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Soil Fertility Management

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THE MARYLAND PHOSPHORUS SITE INDEX TECHNICAL USERS GUIDE

The Phosphorus Index Concept

In 1990, a national cooperative workgroup of scientists from numerous Universities and the USDA was organized to develop a procedure that could identify soils, farm management practices, and specific locations within a farm where phosphorus (P) losses in field drainage water may pose the potential for negative environmental impacts on nearby surface waters. The goals of this national workgroup were:

- To develop an easily used field rating system that rates farm fields according to the potential for P loss to surface water (the Phosphorus Index).
- To relate the P Index to the sensitivity of receiving surface waters to eutrophication and degradation resulting from non-point source P enrichment.
- To facilitate adaptation and modification of the P Index to regional and site-specific conditions.
- To develop agricultural management practices that will minimize the buildup of soil P to excessive levels and the transport of P from soils to sensitive water bodies.

The Objective of the Phosphorus Index

The P Index uses readily available information to evaluate two broad categories of factors that contribute to the potential for P loss from agricultural land: (1) P loss potential due to site and transport characteristics, and (2) P loss potential due to management and source characteristics. The first group of factors assesses the potential for P to be transported off the field with runoff, leaching, and drainage water. The second group of factors assesses the quantity, availability, and forms of P present at the site and the likelihood that the P present in the soil is a source of potential environmental concern. The aim of the P Index is to identify critical areas where there is a high P loss potential from the site because there is both a large potential for transport of P off the field and a large source of P present in the soil that may potentially pose a significant environmental impact if it reaches nearby surface waters.

Development of a Modified Phosphorus Index Specifically for Maryland Conditions

In 1994, we began the development of a P Index specifically tailored to Maryland's soils, agricultural management practices, climate, topography, hydrology and surface water characteristics. The Maryland Phosphorus Site Index (PSI) was originally based on the generic national model published in 1993 by the USDA's Natural Resources Conservation Service, but has undergone many substantive changes and modifications since its development so that it more accurately reflects Maryland conditions.

The Maryland PSI has been evaluated on nearly eight hundred farm fields across the state. The information generated from those on-farm evaluations has been used to develop this initial version of the PSI. As more farm fields are evaluated and we gain more information on the strengths and weaknesses of this nutrient management planning tool, revised and improved versions of the PSI will likely be developed.

An Overview of How the Maryland Phosphorus Site Index Works

The Maryland PSI is structured into two distinct portions: Part A and Part B (Table 1). Part A evaluates the P loss potential due to physical site characteristics and P transport potential. This assessment is made by evaluation of six site-specific characteristics: soil erosion, surface runoff, subsurface drainage, leaching potential, distance to surface water, and watershed priority ranking. Part B evaluates the P loss potential due to farm management practices and P source characteristics by assessing six additional factors: conventional soil-test P level, P fertilizer application rate, P fertilizer application method, organic-source P (manures, biosolids, composts, etc.) application rate, organic-source P availability or solubility, and organic-source P application method.

Each of the twelve site characteristics or management factors is evaluated for a specific location and assigned a numeric value. The sum of the site characteristics determined for Part A is multiplied by a scaling factor (0.02) so that P transport potential is expressed on a relative scale with a range of 0 to 1, for most situations. Thus, the total site and transport value determined for Part A can be interpreted as the proportion of the P source present at the site that is susceptible to being transported off of the field by drainage water and impacting adjacent surface waters.

The sum of the management practice and source characteristic values determined for Part B is multiplied by the total site and transport value determined for Part A and the product is the final "P Loss Rating" for the site. This multiplicative operation assures that the fields that have the highest P Loss Rating have both a high P transport potential (large Part A value) and large source of potentially damaging P (large Part B value). If either the P transport potential (Part A) or the P source characteristics (Part B) are low, then the final P Loss Rating will be relatively low.

General Interpretation of the P Loss Ratings

The final P Loss Rating is subdivided into four interpretive categories: Low, Medium, High, and Very High. Table 2 can be used to interpret the management implications of the P Loss Rating determined for a specific site. It is important to understand that the P Loss Rating is only a relative value and is not a numeric or quantitative prediction of P loss from the field. Sites with a P Loss Rating in the "Low" category are predicted to have a relatively lower potential for P losses than sites in the "Medium" category. Sites with a P Loss Rating in the "Medium" category are predicted to have a relatively lower potential for P losses then those locations with a "High" P Loss Rating, and so on.

Using the Maryland Phosphorus Site Index

This Technical Users Guide presents the step-by-step procedure for using the Maryland P Site Index as a component of an overall agricultural nutrient management plan. Although attempts were made to make this Technical Users Guide comprehensive, nutrient management advisors and certified consultants will undoubtedly encounter real-world situations and physical circumstances that do not precisely correspond with the categorical or numerical options presented in various sections of the PSI determination. In such cases, the certified nutrient management planner should use the category or value that most accurately represents the real-world conditions or interpolate between two numeric choices. In some cases, averaging across values for a single site characteristic (weighted values) may most accurately represent the real-world conditions.

Gathering All Appropriate Information

The following is a list of information needed to determine the P Site Index, as well as the source from which to obtain the information.

Information Source #1: Farm Operator

1. Soil-test P level from soil-test report
2. Amount, analysis and type of P fertilizer applied
3. Application method and timing of P fertilizer application
4. Amount and type of manure, compost or biosolids applied
5. Application method and timing for manure, compost or biosolids application
6. Manure, compost or biosolids analysis
7. Type and width of vegetated field buffers
8. Width of "no P application zone" buffers
9. Crop rotation sequence
10. Tillage rotation sequence
11. Conservation practices such as strip or contour cropping, buffer strips, etc.
12. Artificial drainage areas (tile or mole drains)

Information Source #2: County Soil Survey

1. Predominant soil mapping unit in the field
2. Soil permeability class
3. Soil drainage class
4. Depth to seasonal high water table

Information Source #3: Watershed Map

1. Watershed name and/or number for location

Information Source #4: Field Visit

1. Distance to surface water
2. Slope of field (length and steepness)
3. RUSLE "P" practices: ridge height, furrow grade, cover management condition, number of crop strips across RUSLE slope, width of crop and/or buffer strips.

Supplies Necessary for Data Collection

The following is a list of supplies or equipment that is necessary for collecting P Site Index data.

1. P Site Index Technical Users Guide
2. Maryland NRCS RUSLE section of the PSI Training Materials
3. Maryland watershed map
4. Maryland Nutrient Management Training Manual
5. County soil survey
6. Clinometer or similar slope measuring device
7. Measuring wheel or measuring tape

Determining Values for Site Characteristics and Management Practices

On the following pages are detailed procedures for determining values for each site characteristic, management practice, and the final P Loss Rating. Manual calculation of each value can be quite time consuming. New computer software is currently being developed that will speed-up and simplify the P Site Index calculation. Although the new P Site Index computer program will expedite the calculations, the certified nutrient management consultant must ensure, as always, that the information gathered for input into the computer program accurately describes planned farm management practices.

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Table 1. The Maryland Phosphorus Site Index, April 2005.

Part A: Phosphorus loss potential due to site and transport characteristics

Characteristics	Phosphorus Loss Rating					Value
Soil Erosion (tons/acre)	**2** X tons soil loss/acre/year					
Soil Runoff Class	Negligible or Very Low **0**	Low **2**	Medium **4**	High **6**	Very High **8**	
Subsurface Drainage	Very Low **0**	Low **2**	Medium **4**	High **6**	Very High **8**	
Leaching Potential	Low **0**		Medium **2**	High **4**		
Distance From Edge of Field to Surface Water (feet)	> 100 feet **0**	< 100 feet AND >50 feet vegetated buffer OR <100 feet AND > 25 feet vegetated buffer AND > 25 feet additional no P application zone **2**	< 100 feet AND > 25 feet vegetated buffer AND < 25 ft additional no P application zone **4**	< 100 feet AND < 25 feet vegetative buffer AND > 25 feet additional no P application zone **6**	< 100 feet AND < 25 feet vegetative buffer AND < 25 ft additional no P application zone **8**	
Priority of Receiving Water	Category 2 **0**	Category 3 **1**	Category 3, Selected **2**	Category 1 **3**	Category 1, Priority **4**	

Sum of Site and Transport Characteristics:__________

Scaling Factor: ***x*** **0.02**

Total Site and Transport Value: __________

Part B: Phosphorus loss potential due to management practice and source characteristics

Characteristics	Phosphorus Loss Rating					Value
Soil Test P Fertility Index Value	**0.2** X FIV					
P Fertilizer Application Rate (lbs P_2O_5)	**0.6** X (lbs P_2O_5 / acre)					
P Fertilizer Application Method	None applied **0**	Injected/ Banded below surface at least 2" **15**	Incorporated within 5 days of application **30**	Surface applied March through November OR Incorporated more than 5 days after application **45**	Surface applied December through February **60**	
Organic P Application Rate (lbs P_2O_5)	**PSC** X (lbs P_2O_5 / acre)					
Organic P Application Method	None applied **0**	Injected/banded below surface at least 2" **15**	Incorporated within 5 days of application **30**	Surface applied March through November OR Incorporated more than 5 days after application **45**	Surface applied December through February **60**	

Total Management and Source Value:__________

PART A: Phosphorus Loss Potential Due to Site and Transport Characteristics

1. Soil Erosion: RUSLE (Revised Universal Soil Loss Equation)

$$A = R*K*LS*C*P$$

Where: A = Average annual soil loss (tons/acre/yr)
R = Runoff and erosion factor
K = Soil erodibility factor
LS = Slope length/steepness factor
C = Cover and management factor
P = Supporting practice factor

Using information already collected, each RUSLE factor is determined by:

Factor	Determined by
R	table in RUSLE manual; based on county
K	table in RUSLE manual; based on soil type
LS	table in RUSLE manual; based on slope length and steepness measured in field
C	simplified table in RUSLE manual; based on crop type and tillage
P	simplified table in RUSLE manual; based on any special practices

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How to do it

The *Maryland NRCS RUSLE* section of the PSI Training Material should be used to calculate this factor. After determining the five individual RUSLE factors, they should be multiplied together to determine A (tons soil loss/acre/year).

To find the P Site Index value for soil erosion, A (average annual soil loss) is multiplied by 2.

2. Surface Runoff Class

Soil Runoff Class is determined from the following chart:

	Soil Permeability Class (inches/hour)*				
Slope (%)	Very Rapid (> 20)	Moderately Rapid *and* Rapid (2.0 to 20)	Moderately Slow *and* Moderate (0.2 to 2.0)	Slow (0.06 to 0.2)	Very Slow (< 0.06)
Concave**	N	N	N	N	N
< 1	N	N	N	L	M
1 – 5	N	VL	L	M	H
6 – 10	VL	L	M	H	VH
11 – 20	VL	L	M	H	VH
> 20	L	M	H	VH	VH

N = negligible VL = very low L = low M = medium H = high VH = very high

* Permeability class of the *least permeable layer* within the upper 39 inches (one meter) of the soil profile. Permeability classes can be obtained from the applicable county soil survey.

Soil Permeability Classes (inches/hour):

Very Slow	< 0.06
Slow	0.06 - 0.20
Moderately Slow	0.20 - 0.60
Moderate	0.60 - 2.00
Moderately Rapid	2.00 - 6.00
Rapid	6.00 - 20.00
Very Rapid	>20.00

**Area from which no or very little water escapes by overland flow

How to do it

Move down the left-hand column to find the slope that was determined in the field. Move across the top row to find the soil permeability class that corresponds to the permeability rate of the *least permeable layer* within the upper 39 inches (one meter) of the soil profile. Soil permeability information is found in the soil survey. The intersection of the selected column and row defines the soil runoff class. The runoff class value is determined from the chart below.

Runoff Class	N or VL	L	M	H	VH
Value	0	2	4	6	8

3. Subsurface Drainage Class

The subsurface drainage class is determined from the following chart:

Depth to Seasonal High Water Table (feet)	Soil Drainage Class						
	very poorly drained	poorly drained	somewhat poorly drained	moderately well drained	well-drained soils	somewhat excessively drained	excessively drained
0 - 1	H	VH	VH	VH	VH	VH	VH
2 - 3	M	M	M	M	H	H	H
4 - 6	L	L	L	L	M	M	M
> 6	VL	VL	VL	L	L	L	L
Artificial Subsurface Drainage (any depth)	H	H	H	H	H	H	H

VL = very lowL = low M = medium H = high VH = very high

<u>How to do it</u>

Move down the left-hand column to find the seasonal high water table depth found in the soil survey. Move across the top row to find the soil drainage class found in the soil survey. The intersection of the selected column and row defines the subsurface drainage class. The presence of any artificial subsurface drainage (tile drains, mole drains, etc.) will automatically give the field a HIGH subsurface drainage class (bottom row of chart). The subsurface drainage class value is determined from the chart below.

Subsurface Drainage Class	VL	L	M	H	VH
Value	0	2	4	6	8

4. Leaching potential

The leaching potential is determined from the following chart:

Depth to Seasonal High Water	Maryland NRCS Leaching Value		
	1	2	3
0 - 1	M	H	H
2 - 3	L	M	H
4 - 6	L	M	H
> 6	L	L	M

L = low M = medium H = high

How to do it

Refer to the *PSI Leaching Potential* section of the Maryland Phosphorus Site Index training materials to find the table of Maryland NRCS Leaching Values. To find the appropriate leaching value, determine the county in which the field is located and the predominant soil type in the field (from the soil survey). Soil types (soil mapping units, *musym*) are listed alphabetically by name within each county. Move across the row for the predominant soil type to find the Maryland NRCS Leaching Value, listed as 1, 2, or 3. For most soils, a leaching value for natural, undrained conditions is listed (u_leaching). For soil types that are frequently artificially drained, a drained leaching value (d_leaching) may be listed. Use the leaching value appropriate for the field drainage situation. If no leaching value is listed for the predominant soil type, substitute the value listed for a similar, closely associated soil mapping unit.

To find the P Site Index leaching potential rating in the above chart, move down the left-hand column to find the seasonal high water table depth as listed in the county soil survey. Then, move across the top row to find the appropriate Maryland NRCS Leaching Value (1, 2, or 3). The intersection of the selected column and row defines the leaching potential classification. The leaching potential class value is determined from the chart below.

Leaching Potential Classification	L	M	H
Value	0	2	4

5. Distance from edge of field to surface water

The distance to surface water factor is determined from the following chart:

Distance and Buffer Information	Value
Greater than 100 feet to surface water	0
Less than 100 feet to surface water AND greater than 50 feet permanent vegetative buffer OR Less than 100 feet to surface water AND greater than 25 feet permanent vegetative buffer AND greater than 25 feet additional "No P Application Zone" beyond permanent vegetative buffer	2
Less than 100 feet to surface water AND greater than 25 feet permanent vegetative buffer AND less than 25 feet additional "No P Application Zone" beyond permanent vegetative buffer	4
Less than 100 feet to surface water AND less than 25 feet permanent vegetative buffer AND greater than 25 feet "No P Application Zone"	6
Less than 100 feet to surface water AND less than 25 feet permanent vegetative buffer AND less than 25 feet "No P Application Zone"	8

How to do it

Having collected the necessary information during the farm visit, simply choose the category that best describes the field conditions. For purposes of the PSI, "surface water" includes any permanent, continuous, physical conduit for transporting surface water, including permanent streams and ditches that only flow intermittently during the course of the year. The distance to surface water value is determined directly from the above chart. Permanent vegetative buffers do not receive fertilizer or manure P application.

6. Priority of Receiving Water

The priority of the receiving water, or watershed priority, was derived from the Maryland Clean Water Action Plan (December 1998). In the Clean Water Action Plan, each of Maryland's 138 "8-digit" watersheds (average area = approximately 75 square miles) was classified into three primary categories and two sub-categories:

Category 1 - Watersheds not meeting clean water and other natural resource goals and in need of restoration.

Category 1, Priority - Watersheds not meeting clean water and other natural resource goals and in most need of restoration during the next two years.

Category 2 - Watersheds currently meeting goals that need preventative actions to sustain water quality and aquatic resources.

Category 3 - Pristine or sensitive watersheds that need an extra level of protection.

Category 3, Selected - Extra-pristine or extra-sensitive watersheds that need an ultimate level of protection.

The above categories are not always mutually exclusive and some watersheds are listed under more than one category or subcategory. For purposes of the PSI, watersheds that are listed under more than one category are assigned the value corresponding to the highest priority rating associated with that watershed.

How to do it

The watershed location, watershed name, and watershed code number are determined from the Maryland Nutrient Management Training Manual County Watershed Maps. Use the "Priority of Receiving Waters: Maryland State Watersheds" table (following page) to find the priority of receiving water (Watershed Priority). The watersheds are listed in numeric order within each category, so it is easier to find the watershed by the watershed code number than by the watershed name. The priority of receiving water value is determined from the chart below.

Watershed Priority	Category 2	Category 3	Category 3, Selected	Category 1	Category 1, Priority
Value	0	1	2	3	4

Priority of Receiving Waters: Maryland State Watersheds
(Derived from Maryland Clean Water Action Plan, December 1998)

Category 1

02050301	Conewago Creek	02130104	Sinepuxent Bay
02130402	Little Choptank	02130403	Lower Choptank
02130501	Eastern Bay	02130502	Miles River
02130504	Kent Narrows	02130505	Lower Chester River
02130605	Little Elk Creek	02130705	Aberdeen Proving Ground
02131106	Middle Patuxent River	02140301	Potomac River FR County

Category 1, Priority

02130102	Assawoman Bay	02130103	Isle of Wight Bay
02130105	Newport Bay	02130203	Upper Pocomoke River
02130208	Manokin River	02130301	Lower Wicomico River
02130304	Wicomico River Headwaters	02130308	Transquaking River
02130405	Tuckahoe Creek	02130506	Langford Creek
02130507	Corsica River	02130509	Middle Chester River
02130511	Kent Island Bay	02130604	Back Creek
02130610	Sassafras River	02130611	Stillpond-Fairlee
02130701	Bush River	02130704	Bynum Run
02130706	Swan Creek	02130803	Bird River
02130807	Middle River - Browns Creek	02130901	Back River
02130902	Bodkin Creek	02130903	Baltimore Harbor
02130904	Jones Falls	02131002	Severn River
02131003	South River	02131102	Patuxent River Middle tidal
02131103	Western Branch	02131104	Patuxent River upper
02131105	Little Patuxent River	02140104	Breton Bay
02140203	Piscataway Creek	02140204	Oxon Creek
02140205	Anacostia River	02140206	Rock Creek
02140207	Cabin John Creek	02140208	Seneca Creek
02140305	Catoctin Creek	02140504	Conococheague Creek
05020203	Deep Creek Lake		

Category 2

02130101	Atlantic Ocean
02130607	Christina River

Category 3

02120203	Octoraro Creek	02120205	Broad Creek
02130106	Chincoteague Bay	02130201	Pocomoke Sound
02130204	Dividing Creek	02130205	Nassawango Creek
02130206	Tangier Sound	02130207	Big Annemessex River
02130302	Monie Bay	02130303	Wicomico Creek
02130306	Marshyhope Creek	02130307	Fishing Bay
02130401	Honga River	02130404	Upper Choptank
02130508	Southeast Creek	02130510	Upper Chester River
02130601	Lower Elk River	02130602	Bohemia River
02130606	Big Elk Creek	02130609	Furnace Bay
02130702	Lower Winters Run	02130703	Atkisson Reservoir
02130801	Gunpowder River	02130802	Lower Gunpowder Falls
02130804	Little Gunpowder Falls	02130805	Loch Raven Reservoir
02130906	Patapsco River LN	02130908	S Branch Pastapsco
02131001	Magothy River	02131004	West River
02131005	West Chesapeake Bay	02131107	Rocky Gorge Dam

Priority of Receiving Waters: Maryland State Watersheds (continued)

Category 3 (continued)

02131108	Brighton Dam	02140101	Potomac River Lower tidal
02140105	St. Clements Bay	02140106	Wicomico River
02140108	Zekiah Swamp	02140201	Potomac River Upper Tidal
02140202	Potomac River MO County	02140304	Double Pipe Creek
02140501	Potomac River WA County	02140503	Marsh Run
02140505	Little Conococheague	02140506	Licking Creek
02140508	Potomac River AL County	02140509	Little Tonoloway Creek
02141003	Wills Creek	05020202	Little Youghiogheny River

Category 3, Selected

02120201	Lower Susquehanna River	02120202	Deer Creek
02120204	Conowingo Dam Susq Run	02130202	Lower Pocomoke River
02130305	Nanticoke River	02130503	Wye River
02130603	Upper Elk River	02130608	Northeast River
02130806	Prettyboy Reservoir	02130905	Gwynns Falls
02130907	Liberty Reservoir	02131101	Patuxent River Lower tidal
02140102	Potomac River Middle tidal	02140103	St. Mary's River
02140107	Gilbert Swamp	02140109	Port Tobacco River
02140110	Nanjemoy Creek	02140111	Mattawoman Creek
02140302	Lower Monocacy River	02140303	Upper Monocacy River
02140502	Antietam Creek	02140507	Tonoloway Creek
02140510	Sideling Hill Creek	02140511	Fifteen Mile Creek
02140512	Town Creek	02141001	Potomac River Lower N Br.
02141002	Evitts Creek	02141004	Georges Creek
02141005	Potomac River Upper N Br.	02141006	Savage River
05020201	Youghiogheny River	05020204	Casselman River

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You now have all the site and transport characteristic values for **PART A**.

1) Add **PART A** values together.
2) Multiply sum by 0.02.

The product equals the **Total Site and Transport Value (Part A)**.

PART B: Phosphorus Loss Potential Due to Management Practices and Source Characteristics

1. Soil Test P

The soil-test P factor is directly determined from the soil-test report. It is imperative that soil-test P values be expressed as a Fertility Index Value, FIV, as used by the University of Maryland Soil Testing Laboratory. Soil-test P values from other soil testing laboratories must be converted to the equivalent FIV prior to use in the P Site Index. Information on interconverting among different soil test analyses can be found in the Maryland Cooperative Extension publication, *"Converting Among Soil Test Analyses Frequently Used In Maryland,"* Soil Fertility Management Information Series, SFM-4.

How to do it

To find the PSI value for soil-test P, assure that the soil-test P level has been converted to the FIV scale, and then multiply by 0.2 to find the field value. Round the result to the nearest whole number.

$$\text{FIV} \; x \; 0.2 = \text{soil-test P value}$$

2. P Fertilizer Application Rate

The planned P fertilizer application rate, expressed in pounds P_2O_5 per acre, is determined from the interview with the farm operator.

How to do it

Multiply the planned P fertilizer application rate by 0.6 to find the P fertilizer application rate value for the PSI.

$$P_2O_5 \text{ (lbs/acre) } x \; 0.6 = \text{P fertilizer application rate value}$$

3. P Fertilizer Application Method

The planned P fertilizer application method and timing are determined from the farm operator interview.

How to do it

Select the P application method that best describes the field management and assign the corresponding value from the table below. For split applications, it may be necessary to appropriately weight P fertilizer rate and P fertilizer application method values to find an "average" value for the management system.

P Fertilizer Application Method	Value
None applied	0
Injected/Banded below surface at least 2"	15
Incorporated within 5 days of application	30
Surface applied March through November **OR** Incorporated more than 5 days after application	45
Surface applied December through February	60

4. Organic P Application Rate

The planned rate of P application from organic sources (manures, biosolids, composts, etc.), expressed in pounds P_2O_5 per acre, is determined from application rate information and manure (or biosolids, compost, etc.) analyses provided by the farm operator. The organic-source P application rate is multiplied by the Phosphorus Source Coefficient (PSC) to express the relative portion of the P applied that is potentially subject to loss with surface runoff water.

<u>How to do it</u>

Multiply the organic-source P application rate (pounds P_2O_5 per acre) by the corresponding P Source Coefficient (PSC). The resulting product is the PSI organic P application rate value. The PSC table (below) is subject to future amendment. As research continues and the relative P solubilities of different organic sources are better understood, the phosphorus source coefficients (PSC) may be modified. The default PAC value of 0.6 should be used for amendments not represented in the table below.

Organic P Source	PSC
Default	0.6
Inorganic P fertilizer	0.6
Swine manure	0.6
Other manures (beef, dairy, poultry, horse, etc.)	0.5
BPR & BNR biosolids	0.5
Alum-treated manures	0.3
Biosolids (all except BPR & BNR biosolids)	0.2

If the water-soluble or water-extractable P concentration of an organic amendment is known from laboratory analysis, the PSC may be determined for that specific organic amendment material as follows:

$$PSC = 0.1 + 0.14 \times WEP^{0.86}$$

In the above equation, WEP represents the water-extractable P concentration (g P kg^{-1}) of the amendment material. The relationship between water-extractable P and PSC of various organic nutrient amendments is the subject of continuing research and, thus, the equation given is subject to change in the future.

5. Organic P Application Method

The planned organic-source P application method and timing are determined from the farm operator interview.

<u>How to do it</u>

Select the P application method that best describes the field management and assign the corresponding value from the table below. For split applications, it may be necessary to appropriately weight organic-source P rate and application method values to find an "average" value for the management system.

P Fertilizer Application Method	Value
None applied	0
Injected/Banded below surface at least 2"	15
Incorporated within 5 days of application	30
Surface applied March through November **OR** Incorporated more than 5 days after application	45
Surface applied December through February	60

You now have all the values for **PART B**.

Add **PART B** values together.

The sum equals the **Total Management and Source Value (Part B)**.

Determining the Final P Loss Rating

<u>How to do it</u>

Multiply the total site and transport value determined in Part A by the total management and source value determined in Part B. The resulting product is the final P Loss Rating.

Part A *x* Part B = P Loss Rating

Interpreting the P Loss Rating

Use the following chart to determine the farm management implications of the final P Loss Rating. It is important to understand that the P Loss Rating does not have a numeric, quantitative interpretation. The P Loss Rating conveys only a relative meaning. Those fields in the “Low” category are predicted to have a relatively lower potential for P losses than those fields in the “Medium” P Loss Rating category. Those fields in the “Medium” P Loss Rating category are predicted to have a relatively lower potential for P losses then those fields in the “High” P Loss Rating category, and so on.

P Loss Rating	Generalized Interpretation of P Loss Rating
0-50	**LOW** potential for P movement from this site given current management practices and site characteristics. There is a low probability of an adverse impact to surface waters from P losses from this site. - Nitrogen-based nutrient management planning is satisfactory for this site. - Soil P levels and P loss potential may increase in the future due to continued nitrogen-based nutrient management.
51-75	**MEDIUM** potential for P movement from this site given current management practices and site characteristics. Practices should be implemented to reduce P losses by surface runoff, subsurface flow, and erosion. - Nitrogen-based nutrient management should be implemented no more than one year out of three. - Phosphorus-based nutrient management planning should be implemented two years out of three during which time P applications should be limited to the amount expected to be removed from the field by crop harvest or soil-test based P application recommendations, whichever is greater.
76-100	**HIGH** potential for P movement from this site given current management practices and site characteristics. - Phosphorus-based nutrient management planning should be used for this site. Phosphorus applications should be limited to the amount expected to be removed from the field by crop harvest or soil-test based P application recommendations. - All practical management practices for reducing P losses by surface runoff, subsurface flow, or erosion should be implemented.
> 100	**VERY HIGH** potential for P movement from this site given current management practices and site characteristics. - No phosphorus should be applied to this site. - Active remediation techniques should be implemented in an effort to reduce the P loss potential from this site.

Definitions

Before using the P Site Index, it is important to understand the meanings of all of the factors:

Soil Erosion

Average annual sheet and rill erosion, estimated by the Revised Universal Soil Loss Equation (RUSLE) and measured in tons soil loss/acre/year.

Surface Runoff Class

Potential for water to leave the field from overland or surface flow; determined from slope and soil permeability.

Subsurface Drainage Potential

Potential for water to move below the soil surface in subsurface lateral flow; determined from depth to seasonal high water table, soil drainage class, and possible existence of artificial subsurface drainage.

Leaching Potential

Potential for water to move vertically down through the soil towards groundwater; determined by depth to seasonal high water table and the NRCS leaching potential rating which is calculated using inherent soil characteristics.

Distance from edge of field to surface water

Distance (feet) from the edge of the cropped area to the nearest surface water. Surface water includes any permanent, continuous, physical conduit for transporting surface water, including permanent streams and ditches that flow intermittently through the year. This category also includes the width of a permanent vegetated buffer strip and the possible inclusion of a "no P application zone" along the edge nearest water.

Priority of Receiving Water

A listing derived from the *Maryland Clean Water Action Plan (1998)* which ranks watersheds using many water quality and aquatic habitat assessment factors.

Soil Test P

The relative amount of plant available P in the soil determined by a soil test and reported as FIV (Fertility Index Value).

P Fertilizer Application Rate

P applied as manufactured, commercial fertilizer; expressed as pounds P_2O_5 per acre.

P Fertilizer Application Method

P fertilizer placement and timing; includes injected, surface applied (including date of surface application), and incorporated (including time after application to incorporation).

Organic P Application Rate

Organic-source P application rate, expressed as pounds P_2O_5 per acre, modified by P Availability Coefficient (PAC) that is organic-source dependent.

Organic P Application Method

Organic-source P placement and timing; includes injected, surface applied (including date of surface application), and incorporated (including time after application to incorporation)

NOTES FOR FIELD MEASUREMENTS

SLOPE

Steepness should be measured using a standard clinometer (available through any forestry supply catalog). This technique should not be attempted without guidance from a trained professional. Although not difficult, it takes some practice to learn how to take this measurement. It helps to have another person in the field at which to aim the clinometer.

Length can be measured using a measuring wheel or tape, or estimated by counting the number of steps it takes to walk the slope. An experienced professional can estimate by just looking at the slope. Although not difficult, it takes some practice to learn how to estimate this measurement.

DISTANCE TO SURFACE WATER

This distance should be measured using a measuring tape. When looking at this distance, one must also note the existence of a vegetated buffer. Included in this category is the possibility of a “25 foot no P application zone.” This is simply a 25-foot wide area adjacent to any surface water or vegetated buffer which has had no P applied to it. This is typically not measured in the field, but is determined by talking to the farm operator. It is a possible management practice that may be implemented to lower the final P Loss Rating for a field.

ARTIFICIAL DRAINAGE

Tile drainage should be noted if it exists in any field, as it affects the subsurface drainage potential factor.

CONSERVATION CROPPING PRACTICES

Special practices are also important to note, as these will affect the “P” factor in the RUSLE calculation. To determine the P factor, it is important to note hydrologic soil group, ridge height, furrow grade, and cover management condition (throughout the entire rotation).