TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE — NATURAL RESOURCES CONSERVATION SERVICE
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WATER QUALITY TECHNICAL NOTE NO. 2 (Revised)

THE PHOSPHORUS INDEX

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The Phosphorus Index (PI) is an integrated approach to estimating the relative potential for off-site movement of phosphorus from individual fields on the landscape. Soil and field characteristics, as well as management practices that influence potential P movement to surface water, are identified. The purpose of the Phosphorus Index is to provide field personnel, watershed planners, and land managers with a tool to assess these site characteristics and management practices to reduce the potential risk of phosphorus transport into surface waters. Conservation planners can use the PI to develop conservation system alternatives that will reduce the risk of phosphorus transport.

Phosphorus Concerns in the Environment

Phosphorus is an important nutrient needed for crop production. Many fertilizers and organic sources are used to supplement the supply of available phosphorus (P) in soils. However, there are environmental concerns when excess amounts of P and other nutrients from various sources reach water bodies. Phosphorus from soil, manure, fertilizer, and runoff, or subsurface flow that reach surface water can accelerate eutrophication. Eutrophication is defined as an increase in the fertility status of natural waters that causes accelerated growth of algae or aquatic plants. The net result of a eutrophic condition is the depletion of oxygen in the water due to the heavy oxygen demand by microorganisms as they decompose the organic material. Phosphorus is generally the limiting nutrient in fresh and brackish water systems. Any increase in P commonly causes an increase in the growth of aquatic vegetation.

Phosphorus Movement in the Landscape

Nutrient movement in runoff and erosion from agricultural non-point sources is a resource management concern. Phosphorus movement in runoff occurs in sediment-bound and dissolved forms. Sediment-bound P is attached to mineral and organic particles and is transported during erosion events. In general, sediment P contributes about 60 to 90 percent of the P transported in runoff from cultivated land. Dissolved P makes up a large portion of the total P in runoff from non-cultivated lands such as pastures, haylands, forests and cropland fields using no-till conservation practices. Some transport of P occurs vertically down the soil profile. Specific soil structure and soil mineralogy conditions must exist for vertical transport to occur.

In terms of their impact on water bodies, sediment-bound P is less available for algae and plant uptake than dissolved P because it is chemically bound with mineral (particularly iron, aluminum, and calcium) and organic compounds. Sediment P can however represent a long-term source of P for algae and plant uptake from a waterbody. Dissolved P is immediately available to plants. Added together, the bio-available portion of sediment P and dissolved P represent the phosphorus that promotes eutrophication of surface waters.

Phosphorus Movement Factors

The main factors influencing P movement can be separated into two main categories: **transport** and **source.**

Transport factors:

- Soil erosion (sheet and rill, wind)
- Irrigation-induced erosion rate
- Runoff class
- Flooding hazard
- Distance to surface waters / buffer width
- Subsurface drainage

Source Factors

- Soil test P concentration
- Commercial P fertilizer application
- Commercial P fertilizer application method
- Organic P source application rate
- Organic P source application method

Each factor is assigned a ***Phosphorus Loss Rating*** of: ***None, Low, Medium, High, or Very High*** based on the relative risk of phosphorus transport. In addition, each factor is assigned a ***Factor Weight*** ranging from 0.25 to 1.5, based on the relative contribution of that factor to transport phosphorus.

Descriptions of Phosphorus Index Factors

Soil Erosion

This factor includes both sheet and rill and wind erosion. Sheet and rill erosion is the detachment of soil particles by raindrop impact, surface runoff from rainfall, and snowmelt runoff on frozen or thawing soil. Wind erosion is the detachment and transport of soil particles by wind forces. Sheet and rill erosion rates are estimated with the Revised Universal Soil Loss Equation (RUSLE). Wind erosion rates are estimated using the Wind Erosion Equation (WEQ). These soil loss models predict long-term average erosion rates, over the entire crop rotation, in tons of soil loss per acre per year (ton/ac/yr). They do not predict sediment transport and delivery to a water body. The prediction models are used in the P Index to quantify the movement of soil, thus the potential for sediment and attached phosphorus transport toward a water body.

Soil Erosion from Sprinkler Irrigation

This factor is evaluated by comparing the application rate of the sprinkler irrigation system (inches of water per hour) with the infiltration rate of the soil. Information on the infiltration rates for most irrigated agricultural soils is located in the Washington Irrigation Guide, Appendix

A. A visual assessment of runoff and soil erosion caused by irrigation water is also conducted when assigning a Phosphorus Loss Rating to this factor.

Soil Erosion from Surface Irrigation

This factor is used on fields that are surface irrigated through furrows or corrugations with devices such as siphon tubes, gated pipe or small feeder ditches or basins. Erosion rates are evaluated using the Furrow Sediment and Erosion (FUSED) program. FUSED predicts the average soil particle displacement (sediment) from the bottom of irrigated fields, in tons per acre per year (tons/ac/yr). FUSED does not predict sediment transport and delivery to waterbodies. This factor is used only in the Eastern Washington Phosphorus Index.

Runoff Class

The runoff class is determined from the hydrologic group and average slope gradient assigned to the soil map units in a field. Hydrologic groups are groups of soils having similar runoff potential under similar storm and cover conditions. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonally high water table, intake rate and permeability after prolonged wetting, and/or depth to a very slowly permeable layer. (National Soil Survey Handbook, Part 618.35).

Soils are placed into four groups, **A, B, C, and D**. In the definitions of the classes, infiltration rate is the rate at which water enters the soil at the surface and is controlled by the surface conditions. Transmission rate is the rate at which water moves in the soil and is controlled by soil properties. Definitions of the classes are as follows:

A - The soils have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission (low runoff potential).

B - The soils have a moderate infiltration rate when thoroughly wetted. They chiefly are moderately deep to deep, moderately well drained to well-drained soils that have moderately fine to moderately coarse textures. They have a moderate rate of water transmission.

C - The soils have a slow infiltration rate when thoroughly wetted. They chiefly have a layer that impedes downward movement of water or have moderately fine to fine texture. They have a slow rate of water transmission.

D - The soils have a very slow infiltration rate when thoroughly wetted. These predominately clay soils have either a high swelling potential, a permanent high water table, a clay pan or clay layer at or near the surface, or are shallow soils over nearly impervious material. They have a very slow rate of water transmission (high runoff potential).

Dual Hydrologic groups A/D, B/D, and C/D are given for certain wet soils that can be adequately drained. The first letter applies to the drained, the second to the undrained condition. Only soils that are rated D in their natural condition are assigned to dual classes.

Flooding Frequency Class

Flooding is the temporary covering of the soil surface by flowing water from any source, such as streams overflowing their banks, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of sources. Floodwaters can carry both sediment-bound and dissolved P into surface waters. Estimates of flooding frequency are based on the interpretation of soil properties and other evidence gathered during soil survey field investigations. Flooding frequency is defined as the number of times flooding occurs over a period of time and is expressed as a class. Definitions of flooding frequency classes are given under ***Procedures for Making a Phosphorus Index Assessment*** in this document.

Distance to Perennial Surface Waters / Buffer Widths

This factor considers the flow distance from the edge of the field to the closest perennial surface water. It also considers the presence and width of a permanent vegetated buffer adjacent to that surface water. Topographic maps, soil survey maps, and local information can be used to identify perennial surface waters. The closer the edge of the field is to surface water, the higher the potential risk of P transport. This factor will only be used if perennial waters are downslope from the edge of a field.

Vegetated buffers are effective in trapping sediment-bound P in runoff water. They are less effective in reducing dissolved P transport. The wider the vegetated buffer, the more effective it will be in reducing total P transport to surface water. Vegetated buffers that are commonly used adjacent to perennial water include Filter Strips (NRCS Conservation Practice Standard 393) and Riparian Forest Buffers (NRCS Conservation Practice Standard 391).

Subsurface Drainage

Recent research has shown that P can leach through the soil profile, and the risk of leaching is directly related to the soil test P concentration in the soil. The higher the P concentration, the greater the potential for leaching. When subsurface drainage is present, dissolved and sediment-bound P can enter the drains and be directly transported to surface water at the drain outlet. This factor therefore considers whether tile drains are present in the field and the soil test P concentration.

Soil Test P

A soil sample from the site is necessary to assess the level of "available P" in the surface layer of the soil. The available P is the level customarily reported in a soil test analysis by commercial soil test laboratories. 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 (organic, adsorbed, and labile P) and the solution P available for crop uptake. The higher the level of soil test P, the greater the risk of transport to surface waters.

The depth at which soil samples are collected for available P analysis should be determined from the fertilizer or nutrient management guides for the crops being grown on the site. These guides are available from the Pacific Northwest Land Grant Universities. Sampling depth normally ranges from 0 to 6 or 0 to 12 inches for cultivated crops, and generally corresponds to typical depth of primary tillage. For established pastures that have not been cultivated for many years,

a sample depth of 0 to 3 inches may be appropriate because P will tend to be concentrated near the surface.

P Fertilizer Application Rate

The P fertilizer application rate is the amount of commercial phosphate fertilizer (P_2O_5), in pounds per acre per year (lbs/ac/yr), which is applied to the soil. This factor does not include phosphorus from organic sources. The higher the P fertilizer application rate, the greater the risk of P transport to surface waters.

Commercial P Fertilizer Application Method

The manner in which P fertilizer is applied to the soil and the length of time that the fertilizer remains on the soil surface will affect potential P movement. Banding or incorporating P fertilizer into the soil reduces the risk of P transport. P fertilizer that is applied to the surface, and not incorporated into the soil, has a higher risk of transport to surface water.

The time of year that P fertilizer is applied also affects the risk of P movement. In Western Washington, P fertilizer that is applied during the winter and early spring, when heavy or prolonged precipitation events are likely to occur, creates a higher risk of P transport than applications made from mid-spring to early fall. There is a greater risk of P transport in Eastern Washington when fertilizer is surface applied and not incorporated prior to irrigation or winter precipitation.

Organic P Source Application Rate

The organic P application rate is the amount of phosphate (P_2O_5) contained in the organic material that is applied to the soil, lbs/ac/yr. An analysis of the organic material is desirable to determine the phosphorus content. When an analysis of the organic material is not available, values from the Agricultural Waste Management Field Handbook (AWMFHB) or other NRCS approved documents can be used. The higher the organic P application rate, the greater the risk of P transport to surface waters.

Organic P Source Application Method

The manner in which organic P material is applied to the soil and the length of time that the organic material is exposed on the soil surface until crop utilization will affect potential P movement. Incorporation or injection of organic P material below the soil surface reduces the potential for P transport.

The time of year that P fertilizer is applied also affects the risk of P movement. In Western Washington, organic P that is applied during the winter and early spring, when heavy or prolonged precipitation events are likely to occur, creates a higher risk of P transport than applications made from mid-spring to early fall. There is a greater risk of P transport in Eastern Washington when organic P is surface applied and not incorporated prior to irrigation or winter precipitation.

Procedures for Using the Phosphorus Index Assessment

Use the Phosphorus Index Worksheets in Appendix 1 for Western Washington and Appendix 2 for Eastern Washington for field assessments. An individual worksheet should be completed for each field. A single assessment can be made for a group of fields if the user is certain that all the source and transport factors are similar.

For each transport and source factor, except those determined by formulas, the Weighted Rating Value has been calculated on the worksheets by multiplying the Factor Weight by the Phosphorus Loss Rating. For example, a site with a Soil Erosion Rate of 5 ton/ac/yr receives a Phosphorus Loss Rating of Medium or 2 points. The Factor Weight of 1.5 multiplied by the Phosphorus Loss Rating of 2 results in 3 points for the Weighted Rating Value. This value is given in parentheses at the bottom of the cell that contains the 4-6 ton/ac/yr soil erosion rate.

The worksheets are designed so that an assessment can be made for both the Current and Planned conditions. For example, during the planning process a producer may select a conservation system alternative that would reduce soil erosion rates and install a vegetated buffer next to a perennial stream. This system would reduce the risk of P transport and would result in a lower Phosphorus Index Total Rating Value or Site Vulnerability Class. See Appendix 3 for an example of a completed Phosphorus Index Worksheet.

Instructions for the Phosphorus Index Worksheets

1. **Site Information** – document all information required for the producer and field(s) included in the assessment in the appropriate blanks.
2. **Soil Erosion** – use RUSLE and/or WEQ erosion rate estimates. For fields where both sheet and rill and wind erosion occur, the combined erosion rate should be used. See Section 1 of the Field Office Technical Guide (FOTG) for RUSLE and WEQ instructions.
3. **Soil Erosion from Sprinkler Irrigation** – evaluate the application rate of the existing and/or planned irrigation system. Compare the application rate to the infiltration rate of the soil map units. Refer to Washington Irrigation Guide, Appendix A and Irrigation Water Management software or programs for information on most irrigated soils. A visual assessment of erosion and runoff that occur as a result of irrigation water applications will support the evaluation.
4. **Soil Erosion from Surface Irrigation** (Eastern Washington) – document FUSED average erosion rate estimates for the entire crop rotation. Assign a Low Phosphorus Loss Rating for this factor if a well functioning tail water return flow/re-use system is in place.
5. **Runoff Class** – use the following table to select the Runoff Class using Hydrologic Groups and average field slope measurements. Soils data for Hydrologic Soil Groups is located in Section 2 of the FOTG, Water Features. The average field slope for each soil map unit is also located in Section 2 of the FOTG and may be used to evaluate the Phosphorus Loss Rating for Current conditions. Actual average field slope measurements should be used for evaluating Planned conditions, especially for soil map units with broad slope classes.

Soil Survey Manual Table 3-10

Slope (%)	Hydrologic Soil Group			
	A	B	C	D
	---------- Runoff Classes ----------			
Concave	Negligible	Negligible	Negligible	Negligible
< 1	Negligible	Negligible	Low	Low
1 – 5	Negligible	Low	Medium	Medium
6 – 10	Very Low	Medium	High	High
11 – 20	Low	Medium	High	Very High
> 20	Medium	High	Very High	Very High

The Hydrologic Soil Group for soils with a well functioning drainage system, either surface or sub-surface, should be lowered one class to determine runoff potential. For example: use Hydrologic Soil Group B for a soil assigned to Hydrologic Soil Group C if a drainage system is present.

6. **Flooding Frequency Class** (Western Washington) – use the class assigned based on soils information obtained in Section II of the FOTG. Water Features, unless more accurate local information on flooding frequency is available. Flooding Frequency Classes are defined as follows (National Soil Survey Handbook, Part 618.26):

   None - no reasonable possibility of flooding; near 0 percent chance of flooding in any year or less than 1 time in 500 years.

   Very Rare - flooding is very unlikely but possible under extremely unusual weather conditions; less than 1- percent chance of flooding in any year or less than 1 time in 100 years but at least 1 time in 500 years.

   Rare - Flooding unlikely but possible under unusual weather conditions; 1 to 5 percent chance of flooding in any year or nearly 1 to 5 times in 100 years.

   Occasional - Flooding is expected infrequently under usual weather conditions; 5 to 50 percent chance of flooding in any year or >5 to 50 times in 100 years.

   Frequent - Flooding is likely to occur often under usual weather conditions; more than a 50 percent chance of flooding in any year or more than 50 times in 100 years, but less than a 50 percent chance of flooding in all months in any year.

   Very Frequent - Flooding is likely to occur very often under usual weather conditions; more than a 50 percent chance of flooding in all months of any year.

7. **Distance to Perennial Surface Waters/Buffer Widths** – determine the shortest distance from the edge of the field down slope to a perennial surface water body. Perennial surface water bodies may include streams, lakes, and those irrigation and drainage ditches that contain water year-round. Topographic maps, soil survey maps, local information, and field observations should be used to identify and document perennial surface waters. Determine

the average width of existing and planned vegetated buffers adjacent to the water body. The buffer should meet NRCS technical standards in order to be considered in the rating. Pastures that are grazed should not be considered as buffers for this factor.

8. **Subsurface Drainage** - determine whether subsurface drainage, such as perforated tile-drains, are present in the field. If drains are present, use the soil test P level to determine the Phosphorus Loss Rating.
9. **Soil Test P** – enter the soil test P level (ppm) for the field into the formula to calculate the Phosphorus Loss Rating. The Olsen (sodium bi-carbonate) extraction method should be used on most soils in Eastern Washington. The Bray P1 extraction method should be used in Western Washington. If other extraction methods are used, request analysis for the Bray P1 or Olsen extraction method to correlate values for the Phosphorus Loss Rating value.
10. **Commercial P Fertilizer Application Rate** - enter the phosphate (P_2O_5) fertilizer application rate into the formula to calculate the Phosphorus Loss Rating. Average annual application rates for the entire crop rotation should be used for this factor. Elemental P can be converted to P_2O_5 by using the formula P x 2.29 = P_2O_5.
11. **Commercial P Fertilizer Application Method** - select the predominate method and time of year the commercial P fertilizer is applied.
12. **Organic P Source Application Rate** - enter the organic source P_2O_5 application rate for the field into the formula to calculate the Phosphorus Loss Rating. Average annual application rates for the entire crop rotation should be used for this factor. Elemental P can be converted to P_2O_5 according the formula P x 2.29 = P_2O_5.
13. **Organic P Source Application Method** - determine the predominant method and time of year the organic source of P is applied.
14. Sum the Transport and Source Factor Weighted Rating Values and use the formulas as described on the worksheets to determine the Total Rating Value and Site Vulnerability Class. Note that the Western Washington PI **sums** the Transport and Source Factor Subtotals to determine the Total Rating Value. The Transport and Source Factor Subtotals are **multiplied** to determine the Total Rating Value (TRV) for the Eastern Washington PI.

Interpretations of the Phosphorus Index Site Vulnerability Class

LOW - This site has a LOW potential for P movement from the site. If farming practices are maintained at the current level, the probability of an adverse impact to surface water resources from P losses from this site would be low.

MEDIUM - This site has a MEDIUM potential for P movement from the site. The probability for an adverse impact to surface water resources is greater than that from a LOW vulnerability rated site. Some remedial action should be taken to lessen the probability of P movement.

HIGH - This site has a HIGH potential for P movement from the site. There is a high probability for an adverse impact to surface water resources unless remedial action is taken. Soil and water conservation as well as a phosphorus management plan are necessary to reduce the risk of P movement and probable water quality degradation. Manure or organic by-products will not be applied on sites considered vulnerable to off-site phosphorus transport unless appropriate conservation practices are in place to prevent off-site transport occurring.

VERY HIGH - This site has a VERY HIGH potential for P movement from the site. The probability for an adverse impact to surface water resources is very high. Remedial action is required to reduce the risk of P movement. All necessary soil and water conservation practices plus a phosphorus management plan must be put in place to reduce the potential of water quality degradation. Manure or organic by-products will not be applied on sites considered vulnerable to off-site phosphorus transport unless appropriate conservation practices are in place that will prevent off-site transport occurring.

Precautions in the Use of the Phosphorus Index

The Phosphorus Index is an assessment tool to be used by planners and land managers to assess the risk that exists for phosphorus leaving the site and travelling toward a water body. It can be used to identify the critical parameters of soil, topography, and management that most influence the potential for movement of phosphorus. Using these parameters, the phosphorus index can be used to determine management alternatives that would address the potential impact to surface water and reduce that risk. The index is intended to be part of the planning process that takes place between the land manager and resource planner.

The Phosphorus Index is not intended to be an evaluation tool for determining compliance provisions established by local, state, tribal, or federal agencies. Any attempt to use this index as a regulatory scale would be grossly beyond the intent of the assessment tool and the concept and philosophy of the group that developed it.

Phosphorus Index Working Group

Assessing the potential for soil P to move in the landscape and play a significant role in eutrophication of surface waters is a prerequisite for an effective, prioritized nutrient management and water quality program. This phosphorus assessment tool, the Phosphorus Index, as described in this technical note was initially developed by a national group of scientists with the USDA, universities, extension, private agencies, and industry. This group was titled the Phosphorus Index Core Team (PICT). The objective of the group was to develop a P indexing procedure that would identify soil, landforms, and management practices with varying degrees of potential risk that have unfavorable impacts on water bodies because of the potential for P movement. This group recognized the need for a simple, field-based index using readily available information that could be used to assess site conditions and potential vulnerability. The work group expanded and diversified its effort (now known as the Southern Regional Extension and Research Information Exchange Group) and continues to develop the science of P behavior and management in the soil.

The Phosphorus Index for Washington and Oregon was develop by a nutrient management advisory group comprised of members from the Natural Resources Conservation Service, Oregon State University, Washington State University, Conservation District representatives, Washington State Department of Ecology, agriculture industry representatives and agriculture producers.

Use of the Phosphorus Index in the Natural Resources Conservation Service

The Phosphorus Index 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. It is intended to be used by the planner to communicate to the land manager the relative potential for phosphorus movement in the landscape. The NRCS does not condone or promote the use of the index for placing any restrictions on land use or other regulatory purposes that could be construed by manipulating the parameters of the index.

Last updated 9/01

PHOSPHORUS INDEX WORKSHEET – **WESTERN** WASHINGTON

Producer: _____ County:_____ Tract No. _____ Field No(s). _____ Date: _____

Soil Map Unit(s): _____ Soil Test P: _____ ppm Lab. Method: _____ Sample Depth: _____

Crop Rotation: _____ Nutrient Application Method(s) _____

Planner: _____ Notes: _____

		PHOSPHORUS LOSS RATING					**Weighted Rating Value**	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	_____	_____
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75)	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	_____	_____
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0)	High (4.0)	Very High (8.0)	_____	_____
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5)	Frequent (3.0)	Very Frequent (6.0)	_____	_____
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	_____	_____
Subsurface Drainage	0.50	No Tile Drains (0)	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	_____	_____
						Transport Factors Subtotal (TFS)		

PHOSPHORUS INDEX WORKSHEET – **WESTERN** WASHINGTON

Tract _____ Fields _____

SOURCE FACTORS	Factor Weight	PHOSPHORUS LOSS RATING None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Weighted Rating Value Current	Planned
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) / 10 (_____ - 40) / 10 = _____ (Soil Test P) Assign 0 points if Soil Test P < 40 ppm					_____	_____
Commercial P Fertilizer Application Rate	1.00	(lbs/ac P_2O_5 / 50) (_____ / 50) = _____ (lbs/ac P_2O_5)					_____	_____
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	_____	_____
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 / 50 _____ / 50 = _____ (lbs/ac P_2O_5)					_____	_____
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	_____	_____

Total Rating Value TFS + SFS	Site Vulnerability Class
< 14.0	**Low**
14.0 – 27.0	**Medium**
27.1 – 55.0	**High**
> 55.0	**Very High**

	Current	Planned
Transport Factors Subtotal (TFS)		
Source Factors Subtotal (SFS)		
Total Rating Value (TFS **+** SFS)		
Site Vulnerability Class		

PHOSPHORUS INDEX WORKSHEET – **EASTERN** WASHINGTON

Producer: _____ County:_____ Tract No. _____ Field No(s). _____ Date: _____

Soil Map Unit(s): _____ Soil Test P: _____ ppm Lab. Method: _____ Sample Depth: _____

Crop Rotation: _____ Nutrient Application Method(s) _____

Planner: _____ Notes: _____

		PHOSPHORUS LOSS RATING					Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE and/or WEQ)	1.50	< 1 (0)	1 – 3 (1.5)	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	_____	_____
Soil Erosion from Sprinkler Irrigation	0.25	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.25)	Application rate = infiltration rate OR Little to no visible runoff at field borders (0.5)	Application rate > infiltration rate OR Visible runoff at field borders (2.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (4.0)	_____	_____
Soil Erosion from Surface Irrigation – tons/ac/yr (FUSED)	1.00	< 1 (0)	1-5 OR tail water return flow in place (1.0)	>5-20 (2.0)	>20-40 (4.0)	> 40 (8.0)	_____	_____
Runoff Class	1.00 – nonirri-gated 0.50 - irrigated	Negligible (0)	Very low or low (0.5 IRR, 1.0 NIRR)	Medium (1.0 IRR, 2.0 NIRR)	High (2.0 IRR, 4.0 NIRR)	Very High (4.0 IRR, 8.0 NIRR)	_____	_____
Distance to Perennial Surface Waters / Buffer Widths	0.50	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0)	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.5)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.0)	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (2.0)	< 100 feet AND No buffer next to surface waters OR Return flow from surface irrigation occurs with no buffer (4.0)	_____	_____
Subsurface Drainage	0.50	No tile drains (0)	Tile drains present Soil Test P (Olsen) < 40 ppm (0.5)	Tile drains present Soil Test P (Olsen) 40 - 120 ppm (1.0)	Tile drains present Soil Test P (Olsen) 121 - 170 ppm (2.0)	Tile drains present Soil Test P (Olsen) > 170 ppm (4.0)	_____	_____
						Transport Factors Subtotal (TFS)		

PHOSPHORUS INDEX WORKSHEET – **EASTERN** WASHINGTON

Tract _____ Fields _____

SOURCE FACTORS	Factor Weight	PHOSPHORUS LOSS RATING None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Weighted Rating Value Current	Planned
Soil Test P – 0-12" ppm (Olsen $NaHCO_3$)	1.00	(Soil Test P – 20) / 10 (_____ - 20) / 10 = _____ (Soil Test P) Assign 0 points if Soil Test P < 20 ppm					_____	_____
Commercial P Fertilizer Application Rate	1.00	(lbs/ac P_2O_5 / 50) (_____ / 50) = _____ (lbs/ac P_2O_5)					_____	_____
Commercial P Fertilizer Application Method	1.00	None Applied (0)	Placed with planter OR Injected deeper than 2 inches OR Incorporated by plowing (1.0)	Incorporated deeper than 3 inches by disking, chiseling, etc. (2.0)	Incorporated less than 3 inches deep by harrowing, etc. (4.0)	Surface applied – not incorporated prior to irrigation or winter precipitation (8.0)	_____	_____
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 / 50 _____ (lbs/ac P_2O_5) / 50 = _____					_____	_____
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated immediately (1.0)	Incorporated deeper than 3 inches by disking, chiseling, etc. within 5 days of application (2.0)	Incorporated less than 3 inches deep by harrowing, etc. within 21 days of application (4.0)	Surface applied – not incorporated prior to irrigation or winter precipitation (8.0)	_____	_____

Total Rating Value TFS **x** SFS	**Site Vulnerability Class**
< 40	**Low**
40 – 160	**Medium**
161 – 640	**High**
> 640	**Very High**

	Current	**Planned**
Transport Factors Subtotal (TFS)		
Source Factors Subtotal (SFS)		
Total Rating Value (TFS **x** SFS)		
Site Vulnerability Class		

EXAMPLE PHOSPHORUS INDEX WORKSHEET – **WESTERN** WASHINGTON

Producer: Dale's Dairy	County: Thurston	Tract No. ****	Field No(s). 1	Date: July 10, 2001
Soil Map Unit(s): 115 Sultan sil 2%	Soil Test P: 129 ppm	Lab. Method: Bray P1	Sample Depth: 0 – 12 inches	
Crop Rotation: corn silage with ryegrass cover crop	Nutrient Application Method(s): **big gun for manure liquids, spreader for solids**			
Planner: **Resource Conservationist**	Notes: **Field edge is 250 feet from a perennial stream and there is a buffer about 15 feet wide. Producer plans to increase buffer width to 40 feet and reduce annual P_2O_5 applications to 250 lb/ac.**			

		PHOSPHORUS LOSS RATING					Weighted Rating Value	
TRANSPORT FACTORS	Factor Weight	None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	**Current**	**Planned**
Soil Erosion – tons/ac/yr (RUSLE)	1.50	< 1 (0)	1 – 3 (1.5) ⇦	4 – 6 (3.0)	7 – 15 (6.0)	> 15 (12.0)	1.5	1.5
Soil Erosion from Sprinkler Irrigation	0.75	No sprinkler irrigation (0)	Application rate < infiltration rate OR No visible runoff at field borders (0.75) ⇦	Application rate = infiltration rate OR Little to no visible runoff at field borders (1.5)	Application rate > infiltration rate OR Visible runoff at field borders (3.0)	Application rate > infiltration rate OR Excessive runoff visible at field borders. Rills and gullies present. (6.0)	0.75	0.75
Runoff Class	1.00	Negligible (0)	Very low or low (1.0)	Medium (2.0) ⇦	High (4.0)	Very High (8.0)	2.0	2.0
Flooding Frequency Class	0.75	None or very rare (0)	Rare (0.75)	Occasional (1.5) ⇦	Frequent (3.0)	Very Frequent (6.0)	1.5	1.5
Distance to Perennial Surface Waters / Buffer Widths	0.75	> 500 feet OR buffer > 30 ft. wide (or meets NRCS standards) next to surface waters (0) ⇦	300 – 500 feet OR buffer 20 - 30 ft. wide next to surface waters (0.75)	200 – 299 feet OR buffer 10 -19 ft. wide next to surface waters (1.5) ⇦	100 – 199 feet AND buffer < 10 ft. wide next to surface waters (3.0)	< 100 feet AND No buffer next to surface waters (6.0)	1.5	0
Subsurface Drainage	0.50	No Tile Drains (0) ⇦	Tile drains present Soil Test P (Bray P1) < 60 ppm (0.5)	Tile drains present Soil Test P (Bray P1) 61 - 140 ppm (1.0)	Tile drains present Soil Test P (Bray P1) 141- 190 ppm (2.0)	Tile drains present Soil Test P (Bray P1) > 190 ppm (4.0)	0	0
						Transport Factors Subtotal (TFS)	7.25	5.75

EXAMPLE PHOSPHORUS INDEX WORKSHEET – **WESTERN** Washington

Tract ****** Field(s): 1

SOURCE FACTORS	Factor Weight	PHOSPHORUS LOSS RATING: None (0)	Low (1)	Medium (2)	High (4)	Very High (8)	Weighted Rating Value: Current	Planned
Soil Test P – ppm (Bray P1)	1.00	(Soil Test P – 40) / 10 (129 - 40) / 10 = 8.9 (Soil Test P); Assign 0 points if Soil Test P < 40 ppm					8.9	8.9
Commercial P Fertilizer Application Rate	1.00	(lbs/ac P_2O_5 / 50) (0 / 50) x 0.75 = 0 ($lbs/ac\ P_2O_5$)					0	0
Commercial P Fertilizer Application Method	1.00	None Applied (0) ⇦	Injected / banded deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August (2.0)	Incorporated more than 5 days after application OR Surface applied September through October (4.0)	Surface applied November through February (8.0)	0	0
Organic P Source Application Rate	1.00	lbs/ac P_2O_5 / 50 **Current**: 700 ($lbs/ac\ P_2O_5$) / 50 = 14.0 **Planned**: 250 ($lbs/ac\ P_2O_5$) / 50 = 5.0					14.0	5.0
Organic P Source Application Method	1.00	None Applied (0)	Injected deeper than 2 inches OR Incorporated within 5 days of application from March through September (1.0)	Incorporated within 5 days of application from October through February OR Surface applied March through August ⇦ (2.0)	Incorporated more than 5 days after application OR Surface applied September through October ⇦ (4.0)	Surface applied November through February (8.0)	4.0	2.0

Total Rating Value TFS + SFS	Site Vulnerability Class
< 14.0	**Low**
14.0 – 27.0	**Medium**
27.1– 55.0	**High**
> 55.0	**Very High**

	Current	Planned
Transport Factors Subtotal (TFS)	7.25	5.75
Source Factors Subtotal (SFS)	26.90	15.90
Total Rating Value (TFS + SFS)	34.15	21.65
Site Vulnerability Class	High	Medium