How to Complete Residual N Calculator

Overview and Purpose:

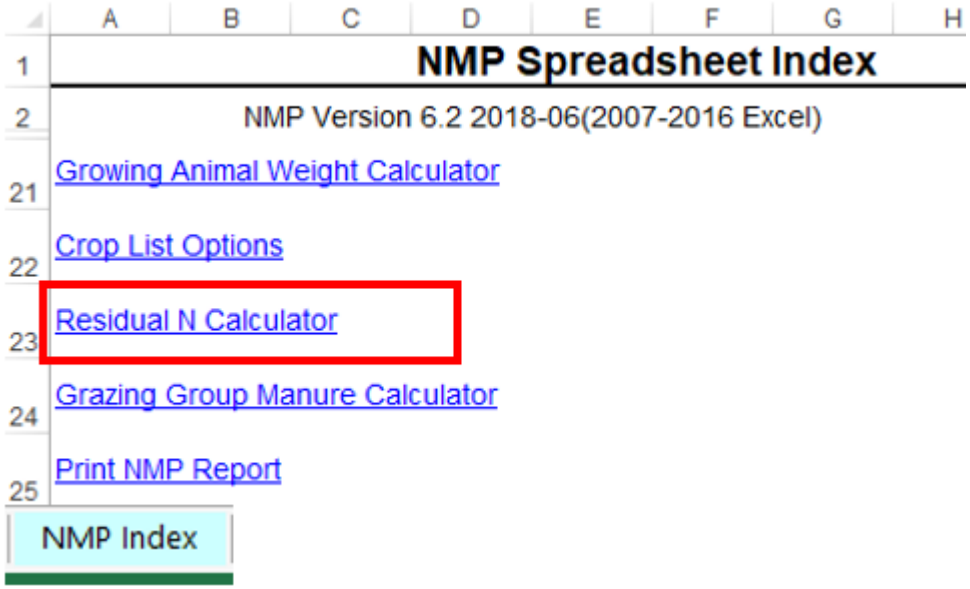
There are two ways to determine the amount of residual manure nitrogen. These options are outlined in the Penn State Agronomy Guide. Both options rely on the manure application history, particularly the frequency of manure application provided by the operator for each field. This is noted as the number of years out of the past five years that a field has received manure. In addition, option 2 requires the type of manure, the manure analysis and the application rates for each year in the past 5 that manure was applied to a field.

Option 1 uses the Penn State Agronomy Guide, Table 1.2-14B. This method is commonly called the "Total N Method". Based on the frequency of manure application over the past five years the appropriate residual nitrogen value is determined.

Option 2 uses the Penn State Agronomy Guide, Table 1.2-15.
This method provides a more refined estimate of residual manure nitrogen that utilizes the chemical manure analysis that provides the amount of ammonium N and organic N in the manure to calculate the amount of residual nitrogen. This method is commonly called the "N Fractions Method". The Manure N Residual Calculator that must be completed for Option 2 and must be included in Appendix 10: Supporting Information and Documentation.

This procedure describes how to complete the optional Residual N Calculator for determining the manure residual nitrogen in a Nutrient Management Plan (NMP) using the "N Fractions Method".

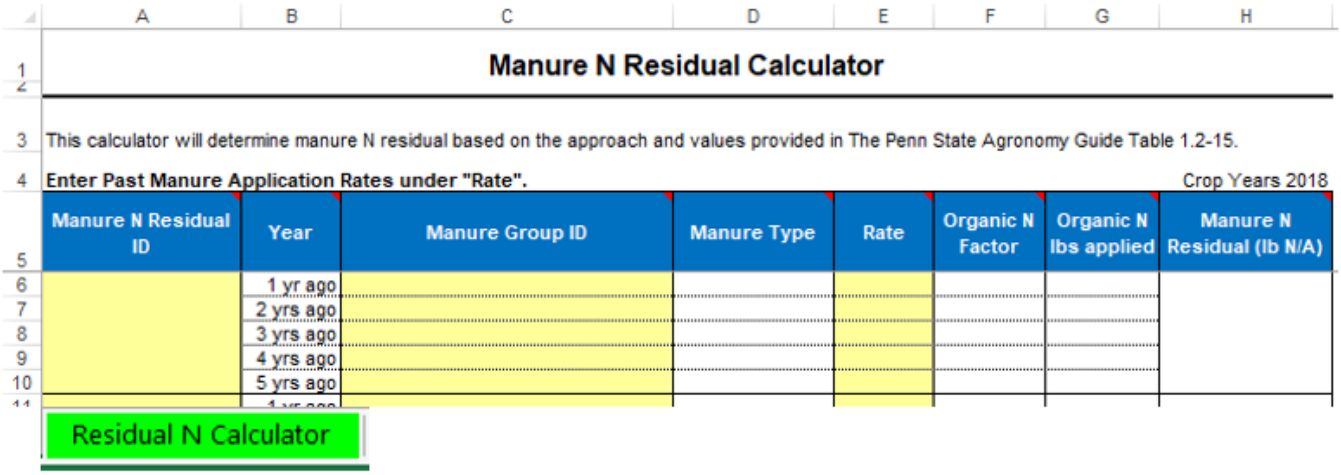
You can find Residual N Calculator Worksheet tabs by looking for the hyper link in the NMP Spreadsheet Index



This particular worksheet is an optional worksheet so it has a green colored sheet tab in the NMP workbook.
The tab looks like this:

How to Complete Residual N Calculator

Layout of the Calculator to determine manure nutrients deposited by grazing animals



Manure N Residual Calculator

This calculator will determine manure N residual based on the approach and values provided in The Penn State Agronomy Guide Table 1.2-15.

Enter Past Manure Application Rates under "Rate". Crop Years 2018

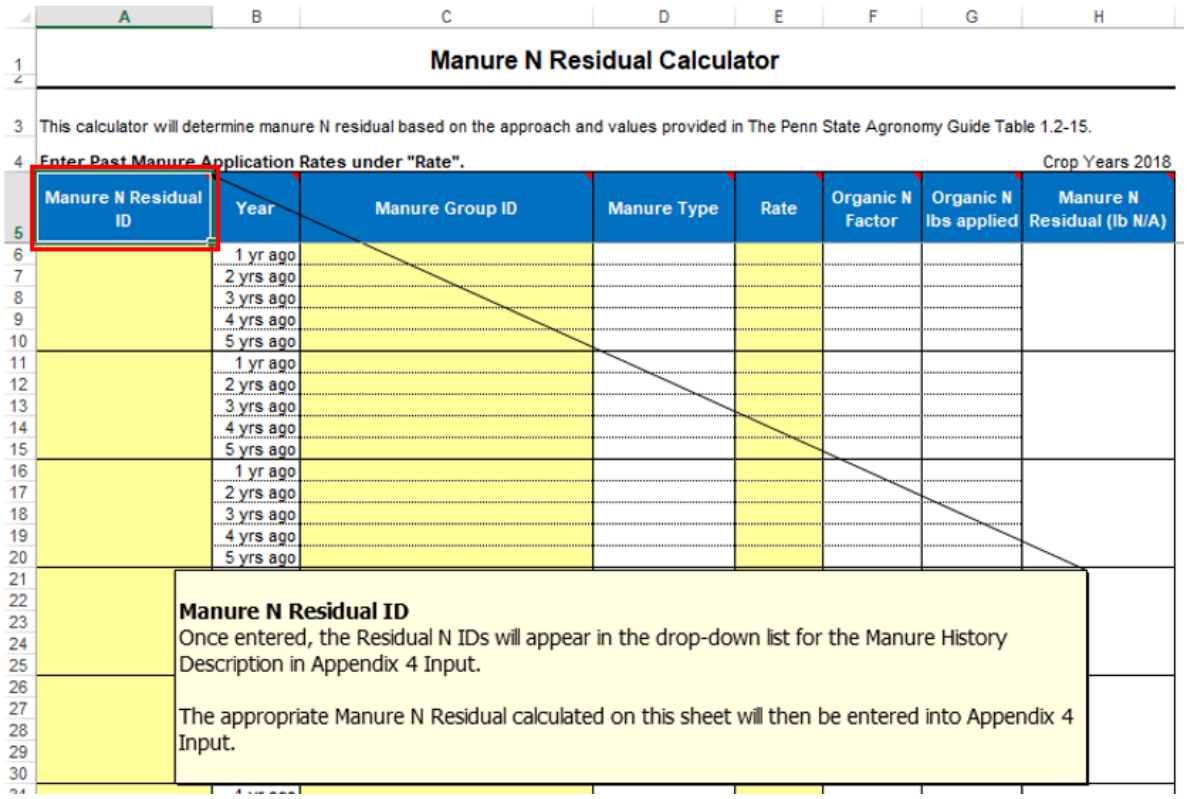
Manure N Residual ID	Year	Manure Group ID	Manure Type	Rate	Organic N Factor	Organic N lbs applied	Manure N Residual (lb N/A)
	1 yr ago						
	2 yrs ago						
	3 yrs ago						
	4 yrs ago						
	5 yrs ago						

Residual N Calculator

Helpful notes added in Column Headers

The blue column headers cells with red triangles have helpful notes included to help you understand what needs to be entered or what the cell data is used for. Where you see a red triangle in the cell, there is a note to help explain what should be entered in that column.

For example when you click in the blue column header "Field or CMU ID", the following pop-up box will appear:



Manure N Residual Calculator

This calculator will determine manure N residual based on the approach and values provided in The Penn State Agronomy Guide Table 1.2-15.

Enter Past Manure Application Rates under "Rate". Crop Years 2018

Manure N Residual ID	Year	Manure Group ID	Manure Type	Rate	Organic N Factor	Organic N lbs applied	Manure N Residual (lb N/A)
	1 yr ago						
	2 yrs ago						
	3 yrs ago						
	4 yrs ago						
	5 yrs ago						
	1 yr ago						
	2 yrs ago						
	3 yrs ago						
	4 yrs ago						
	5 yrs ago						
	1 yr ago						
	2 yrs ago						
	3 yrs ago						
	4 yrs ago						
	5 yrs ago						

Manure N Residual ID
Once entered, the Residual N IDs will appear in the drop-down list for the Manure History Description in Appendix 4 Input.

The appropriate Manure N Residual calculated on this sheet will then be entered into Appendix 4 Input.

How to Complete Residual N Calculator

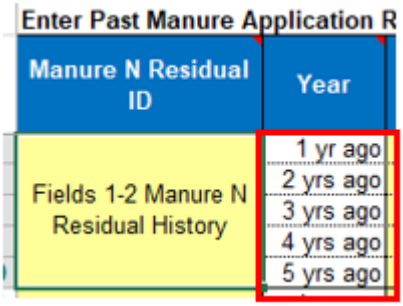
1. Procedure

1.1. Enter the Manure N Residual ID

Enter a name that best describes the manure N history. Once entered, the Residual N IDs will appear in the drop-down list for the Manure History Description in Appendix 4 Input

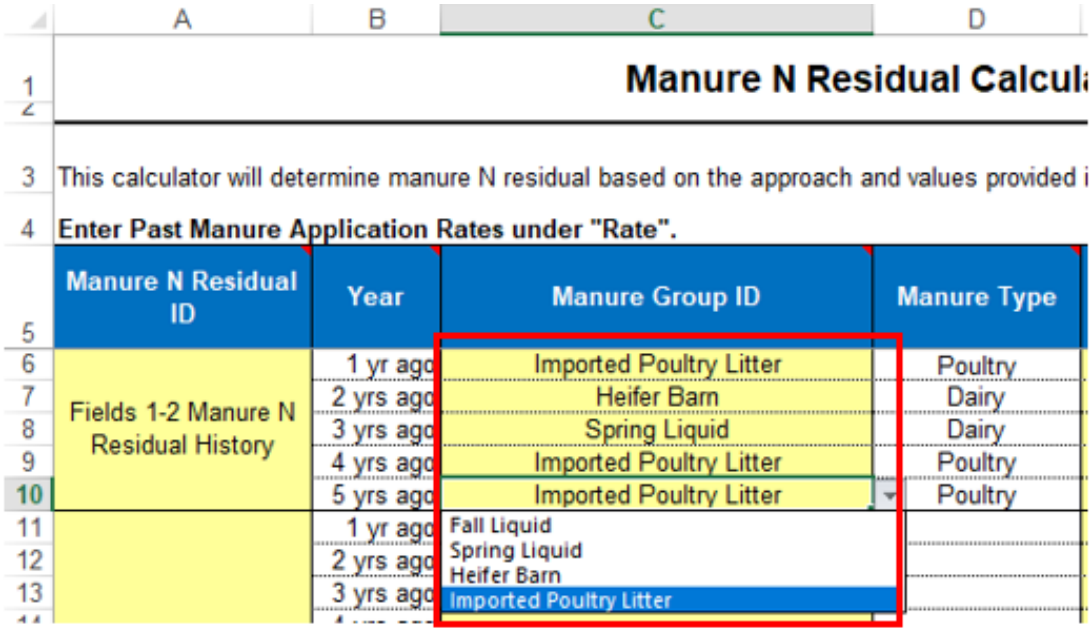
1.2. Year

Each year is the timeframe from the plan year.



1.3. Manure Group ID

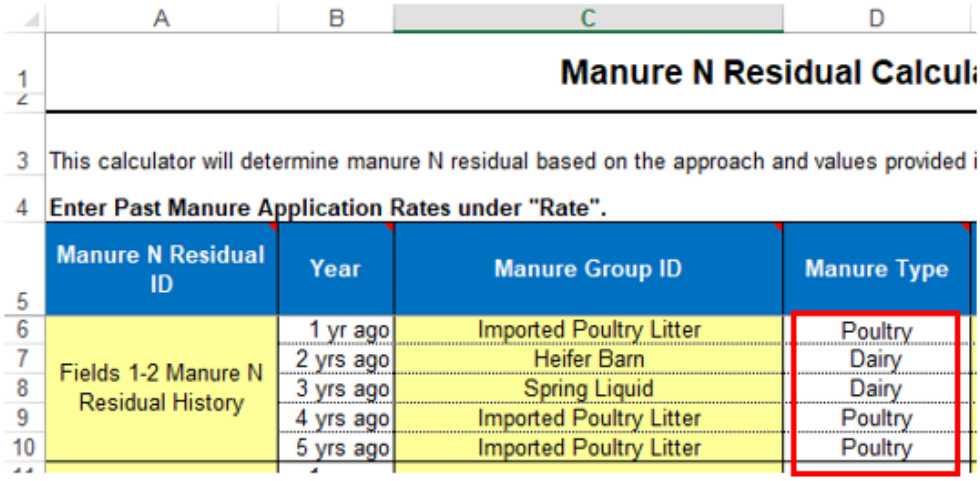
The manure group names are selected drop-down list. They are the manure groups created in Appendix 3 Input sheet. For a manure group is not part of the current NMP, enter the manure group Id in Appendix 3 Input tab and the manure nutrient information in the Manure Average Input tab. The manure group selected must have the manure analysis values completed or the calculator won't work. An example might be imported Poultry Litter.



Note: An example Appendix 3 Manure Group Information sheet is attached at the end of this document listing the manure groups and analysis information used to complete the manure N residual calculator.

1.4. Manure Type

The manure type will be automatically transferred from Manure Average Input sheet. The manure type must be completed for the calculations to work.



Manure N Residual Calcul

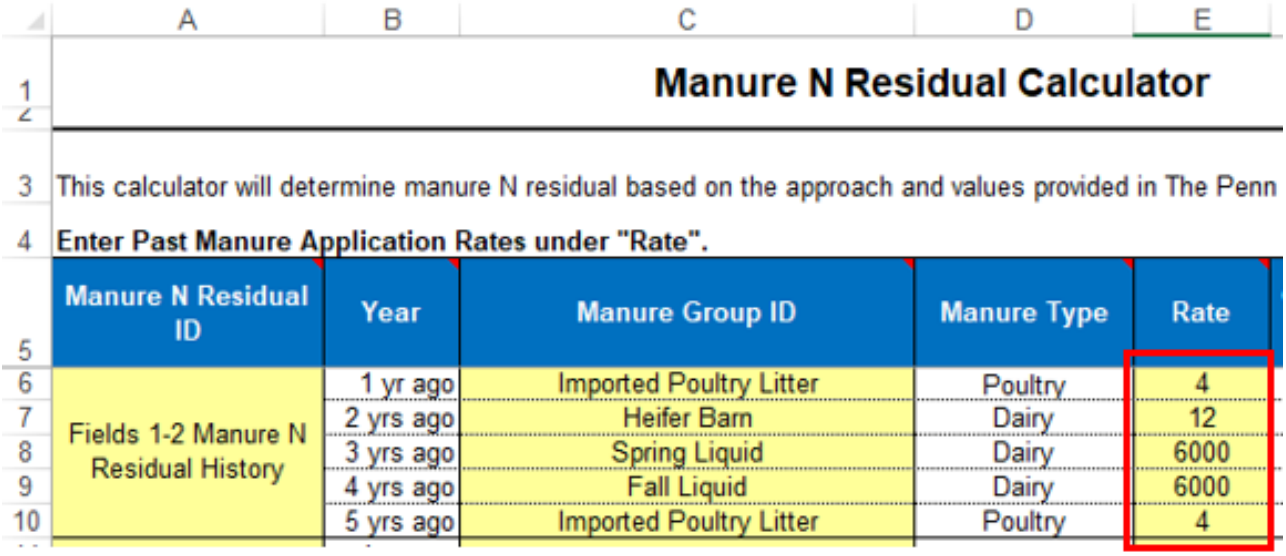
This calculator will determine manure N residual based on the approach and values provided i

Enter Past Manure Application Rates under "Rate".

Manure N Residual ID	Year	Manure Group ID	Manure Type
Fields 1-2 Manure N Residual History	1 yr ago	Imported Poultry Litter	Poultry
	2 yrs ago	Heifer Barn	Dairy
	3 yrs ago	Spring Liquid	Dairy
	4 yrs ago	Imported Poultry Litter	Poultry
	5 yrs ago	Imported Poultry Litter	Poultry

1.5. Rate

Enter the manure rate applied for the year listed. Don't enter the units (tons/Acre or gallons/Acre).
For example if poultry litter was applied one year ago at a rate of 4 tons/Acres then enter only 4. Don't enter the units of ton/A.



Manure N Residual Calculator

This calculator will determine manure N residual based on the approach and values provided in The Penn

Enter Past Manure Application Rates under "Rate".

Manure N Residual ID	Year	Manure Group ID	Manure Type	Rate
Fields 1-2 Manure N Residual History	1 yr ago	Imported Poultry Litter	Poultry	4
	2 yrs ago	Heifer Barn	Dairy	12
	3 yrs ago	Spring Liquid	Dairy	6000
	4 yrs ago	Fall Liquid	Dairy	6000
	5 yrs ago	Imported Poultry Litter	Poultry	4

1.6. N Factor

The Organic N Factor from past applications is transferred from Table 6in the NMP. (Agronomy Guide Table 1.2-15)

Manure N Residual Calculator

This calculator will determine manure N residual based on the approach and values provided in The Penn State Agronc

Enter Past Manure Application Rates under "Rate".

Manure N Residual ID	Year	Manure Group ID	Manure Type	Rate	Organic N Factor
Fields 1-2 Manure N Residual History	1 yr ago	Imported Poultry Litter	Poultry	4	0.12
	2 yrs ago	Heifer Barn	Dairy	12	0.05
	3 yrs ago	Spring Liquid	Dairy	6000	0.02
	4 yrs ago	Fall Liquid	Dairy	6000	0.02
	5 yrs ago	Imported Poultry Litter	Poultry	4	0.01

The Organic N factors are listed in Table 6 of the NMP.

Table 6. Factors for calculating manure nitrogen availability based on time of application, incorporation, field history, and manure analysis with ammonium and organic N fractions. Recommended for all manures, but required for atypical or treated manures. Based on Penn State Agronomy Guide Table 1.2-15.

Total Manure N

Application Season	Application Method / Days to incorporation[1]	Ammonium N Analysis: Poultry	Poultry <5% Solids[2]	Other	Other <5% Solids[2]	Compost
Spring: 1.2-15 For corn, other summer annuals, grass hay	Spring 1.2-15: Incorporated the same day	0.90	0.90	0.80	0.80	0.80
	Spring 1.2-15: Incorporated within 1 day	0.80	0.80	0.60	0.60	0.60
	Spring 1.2-15: Incorporated within 2 - 4 days	0.60	0.80	0.40	0.60	0.40
	Spring 1.2-15: Incorporated within 5 - 7 days	0.40	0.60	0.20	0.40	0.20
	Spring 1.2-15: Incorporated after 7 days	0.20	0.40	0.10	0.30	0.10
Summer: 1.2-15 For corn, other summer annuals, grass hay	Summer 1.2-15: Incorporated the same day	0.90	0.90	0.80	0.80	0.80
	Summer 1.2-15: Incorporated within 1 day	0.80	0.80	0.60	0.60	0.60
	Summer 1.2-15: Incorporated within 2 - 4 days	0.60	0.80	0.40	0.60	0.40
	Summer 1.2-15: Incorporated within 5 - 7 days	0.40	0.60	0.20	0.40	0.20
	Summer 1.2-15: Incorporated after 7 days	0.20	0.40	0.10	0.30	0.10
Early Fall: 1.2-15[3] For fall and spring use by grass hay, small grains and small grain silage	Early Fall 1.2-15: Fall and spring use by grass hay, small grains and small grain silage. Incorp 0-2 days	0.80	0.80	0.60	0.60	0.40
	Early Fall 1.2-15: Fall and spring use by grass hay, small grains and small grain silage. Incorp 3-7 days	0.50	0.70	0.30	0.50	0.20
	Early Fall 1.2-15: Fall and spring use by grass hay, small grains and small grain silage. Incorp after 7 days	0.20	0.40	0.10	0.30	0.00
Early Fall: 1.2-15[3] For following summer utilization by a summer crop following a non-harvested cover crop used as a green manure.	Early Fall 1.2-15: next summer use by a summer crop after a green manure cover crop. Incorp 0-2 days	0.45	0.45	0.35	0.35	0.35
	Early Fall 1.2-15: next summer use by a summer crop after a green manure cover crop. Incorp 3-7 days	0.20	0.40	0.15	0.35	0.15
	Early Fall 1.2-15: next summer use by a summer crop after a green manure cover crop. Incorp after 7 days	0.00	0.20	0.00	0.20	0.00
	Early Fall 1.2-15: next summer use by a summer crop following a harvested winter crop or no winter crop	0.00	0.00	0.00	0.00	0.00
Late Fall: 1.2-15[4] For following summer utilization by a summer crop following a harvested winter crop or no winter crop	Late Fall 1.2-15: Summer corn or annual with no cover crop or cover crop harvested for silage	0.00	0.00	0.00	0.00	0.00
	Late Fall 1.2-15: Spring grass hay, small grains or Summer corn, annual with green manure cover crop	0.60	0.60	0.50	0.50	0.50
[4,5] g summer utilization	Winter 1.2-15: Summer corn or annual with no cover crop or cover crop harvested for silage	0.00	0.00	0.00	0.00	0.00

Organic N Analysis (Total N - ammonium N)

Organic N decomposed during year applied

	Poultry	Swine	Other	Dairy	Compost
Summer Crop	0.60	0.50	0.35	0.35	0.10
Winter Crop	0.40	0.30	0.25	0.25	0.10

Additional organic N available to the summer crop in a double crop system from manure applied in the fall for the winter crop (above)

Summer Crop	0.30	0.25	0.20	0.20	0.10

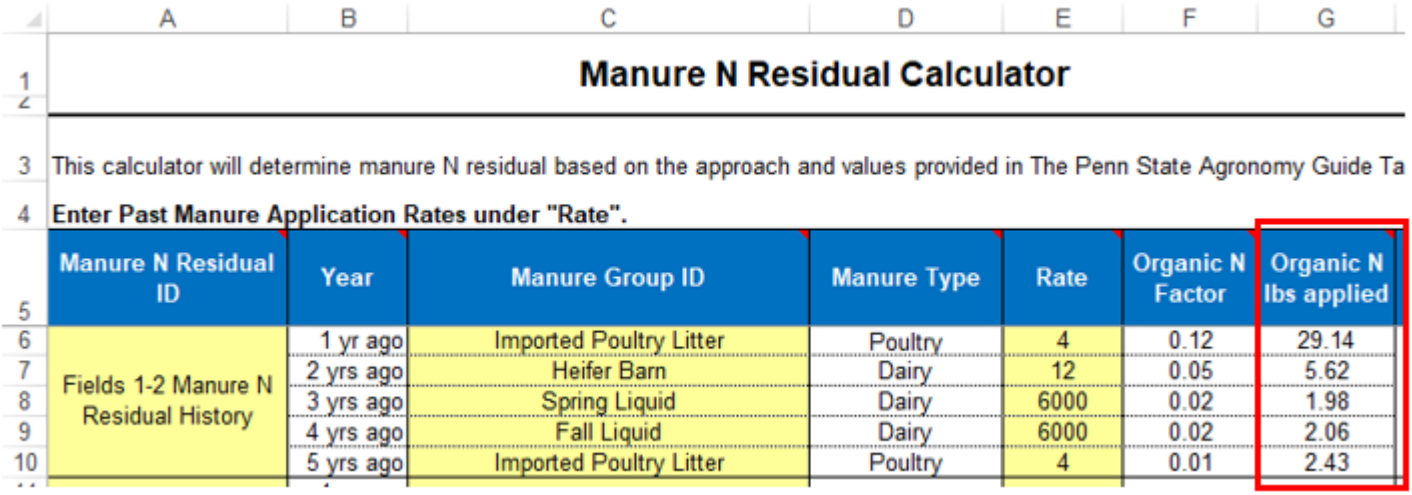
Organic N decomposed from past applications

Manure applied	Manure	Compost
1 yr ago	0.12	0.05
2 yrs ago	0.05	0.02
3 yrs ago	0.02	0.01
4 yrs ago	0.02	0.01
5 yrs ago	0.01	0.01

Table 6

1.7. Organic N lbs. applied

The amount of residual organic nitrogen applied during the year applied is calculated for each manure applied for up to five previous years.



Manure N Residual Calculator

This calculator will determine manure N residual based on the approach and values provided in The Penn State Agronomy Guide Ta

Enter Past Manure Application Rates under "Rate".

Manure N Residual ID	Year	Manure Group ID	Manure Type	Rate	Organic N Factor	Organic N lbs applied
Fields 1-2 Manure N Residual History	1 yr ago	Imported Poultry Litter	Poultry	4	0.12	29.14
	2 yrs ago	Heifer Barn	Dairy	12	0.05	5.62
	3 yrs ago	Spring Liquid	Dairy	6000	0.02	1.98
	4 yrs ago	Fall Liquid	Dairy	6000	0.02	2.06
	5 yrs ago	Imported Poultry Litter	Poultry	4	0.01	2.43

In the example above the application rate for each previous year is multiplied by the manure group organic N then multiplied by the Organic N Factor to determine the pounds of organic nitrogen applied in that year.

(See Section 4.1 of this document for the Appendix 3 Manure Group Information)

Example Calculation for Fields 1-2 Manure N Residual History

1 year ago Imported Poultry Litter manure applied

$$\frac{4\ tons\ poultry\ litter}{1\ acre} \times \frac{60.70\ lbs\ Organic\ Nitrogen}{1\ ton\ \ poultry\ litter} \times\ 0.12\ Organic\ N\ Factor = \ 29.14\ lbs\ Organic\ N$$ lbs. applied

2 years ago Heifer Barn manure applied

$$\frac{12\ tons\ Heifer\ Barn}{1\ acre} \times \frac{9.36\ lbs\ Organic\ Nitrogen}{1\ ton\ \ Heifer\ Barn} \times\ 0.05\ Organic\ N\ Factor = \ 5.62\ lbs\ Organic\ N$$ lbs. applied

3 years ago Spring Liquid manure applied

$$\frac{6000\ gallons\ Spring\ Liquid}{1\ acre} \times \frac{16.5\ lbs\ Organic\ Nitrogen}{1000\ gallons\ Spring\ Liquid} \times 0.02\ Organic\ N\ Factor = \ 1.98\ lbs\ Organic\ N$$ lbs. applied

4 years ago Fall Liquid manure applied

$$\frac{6000\ gallons\ Fall\ \ Liquid}{1\ acre} \times \frac{17.2\ lbs\ Organic\ Nitrogen}{1000\ gallons\ Fall\ Liquid} \times\ 0.02\ Organic\ N\ Factor = \ 2.06\ lbs\ Organic\ N$$ lbs. applied

5 years ago Imported Poultry Litter manure applied

$$\frac{4\ tons\ poultry\ litter}{1\ acre} \times \frac{60.70\ lbs\ Organic\ Nitrogen}{1\ ton\ \ poultry\ litter} \times\ 0.01\ Organic\ N\ Factor = \ 2.43\ lbs\ Organic\ N$$ lbs. applied

1.8. Manure N Residual (lb. Nitrogen/Acre)

The value is the sum of the residual manure nitrogen from up to five years of manure application. In the example below, a total of 41 pounds of residual organic nitrogen is available in the current crop year.

Manure N Residual Calculator

This calculator will determine manure N residual based on the approach and values provided in The Penn State Agronomy Guide Table 1.2-15.

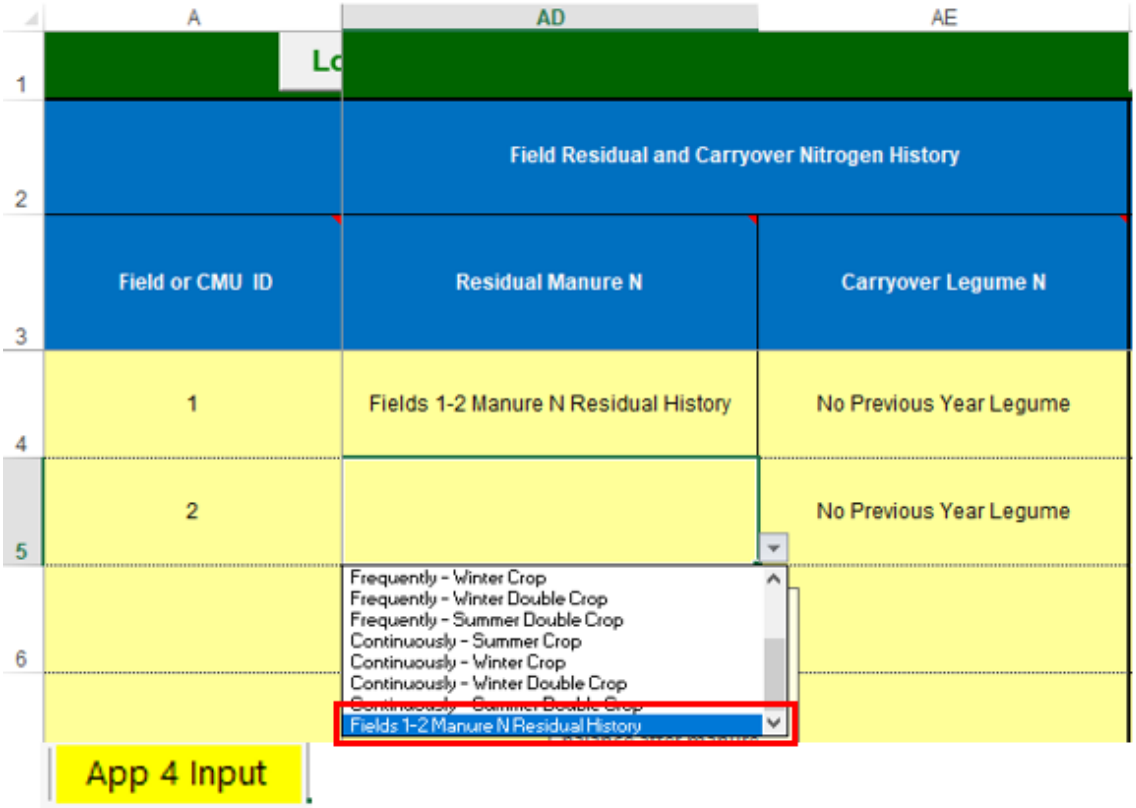
Enter Past Manure Application Rates under "Rate". Crop Years 2018

Manure N Residual ID	Year	Manure Group ID	Manure Type	Rate	Organic N Factor	Organic N lbs applied	Manure N Residual (lb N/A)
Fields 1-2 Manure N Residual History	1 yr ago	Imported Poultry Litter	Poultry	4	0.12	29.14	41
	2 yrs ago	Heifer Barn	Dairy	12	0.05	5.62	
	3 yrs ago	Spring Liquid	Dairy	6000	0.02	1.98	
	4 yrs ago	Fall Liquid	Dairy	6000	0.02	2.06	
	5 yrs ago	Imported Poultry Litter	Poultry	4	0.01	2.43	

2. Selecting manure nitrogen history in Appendix 4 Input

2.1. Residual Manure Nitrogen

The completed Residual Manure Nitrogen group will be available as a selection at the bottom of the Residual Manure N drop-down list.



How to Complete Residual N Calculator

3. Appendix 4 Crop & Manure Management Printout

The newly created manure residual group and pounds of available organic nitrogen will be displayed in the manure history description.

App. 4: Crop Yrs. 2018	1		
CMU/Field ID			
Acres	10.0		
Soil Test Report Date	October 2, 2016		
Laboratory Name	AASL		
Soil Test Levels (Mehlich-3 P & K)	ppm P	ppm K	pH
(Show conversions to ppm in Appendix 10)	121	150	6.8
P Index Part A Evaluation	No to All Part A		
Part A Result	N Based		
Crop	Corn for Silage		
Planned Yield	21 tons/A		
PSU Soil Test Recommendation (lb/A)	**N**	**P2O5**	**K2O**
	160	0	90
User Soil Test Recommendation (lb/A)			
Other Nutrients Applied (lb/A) (Nutrients applied regardless of manure)	0	0	0
P Index Application Method			
Double Crop CarryOver N (lb/A)	0		
Manure History Description Residual Manure N (lb/A)	41	Fields 1-2 Manure N Residual History	
Legume History Description Residual Legume N (lb/A)	0	No Previous Year Legume	
Net Nutrients Required (lb/A)	119	0	90
Manure Group	Imported Poultry Litter		
Application Season: Management (Incorporation, cover crops, etc.)	Spring: Spring or summer utilization-Incorporation after 7 days or more		
Availability Factors (Total N or NH4-N & Organic N)	**Total N**	**NH4-N**	**Org. N**
	0.15		
P Index Application Method			
N Balanced Manure Rate (ton; gal/A)	11 tons/A		
P Removal Balance Manure Rate (ton or gal/A; If required by P Index)	1 tons/A		
	Crop P Removal (lb/A) 84.0		
P Index Value			
Planned Manure Rate (ton or gal/A)	**4 tons/A**		
Nutrients Applied at Planned Manure Rate (lb/A)	44	238	193
Nutrient Balance after Manure	75	-238	-103
Supplemental Fertilizer (lb/A)	75	0	0
P Index Application Method			
Final Nutrient Balance (lb/A)	**0**	**-238**	**-103**
Multiple Application			
Manure Utilized on CMU	40 tons		

Appendix 4 Crop & Manure Mgmt.

How to Complete Residual N Calculator

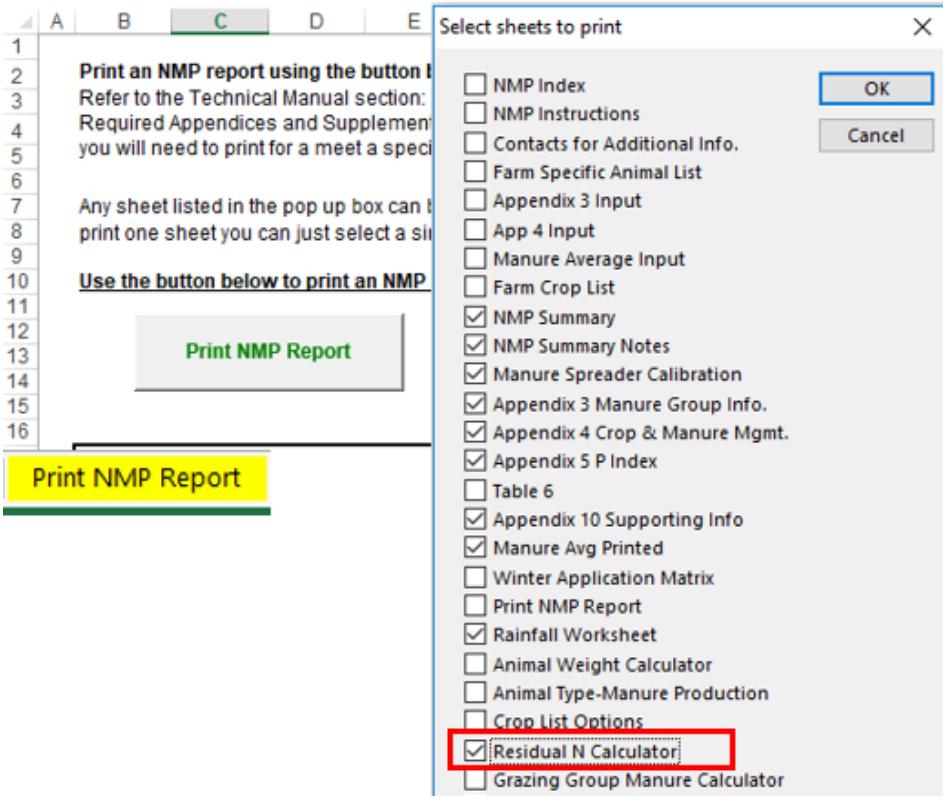
4. Supplemental Information

4.1. Appendix 3 Manure Group Information for use in section 1.7 calculation

Appendix 3 Manure Group Information Crop Yrs. 2018	Fall Liquid		Spring Liquid	Heifer Barn	Imported Poultry Litter
Manure Report Date (note if averaging several reports)	November 1, 2016		March 31, 2017	March 20, 2017	November 20, 2017
Laboratory Name	AASL		AASL	AASL	AASL
Manure Type	Dairy		Dairy	Dairy	Poultry
Manure Unit (lbs/ton or 1000 gal)	lb/1000 gal		lb/1000 gal	lb/ton	lb/ton
Total Nitrogen (N) (lbs/ton or 1000 gal)	27.00		25.00	11.00	73.42
Ammonium N (NH_4-N) (lbs/ton or 1000 gal)	9.80		8.50	1.64	12.72
Total Organic N (lbs/ton or 1000 gal)	17.20	Go to NMP Index	16.50	9.36	60.70
Total Phosphate (P_2O_5) (lbs/ton or 1000 gal)	12.00	Go to Appendix 3 Input	10.00	6.00	59.41
Total Potash (K_2O) (lbs/ton or 1000 gal)	23.00	Go to Manure Avg Inout	22.00	7.00	48.31

Appendix 3 Manure Group Info.

4.2. Print the Residual N Calculator for submission in Appendix 10: Supporting Information and Documentation



4.3. Printed Residual N Calculator

Manure N Residual Calculator

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Enter Past Manure Application Rates under "Rate". Crop Years 2018

Manure N Residual ID	Year	Manure Group ID	Manure Type	Rate	Organic N Factor	Organic N lbs applied	Manure N Residual (lb N/A)
Field 1	1 yr ago	Imported Poultry Litter	Poultry	4	0.12	29.14	41
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	3 yrs ago	Spring Liquid	Dairy	6000	0.02	1.98	
	4 yrs ago	Fall Liquid	Dairy	6000	0.02	2.06	
	5 yrs ago	Imported Poultry Litter	Poultry	4	0.01	2.43	

Version 6.2 - March 2018 Residual N Calculator Page - 1

Date	Previous Revision	Description of Significant Changes
Apr 2, 2018	None	First issue of the document.