



## Worksheet for Land Application of Biosolids

This workshop will provide guidance in determining the proper application rate for biosolids. This application rate is a function of the nutrient content of the biosolids and the crop's nutrient requirements, and credits from nutrients available prior to application.

Prior to completing the worksheet, you will need a current soil test for the site, and the analysis of the biosolids you plan to apply. To convert mg/kg dry weight to pounds per ton wet weight, multiply mg/kg dry weight by 0.002, then multiply by the percent solids, expressed as a decimal.

The goal of determining responsible application rates is to prevent loading the soil with excessive nitrates or phosphorus; whether application rates are based on crop nitrogen needs or on phosphorus removal by crops depends on soil test phosphorus levels, the extent of nutrient loading on the soil, and how the site and crop is managed. In those cases where soil nutrient levels are low, it is appropriate to base biosolids applications on the crop's nitrogen requirements. In cases where soil test phosphorus levels are high, it may be more appropriate to use application rates that do not provide additional phosphorus in excess of what is removed by the crop, or in some cases, to avoid the application of additional phosphorus altogether.

Using the Phosphorus Index helps to determine both the extent of phosphorus loading in the soil and how likely it is for P-enriched sediment to move off site. Fields with low ratings are suitable sites for nitrogen-based application rates, moderate and high ratings indicate the need for phosphorus-based application rates, and sites with very high ratings indicate that no additional phosphorus should be applied.

### Section 1 – Basing applications on Nitrogen requirements

1. Enter the nitrogen requirement for your crop (from the soil test) in Box A
2. Credit nitrogen from previous management practices, manure or biosolids use, soil organic matter, or planned fertilizer applications. Use the following values or, if available, mineralization values specific to the product you intend to use:

		% of Organic N Available from Previous Applications of Manure or Biosolids				
		Years of application	Manure	Undigested Biosolids	Anaerobically Digested Biosolids	Composted Biosolids
Previous crop:		0 - 1	40	45	30	10
Grass sod	40	1 - 2	15	15	10	5
Mixed, mostly grass sod	70	2 - 3	5	10	10	3
Mixed, mostly legume sod	100	3 - 4	2	5	5	3
Clear legume	125	4+ years	2	3	5	3
Corn stover	35					
Cover crop	30					
% Soil organic matter x 10 (enter 0 if crop is grass)						

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3. Subtract the total N credits (in Box B) from the crop N requirement to determine the amount of N you will need to provide from biosolids, and enter in Box C
  4. Determine the total amount of available N from biosolids by adding up the  $\text{NO}_3\text{-N}$ ,  $\text{NH}_4\text{-N}$ , and the portion of Organic N that will be available this year and that is available from previous years. If biosolids are not incorporated in the soil within 24 hours after application, divide the total amount of  $\text{NH}_4\text{-N}$  by 2. Enter the sum in Box D
  5. The application rate (wet tons per acre) is the amount of N required from biosolids divided by the total pounds of N available per ton (Box C divided by Box D)

## Section 2 – Basing Applications on Phosphorus Removal by Crops

In cases where soil test phosphorus levels exceed the Optimum range, it is necessary to calculate a P index to determine whether nitrogen- or phosphorus-based applications are appropriate. When P Index values are in the High range, phosphorus applications should not exceed crop removal.

Use the NH Phosphorus Index available to determine the risk for phosphorus leaving the field. Follow the instructions on the spreadsheet for entering crop and management information. Estimated soil erosion should be calculated with the Revised Universal Soil Loss Equation (RUSLE2); consult with your nutrient management planner to obtain these values.

If the Phosphorus Index indicates there is a low risk of phosphorus leaving the site, it is appropriate to continue basing application rates on crop nitrogen needs. Nutrient applications on sites with High ratings, however, should not exceed phosphorus removal by the crop. Phosphorus-based application rates can be determined in Section 2 of the worksheet.

1. Determine your crop yield from previous field records, and multiply it by the amount of phosphorus removed per unit yield listed on the left-hand side of the table on the worksheet. Enter in Box A
2. Divide the P removal per acre by the Biosolids P content to determine the application rate in wet tons per acre (Box A divided by Box B)

Field ID:

Crop to be grown:

<b>Biosolids Nutrient Analysis from Laboratory</b>			
Pounds per wet ton <i>refer to worksheet instructions to convert from mg/kg dry weight</i>			
Total N		Organic N	
NH <sub>4</sub> - N		P	
NO <sub>2</sub> & NO <sub>3</sub> -N		% Solids	

<b>Nutrient Application Basis</b>
If soil test phosphorus is less than <b>50 ppm</b> , base applications on crop <b>nitrogen</b> needs. <b>Go to Section 1.</b>
If soil test phosphorus is greater than 50 ppm ( <i>Mehlich 3</i> ) 13 ppm ( <i>modified Morgan</i> ) or 35 ppm ( <i>Bray 1</i> ), the site may not be appropriate for biosolids application unless a P index indicates a low risk of P movement from the site.
If soil pH is greater than 7.5, avoid applications of lime-stabilized biosolids that will further increase pH.

**Section 1 - Basing Applications on crop nitrogen needs** (*refer to worksheet instructions for N credits*)

<b>Crop Nitrogen requirement</b> <i>(from soil test)</i>		<b>A</b>	Available N from Biosolids	NO <sub>3</sub> -N (lb/wet ton)	
<b>N credits</b>	Crop history		Organic N from Biosolids - Refer to worksheet instructions for N mineralization rates	NH <sub>4</sub> -N (lb/wet ton) <i>(divide by 2 if unincorporated)</i>	
	Cover crop			Organic N x mineralization	
	Organic matter <i>(% OM from soil x 10; not to exceed 50#; (enter 0 if crop is grass)</i>			Residential from last year	
	Previous manure			Residential from 2 years ago	
	Starter fertilizer			Residential from 3 years ago	
	<b>Total N credits</b>	<b>B</b>	<b>Total Biosolids N</b>	<b>D</b>	
<b>N required from biosolids</b> <b>(A minus B)</b>	<b>C</b>	<b>Application rate:</b> <b>(C divided by D)</b>			Wet tons/acre

**Section 2 - Basing Applications on phosphorus removal by crop if P index is rated High**

P removal per unit yield	Your yield per acre X	Crop removal = <i>(from left)</i>	P removal per acre	Application rate: <b>(A divided by B)</b>
			<b>A</b>	
Silage corn (T) - 5# Grain corn (bu) - 0.4# Perennnial forages (T) - 15# Sod harvest (A) - 80#			#P per wet ton biosolids	Wet tons per acre
			<b>B</b>	