TECHNICAL NOTES

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IDAHO COMMERCIAL FERTILIZER NUTRIENT MANAGEMENT PLANNER (ICFNMP)

A Nutrient Management Planning Tool for Conservation Planning

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The Idaho Commercial Fertilizer Nutrient Management Planner (ICFNMP) develops a Nutrient Management Plan (NMP) for a Conservation Management Unit. The NMP considers:

- Crop rotation
- Idaho Nutrient Transport Risk Assessment (INTRA) for the crop rotation
- Current soil tests
- Nutrient recommendations from the University of Idaho Fertilizer Guides
- Planned commercial fertilizer application(s)
- Actual commercial fertilizer applied (adjusted to the actual crop yield)

The ICFNMP was designed to determine quantities and probability of risk from the application of nutrients (primarily nitrogen, phosphorus and potassium).

The purpose of the ICFNMP is to provide planners with an evaluation tool for a grower's proposed NMP for commercial fertilizer application as it relates to the current Idaho Nutrient Management (590) standard, and in determining if there are additional mitigation practices required due to a potential risk of nutrient movement to surface and ground waters. The ICFNMP is used in the **conservation planning process** to determine if the proposed commercial fertilizer application rate meets the recommendations of the crop specific University of Idaho Fertilizer Guides, and policy and specifications outlined in the Idaho Nutrient Management (590) standard. The tool has similarities to Idaho's OnePlan NMP to determine bio-nutrient application, but is modified to evaluate the risk of multiple applications often associated with commercial fertilizer. It was field-tested in both northern and southern Idaho in various cropping scenarios.

Additionally, the ICFNMP provides a tool for calculating fertilizer mixes, applied nutrients verification, a Field Summary report and a Risk Summary report which makes recommendations to assist the planner in selecting appropriate conservation practices to address the risk factors associated with commercial fertilizer application. These mitigating practices are recommended to protect or enhance water quality as outlined in Idaho's NMP.

The ICFNMP allows the rotational application of phosphorus (P) and potassium (K). Rotational applications may be appropriate to reduce application costs, allow applications when there is

reduced risk of off-site transport or accommodate more sensitive crops. The rotational application of P or K is limited to the crop uptake of the crops in the rotation.

If the planner, working with the producer, chooses to use this option, then additional application of P or K may be restricted in the remaining rotation years unless the soil test for P or K indicates that a deficiency exists for the crop being produced. For example, a producer plans to grow four years of alfalfa in an eight-year crop rotation. The planner can show the application of P or K in the crops preceding the alfalfa planting, but can not exceed the crop uptake requirement for the four alfalfa years.

The Idaho Commercial Fertilizer Nutrient Management Plan: Input Factors

The crop rotation, soil, climate, irrigation management, land management and commercial fertilizer practices have a major influence on nutrient management. The crop rotation and choice of crops are critical in determining if the rotation is capable of utilizing residual and/or available nutrients. Precipitation pattern and irrigation management, along with fertilizer management, are factors used to predict how nutrients move within or off a field. These moisture considerations are rainfall, irrigation, erosion and runoff and deep percolation. Other factors which influence the movement of nutrients are fertilizer sources and amount of nutrients available for transport. Management factors include the method of application, timing and placement in relationship to when the nutrient is needed by the crop.

The factors assist in determining when residual nutrients, either below the rooting zone or retained in the soil's surface after the crop is produced, are critical factors to off-field nutrient transport. Fertilizer application method, placement and timing must be considered when assisting with a Nutrient Management plan to address the best corrective soil and water conservation practices and management techniques.

Field-specific data required for the development of an ICFNMP are:

- Crop rotation
- INTRA determination for the rotation
- Crop residue type and management
- Current soil test
- Fertilizer application date
- University of Idaho Fertilizer Guide recommendation
- Grower-planned nutrient application rate
- Fertilizer application method
- Fertilizer application timing
- Fertilizer risk assessment

These factors are used for planning and verification that the producer's NMP meets the basic requirement of the Idaho Nutrient Management (590) standard.

Crop rotation - Selection of a cropping sequence within a crop rotation is critical in utilizing nutrients (nitrogen) that are residual following, for example, a shallow-rooted crop. If a crop is

restricted to a shallow rooting depth and moisture moves nitrogen beyond the rooting depth of the following crop, nitrogen is lost and becomes an environmental risk to ground water.

INTRA determination for the rotation - INTRA must be run for the crop rotation, with special consideration for the crop(s), within the rotation which have the potential of off-site environmental concern. INTRA provides the risk assessment factors that determine the recommended, applicable management practices for the field operation to mitigate the primary resource concern.

Crop residue type and management - Crop residues can either be a source or sink for applied and residual nutrients. Plant residues with a high carbon to nitrogen (C/N) ratio or content will immobilize (tie-up) nutrients, specifically nitrogen, as the residue is converted by soil micro-organisms into organic matter. Conversely, crop residues that have a low C/N ratio, such as legumes, will mineralize (release) nutrients and thus serve as a plant production source. The ICFNMP model assumes that for each ton of high C/N residues, 20 pounds of N will eventually be immobilized, up to a maximum of 50 pounds per acre. It also assumes that if alfalfa is the previous crop in the rotation, then 60 pounds of N is potentially available to the following crop.

Current soil test – As with all NMP processes, the current soil test is critical in planning nutrient management. Soil tests give the planner a "point in time" evaluation of the key soil factors' ability to produce a crop and supply critical nutrients for crop production. Table 1 of the Idaho NM standard (June 2007) specifies the sampling dates and soil test requirement that the ICFNMP requires to develop the recommendations.

Table 1. Soil sampling requirements for annual budget development

	Northern Idaho		Southern Idaho	
Depth	**Constituent Analyzed[1]**	**Sampling Date No Older Than:**	**Constituent Analyzed[1]**	**Sampling Date No Older Than:**
0 – 12 inches	**NO_3-N, NH_4-N, P, K, pH, %SOM[2], EC[3]**	**9 month**	**NO_3-N, NH_4-N**	**3 months**
			P, K, pH, %SOM[2], % Free Line, EC[3]	**9 months**
12 – 24 inches	**NO_3-N**	**9 months**	**NO_3-N, NH_4-N**	**3 months**

[1] In northern Idaho, P is usually analyzed using the Morgan (Sodium Acetate) method or Bray1 (Ammonium Fluoride-Hydrochloric Acid), and in southern Idaho, P is analyzed using the Olsen (Sodium Bicarbonate) method.
[2] SOM is soil organic matter.
[3] EC is electrical conductivity, salt concentration, soluble salts, etc.

Fertilizer application date – The ICFNMP requires the entry of a proposed fertilizer application date to compare with the soil test date as verification of the "Sample Date No Older Than" requirement of the NM standard.

University of Idaho Fertilizer Guide recommendation – A key factor in the development of an NMP, within the planning tool, is the University of Idaho's Fertilizer Guide recommendation (UI-FG). The ICFNMP interprets the guide for each crop in the rotation based on data resulting from the current soil test, previous crop and yield goal for the current crop entries.

Grower-planned nutrient application rate – The objective of the ICFNMP process is to certify and verify what the producer plans to apply in the form of commercial fertilizers. **The objective is not to make the recommendation for commercial fertilizer application**. The purpose is to interpret the UI-FG based on what the producer proposes for N, P, K and S applications and then to develop the Risk Assessment (RA) and mitigation conservation practices if the RA is HIGH or VERY HIGH.

Fertilizer application method/fertilizer application timing – When, where and how nutrients are applied are key factors in determining the risk associated with nutrient application. The length of time between nutrient application and nutrient crop uptake elevates the risk for nutrient loss to the environment. The method of nutrient application becomes an important factor if that applied nutrient is subject to either transport by solution surface runoff or erosion soil particle attachment runoff.

The manner in which a fertilizer is applied to the soil affects potential nutrient movement. Incorporation implies that the fertilizer is buried below the soil surface. If fertilizer is surface applied on a field with runoff (from precipitation or from irrigation) and there is no incorporation, it is considered a significant risk. Placement of the nutrient near or below the developing crop's root system often enhances its ability to utilize the nutrients applied.

Fertilizer risk assessment – The risk assessment found in the ICFNMP evaluates the planned nutrient application rate, method of application and application timing.

The Risk Summary page summarizes the overall risk of the rotations and the planned commercial fertilizer application. It documents the INTRA Risk Assessment and allows the producer, with the assistance of the planner, to develop a conservation strategy based upon recommended conservation practices which serve to reduce both surface runoff and soil movement, and the potential for deep percolation and nitrogen leaching beyond the active rooting zone of crops planned in the rotation.

Under non-irrigated (dryland) conditions, crop rotation, tillage management, nutrient placement/timing and residue management are key factors. Under irrigated conditions, managing irrigation water plays the key role in minimizing nutrient losses from leaching and surface runoff. Potential irrigation efficiency and irrigation water management have significant impacts on actual water movement through the root zone.

Technical Guidance: Idaho Commercial Fertilizer Nutrient Management Plan (ICFNMP)

Purpose and Application of the Planning Tool

- To develop the Nutrient Management Plan (NMP) for a defined planning unit based on the application of commercial fertilizer
- To be used during the planning process to develop the annual nutrient budget based on data extracted from the current University of Idaho Fertilizer Guides (UI-FG)
- To be used to evaluate the risk from the application of nutrients (N, P and K) on two resource concerns

    - Nutrients in ground water
    - Nutrients in surface water
- Applies to cropland, pasture and/or hayland where commercial fertilizer nutrients are added

Output of the ICFNMP Tool

- The output of the planning tool is displayed on printable reports. The file can be saved, edited and renamed as needed.
- The ICFNMP generates the basic requirements of a Nutrient Management Plan (NMP)
    - Develops the current and/or planned plant production sequence or crop rotation
    - Develops the nutrient budget for N, P and K for the rotation
    - Documents the annual soil tests
    - Interprets the UI-FG nutrient application rate and documents the grower's planned nutrient rates, timing and method of application and incorporation
    - Documents the designated Idaho nutrient transport risk assessment for the planning unit and associated practices or methods planned to protect the area
    - Develops the annual nutrient budget for the current crop
- Reports
    - **Crop & Soil Test** - Data entry page
    - **Com Fert Sch'd & Cert** - Allows a planner to develop and certify a planned and applied fertilizer mix. The certification section allows the planner to certify the actual crop yields and nutrients applied.
    - **Farm Summary** - Summarizes key information about the producer, soil test results, UI-FG nutrient recommendation, planned nutrients and actual nutrients applied.
    - **Risk Summary** - Summarizes the key elements of the rotational INTRA risk assessment and the mitigating practices for meeting the NM (590) standard.
    - **Rotations** - Documents the crop rotations used to develop the NMP.

Requirements for Meeting the Idaho Nutrient Management (590) Standard

The Idaho Nutrient Management (590) standard is met when the ICFNMP is completed and the nutrients applied are documented and evaluated as meeting the **annual nutrient budget requirements** of the standard.

Identification of Mitigating Practices

The rating for each field and the overall INTRA risk assessment for the conservation management unit (CMU) and its rotation are documented in the Risk Summary. If any CMU has a MEDIUM or Higher INTRA rating, then mitigating practices are required. Mitigating practices are not required for any CMU which has a rating of VERY LOW or LOW; however, "recommended" practices might be suggested. Recommended and required practices are identified in the INTRA report in the column titled "Management Techniques and Mitigating Conservation Practices Required".

Use of ICFNMP Tool

Purpose

To develop an Idaho Commercial Fertilizer Nutrient Management Plan for each farming unit or conservation management unit

Example: A farming operation has three cropping systems of:

- Small grains in rotation with row crop, where commercial fertilizer is applied.
- A conservation management plan that involves the production of small grains across several farms and/or several fields that are a part of a Conservation Management Unit (CMU) having the same predominate soil type, crop rotation, previous crop and current crop.
- Pasture where commercial fertilizer is applied.

Therefore, an ICFNMP is required for each system.

Crop and Soil Test

The planner proceeds to develop the NMP for the farming operation, and must obtain the following information from the producer.

Step 1. Rotation

a. **INTRA** has to be run on the critical crop(s) in the rotation which has the highest potential for off-site transport of nutrients.
b. To assist the planner, tools are linked with the ICFNMP tool
    i. Web Soil Survey – development of soil background
    ii. USDA Plant Crop Nutrient Tool – development of crop nutrient uptake data in the absence of a current UI Fertilizer Guide.
    iii. Grower's Rotational Phosphorus – The ICFNMP allows the development of rotational phosphorus.
        1. Rotational phosphorus or potassium applied pre-season to a crop having higher soil phosphorus or potassium requirement will be limited to applications for minimizing phosphorus loss due to run-off or as a split application alternative where there is a potential fertilizer salt affect on crop production.
        2. The total rotational P_2O_5 or K_2O cannot exceed the sum of the phosphorus or potassium uptake for the crops in the planned rotation.
    iv. The rotation **has to be saved** in order to proceed with further development of the NMP.
c. The ICFNMP tool calculates the recommended N, P and K from the University of Idaho Fertilizer Guides (UI-FG), and the potential crop residues in the rotation.

Step 2. Development of the current and prior crops for each field in the CMU

Step 3. Development of the field detail

a. Selection of the field for development of the annual nutrient plan.

Step 4. Soil test data using the appropriate analysis method (Olson, Morgan or Bray)

a. For northern Idaho, the soil test has to be taken within the last 9 month and specifically requires Nitrate-N to be determined on both the 1st and 2nd foot of soil and Ammonium-N from the 1st foot only.
b. For southern Idaho, the soil test has to be taken within the last 9 months for P, K, pH, EC %OM and %Free Line from the 1st foot and requires a Nitrate-N and Ammonium-N soil test on the 1st and 2nd foot of soil to be taken within the last 90 days prior to fertilizer application.

Step 5. Development of the Current Crop

a. Crop residue management
b. Planned commercial fertilizer application
    i. Planned fertilizer application date
    ii. Selected method of fertilizer application
    iii. Selected timing of fertilizer application
c. The program calculates the current risk from the proposed fertilizer application.
    i. The proposed application scenario will be compared to the UI-FG.
        1. If nutrients are under applied, the comparison will show "Caution/Deficient".
        2. If nutrients are within the reasonable limits, as defined in the NM (590) standard, as 40 lbs-N, 20 lbs-P_2O_5 and 40 lbs-K_2O per acre, comparison will show "OK".
        3. If additional fertilizer is applied following the development of the NMP and the rate of N, P_2O_5 or K_2O exceeds the reasonable limits as defined above, the application must be justified by either a pre-application soil test, approved tissue test or feed analysis. If the actual crop yield exceeds the planned yield, then additional applied nutrients can be justified by a certification of the actual yield.
        4. For over application of N without justification, a post-harvest rooting depth soil test will be required.
        5. Potassium shall not be applied in situations where excess K_2O causes unacceptable nutrient imbalances in crops or forages.
        6. The planned application rates of other plant nutrients shall be consistent with the University of Idaho recommendations.
        7. A starter band, of up to 30 lbs of P_2O_5 per acre, is allowed under special localized conditions (wet-cold or high P fixing soils) regardless of soil test. When starter fertilizers are used, they shall be applied in accordance with UI recommendations and be a part of the fertilizer budget.

<u>Com Fert Sch'd & Cert</u>

Allows a planner to develop specific fertilizer mixes and certify a planned and applied fertilizer mix. There are three sections to the Commercial Fertilizer Scheduled (COM FERT SCH'D and CERT Worksheet).

Commercial Fertilizer Formulation

The planner assists the producer in the development of a commercial fertilizer blend. Based on the pounds of N, P or K and the selection of common fertilizer materials, the tool will

calculate the pounds of materials, percent analysis, pounds and tons of material to be applied per acre.

a. The commercial fertilizer annual N, P, K and S plan is automatically transferred from the "Crop and Soil Test" page. The planner can enter each of the planned applications and choose a grower selected fertilizer source. A source has to be selected for each nutrient. The program calculates the pounds of fertilizer required to apply the required nutrient. If the selected fertilizer is a multiple grade product [for example, a urea/ammonium phosphate sulfate (16-20-0-24S) blend], then the program will adjust the urea to account for the nitrogen contained in the 16-20-0-24S.

Commercial Blend Verification

The planner verifies the pounds of N, P_2O_5 or K_2O applied per acre from the fertilizer analysis, or pounds or tons of fertilizer materials applied per acre. There are two options:

a. If the fertilizer lists the percent analysis for the blend, the planner can enter the analysis and tons delivered. The program will calculate the pounds of N, P_2O_5, K_2O and S applied per acre.
b. If the fertilizer invoice list pounds or tons of products delivered, the planner enters either the pounds or tons for each fertilizer source. The program will calculate the pounds of N, P_2O_5, K_2O and S applied per acre.

Applied N, P_2O_5 or K_2O Certification

Based on the actual pounds of material applied and actual field yields, the planner certifies the nutrients applied to crop yield. Once the planner calculates the pounds of N, P_2O_5 and K_2O applied, these values can be entered into the model for certification. The model allows the planner to enter the grower's actual yield to adjust the UI-FG recommendations.

Farm Summary

Summarizes key information about the producer, soil test results, UI nutrient recommendations, planned nutrients to be applied and actual nutrients applied. This is the certification document showing the UI-FG recommendation, the grower's planned nutrients to be applied and the actual nutrients applied adjusted to the actual yield(s) in the plan.

Risk Summary

Summarizes the key elements of the INTRA Risk Assessment and documents the mitigating practices for meeting the Idaho NM (590) standard.

Rotations

Documents the crop rotations used to develop the NMP.

References

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Idaho Commercial Nutrient Management Data Collection

PLANNING DATA ENTRY

Date: _____ Field Office: _____ Planner:_____

Producer: _____ Contract No.: _____

Legal Description: T: _____ R: _____ Sec: _____

Land Use: _____

Tract: _____ **Field Name: _____ Acres: _____**

Current Rotation:

Year:	Crop:	Expected Yield:	Units of Yield:
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

SOIL TEST INFORMATION: **Date of Soil Test: _____**

1st FOOT:

NO3-N	NH4-N	P	K	S	pH	OM	EC	Free Lime
---------- (ppm) ----------						%	(mm)	%
_____	_____	_____	_____	_____	_____	_____	_____	_____

2nd FOOT:

NO3-N	NH4-N
-------- (ppm) -------	
_____	_____

Planned Fertilizer Applications:

	Date of Applications	Application Rates (lbs) N	P2O5	K2O	Method and Placement
1	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____
8	_____	_____	_____	_____	_____
9	_____	_____	_____	_____	_____
10	_____	_____	_____	_____	_____

Data from INTRA:

	LOW	MEDIUM	HIGH
Over-all Risk for Surface Water:	_____	_____	_____
Over-all Risk for Ground Water:	_____	_____	_____

Risk Factors from INTRA (for critical crop(s) identified):

	LOW	MEDIUM	HIGH
Soil Test P	_____	_____	_____
P Rate	_____	_____	_____
P Timing	_____	_____	_____
P Method	_____	_____	_____
N Rate	_____	_____	_____
N Timing	_____	_____	_____
N Method	_____	_____	_____
Runoff Class	_____	_____	_____
Irrigation Index	_____	_____	_____
Leaching Index	_____	_____	_____
Distance to Surface Water	_____	_____	_____
Soil Erosion	_____	_____	_____

Planned BMP's or other Mitigation Practices:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

NMP Plan - Application/Certification

Actual Fertilizer Applications:

	Date of Applications	**Application Rates** (lbs or tons)	**Product Analysis** Units for the fertilizer applied (% or lbs)		
			N	**P2O5**	**K2O**
1	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____

NMP Certification

	Date	**Signed**
Planned:	_____	_____
Applied:	_____	_____
Certification:	_____	_____

COMMENTS_____

_____

_____

_____

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