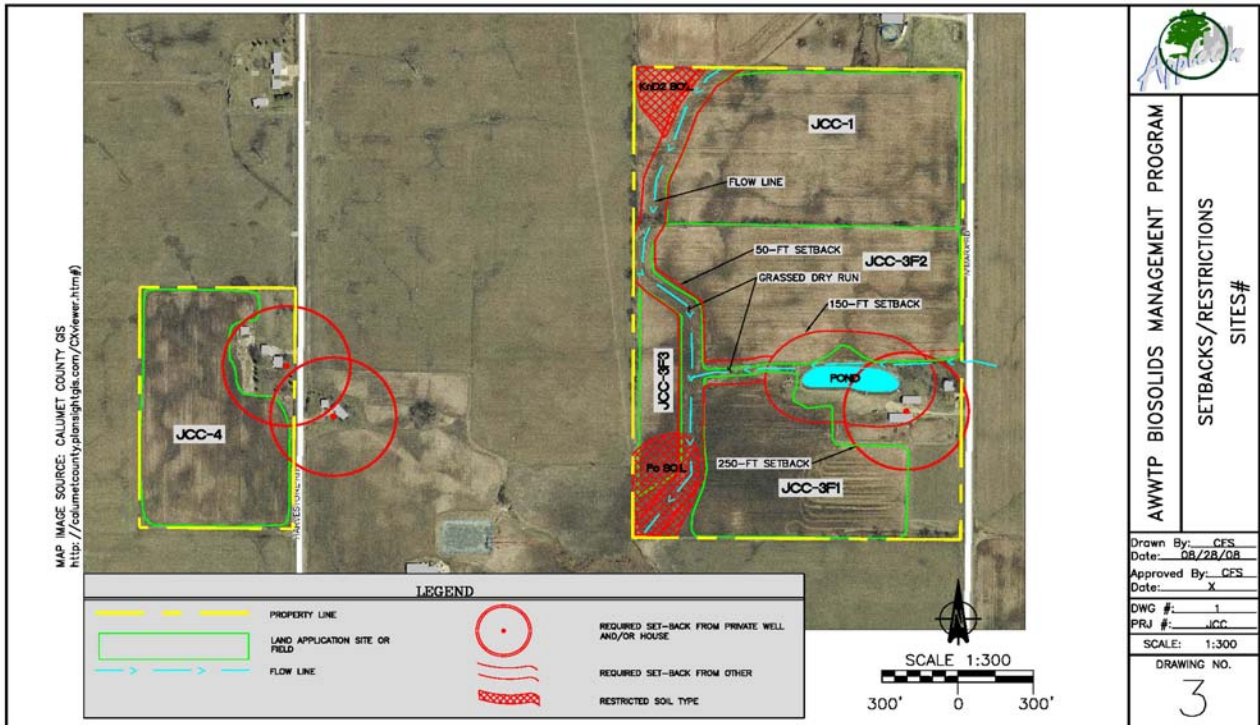
Attachment 1 Topographic and Aerial Site Maps



AWWTP BIOSOLIDS MANAGEMENT PROGRAM

USGS QUADRANGLE SITES

Drawn By: CFS
Date: 08/28/08
Approved By: CFS
Date: X
DWG #: 1
PRJ #: JCC
SCALE: 1:500
DRAWING NO. 1



AWWTP BIOSOLIDS MANAGEMENT PROGRAM

SETBACKS/RESTRICTIONS SITES#

Drawn By: CFS
Date: 08/28/08
Approved By: CFS
Date: X
DWG #: 1
PRJ #: JCC
SCALE: 1:300
DRAWING NO. 3

Attachment 2 Nutrient Management Sheet

City of Appleton Wastewater Division Biosolids Use Program / Nutrient Management						Soil Sampling Agenda			
						Year Last Sampled	Next Sampling Year		
						2010	2014		
Site Owner:	NAME	Appleton WPDES 23221				Total Site Acres:	10.0		
Appleton Site ID:	SITE-#	DNRSite ID # #####				Application Acres:	10.0		
						4-Year Crop Rotation (Code):	17-18-48-1		
Biosolids Analysis:		Applied (lbs/Acre)				Previous crop grown: 18 Corn, silage			
Macronutrients	%					Crop to be grown: 17 Corn, grain			
Total Solids %	41.4	<i>see "Actual Application of Nutrients"</i>		NR 204 & 40 CFR 503 Lifetime Loadings Allowed (lbs/Acre)		Pounds of Nitrogen required: 140 N Credit from:			
TKN %	1.76					Pounds of Nitrogen credit: 10 Manure			
NH4 %	0.29					Pounds of Nitrogen to apply: 130			
Phosphorus %	0.51					Dry weight per wet ton: 828			
Potassium %	0.08					Lbs of Nitrogen per wet ton: 5.43			
Sulfur %	0.16					Lbs of Phosphorus per wet ton: 4.19			
Magnesium %	0.91					Lbs of Potassium per wet ton: 0.62			
Calcium %	22.8					Lbs of Sulfur per wet ton: 1.35			
Metals/Micronutrients	mg/kg	Applied (lbs/Acre)	Accumulative (lbs/Acre)	Loadings Allowed (lbs/Acre)	Site Life Usage (Years)	Lbs of Magnesium per wet ton: 7.52			
Arsenic	2.45	0.044	0.044	36	824	Lbs Lime per wet ton: 188.9			
Boron	9.3	0.165	0.165	N/A	--	*Calculated Biosolids Application: Tons			
Cadmium	0.14	0.002	0.002	34	14,146	Calculated wet tons per acre: 23.95			
Copper	125	2.216	2.216	1,339	603	Calculated wet tons applied to site: 239.52			
Iron	20,187	359.360	359.360	N/A	--	<i>* The calculated biosolids application rate is based on supplying 100% total recommended N minus any N credits.</i>			
Lead	3.8	0.067	0.067	268	4,014				
Manganese	875	15.568	15.568	N/A	--	Actual Biosolids Application: Tons			
Mercury	0.22	0.004	0.004	15	3,829	Actual wet tons per acre: 21.50			
Molybdenum	4.70	0.084	0.084	N/A	--	Actual wet tons applied to site: 215.00			
Nickel	9.0	0.160	0.160	375	2,340	Dry tons per acre: 8.90			
Selenium	1.40	0.025	0.025	89	3,570	Dry tons applied to site: 89.01			
Sodium	4,626	82.352	82.352	N/A	--				
Zinc	197	3.498	3.498	2,500	714				
Actual Application of Nutrients: (lbs/Acre)						Approximate Nutrient Value			
			Nitrogen	116.7					
Total P	90.1	$P_2O_5^{(2)}$	113.5				N (Urea)	\$0.50	\$58.35
Total K	13.4	K_2O	12.1				P_2O_5	\$0.76	\$86.22
Total S	28.9	Lime (60-69)	4,062.3				K_2O	\$0.66	\$8.00
Total Mg	161.7	Lime (60-69)	2.0	Tons/Acre			60-69 Lime	\$0.0120	\$48.75
						Total	\$1.92	\$201.32	
						Total/site		\$2,013.16	
						Total/site exclusive of P_2O_5		\$1,150.91	
Nutrient Management:									
Date	Field ID	Acres Used	Extension Service Crop Code	Lbs/acre Nitrogen Required	Lbs/acre Nitrogen Applied	Lbs/acre Nitrogen Credit 2 yr	Lbs/acre Nitrogen Credit 3 yr	Lime Applied Tons per Acre	Comments
	SITE-#	10	17 Corn, grain	130	116.7	23.5	10.4	2.03	
Approximately 215 wet tons of biosolids would need to be applied over 10 acres to approach recommended crop nitrogen need and obtain a lime recommendation of 2 tons/acre in the worksheet provided. In this example that would equate to 116.7 lbs per acre (lb/acre) of total calculated available nitrogen assuming a 25% first year mineralization rate, 90 lb/acre total P or 113.5 lb/acre P_2O_5 (total P x elemental conversion of available P [2.29]*0.55 or 55% assumed 1st year P availability), and 13.4 lb/acre total K or 12.1 lb/acre K_2O (total K x elemental conversion of total K 1.21 x 0.75 [assume 75% available]). Rates will change slightly based upon the current biosolids testing data used in the nutrient management calculation worksheet. Lifetime loadings of metals allowable by State and Federal regulations are monitored with every biosolids application. Site usage is calculated by dividing the lifetime allowable concentration by the applied amount of metals (lbs/acre). The									

Note: 1) Application rate derived from UWEX MRTN and A2809 rate guidelines for high/v. high productive soils, or 135-190 lb N/acre.

2) P_2O_5 value derived by multiplying total P by the elemental conversion factor 2.29 and then by 55% which assumes 1st year availability. The typical water soluble P fraction in AWWTP biosolids is less than 3% of total P.

3) K_2O value derived by multiplying total K by elemental conversion factor 1.21 multiplied by 75% which assumes plant available fraction.