TECHNICAL NOTES

USDA-Natural Resources Conservation Service
Boise, Idaho

TN - Water Quality No. 5 ***August 2005***

PHOSPHORUS TRANSPORT RISK ASSESSMENT:
A Phosphorus Assessment Tool

This Phosphorus Transport Risk Assessment is a 9 x 6 matrix that uses a limited number of landform site and management characteristics to determine the probability of off-site transport of phosphorus. The assessment can be used as a stand-alone site evaluation or as part of an overall planning process imbedded within the ONEPLAN Nutrient Management Planner program. The assessment, together with a nutrient management plan, is used as a tool for understanding the contribution that individual landform and management parameters have on phosphorus transport, and the potential for applied conservation practices (Best Management Practices) to mitigate situations where transport can occur.

Phosphorus Concerns in the Environment

Eutrophication can be caused by the nutrient enrichment of a water body. Nutrient movement in runoff and erosion from agricultural non-point sources is a resource management concern. The movement of phosphorus (P) in runoff from agricultural land to surface water can accelerate eutrophication. Undesirable aquatic plant growth results from additions of phosphorus to the water. The net result of the eutrophic condition and excess plant growth is the depletion of oxygen in the water due to the heavy oxygen demand by microorganisms as they decompose organic material. Past control efforts have focused on identification and control of point source inputs of P to surface waters. Recent emphasis has shifted to management strategies to minimize the non-point movement of P in the landscape. Phosphorus is generally the limiting nutrient in fresh water systems and any increase in P usually results in more aquatic vegetation. Although there are no direct human health impacts from eutrophication of surface waters, society is concerned about maintaining clean water, especially for drinking water purposes. This concern now includes a cost for removing the color, taste and odor associated with the high trophic condition and vegetation growth in surface water due to excess nutrients.

Phosphorus Movement Factors

The main factors influencing P movement can be separated into the transport, phosphorus source and phosphorus management factors. Transport factors include the mechanism by which P moves within the landscape. These are rainfall, irrigation, erosion and runoff. Factors which influence the source and amount of P available to be transported are soil P content and form of P applied. Phosphorus management factors include the method of application, timing and placement in the landscape as influenced by the management of application equipment and tillage.

Phosphorus Movement in the Landscape

Phosphorus movement in runoff occurs as particulate P and dissolved P. Particulate P is attached to mineral and organic sediment as it moves with the runoff. Dissolved P is in the water solution. In general, particulate P is the major portion (75-90%) of the P transported in runoff from cultivated land. Dissolved P makes up a larger portion of the total P in runoff from non-cultivated lands such as pastures and fields with reduced tillage. In terms of its impact on eutrophication of water bodies, particulate P becomes less available to algae and plant uptake than dissolved P because of the chemical form it has with the mineral (particularly iron, manganese, aluminum, or calcium amorphous oxides and silicates) and organic compounds. The availability of particulate P to plants and algae is variable, ranging from 10 - 90% of the total P, yet can represent a long-term source of P for algae and plant uptake from the water body. Dissolved P is 100% bioavailable to plants. Added together, the bioavailable portion of particulate P and the dissolved P represent the phosphorus that promotes eutrophication of surface waters.

The method by which P in both particulate and dissolved form moves within the landscape is simplified in the following description. Eroding soil material is transported by runoff. During detachment and movement of sediment in runoff, the finer clay-sized fraction of the source material is preferentially eroded. The P content and reactivity of the eroded material to P are usually greater than the source soil from which it was eroded. The suspended sediment in the runoff can rapidly adsorb the dissolved P in the runoff water.

As runoff moves from the landscape toward the water body, there is generally a progressive dilution of P through additions of water and a reduction in the amount of sediment carried due to sediment deposition. Phosphorus may become more bioavailable by the sorption and desorption processes, and by the preferential transport of clay-sized material as sediment moves over the landscape.

The movement of dissolved P begins with desorption, dissolution, and extraction of P from the soil, plant and organic material. These processes occur when rain and runoff water interact with the thin layer of surface soil (0.05 - 0.10 inches). Some water infiltrates into the soil and percolates through the profile where desorption of P will result in a low dissolved concentration in subsurface and return flow. High dissolved P concentration can be expected in the water percolating through organic, coarse-textured, and oxygen depleted (reduced), water-logged soils. Soil pH also affects the movement and availability of phosphorus.

The interaction between the particulate and dissolved P in the runoff is very dynamic and the mechanism of transport is complex. Therefore, it is difficult to predict the transformation and ultimate fate of P as it moves through the landscape.

The Concept

The purpose of the Phosphorus Transport Risk Assessment is to provide field staffs, watershed planners and land users with a tool to assess the various landforms and management practices for potential risk of phosphorus movement to water bodies. The assessment ranking identifies sites where the risk of phosphorus movement may be relatively higher than that of other sites. When the parameters of the assessment are analyzed, it will become apparent that an individual parameter or parameters may be influencing the assessment disproportionately. These identified parameters can be the basis for planning corrective soil and water conservation practices and management techniques. If successful in reducing the movement of phosphorus, the concern of phosphorus enrichment will also be reduced.

A number of soil, hydrology and land management site characteristics will describe the landform. The Phosphorus Transport Risk Assessment (Table 1) is a simple 9 by 6 matrix utilizing parameters that can have an influence on phosphorus availability, retention, management and movement. These nine site characteristics are:

- Soil test P (available phosphorus in soil laboratory test units relative to the *Phosphorus Threshold* per Idaho Nutrient Management Practice Standard 590)
- P fertilizer application rates (in pounds available phosphate per acre)
- P fertilizer application methods
- Organic P source application rates (in pounds available phosphates per acre)
- Organic P source application methods
- Runoff index/runoff class
- Runoff conservation practices
- Sheet and rill or irrigation-induced soil erosion (in tons per acre per year)
- Distance to the nearest receiving water body

Field specific data for the nine site characteristics selected for this version (Table 1) of the Phosphorus Transport Risk Assessment are readily available at the field level. Some analytical testing of the soil and organic material is required to determine the rating levels. This soil and material analysis is considered essential as a basis for the assessment.

The nine site characteristics (described below) used in the assessment are rated as VERY LOW/NOT APPLICABLE, LOW, MEDIUM, HIGH, or VERY HIGH (and some use CRITICAL) by determining the range for each category. The sum of the site characteristic rankings provides an index of the potential for off-site phosphorus transport (Table 2).The following describes how the assessment functions within ONEPLAN, but the descriptions and rating categories also apply to the worksheet and spreadsheet formats as well.

Soil P Test

A soil sample from the site is necessary to assess the relative level of "plant available P" in the surface layer of the soil. The plant available P is the level customarily given in a soil test analysis by the Cooperative Extension Service or commercial soil test laboratories. The Assessment uses ranges of soil test P. The Olsen, Bray I, or Morgan soil test P methods are required by the NRCS Idaho Nutrient Management Standard depending upon the soil pH. The soil test level for "plant available P" does not ascertain the total P in the surface soil. Rather, it gives an indication of the relative amount of total P that may be present because of the general relationship between the forms of P (organic, adsorbed, and labile P) and the solution P available for plant uptake. If a soil test P result is above the P threshold as identified in the Idaho Nutrient Management Standard (590), the category automatically defaults to CRITICAL. The threshold value differs depending on whether there is a surface water concern (0-12” soil test used) or a ground water concern (18-24” soil test used).

P Fertilizer Application Rate
The P fertilizer application rate is the amount, in pounds per acre (lbs/ac), of commercial phosphate fertilizer (P_20_5) applied to the soil. This phosphate fertilizer does not include phosphorus from organic sources that are recorded in Organic P Sources Application Rate.

P Fertilizer Application Method
The manner in which P fertilizer is applied to the soil affects potential P movement. Incorporation implies that the fertilizer P is buried below the soil surface. If fertilizer is surface applied on a field with surface runoff (natural or from irrigation) and there is no incorporation, it is considered a significant risk and therefore the category automatically defaults to CRITICAL.

Organic P Source Application Rate
The organic P application rate is the amount, in pounds per acre (lbs/ac), of potential phosphate (P_20_5) contained in the manure and applied to the soil. This organic phosphate source does not include phosphorus from fertilizer sources that are recorded in P Fertilizer Application Rate.

Organic P Source Application Method
The manner in which organic P material is applied to the soil can determine potential P movement. Incorporation implies that the organic P material is buried below the soil surface. If manure is surface applied on a field with surface runoff (natural or from irrigation) and there is no incorporation, it is considered to be a discharge and a violation of existing regulations. Because of this, the category automatically defaults to CRITICAL.

Runoff Class/Runoff Index
Runoff Class: The runoff class of the site is used for non-irrigated lands. One method to determine the runoff class is based on the soil permeability and the percent slope of the site (USDA-NRCS Soil Survey Manual, Agricultural Handbook 18, 1993). This is the method used within ONEPLAN. The matrix relating soil permeability class and slope (Table 3) provides the value categories: NEGLIGIBLE, VERY LOW, LOW, MEDIUM, HIGH and VERY HIGH.

Runoff Index: The runoff index of the site is used for irrigated lands. For surface irrigated lands, the runoff index is:

$$RI = (1 – (Tf /Ts) \times 100$$

where Tf is the time to reach the end of the furrow, and Ts is the set time (both in hours). For sprinkler irrigated lands, the runoff index is simply the percent of irrigation water applied that runs off (user estimate).

Runoff Conservation Practices
Runoff conservation practices include any conservation practices which serve to reduce runoff and the movement of soil, thereby reducing potential for runoff phosphorus and/or sediment attached phosphorus movement across the landscape toward a receiving water body. Runoff conservation practices are separated into on-field and off-field categories. Off-field conservation

measures, like buffers, receive runoff from a given field and attempt to mitigate or reduce the eventual loss and transport of P to a receiving water body. The rating system utilized by the assessment progresses from a situation where there is little runoff risk and runoff conservation practices are in place, to severe runoff problems with no mitigating practices.

Soil Erosion
Soil erosion is defined as the loss of soil along the slope or unsheltered distance caused by the processes of water and wind. Soil erosion is estimated from erosion prediction models including the Revised Universal Soil Loss Equation (RUSLE/RUSLE2) for water erosion from non-irrigated lands (and sprinkler irrigated lands if runoff exists) and the Surface Irrigation Soil Loss equation (SISL) for water erosion from surface irrigated lands. The Wind Erosion Equation (WEQ) is generally not used in this assessment. The value category is given in tons of soil loss per acre per year (ton/ac/yr). These soil loss prediction models do not predict sediment delivery rates from the end of a field to a water body. The prediction models are used in this assessment to indicate the potential for sediment and attached phosphorus movement across the slope or unsheltered distance and toward a water body.

Distance to Nearest Receiving Water Body
The distance to the nearest receiving water body is the distance in feet between the edge of the field and the nearest receiving water body. The closer the distance the greater the likelihood that the majority of the phosphorus lost from the field will reach the receiving water body.

Procedures for Making an Assessment

Assessments can be made by hand using the Risk Assessment Worksheet (Attachment 1), or electronically using ID Phosphorus Transport Risk Assessment EXCEL spreadsheet (see Attachment 2). The nutrient management component of ONEPLAN contains the same Risk Assessment. The site characteristics were assigned a weighting based on probable contribution to potential phosphorus movement from the site. There is scientific basis for concluding that these relative differences exist; however, the absolute weighting factors given are currently based on professional judgment.

The site characteristic weighting factors are:

- Soil test phosphorus (1.00)
- P fertilizer application rate (0.75)
- P fertilizer application method (0.50)
- Organic P source application rate (1.00)
- Organic P source application method (0.75)
- Runoff class/runoff index (0.50)
- Runoff conservation practices (1.00)
- Soil erosion/irrigation erosion (1.00)
- Distance to nearest receiving water body (1.00)

A log base of 2 is used for the rating categories (with the exception of the CRITICAL rating). Therefore, a VERY LOW rating is assigned 0 points, while a VERY HIGH rating is assigned 8 points. The higher the point value, the greater the potential for significant problems related to phosphorus movement. The value ratings for each factor are provided in Table 1.

References

Cyzemmek, KJ, QM Ketterings, and L Geohring. 2001. Phosphorus and agriculture VIII: The new phosphorus index for New York state. What's Cropping Up? 11: 1-3.

Lemunyon, JL, and TC Daniel. 2002. Quantifying phosphorus losses from the agricultural system. J. Soil and Water Conservation 57: 399-401.

NRCS Conservation Practice Standard, Nutrient Management, Idaho 590.

NRCS, Engineering Technical Note, Series 1901. A Phosphorus Assessment Tool, August 1994.

Sharpley, AN, T Daniel, T Sims, J Lemunyon, R Stevens, and R Parry. 2003. Agricultural phosphorus and eutrophication (second edition). USDA-Agricultural Research Service, ARS-149.

Table 1. Phosphorus Transport Risk Assessment. The sum of all weighted rating values is used to determine the site vulnerability.

Site Characteristic	Factor Weight	Rating and Weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Soil Test (ppm) 0-12"	Olsen Method 1.0	< 8	8 - 15	15 - 25	25 - 35	35 - 40	> Threshold[1]
Soil Test (ppm) 0-12"	Bray I Method 1.0	< 10	10 - 20	20 - 40	40 - 50	50 - 60	> Threshold[1]
Soil Test (ppm) 0-12"	Morgan (NaOAc) Method 1.0	< 1.0	1.0 – 2.0	2.0 – 4.0	4.0 – 5.0	5.0 – 6.0	> Threshold[1]

[1] The threshold value for the critical rating depends on whether the field has a **ground water or surface water concern**. For surface water concerns, the threshold values for Olsen, Bray and Morgan, respectively, are 40 ppm, 60 ppm and 6 ppm determined at the 0 – 12" depth. For ground water concerns within 5 feet of the surface, the threshold for the soil test P determined at 18-24" is 20 ppm, 25 ppm or 2.5 ppm for Olsen, Bray and Morgan, respectively; if the ground water concern is > 5 feet, then the threshold is 30 ppm, 45 ppm or 4.5 ppm for Olsen, Bray and Morgan, respectively. All other rating categories only refer to surface water concerns and the 0-12" soil test.

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Phosphorus Fertilizer Application Rate (lbs/ac P_2O_5)	0.75	0	< 60	60 - 150	151- 300	> 300	

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Phosphorus Fertilizer Application Method	0.5	0	Placed with planter or injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Irrigated or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied on a field with surface runoff (natural or from irrigation) and no incorporation

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Organic Phosphorus Application Rate (lbs/ac P_2O_5)	1	0	< 40	40 - 100	101 - 200	> 200	

Table 1. Continued.

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Organic Phosphorus Application Method	0.75	0	Injected > 2" or plowed	Incorporated > 3" by disking or chiseling, etc.	Irrigated or incorporated < 3" by harrowing, etc.	Surface applied, no incorporation	Surface applied, on a field with surface runoff (natural or from irrigation) and no incorporation.

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Runoff Index (Surface Irrigated)	0.5	< 10	10 - 20	20 - 40	40 - 60	> 60	
Runoff Index (Sprinkler Irrigated)	0.5	< 5	5 - 10	10 - 20	20 - 40	> 40	
Runoff Class (Non-irrigated)	0.5	Negligible	Very low or low	Medium	High	Very High	

Runoff Index for Surface Irrigated = [1 - (Time for water to reach end of furrow / Set time)] x 100
Runoff Index for Sprinkler Irrigated = (Amount runoff/amount water applied) x 100

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Runoff Conservation Practices	1	No runoff with conservation practices	No runoff with no conservation practices	Runoff with onsite and offsite conservation practices	Runoff with onsite or offsite conservation practices	Runoff with no conservation practices	

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Soil Erosion	1	0	< 5 tons/acre	5 - 10 tons/acre	10 - 15 tons/acre	> 15 tons/acre	

Site Characteristic	Factor Weight	Rating and weight					
		Very Low or N.A. 0	Low 1	Med 2	High 4	Very High 8	Critical 50
Distance to Surface Water Body	1	> 2640 feet (> 0.5 mile)	2640 - 1320 feet	1319 - 600 feet	599 - 200 feet	< 200 feet	

Table 2. Phosphorus Transport Risk Assessment Index rating and sit e vulnerability.

Phosphorus Transport Risk Assessment Rating	Total	Site Vulnerability Chart
LOW	< 10	Low potential for phosphorus loss if current farming practices are maintained.
MEDIUM	10 - 20	Medium potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probability of phosphorus loss.
HIGH	21 - 40	High potential for P loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of phosphorus loss.
VERY HIGH	> 40	Very high potential for phosphorus loss and adverse effects on surface and/or ground waters. All necessary soil and water conservation measures and a nutrient management plan must be implemented to minimize phosphorus loss from this field.

Table 3. The surface RUNOFF CLASS site characteristic determined from the relationship of the soil permeability class and field slope. Adapted from NRCS Soil Survey Manual (1993) Table 3-10.

Slope (%)	Soil Permeability Class [1] *(in/hr)*				
	Very Rapid *(>20.00 in/hr)*	Moderately Rapid and Rapid *(2.00 – 20.00)*	Moderately Slow and Moderate *(0.20 – 2.00)*	Slow *(0.06 - 0.20)*	Very Slow *(< 0.06 in/hr)*
	Runoff Class [3]				
Concave [2]	N	N	N	N	N
< 1	N	N	N	L	M
1 - 5	N	VL	L	M	H
5 - 10	VL	L	M	H	VH
10 - 20	VL	L	M	H	VH
> 20	L	M	H	VH	VH

[1] Permeability class of the least permeable layer within the upper 39 inches (one meter) of the soil profile. Permeability classes for specific soils can be obtained from a published soil survey or from local USDA-NRCS field offices (soils database).
[2] Area from which no or very little water escapes by overland flow.
[3] RUNOFF CLASS: N = negligible, VL = very low, L = low, M = medium, H = high, VH = very high.

Table 4. Management options to minimize nonpoint source pollution of surface waters by soil P (from Sharpley et al. 2003).

P Risk Assessment	Management Options
< 10 (Low)	***Soil testing:*** Test soils for P annually to monitor buildup or decline in soil P, and to determine if plant available P meets crop requirements. ***Soil conservation:*** Follow good soil conservation practices. Consider effects of changes in tillage practices or land use on potential for increased transport of P from site. ***Nutrient management:*** Consider effects of any major changes in agricultural practices on P loss *before* implementing them on the farm. Examples include increasing the number of animal units on a farm or changing to crops with a high demand for fertilizer P.
10 to 20 (Medium)	***Soil testing:*** Test soils for P annually to monitor buildup or decline in soil P, and to determine if plant available P meets crop requirements. Conduct a more comprehensive soil testing program in areas identified by the P Assessment as most sensitive to P loss by surface runoff, subsurface flow and erosion. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders. grassed waterways. and improved irrigation and drainage management). ***Nutrient management:*** Any changes in agricultural practices may affect P loss. Carefully consider the sensitivity of fields to P loss before implementing any activity that will increase soil P. Avoid broadcast applications of P fertilizers and apply manure only to fields with low P Assessment values.
21 to 40 (High)	***Soil testing:*** A comprehensive soil testing program should be conducted on the entire farm to determine fields that are most suitable for further additions of P. For fields with excessive P in soils, estimate the time required to deplete soil P to optimum levels for use in long-range planning. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders, grassed waterways, buffers, and improved irrigation and drainage management). Consider using crops with high P removal capacities in fields with high P Assessment values. ***Nutrient management:*** In most situations involving fertilizer P, only a small amount used in starter fertilizers is needed. Manure may be in excess on the farm and should only be applied to fields with lower P Assessment values. A long-term P management plan should be considered.
> 40 (Very High)	***Soil testing:*** For fields with excessive P in soils, estimate the time required to deplete soil P to optimum levels for use in long-range planning. Consider using new soil testing methods that provide more information on environmental impact of soil P. ***Soil conservation:*** Implement practices to reduce P loss by surface runoff, subsurface flow, and erosion in the most sensitive fields (i.e., reduced tillage, field borders, grassed waterways, buffers, and improved irrigation and drainage management). Consider using crops with high P removal capacities in fields with high P Assessment values. ***Nutrient management:*** Fertilizer and manure P should not be applied for 3 years or more. A comprehensive, long-term P management plan must be developed and implemented.

Use And Precautions of the Phosphorus Transport Risk Assessment

The Phosphorus Transport Risk Assessment is a planning tool that can be used in resource management plans, for water and soil quality, nutrient management and ecosystem based planning assistance in watersheds. Its intended use is to help the planner communicate to the land user the relative potential for phosphorus movement in the landscape. It can aid in identifying the critical parameters of soil, topography and management that most influence P movement. Using these parameters, the assessment can then help in the selection of management alternatives that would significantly address the potential impact and reduce phosphorus risk (Table 4). Quality criteria for surface and ground water resource concerns cite the NRCS Nutrient Management 590 practice standard. The *Additional Criteria to Protect Quality on Vulnerable Sites* section of the standard states that "resource and or environmental concerns identified by the analysis (assessment) will be addressed with inclusion of needed conservation practices to address the concern." A risk assessment of LOW to MEDIUM signifies that the producer should consider including conservation practices in their conservation plan that will correct or mitigate for identified resource concerns. A risk assessment of HIGH or CRITICAL requires that the producer plan and apply conservation practices which will correct or mitigate for the resource concern(s) identified during the planning process.

THE PHOSPHORUS TRANSPORT RISK ASSESSMENT IS NOT INTENDED TO EVALUATE WHETHER LAND USERS ARE ABIDING WITHIN REGULATORY RULES OR LAWS THAT HAVE BEEN ESTABLISHED BY LOCAL, STATE, OR FEDERAL AGENCIES. Any attempt to use this assessment at a regulatory scale would be grossly beyond the intent of the assessment tool and the concept and philosophy of the working group that developed the assessment. The NRCS does not condone or promote the use of the assessment for placing any restrictions on land use or other regulatory purposes that could be construed by manipulating the parameters of the assessment. Field testing of the assessment is one of the most appropriate methods for determining the value of the assessment and whether it is giving valid and reasonable results.

ATTACHMENT 1: Conducting a Risk Analysis by Hand

Complete the heading on the Idaho Phosphorus Risk Assessment Worksheet, and enter the Tract and Field numbers in columns A - F. Planning units which have more than six fields will require additional worksheets. Note that each column is divided into 2 subcolumns below the tract and field numbers. The first subcolumn is the "*RATING*" and the second subcolumn is "*RATING X FW*". The value rating for a given site characteristic derived from Table 1 is entered in the first subcolumn on the Worksheet, then multiplied by the weighting factor (FW) for that site characteristic. The result is entered in the second subcolumn. The process is repeated for each site characteristic and then totaled at the bottom of the second subcolumn for each field. The total is used to determine the overall Risk Level for each field using the Site Vulnerability Chart below the worksheet.

Example:

1. The Olson soil test for Field A is 15 ppm.
2. From Table 1, an Olson soil test value of 15 ppm results in a medium rating. Medium ratings have a value of 2.
3. The value 2 is entered in the first subcolumn for Field A.
4. Multiply the rating value of 2 by the Factor Weight (in this case 1.0) to get the weighted value for that site characteristic and enter in the second subcolumn. In this case, the value of 2 X Factor Weight of 1 = 2. The weighted value of 2 is entered in the second subcolumn. Repeat process for each characteristic of the assessment.
5. Sum the weighted values for all nine characteristics, and compare the total with the Site Vulnerability chart at the bottom of the Worksheet to determine the final rating for that field.

IDAHO PHOSPHORUS TRANSPORT RISK ASSESSMENT

Landowner: ______________________________________ Date: __________ Pg: __ of __

Location: ________________________________ Condition: Before _________ After: ______

Planner: ______________________________________ Field Office: __________________

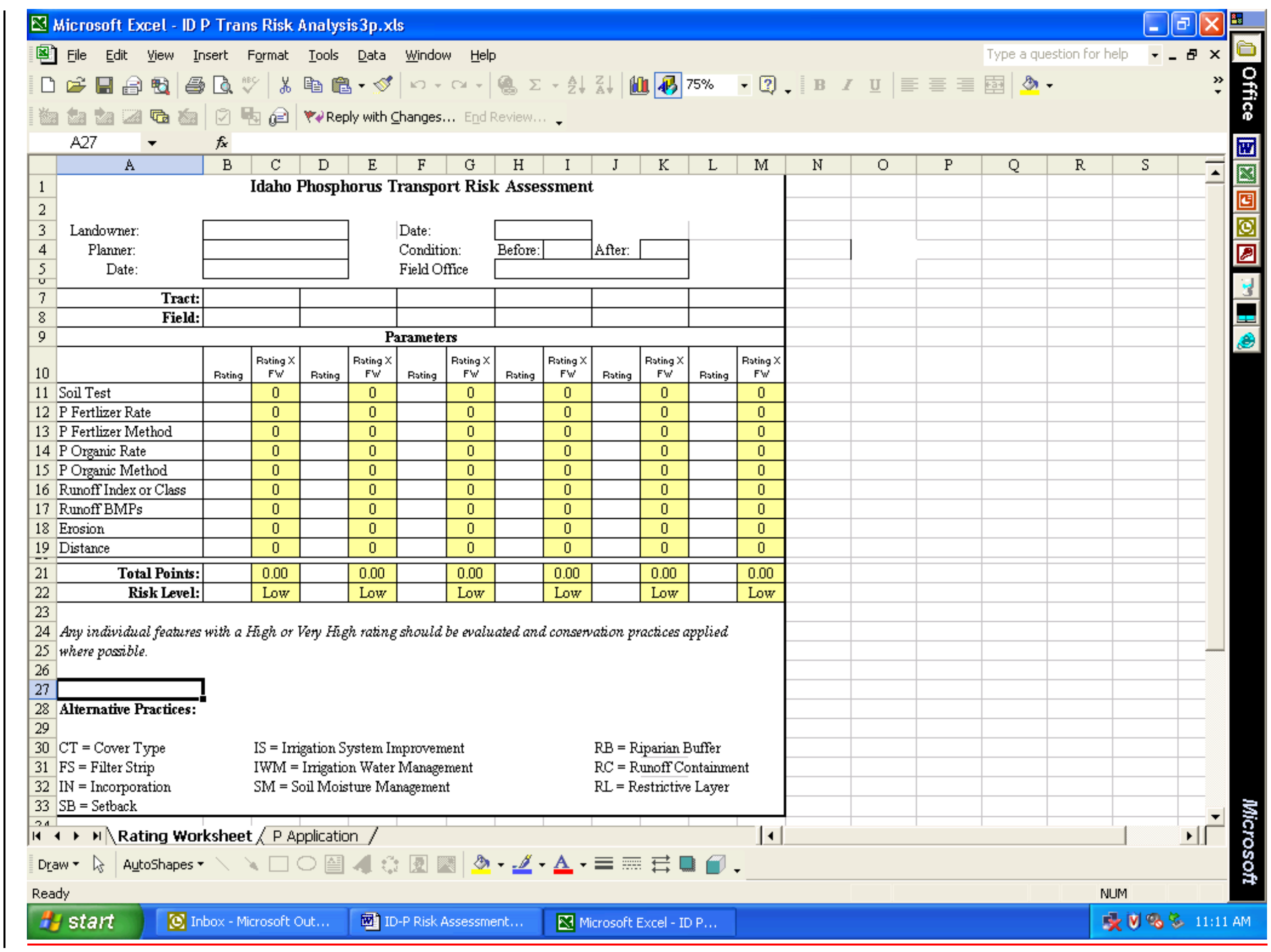
	A		B		C		D		E		F	
Tract												
Field(s)												
	Rating	*Rating X FW*	*Rating*	*Rating X FW*	*Rating*	*Rating X FW*	*Rating*	*Rating X FW*	*Rating*	*Rating X FW*	*Rating*	*Rating X FW*
Soil Test P *Factor Weight (FW) = 1.0*												
P Fertilizer Rate *Factor Weight (FW) = 0.75*												
P Fertilizer Method *Factor Weight (FW) = 0.50*												
P Organic Rate *Factor Weight (FW) = 1.0*												
P Organic Method *Factor Weight (FW) = 0.75*												
Runoff Index (Irrigated) **OR** Runoff Class (Not Irrigated) *Factor Weight (FW) = 0.50*												
Runoff Conserv. Practices *Factor Weight = 1.0*												
Soil Erosion *Factor Weight = 1.0*												
Distance to Water Body *Factor Weight = 1.0*												
Total Points												
Risk Level												

P Index Rating	**Total**	**Site Vulnerability Chart**
Low	< 10	Low potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probably loss.
Medium	10 - 20	Medium potential for phosphorus loss. Some remediation measures should be undertaken to minimize the probability of phosphorus loss.
High	21- 40	High potential for P loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of phosphorus loss.
Very High	> 40	Very high potential for phosphorus loss and adverse effects on surface and/or ground waters. All necessary soil and water conservation measures and a phosphorus management plan must be implemented to minimize phosphorus loss from this field.

ATTACHMENT 2: Conducting a Risk Analysis using ID Phosphorus Transport Risk Assessment EXCEL Spreadsheet

Access the spreadsheet and immediately rename it. There are two tabs at the bottom of the spreadsheet, the "Rating Worksheet" and "P Application". The Rating Worksheet is used to input the ratings determined from either the P Application sheet or Table 1 in this Technical Note.

1. Select the Rating Worksheet and complete the heading.
2. Reference Table 1 or the P Application sheet and determine the rating (e.g. Very Low, Low, etc.) for the appropriate site characteristic.
3. Determine the corresponding rating. For example, an Olson soil test of 15 ppm has a Medium rating and a rating value of 2.
4. Click on the appropriate cell and select the correct rating value from the drop down list. The program automatically calculates the weighted value of each rating as it is entered, totals it at the bottom and determines the overall Risk Level.



ATTACHMENT 3: Example for Conservation Planning

Site Characteristic and Rating Value	Factor Weighting X Rating Value
Soil P test is 35 ppm using an Olsen Test =HIGH (value = 4) [Field has a surface water resource concern]	1.0 x 4 = 4.0
P fertilizer application rate is 50 lbs/ac P_2O_5 =LOW (value = 1)	0.75 x 1 = 0.75
P fertilizer application method is placed with planter =LOW (value = 1)	0.5 x 1 = 0.5
Organic P source application rate is 210 lbs/ac =VERY HIGH (value = 8)	1.0 x 8 = 8.0
Organic P source application method is incorporated less than 3 inches by harrowing, etc. =HIGH, (value =4)	0.75 x 4 = 3.0
Runoff class from Table 3 is Medium =MEDIUM (value = 2)	0.5 x 2 = 1.0
Runoff conservation practices is runoff with no on-field or off-field practices =VERY HIGH (value = 8)	1.0 x 8 = 8.0
Soil erosion is 7.5 tons/ac/yr = MEDIUM (value = 2)	1.0 x 2 = 2.0
Distance to nearest receiving water body is 300 feet =HIGH (value = 4)	1.0 x 4 = 4.0
	Sum total of all weighted values = 30.25

Site Vulnerability is **HIGH**

> **HIGH** - This site has a HIGH potential for P loss and adverse effects on surface and/or ground waters. Soil and water conservation measures and phosphorus management plans are needed to reduce the probability of phosphorus loss.

Using the individual site characteristics, identify some factors of concern and management options that could be used to reduce this site vulnerability:

Soil P Test – The soil P test was HIGH. Remember that the soil test level for "available P" does not ascertain the total P in the surface soil. It does, however, give an indication of the amount of total P that may be present because of the general relationship between the forms of P and the solution P available for crop uptake. Research has conclusively shown that the higher the soil test P level of a site, the proportionately higher the potential P loss will be from that site. Therefore the long-term goal should be to conduct a comprehensive soil testing program on the entire farm to determine fields with lower soil test P levels that are more suitable for additions of phosphorus. For fields with excessive P levels, estimates should be made to determine the time required to deplete the soil P to optimum levels.

Organic P Source Application Rate – The organic P source application rate was > 200 lbs/ac, falling in the VERY HIGH category. This particular site characteristic is especially important. Here we have a field with a soil test P level that is already high and very high rates of organic P are being applied. Considering the long-term management options discussed under Soil P Test, the organic P application rate should either be reduced to crop P uptake or less, or no organic P should be applied to this field until the soil P is depleted back to an optimal level. The organic P material should be applied to fields with lower soil P test and Vulnerability Assessment values.

Organic P Source Application Method – The organic P source application method was incorporated less than 3 inches with a harrow, etc. putting it in the HIGH category. Remember that the manner in which organic P material is applied to the soil can determine potential P movement. Since the organic P was only minimally incorporated, the organic P would still have a substantial surface exposure. Mechanical incorporation reduces the amount of nutrients in the thin mixing zone at the soil surface and/or on crop residue or foliage, thus reducing the interaction with and transfer of nutrients to runoff water. With incorporation, other environmental losses may also be reduced, and nutrient management may be improved. However, mechanical incorporation with tillage may reduce soil protecting crop residue and increase erosion. Incorporated material may be subject to downward movement. Leaching losses may be increased, and the relative importance of the different loss pathways needs to be considered. The organic P material should be injected or plowed greater than 2 inches if possible, and applied immediately before the crop is planted.

Runoff Conservation Practices – Since there was runoff with no conservation practices in place, this factor fell into the VERY HIGH category. By implementing both on-site and off-site conservation measures, this site factor could be greatly reduced (see Soil Erosion).

Soil Erosion – The soil erosion rate was 7.5 tons/ac/yr (MEDIUM category). Prediction models are used in the assessment to indicate a movement of soil, thus potential for sediment and attached phosphorus movement across the slope or unsheltered distance and to a water body. Conservation measures such as residue management or reduced tillage should be considered as a way to reduce erosion. In addition, other conservation measures like field borders, grassed waterways, buffers and improved drainage management should be considered as a means to mitigate off-site transport and improve the quality of runoff leaving the field.

Sites with a vulnerability rating greater than LOW (especially those in the HIGH and VERY HIGH category) have the greatest potential to adversely impact surface water quality. The assessment can be used to identify management options available to land users and will allow them flexibility in developing remedial strategies. The first step is to address areas adjacent to sensitive waters and prioritize the efforts needed to reduce P losses. Then, management options appropriate for soils with different P risk assessment ratings can be implemented. General recommendations are given in Table 4. However, P management is very site specific and requires a well-planned, coordinated effort among farmers, extension agronomist and soil conservation specialist. The risk level can be reduced by planning conservation practices which will mitigate off-site transport of phosphorus. For example, a particular field has a soil erosion rate of 13 tons/acre. That erosion rate falls into the HIGH soil erosion rating and has a value of 4. To correct the problem, the producer applies a suitable system of BMPs and reduces the erosion rate to < 5 tons/acre. A LOW rating of 1 is now used to determine the overall risk.