TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE STATE OF COLORADO NATURAL RESOURCES CONSERVATION SERVICE

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To: All Offices

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Colorado Nitrogen Leaching Index Risk Assessment, Version 3

The Colorado Nitrogen Leaching Index, Version 3, is a risk assessment tool developed cooperatively with Colorado State University in accordance with the Natural Resources Conservation Service (NRCS), Nutrient Management Policy, GM-190-402, January 2012; NRCS National Instruction for Nutrient Policy Implementation, NI-190-302, January 2012; and NRCS National Handbook of Conservation Practices (NHCP) Nutrient Management 590 Conservation Practice Standard, January 2012.

Revised NRCS NHCP Nutrient Management 590 planning criteria, January 2012, requires a field-by-field risk assessment of the potential for nitrogen leaching for all nutrient management plans for which NRCS has technical responsibility, unless a leaching index risk assessment is not required for the field based on the Preliminary Nitrogen Leaching Risk Screening Tool.

Colorado Nitrogen Leaching Index Risk Assessment, Version 3

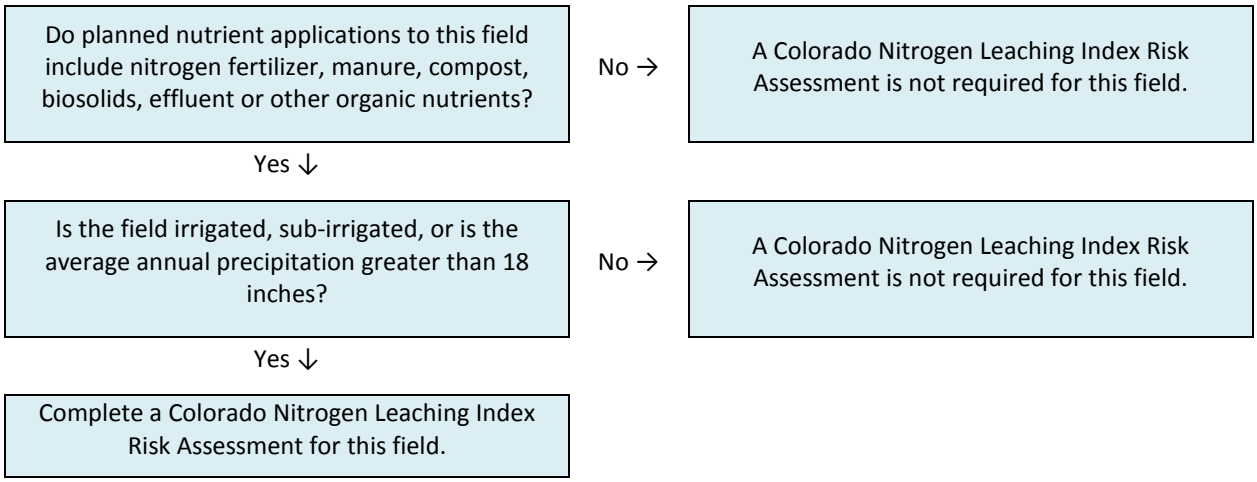
James L. Sharkoff[1], Troy A. Bauder[2] and Jessica G. Davis[3]

The Colorado Nitrogen Leaching Index is a qualitative field assessment tool developed to rank the relative potential for nitrogen leaching from agricultural fields. It can provide planners, producers and consultants a way to identify fields where the risk of nitrogen leaching may be high.

The Colorado Nitrogen Leaching Index will not quantify nitrogen losses from agricultural fields. Rather, it is a planning tool for developing alternatives for the land user to minimize the potential for nitrogen leaching below the crop root zone.

Use the Preliminary Nitrogen Leaching Risk Screening Tool below to determine if you need to complete a nitrogen leaching index risk assessment for an individual field. If the screening tool indicates that a risk assessment is not required for the field, document the specific information used to make the initial determination and include it in the plan to meet the risk assessment requirement.

Preliminary Nitrogen Leaching Risk Screening Tool



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Procedures for Making an Assessment

The Colorado Nitrogen Leaching Index consists of four site and management Risk Factors that can affect the potential for nitrogen leaching below the crop root zone. In order to complete an assessment, rate the relative risk associated with each of the four risk factors listed below.

The rating process requires a field-specific knowledge of soil saturated hydrologic conductivity, irrigation application efficiency, climate, groundwater surface elevation, nitrogen and manure/compost/effluent or other organic amendment application rates, and application timing.

After rating the Risk Factors, add the values together and compare the sum with the Risk Interpretations to determine the relative risk for nitrogen leaching below the crop root zone of this field. Implementation of certain Best Management Practices can mitigate or decrease the relative risk potential.

Risk Factors

Factor 1. Saturated Hydrologic Conductivity

Saturated Hydrologic Conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water, expressed in terms of micrometers per second ($\mu m\ s^{-1}$). The greater the Ksat value, the greater the risk of water moving nitrate through the soil profile.

Critical Dominant Soil - Fields often include several soil map units with different Soil Physical Properties. To evaluate Ksat, select the soil map unit with the highest surface Ksat value that is of a manageable size, 10 acres or 10 percent of the field. Ksat values for specific soils are available in Soil Survey publications and from the NRCS Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app/.

Determine the appropriate Ksat for the Critical Dominant Soil for the field, and then identify the Ksat risk from Table 1.

Table 1. Saturated Hydrologic Conductivity Risk Factor

Saturated Hydraulic Conductivity $\mu m\ s^{-1}$ (in hr^{-1})	<4.23 (<0.6) Clay, Silty clay, Sandy clay, Silty clay loam	4.23-14.11 (0.6-2.0) Clay loam, Sandy clay loam, Silt, Silt Loam	14.11-42.34 (2.0-6.0) Loam, Sandy loams	>42.34 (> 6.0) Loamy sands, Sands
Risk Factor	**1**	**2**	**3**	**4**

Factor 2. Irrigation Application Efficiency

Irrigation application efficiency is the ratio of the average depth of irrigation water infiltrated and stored in the crop root zone to the average depth of irrigation water applied, expressed as a percentage. Application efficiencies will vary depending upon system design and site conditions, and management decisions to apply how much irrigation water and when.

Select the appropriate risk category based upon irrigation system type. Use the Medium (2) risk category for non-irrigated fields that receive greater than 18 inches average annual precipitation and the High (3) risk category for sub-irrigated fields.

Table 2. Irrigation Application Efficiency Risk Factor

Irrigation Application Efficiency	High Efficiency Drip, Micro irrigation	Moderate Efficiency All sprinklers, Furrow with surge, Non-irrigated w/ > 18 inches average annual precipitation	Moderate - Low Efficiency Controlled flood, Border, Furrow and Sub-irrigated	Low Efficiency Uncontrolled flood
Risk Factor	**1**	**2**	**3**	**4**

Factor 3. Nitrogen Application Rate

An “agronomic rate” of N application is a field-specific estimate of crop need for the current growing season minus all N credits available to the crop before inorganic or organic nutrient applications.

Use CSU Extension publications to calculate appropriate N credits and field specific agronomic rates of N application.

For biosolids applications, calculate appropriate N credits from CSU Extension publications and then use the Plant Available Nitrogen tool to determine the appropriate rate of biosolids application.

Compare the planned N application rate including all N sources, to the agronomic N application rate developed in accordance with CSU guidance that includes all appropriate N credits, and then rate the relative risk from Table 3.

Table 3. Nitrogen Application Rate Risk

N Application Rate	Total N application below agronomic rate	Total N application equal to agronomic rate	Total N application 1 to 50 pounds per acre above agronomic rate	Total N application greater than 50 pounds per acre above agronomic rate
Risk Factor	**1**	**2**	**3**	**4**

Factor 4. Nitrogen Application Timing

Nitrogen applications split throughout the growing season have a lower potential for leaching below the crop root zone than applications made before crop planting.

Compare all planned N applications for the current crop year to Table 4 and select the highest applicable N application timing risk. For perennial crops such as grass hay, spring green up is synonymous with crop planting for this purpose.

Table 4. Nitrogen Application Timing Risk Factor

N Application Timing	In season split applications, (2 or more splits)	Any nitrogen application 0 to 3 months before crop planting	Any nitrogen application 3 to 5 months before crop planting	Any nitrogen application more than 5 months before crop planting
Risk Factor	**1**	**2**	**3**	**4**

Factor 5. Best Management Practice (BMP) Implementation Credits

Specific BMPs can decrease the relative potential for nitrogen leaching when properly applied. To take a BMP credit, subtract one point from the gross score for each of the following BMPs implemented on-site.

- Use of slow- or controlled-release N fertilizers, such as sulfur- or polymer-coated urea or urea formaldehyde
- Use of cover crops planted after harvest or crop failure, to assimilate excess nitrogen
- Use of nitrification inhibitors to delay the conversion of NH_4 to NO_3 (BMP credit not applicable for fall applications on soils with rapid or very rapid permeabilities - Ksat > 42.34 µm s^{-1}
- Use of deep rooted crops such as alfalfa in the rotation, to assimilate excess nitrogen
- Use of deep soil sampling to the bottom of the rootzone for the next crop in rotation, to determine sub-soil nitrogen credit
- Implementation of an Irrigation Water Management Plan, that meets NRCS 449 planning criteria

References

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Cooperator _____ Tract/Field No. _____ Crop Year _____

1. Saturated Hydrologic Conductivity (Ksat)……

Ksat µm s^{-1} (in hr^{-1})	<4.23 (<0.6) Clay, Silty clay, Sandy clay, Silty clay loam	4.23-14.11 (0.6-2.0) Clay loam, Sandy clay loam, Silt, Silt Loam	14.11-42.34 (2.0-6.0) Loam, Sandy loams	>42.34 (> 6.0) Loamy sands, Sands
Risk Factor	1	2	3	4

2. Irrigation Application Efficiency……..

Application Efficiency	High Efficiency Drip, Micro irrigation	Moderate Efficiency All sprinklers, Furrow with surge, Non-irrigated w/ > 18 inches average annual precipitation	Moderate - Low Efficiency Controlled flood, Border, Furrow and Sub-irrigated	Low Efficiency Uncontrolled flood
Risk Factor	1	2	3	4

3. Nitrogen Application Rate……

Application Rate	Total N application below agronomic rate	Total N application equal to agronomic rate	Total N application 1 to 50 pounds per acre above agronomic rate	Total N application greater than 50 pounds per acre above agronomic rate
Risk Factor	1	2	3	4

4. Nitrogen Application Timing……

Application Timing	In season split applications, (2 or more splits)	Any nitrogen application 0 to 3 months before crop planting	Any nitrogen application 3 to 5 months before crop planting	Any nitrogen application more than 5 months before crop planting
Risk Factor	1	2	3	4

5. BMP Credits - Subtract 1 point for each of the following that apply to this field and crop year;
Use of slow- or controlled-release N fertilizers; Use of cover crops to assimilate excess nitrogen; Use of deep rooted crops such as alfalfa to assimilate excess nitrogen; Use of deep soil sampling to determine sub-soil N credit; Implementation of a 449 Irrigation Water Management Plan

Sum of Risk Factors 1 - 5 ……

Colorado Nitrogen Leaching Index Risk Assessment Interpretations

< 8 This field has a **LOW** risk for nitrogen leaching if management is maintained at the current level. If there is an underlying aquifer that is shallow (< 20 ft) or used locally as a public drinking water source, increase the risk to **MEDIUM**.

8 - 11 This field has a **MEDIUM** risk for nitrogen leaching and some management changes may be needed to decrease risk. Apply nitrogen at agronomic rates or lower using planting time and or split in-season applications. If there is an underlying aquifer that is shallow (< 20 ft) or used locally as a public drinking water source, increase the risk to **HIGH.**

12 - 15 This field has a **HIGH** risk for nitrogen leaching and management changes should be implemented to decrease risk. Organic nutrients should be applied at P agronomic rates. Apply nitrogen using split in-season applications at or below the agronomic rate. Changes in irrigation management and/or method may also be necessary. If there is an underlying aquifer that is shallow (< 20 ft) or used locally as a public drinking water source, increase the risk to **VERY HIGH**.

16 his field has a **VERY HIGH** risk for nitrogen leaching and management changes are needed to decrease risk. **Organic nutrient applications are NOT recommended**. Apply nitrogen using split in-season applications at or below the agronomic rate. Changes in irrigation management and/or method are necessary to protect ground water. Implement all appropriate BMPs.

Prepared by_____ Date _____