

# Idaho Nutrient Management Handbook

## **DEFINITION**

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

## **PURPOSE**

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To protect air quality by reducing odors, nitrogen, emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical, and biological condition of soil.

## **CONDITIONS WHERE PRACTICE APPLIES**

This practice applies to all lands where plant nutrients and soil amendments are applied. This standard does not apply to one-time nutrients application to establish perennial crops (not to exceed rotational phosphorus crop uptake).

## **CRITERIA**

### **General Criteria Applicable to All Purposes**

A Nutrient Management Plan (NMP) for nitrogen (N), phosphorus (P) and potassium (K) must be developed when nutrients are applied.

An annual nutrient budget for nitrogen, phosphorus, and potassium must be developed that considers all potential sources of nutrients including, but not limited to, green manures,

legumes, crop residues, compost, animal manure, organic by-products, biosolids, waste water, organic matter, soil biological activity, commercial fertilizer, and irrigation water.

Nutrients shall be applied considering the plant's growth habits, irrigation practices and other conditions so as to maximize availability to the plant and minimize risk of runoff, leaching and volatilization losses.

Realistic yield goals should be established based on historical yield data, soil productivity information, climatic conditions, nutrient test results, level of management, and local research results considering comparable production conditions.

On organic operations, the nutrient sources and management must be consistent with the United State Department of Agriculture's (USDA) National Organic Program.

Sensitive areas (e.g., sinkholes, wellheads, gullies, ditches, or surface inlets) shall not receive direct application of nutrients, including applications through irrigation systems.

Application of irrigation water must minimize the risk of nutrient loss to surface and groundwater.

### **Soil and Laboratory Analysis (Testing)- Development of the Initial Nutrient Management Plan.**

Nutrient planning must be based on current soil, manure, and (where used as supplemental information).

Current soil tests are those that are no older than 3 years.

Soil test analyses must be performed by laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program-Performance Assessment Program (NAPT-PAP). Under the auspices of the Soil

Science Society of American (SSSA) and NRCS, or other NRCS approved programs that consider laboratory performance and proficiency to assure accuracy of soil test results.

Soil test P will be determined using the Bray 1 Method for soils with no free lime (PH<6.5) and the Olsen method (NaHCO3) method for soils with free lime (PH>6.5).

A nutrient management plan of N budgeting shall be developed using current soil tests taken in the spring prior to seeding a spring crop, in the fall prior to seeding a fall crop, or in the spring following a fall seeded crop.

A Nutrient Management Plan for P budgeting can be developed using soil tests taken anytime during the year.

Soil tests for P are taken for two main purposes: 1) to develop the P nutrient budget; and 2) for comparison to the appropriate P Threshold value. In some cases, one soil test will serve both purposes.

Current soil tests for purposes of developing the nutrient budget shall be taken as described in Table 1.

If the field has a history of recent manure application or the management has changed significantly, then the requirement is no older than nine (9) months.

Soil samples shall be collected and prepared such that they are representative of the entire field or portion of the field to be managed separately. Requirements for soil sampling shall follow the specifications outlined in the UI publication "Soil Sampling"CES 704.

**Table 1. Soil sampling depth and testing criteria for annual budget development.**

Depth (inches)	Soil Constituent Analyzed	Sample Date No Older Than:
<b>Table 1.</b>		
0 -12"	NO <sub>3</sub> -N, NH <sub>4</sub> -N, P, & K	9 months
		3 years if no manure was applied
18-24"	NO <sub>3</sub> -N, NH <sub>4</sub> -N	9 months if ground water concern exists

A complete lab analyses should be made of samples taken from the first foot for all Nutrient Management Plans.

Fields that are part of a long term sod, pasture, or alfalfa rotation, may not require annual soil tests. Soil tests are to be taken when nutrients will be applied as part of an on-going management program.

Non-inversion cropping systems (i.e. - no till) or areas where resource problems dictate closer management may require soils samples in zones less than 0-12".

Soil tests taken for comparison to the P threshold will be taken at one of two depths, as described in Table 2, dependent upon on-site surface or ground water resource concerns.

**Surface water runoff concerns** exist when runoff leaves the contiguous operating unit from normal storm events, rain on snow or frozen ground, or irrigation.

**Ground water concerns** exists when a high water table, fractured bedrock, cobbles, gravel, or coarse-textured soils are conducive for the downward movement of water and associated nutrients.

<b>Primary Resource Concern</b>	<b>P Threshold Soil Sample Depth</b>
Surface Water Runoff	0-12"
Ground Water, fractured bedrock, cobbles or gravel	18-24"

When considering soil P levels, a surface water resource concern is the priority concern. If both concerns exist, a surface water concern resource concern is the priority concern. If neither concern exists, then the Nutrient Management Plan is developed based on the **threshold standard** for the ground water concern to prevent concentration of nutrients above the agronomic requirements of the crop, and to maintain soil quality and long term sustainability of the cropland resource.

To meet local nutrient requirements, as identified in the fertilizer guide or approved industry recommendations, the 0-12" soil test can be used to determine other diagnostic needs.

Fields that are part of a non-irrigated cropland rotation that includes summer fallow do not have to be soil tested the year the fields(s) are in summer fallow.

In situations where specialty crops are raised, or environmental considerations have been identified (high water tables, leaching vulnerability, tile drains, fractured bedrock,

deep or shallow soils), sampling greater than or less than the prescribed depths may be appropriate. The NRCS soil survey data is sufficient to make this determination unless site specific conditions vary substantially from the survey. The production system and environmental considerations will determine soil-sampling depth. Soil samples will represent the field.

Phosphorus Threshold (**TH**) concentrations, segregated by resource concern area, are described in Table 3. Use the primary resource concern identified and site characteristics to determine the **TH** of the site.

<b>Primary Resource Concern</b>	<b>P Threshold Concentration</b>	
	<b>Olsen</b>	<b>Bray 1</b>
Surface Water Runoff	40ppm <sup>†</sup>	60ppm <sup>†</sup>
Ground Water, fractured bedrock, cobbles or gravel		
< 5 feet	20ppm	25ppm
> 5 feet	30ppm	45ppm

\*No land application of phosphorus shall be permitted on any fields or pastures that possess a soil phosphorus level exceeding three hundred (300) parts per million, as determined by the required annual soil test (via Olsen method).

<sup>†</sup>Soil phosphorus test results are understood to contain an average variability of [redacted] ppm

### **Soil Testing – Maintenance of the Nutrient Management Plan**

For purposes of developing annual nutrient budgets, soils samples will be taken and analyzed as described in Table 1.

For a purposes of tracking P trends, soil samples will be taken and analyzed as described in Table 2 and as follows:

**Surface water resource concern:** Use the soil P concentration determined from the 0-12 inch sample taken for development of nutrient budgets.

**Ground water resource concern:** The TH soil test for P at the 18-24 inch zone is required to track P trends in areas where a ground water concern exists, such as a high water table, or in fields with greater than one-half (1/2) mile separation from surface water. If initial soil P results of a field are less than 75% of the TH, then soil sample frequency may be reduced to once every five (5) years to monitor trends of P in the profile and to make adjustments in the plan as necessary.

**Nutrient Application Rates**

Planned nutrient application rates for nitrogen, phosphorus, and potassium must not exceed UI guidelines or industry practice when recognized by the university.

At the minimum, determination of rate must be based on crop/cropping sequence, current soil test results, realistic yield goals and associated plant nutrient uptake rates.

Estimates of yield response must consider factors such as poor soil quality, prior to assuming that nitrogen and/or phosphorus are deficient.

For new crops or varieties, industry-demonstrated yield, and nutrient utilization information may be used until land-grant university information is available. Lower-than-recommended nutrient application rates are permissible if the grower’s objectives are met.

Applications of biosolids, starter fertilizers, or pop-up fertilizers must be accounted for in the nutrient budget. To avoid salt damage, the rate and placement of applied nitrogen and potassium in starter fertilizer must be consistent with UI guidelines, or industry practice recognized by the UI.

Phosphorus application rates will be determined for a single crop or for the crop rotation. Table 4 includes P application rates based on soil test P concentrations as compared to the site TH.

<b>Soil Test P</b>	<b>P Application Rate</b>
Surface Water <TH (ppm)	Recommended rates or Crop P uptake
>TH (ppm)1*	Crop P uptake
Ground water <TH (ppm)	Recommended P rate or Nitrogen based
>TH (ppm)1*	Crop P uptake

**1\* Note: When soil test P concentrations are above TH, the planner and producer will design a E/NMP that will reduce soil test P**

**Nutrient Incorporation.**

Nutrient incorporation is often the best method of reducing or mitigating the application of surface applied nutrients. Incorporation of phosphorus into the seed bed is an effective way of increasing the availability of P to the crop. This practice also reduces the P from direct contact with surface runoff.

Proper nutrient application in combination with other mitigating practices will help reduce potential of transport to gullies, ditches, surface inlets, sinkhole areas, fractured bedrock or wellhead areas. There should be no application of animal byproduct on sites where

runoff is delivered directly to a conveyance channel or receiving water body, unless runoff is treated with a conservation buffer or other mitigating practice prior to delivery.

Recommended mitigating practices include:

- Split fall/spring applications utilizing soil temperatures (<50 F), nitrification inhibitors, or time release fertilizers, or split spring applications of N to provide nutrients at the times of maximum crop uptake;
- Band P near the seed row;
- Incorporate broadcasted nutrients;
- Farm on the contour of cross slope on all non-irrigated fields adjacent to wetlands if nutrient runoff appears to pose a more significant hazard than leaching.
- Utilize fall cover crops whenever possible to immobilize excess residual N and retain for spring crop usage.

### **Nutrient Application Timing**

Application of Solid Byproduct. Solid byproduct shall be incorporated into the soil unless applications are made on frozen ground, perennial crops or cropland under no-till; in those cases, emergency tillage (i.e. chiseling and disking cross slope), construction of berms or other containment practices will be applied to prevent surface runoff.

Application of liquid byproduct. Application of liquid byproduct shall not be made outside the active growing period of the crop, unless the producer receives direct prior authorization from ISDA under the following conditions:

- 1) The E/NMP is up-to-date and all fields to receive liquid nutrients are listed within the plan
- 2) The volume of nutrients to be land applied is predetermined
- 3) Recent soil samples exist on all fields to receive liquid nutrients
- 4) Application of nutrients is consistent with management plan of the field (i.e. – will not exceed agronomic needs of the crop or force an upward trend in soil phosphorus)
- 5) Weather conditions, including precipitation forecast, are favorable for the next 7 days.
- 6) Fields have been evaluated for saturation; liquid nutrients shall be applied to crops at amounts to not exceed soil water holding capacity in the crop-rooting zone.
- 7) Application of liquid nutrients through surface or sprinkler irrigation systems will be timed to prevent deep percolation or runoff.
- 8) ISDA affirms the need to apply liquid nutrients outside of the active crop growing period is necessary and appropriate.

Application of commercial fertilizer. Timing of applications shall be sufficient to provide adequate plants establishment, growth and residue decomposition not to exceed UI Crop Fertilizer Guides or an approved equivalent research database or crop uptake values and to avoid surface runoff and/or leaching.

If most of the commercial N is applied in the fall for a subsequent spring crop, applications shall be made when soil temperatures are low enough to minimize

nitrification (< 50°F), or with a nitrification inhibitor, or controlled release fertilizer.

### **Protecting Vulnerable Sites**

Vulnerable sites are:

- Areas of average annual precipitation greater than 24 inches;
- Coarse textured soils and/or areas with high water tables (perched water less than 24 inches) with average annual precipitation greater than 21 inches or under irrigation;
- Idaho Nitrate Priority Areas and sub-basins with impacted surface water (as identified in Idaho Department of Environmental Quality's Report").

Reference UI fertilizer guides section "Water Quality Considerations" or section which address N movement in soils. Specific guidance is provided in the Fertilizer Guides of application of N in high precipitation areas, or on irrigated crops. Follow the UI fertilizer Guides when addressing movement of N in the soil profile.

### **Additional Criteria Applicable to Manure and Organic Byproduct or Biosolids Applied as a Plan Nutrient Source**

Persons who approve plans for nutrient Management involving the application of animal byproduct shall be certified through a certification program of the ISDA, NRCS, UI.

For purposes of this standard animal byproduct containing less than 10% moisture will be classified as a liquid.

### **Manure Sampling and Laboratory Analyses (Testing).**

Nutrient analysis of manure and organic byproduct is recommended to accurately determine application rates prior to land application.

If manure analysis is conducted it must include, at minimum, total nitrogen (N), ammonium N, total phosphorus (P) or P<sub>2</sub>O<sub>5</sub>, total potassium (K) or K<sub>2</sub>O, and percent solids.

Sampling and testing of nutrient streams (i.e. - manure, organic byproduct, biosolids, etc.) should be conducted annually. Additional testing may be necessary to account for operational changes (feed ration, animal type, manure handling, etc.) that will impact manure nutrient concentrations. If operational practices are consistent and the facility demonstrates a stable trend of manure nutrient concentration for three (3) consecutive years, the facility may reduce their testing frequency.

Samples must be collected, prepared, stored, and shipped, following UI (CIS 1139) guidance industry practice.

When planning for new or modified livestock operations, acceptable "book values" recognized by the NRCS (e.g. NRCS agricultural Field Handbook) and UI, or analyses from similar operations in the geographical area, may be used if they accurately estimate nutrient output from the proposed operation.

### **Additional Criteria to Protect Water Quality on Vulnerable Sites**

If the field lies within a hydrologic unit area that has been designated as having impaired water quality associated with nutrients, is within an area where nutrient contamination has been identified as a ground water quality concern, or is within a sole source water of wellhead

protection area where nutrient contamination is of special concern due to high or very high vulnerability, then the nutrient management plan must include an assessment of the potential risk for nitrogen and/or phosphorus to adversely impact water quality. The Nitrogen Leaching Index and/or the Idaho Phosphorus Index (PI), or other acceptable assessment tools may be used to make these assessments.

Utilize nutrient timing and placement to reduce Nitrogen and Phosphorus pollution of ground and surface waters. Special consideration will be given to application and placement of nutrients on sensitive areas (i.e., Highly Erodible Lands), within flood plains, near sensitive water bodies, in areas of ground water contamination from nutrients application, within sole source wellhead protection areas, or within other areas of water quality concerns.

In areas of special consideration, method will include:

1. Apply nutrient to crop fields to avoid or reduce potential of transport to gullies, ditches, surface inlets, sinkhole areas, or wellhead area.
2. Do not apply nutrients or byproduct on sites where runoff is delivered directly to a conveyance channel or receiving water body unless runoff is treated with a conservation buffer or other mitigating practice prior to delivery.

In areas of special consideration, recommended methods may include:

1. Split applications of Nitrogen to provide nutrients at the times of maximum crop uptake.

2. Band or place application of phosphorus near the seed row.
3. Incorporate broadcast fertilizer on cultivated crops.
4. Farm on the contour or cross slope on all fields adjacent to wetlands if nutrient runoff appears to pose a more significant hazard than leaching.
5. Utilize fall cover crops whenever possible to immobilize residual nitrogen and retain for spring crops.
6. Utilize Conservation Cover, Residue Management, Conservation Crop rotation, Grassed Waterway, Irrigation Water Management, Vegetative Buffer Strips and other conservation practices as needed to protect or improve water quality.

## **CONSIDERATIONS**

Individual conservation practices should be planned as part of a comprehensive conservation plan, which addresses all resource concerns and unit and reaches a resource Management System (RMS) level of treatment.

Elevated P levels in surface water are detrimental to its beneficial use. Runoff waters when exposed to high levels of soil test phosphorus (STP) have the potential of extracting elevated of P. The STP should not exceed the "Zero-Out" threshold established to protect the environment.

Use no-till/strip-till in combination with cover crops to sequester nutrients, increase soil organic matter, increase aggregate stability, reduce compaction, improve nutrient cycling and reduce energy inputs.

Use variable-rate nitrogen, phosphorus, and/or potassium application rates based on site-

specific variability in crop yield, soil characteristics, soil test values, and other soil productivity factors or evaluations.

Use manure management conservation practices to manage manure nutrients to limit losses prior to nutrient utilization. Apply manure at a rate that will result in an “improving” Soil Conditioning Index (SCI) without exceeding acceptable risk of nitrogen or phosphorus loss.

Use legume crops and cover crops in lieu of commercial fertilizers to provide nitrogen through biological fixation and nutrient recycling.

Modify animal feed diets to reduce the nutrient content of manure following guidance contained in Conservation Practice Standards (CPS) code 592, Feed Management.

Soil test information should be no more than one year when developing new plans.

Use soil tests, plant tissue analyses, and field observations to check for secondary plant nutrient deficiencies or toxicity that may impact plant growth or availability of the primary nutrients. Excessive levels of some nutrients can cause induced deficiencies of other nutrients, e.g., high soil test phosphorus levels can result in zinc deficiency in corn.

Use the adaptive nutrient management learning process to improve nutrient use efficiency on farms as outlined in the NRCS National Nutrient Policy in GM 190, Part 402, Nutrient Management.

Potassium should be applied in situations where an excess (greater than soil test potassium recommendation) causes nutrient imbalances in crops or forages.

### **Considerations to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater.**

Use conservation practices that slow runoff, reduce erosion, and increase infiltration, e.g., filter strip, contour farming, or contour buffer strips. These practices can also reduce the loss of nitrates or soluble phosphorus.

Use application methods and timing strategies that reduce the risk of nutrient transport by ground and surface waters, such as:

- Split applications of nitrogen to deliver nutrients during period of maximum crop utilization.
- Banded applications of nitrogen and/or phosphorus to improve nutrient availability.
- Drainage water management to reduce nutrient discharge through drainage systems, and incorporation of surface-applied manures or organic by-product if precipitation capable of producing runoff or erosion is forecast with the time of planned application.
- Use plant tissue testing during the growing season to monitor crop nutrient concentrations.
- Use the agricultural chemical storage facility conservation practice to protect air, soil and water quality.
- Use bioreactors and multistage drainage strategies when approved by land grant university.
- When soil test P concentration approaches 75% of the P TH, consider developing the Nutrient Management Plan using application rates at crop P uptake or less, or consider growing crops

that have a greater potential to remove P from the system.

- When soil test P concentrations are above the P TH, P application rates less than crop uptake should be utilized to reduce the soil phosphorus level.
- When monitoring indicates STP concentrations are increasing over time, consider review the Nutrient Management Plan and implementation for appropriate changes to reduce the P applied, especially when soil test P is near or above the Drawdown P Threshold.

## **PLANS AND SPECIFICATIONS**

The following components must be included in the Nutrient Management Plan:

- Aerial site photograph(s)/imagery or side map(s), and a soil survey map of the site;
- Soil information including: soil type surface texture, permeability, depth to water table, restrictive features, and flooding, and/ or ponding frequency;
- Location of designated sensitive areas and the associated nutrient application restriction and setbacks if applicable.
- Current and/or planned plant production sequence (crop rotation);
- Mandatory sampling/testing of all byproduct streams generated by the facility (e.g., compost, solid stack, slurry, liquids) and applied to owned or operated fields that recent soil tests have identified as above Phos TH.
- Fields identified on soil testing as reaching “zero out”, discussion of the risk associated with phosphorus accumulation and a proposed phosphorus draw-down strategy;

- Realistic yield goals for the crops;
- Complete nutrient requirements for nitrogen, phosphorus, and potassium for the crop rotation;
- Quantification of all nutrients generated by the facility and the types of all nutrients sources used in the NMP Plan;
- All enhanced efficiency fertilizer products that are planned for use;
- Guidance for implementation, operation and maintenance, and record keeping.

## **OPERATION AND MAINTENANCE**

### **Nutrient Management Plan Review and Revision**

The owner/client is responsible for safe operation and maintenance of this practice including all equipment of this practice including all equipment.

Conducting periodic plan reviews to determine if adjustments of modifications to the plan are needed. At a minimum, plans must be reviewed and revised, as needed with each soil test cycle, changes in manure volume or analysis, crops, or crop management. Fields receiving animal manures and/or biosolids must be monitored for the accumulation of phosphorus in accordance with land-grant university guidance and state law. Significant changes in animal numbers, management, and feed ration will necessitate additional manure analysis to establish a revised average nutrient content. Significant changes may include:

- Increase or decrease in livestock numbers by 10%
- Major changes to waste handling and storage system,
- 10% increase/decrease in application area (crop acreage)
- Change in irrigation system
- Change in crop rotation, resulting in a decrease in crop uptake by 10%
- New designation as a sensitive area
- Changes in livestock type
- Changes in feed ration

- Any additional information as required by this standard, (i.e., Site Vulnerability, Site Risk Assessments, and other appropriate cautions and discussions).

Suggested additional records include:

- Irrigation Water Management evaluations
- Recommended conservation practices and management actions that can reduce the potential for nutrient movement.

Document the nutrient application rate. When applied rate differs from the planned rate, provide documentation for the change.

**Field Records.** Records must be maintained for at least 5 years. Records include:

- Soil, manure, organic byproduct analysis resulting in recommendations for nutrient application;
- Variable rate nutrient or soil amendment applications;
- Nutrient application records per field or management zone (i.e. - quantities, analyses and sources of nutrients applied);
- Dates, method(s) of nutrient applications, source of nutrients, and rates of application;
- Non-growing season applications must record weather conditions and soil moisture; lapsed time to manure incorporation; rainfall or irrigation event;
- Crops planted, planting and harvest dates, yields, and crop residues removed.
- Name/date of person performing annual E/NMP review and all documented recommendations.