Technical Brief for Nutrient Management

A part of the Hullcar Situation Review
Nutrient Management Practices - Technical Report

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AGRICULTURAL WASTE CONTROL REGULATION (AWCR) TECHNICAL BRIEF

NUTRIENT MANAGEMENT

Disclaimer: The information presented in this technical brief has been prepared by Ministry of Agriculture staff and is based on conversations that have occurred during Agricultural Waste Control Regulation consultation sessions with industry and the Ministry of Environment since April 2012. The material is presented as a summary of some of the thoughts expressed at working group meetings with the intention of providing relevant background information. While the brief does offer some suggestions from the Ministry of Agriculture, the information contained herein should not be considered a final product but rather a starting point for further discussion at future meetings."

Attention: The comments and questions in this text box were added in November 2015 following the posting of the second intentions paper in July 2015 to add clarification, to provide further context or to flag parts of the original brief which may not have attracted adequate discussion in the first round of consultation. The comments are not intended to suggest a revision to or to provide a reinterpretation of the material presented in the original brief or what was documented in the applicable meeting minutes.

The second policy intentions paper stated that "in high risk areas, nutrients would not be allowed to be applied at rates of application that [i] exceed crop growth requirements, or [ii] result in excessive nutrient accumulation." In addition, the meeting notes of March 10, 2014 stated that "Ministry of Environment staff emphasized that the new regulation should emphasize the 'WHAT' component of environmental protection instead of the 'HOW'.

There are two aspects of the stated policy intentions that need clarification to be meaningful:

- How the "high risk areas" will be determined. Clear criteria must be defined to avoid creating moral hazards for those deciding which areas would have restrictions on nutrient application rates.
- What the "WHAT components" should be to meet the stated policy intentions above. The following two sections (adapted from the original March 2014 "Nutrient Management" brief below) specify options for WHAT without describing HOW:
    - A. To not allow application rates that result in excessive nutrient accumulation.
        1. Total available phosphorus (P) from all nutrient sources applied must not exceed the following rates of annual crop P removal on any field:
            i. Two times (2X) crop P removal if soil test P* is not available or if soil test P is greater than 300 milligrams per kilogram.

ii. Three times (3X) crop P removal if soil test P is greater than 150 milligrams per kilogram but less than or equal to 300 milligrams per kilogram.

iii. Notwithstanding Points (i) and (ii) above, a multiple of crop P removal that is more than or less than that specified in Point (i) and Point (ii) and specified by a director

** soil test P and sampling and analyses of agricultural waste are to be defined in a separate protocol, to be developed consistently with the definition in the Nutrient Management brief from March 10, 2014*

- B. To not allow application rates that exceed crop growth requirements.
  1. Nutrient applications must not exceed the agronomic nitrogen requirement on any field.

A limit based on crop growth requirement should not be based on phosphorus, if the goal is to avoid a de facto ban on manure application to soils enriched with phosphorus.

Despite a focus on the WHAT, how/whether the requirements will be enforced needs further discussion if accountability is important. Whether nutrients were applied at agronomic nitrogen rates can be difficult to verify since the determination of the rate is rather subjective. The elements that are most simple for all parties to verify are animal numbers, crops grown, and spreadable acres (Appendix B) – elements that facilitate the verification of the proposed P-based requirements to the extent that P-based limits become de facto limits on animal densities (relative to crop types and areas). The limits are de facto limits on animal densities if reliable information is not obtained for P contents and amounts of nutrient sources (applied, exported and imported including chemical fertilizers), and how nutrient sources are distributed among fields.

INTRODUCTION

Non-point source nitrogen (N) and phosphorus (P) losses from agricultural land has cumulative impacts on water quality. Excessive N as nitrate in drinking water is a human health concern. Excessive N and P can lead to harmful algal blooms depending on the sensitivity of receiving surface waters. Harmful algal blooms can impact aquatic life, recreation and tourism, drinking water treatment costs, and human and animal health. This brief discusses options to address water quality concerns caused by N and P excesses.

The focus of this brief is on 'right' rates of nutrient applications. "Land Application," a separate brief, focuses on the other "R's" of nutrient management (i.e. right time, right place, and right source). Greater long-term N and P surpluses lead to greater risks for water contamination.[1,2,3] Estimates of N and P surpluses from the 1990s to 2013 in the Lower Fraser Valley[4,5,6] suggested a particular need to assess risks in this region. However, localized risks may be present in any region and vary between fields and farms. To address nutrient surpluses, maximum application rates need to be determined at the farm level.

Out of scope
- Discharge of nutrient-rich effluent (e.g. from greenhouses or nurseries).
- Ammonia emissions and direct impacts of sediments or pathogens on water quality

SUMMARY OF CURRENT REGULATION

"Agricultural waste must not be applied to the land if, due to… the rate of application, runoff or the escape of agricultural waste causes pollution of a watercourse or groundwater" (Section 13).

"Agricultural wastes must not be applied at rates of application that exceed the amount required for crop growth if runoff or escape of agricultural waste causes pollution of a watercourse or groundwater, or goes beyond the farm boundary" (Section 14e).

There are 3 limitations with the above statements from the current AWCR:

1) *Crop growth* requirements do not reference N or P. Repeated manure applications based on crop N requirements typically exceed crop P requirements in the long-term, leading to high risks of P losses from agricultural land.

2) *Runoff* is subject to interpretation: important losses of dissolved or particulate N and P may be excluded.

3) *Pollution* may be occurring but may be difficult to prove.

ANALYSIS OF POTENTIAL OPTIONS

- Although previous discussions suggested that 'high-risk' farms may be required to complete nutrient management plans (NMPs), there has been no discussion of how maximum application rates would be determined in voluntary or mandatory NMPs.
- While regulations and guidelines for determining maximum application rates differ between jurisdictions, there are common principles to guide the approach. This brief presents the principles and approach as a 4-step framework with options at each step:
    - Step 1: Designate the watercourses for which P loading is of sufficient concern to warrant P-based maximum application rates.
    - Step 2: Determine thresholds above which maximum application rates are triggered.
    - Step 3: Determine the amount of excess N or P that is acceptable.
    - Step 4: Determine whether maximum application rates will be required or voluntary.
- Step 4 does not have to come last, but to have a well-informed discussion of the options for Steps 2 to 4 (Appendix A), it is important that all stakeholders understand the implications of different decisions that can be made at each step. Information sharing from NMPs would inform this discussion.

> *"Instead of being lulled into thinking they can have everything, people need to accept the hard truths about the [jurisdiction's] water pollution problems, and weigh the actions that will be needed to turn them around".*[7]

Although the quote was in the context of Vermont's challenges with water quality in Lake Champlain (of which agricultural sources are an important contributor), the idea applies generally to regions of intensive, animal-based agriculture. NMPs aim to minimize nutrient losses, but nonpoint source losses of N and P will occur from agricultural lands.

Immediate suggestions:

- Recognize that maximum application rates may distinguish nutrients as being applied as resources, acceptable excesses, or unacceptable wastes.
- To understand the implications of different decisions for Steps 2 to 4, begin Step 1 now. Also, start with an assessment phase in which NMPs will be required to be completed without requirements to implement maximum application rates in the NMPs.
- After the assessment phase, complete Steps 2 to 4 using the information collected from the NMPs during the assessment phase.

Step 1: Designate the watercourses for which P loading is of sufficient concern to warrant P-based maximum application rates.

- The common approach to nutrient management is to first determine whether P is a concern for particular watercourses receiving runoff from land. If so, P-based application rates are considered in addition to N-based rates.
- Ministry of Agriculture guidelines specify lakes in the Interior of BC as being P-sensitive but are unclear about other watercourses.[8] There are concerns about P sensitivity for other watercourses including those in the BC coastal region and coastal waters.[9,10,11]
- P-based application rates do not necessarily restrict applications to crop P requirements. In addition, P-based rates are usually, but not necessarily, designed to be more restrictive than N-based rates for farms with nutrient surpluses (Appendix A, Step 3).

Option 1 (suggested): Have N and P-based limits on nutrient application rates for areas draining to designated watercourses, and have N-based limits for other areas.

- Ministry of Environment to be responsible for designating the watercourses.
- Ministry of Environment to be responsible for reviewing the relevant evidence and consult with experts and stakeholders to determine which watercourses should be considered P-sensitive.

Option 2: Have N and P-based limits on nutrient application rates for areas draining to all watercourses.

See Appendix A for analysis of Steps 2 to 4.

RELATED ADDITIONAL CONSIDERATIONS/UNRESOLVED ISSUES

The following issues should be resolved after Steps 1 to 4 are taken to address the basic issue of maximum application rates. For example, it is arguably unimportant to require P sampling (e.g. of manures, soil, crops or water) from an environmental perspective if it is determined that P losses to watercourses are not an environmental concern for a particular field or watercourse.

- The Code of Practice for the Slaughter and Poultry Processing Industries refers to “nutrient management plan” with the same limitations identified in this brief.
- The following need to be determined with respect to maximum application rates:
    - Criteria to determine which operations are required to complete (and implement) an NMP.
    - Required qualifications of a ‘qualified planner’ for NMPs.
    - Sampling requirements (frequency, parameters):
        i. Some sampling requirements proposed in the original Policy Intentions Paper may be unnecessary, depending on Steps 1 to 4.
    - Record keeping requirements, including nutrient (e.g. manure) tracking from nutrient generators to nutrient applicators.

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APPENDIX A:
Analysis of Steps 2 to 4 for Determining Limits on Nutrient Application Rates

Step 1: Summary of Suggested Options: an Example Phase-in Schedule for Maximum Application Rates for Operations Requiring Nutrient Management Plans:

- Before 2018, there will be no regulatory limits in AWCR on maximum application rates during the 'assessment phase'.
- In 2018 and subsequent years, nutrient applications should not exceed the agronomic N requirement as determined by a 'qualified planner'.
- By 2020, nutrient applications should not exceed the following rates of P removal, unless otherwise approved:
    - 2 times crop P removal if soil test P* is greater than 300 mg kg^{-1}
    - 3 times crop P removal if soil test P is greater than 150 mg kg^{-1} but less than or equal to 300 mg kg^{-1}
    - *Herein, soil test P is the Kelowna method-equivalent value of a sampling unit (i.e. a field less than 10 ha in farmable area) from the 0-15 cm soil depth. If a soil test P value from the previous 2 years is unavailable, the value should be assumed to be 301 mg kg^{-1} (Kelowna method-equivalent value).
- The above values should be reconsidered before 2018, including the initial year '2018'.
- The above values should be reconsidered periodically after 2018.

Step 2: Determine thresholds above which maximum application rates are triggered:

- Thresholds in this context do not refer to thresholds that trigger NMPs but rather the thresholds that trigger maximum application rates to be specified in NMPs.
- In Alberta, soil nitrate (NO_3) sampling effectively provides thresholds:
    - Proper soil NO_3 sampling should help decide agronomic N rates, but the interpretation is complex for BC climatic conditions (particularly the Coast). The complexity disfavours soil NO_3 from being a clear regulatory threshold for BC.
- In Manitoba, Ontario, and Quebec, high soil P levels effectively provide thresholds:
    - Greater soil P level is correlated with greater risk of loss with water, but overall risk of loss is likely greater for the BC Coast than for the BC Interior.[11,11]
- Alternatively, P loss risk can provide a threshold for P-based limits. An example is one of many P indexes, which account for soil test P. The federal Nutrient Management Standard in the United States refers to soil P indexes as thresholds:[11]
    - Relative to soil test P, P indexes are more complicated to develop and to assess. Most P indexes rely on informed guesses of factors affecting P loss, are validated to a limited extent, and are subject to change as new knowledge develops.[11,11]
    - In Ontario and Quebec, P loss risk assessments are used primarily as educational BMPs as opposed to regulatory tools.

Option 1: Have no thresholds. Application rates simply should not exceed agronomic N rates:

- Agronomic N rates refer to the N application rates required for crop growth. They account for reasonable N losses, soil and manure N release rates, and other factors as determined by a 'qualified planner'.
- Agronomic N rates provide the basis for the rule of thumb of '1 milking cow per acre'.
- This option does not address excessive P rates that increase risks of water contamination by P. Applications of manures at agronomic N rates typically exceed crop P requirements in the long-term.

Option 2: Set thresholds for P based on region-specific P loss risk assessments:

- The P loss risk assessment(s) would need to be developed or adapted from outside BC.

Option 3 (suggested): Set thresholds for P based on soil test P.

In BC, soil test P above 100 ppm indicates no agronomic benefit from P fertilizer unless the fertilizer is small amounts of 'starter' for some crops. Agronomic guidelines in Washington State/Oregon and Alberta specify excessive soil test P at levels lower than 100 ppm:[11,11]

- In BC, soil test P above 100 ppm has been proposed as a threshold for "very high" risk of loss by water transport.[11,11]
- Thresholds may also be chosen to limit the number of producers affected. Different soil test P thresholds would have affected different proportions of fields surveyed in the Lower Fraser Valley (LFV) in 2005[18] or the Okanagan-Similkameen (OK-Sim) in 2007[19]:
    - Soil test P greater than 300 ppm: 7% of fields in LFV; 2% of fields in OK-Sim.
    - Soil test P greater than 250 ppm: 11% of fields in LFV; 5% of fields in OK-Sim.
    - Soil test P greater than 150 ppm: 31% of fields in LFV; 11% of fields in OK-Sim.

Step 3: Determine the amount of excess N or P that is acceptable:

- A maximum application rate distinguishes nutrients as being applied as resources, acceptable excesses, or unacceptable wastes.
- Maximum application rates are determined using agronomic or crop removal rates. Relative to the agronomic rate concept, crop removal is more objective and does not depend on differences in soils, crops, climates, etc. that affect agronomic rates.
- For N, agronomic N rates for land applications allow for N excesses. The qualified planner has discretion for planning to minimize N excesses according to best practices, accounting for time, place, and source.
- Alternatively, crop N removal can be used to specify an upper limit of excess N:
    - California specifies that nutrient applications are not to exceed 1.4 times crop N removal, effectively limiting N excesses to 40% of the amount of N that gets harvested and removed, unless otherwise approved.[11]
    - Different upper limits may be appropriate for different crops or regions.

- For P, the allowable excess is typically based on crop P removal instead of agronomic P rates if soil P levels are high:
    - In Manitoba, nutrient applications are limited to 2 times crop P removal at a particular soil test P level and 1 times crop P removal at a lower soil test P level.
    - In Ontario and Quebec, nutrient applications are effectively limited to crop P removal plus a certain amount.
    - In Ontario, the maximum application rates are on a 5-year basis to allow for above-limit applications in one year and below-limit applications in other years.

Option 1 (suggested): Limit nutrient application rates to agronomic N rates determined by qualified planners:

- This likely reflects the original intent of the AWCR (Sections 13 and 14e).

Option 2: Limit N application rates to a multiple of crop removal (to be determined).

Option 3 (suggested): Limit P application rates to a factor(s) of crop removal at thresholds, unless otherwise approved.
e.g. "*2 times* crop P removal if soil test P* is greater than 300 mg kg^{-1}; *3 times* crop P removal if soil test P is greater than 150 mg kg^{-1} but less than or equal to 300 mg kg^{-1}":

- The practical solution may be a compromise between what is feasible in the short term (e.g. 2 times crop P removal, 0% increases in P losses) and what is desirable in the longer term (e.g. crop P removal exceeding crop P additions, 10% reductions in P losses).
- Without adequate information on crop P removal balances among a representative selection of farms in BC, it is difficult to determine who will be impacted or what the economic impacts will be.

Step 4: Determine whether maximum application rates (limits) will be required or voluntary:

- AGRI presented a *Nutrient Management Strategy* that would require greater "effort" if determined by pre-screening (risk assessment tool & whole farm nutrient balance tool, in development): NMPs represent the greatest level of effort in the strategy.[11]
- The effort required to complete an NMP (assessment) is minimal if there is sufficient support (e.g. cost-share funding and qualified planners), compared to the potential effort and costs of implementing an NMP (i.e. actually reducing nutrient surpluses).
- If the limits are mandatory or triggered by cross-compliance (e.g. with cost-share funding, crop insurance, new quota), consider how records of farm nutrient balances and exports of excesses should be reviewed for compliance and enforcement:
    - Can or should a qualified professional or planner be expected to ensure the limits are implemented, let alone other recommendations (e.g. setbacks) of an NMP?
- For regions with nutrient surplus, limits will likely impose at least modest costs on some individuals. Mandatory limits should consider the following: how much is willing to be paid, who should pay, and what are the external or unpaid costs of business-as-usual?

AGRI 2015a. Technical Brief for Nutrient Management for the AWCR Review.

Option 1: Have voluntary limits:

- Some farms may need to complete an NMP without needing records of implementation.
- Strong technical support and cost-sharing is likely needed to help achieve limits.[11]

Option 2 (suggested): Phase in mandatory limits after a period of voluntary limits.

- This option supports implementing all of the suggested options from Steps 1 to 3.
- Some farms may need to complete an NMP and share records of farm nutrient balances and exports of nutrient excesses.
- Cross-compliance measures may be re-evaluated to provide records.
- Strong technical support and cost-sharing is likely needed to help achieve limits.[22]

APPENDIX B:

Analysis of the November 2015 comments on Page 1 and 2:

- Although only phosphorus is referenced in the requirements discussed, the requirements would be a set of de facto limits on both excess phosphorus and excessive nitrogen for materials currently defined to be agricultural wastes.
- The requirements would be performance-based (the "What"). There is no requirement for nutrient management planning per se, although Ministry of Environment has intentions to apply the requirements only to "high risk areas," implying that may be a "How" to determine whether the requirements apply.
- The requirements would apply to all nutrient source materials and types of agricultural operations (e.g. livestock or horticulture), not just agricultural wastes.
- The requirements would apply to fields at very high soil test P, which is associated with crop production recommendations of 0 lb P2O5/ac for all crops and soils.
- The requirements would not include documentation of nutrient movement (e.g. poultry manure export to other farms).
- The requirement would refer to a specific nutrient (phosphorus), which is necessary to define limits on nutrient applications that are verifiable.
- The "director" would have the prerogative to have less stringent limits (e.g. if appropriate measures to minimize losses of nutrients or other contaminants from fields are taken) or more stringent limits (e.g. if more aggressive reduction of nutrient excesses is warranted).
- The requirements would condone excess phosphorus up to an amount that is greater in absolute quantity for fields with crops that remove greater amounts of phosphorus (e.g., greater phosphorus excess allowed for perennial grass crops than for fruit crops).
- The requirements would compel farms to reduce but not necessarily eliminate the amount of excess nutrients on a farm over time.
- To understand if Section A requirements are met, no sampling or laboratory testing would be required per se but farmers have the option to do so:
    i. Crop P removal = max target yield for harvest x P content in harvested portion.
    ii. Total available P applied = the sum of (the application rate x total P content) for each nutrient source applied.

AGRI 2015a. Technical Brief for Nutrient Management for the AWCR Review.

  - Documentation of target yields by a qualified professional would be likely be required if the farmer does not wish to use maximum target yields (to be defined).
  - Testing of P content in the harvested portion would be required if the farmer does not wish to use average nutrient values to be specified in a protocol.
  - Testing of the nutrient source (e.g. manure, compost) by a qualified professional may be expected if the farmer does not wish to use average nutrient values to be specified in a protocol or if manure is treated (e.g. mechanically separated) to export P from the farm.
  - Soil testing by a qualified professional would be expected if the farmer wishes to demonstrate that he/she can apply more than 2 times the annual crop removal to any field based on the soil P fertility of the particular field.
- The proposed thresholds for soil test P are based loosely on the evidence: the immediate and long-term risks of dissolved P losses are high at soil test P levels lower than the proposed threshold.

IMPLICATIONS FOR THE AGRICULTURE INDUSTRY

Based on surveys of soil nutrients in the Fraser Valley and the Okanagan-Similkameen (from 2005 to 2012), a minority of farms in these regions is currently subject to the soil test P limits.

An annual excess of phosphorus of up to 3 times crop P removal is likely achievable without undue burden on most animal farms. The '3 times' limit would give the flexibility to most animal farms in B.C. that generate and apply animal manures to meet agronomic nitrogen requirements without specifying how (e.g., when and how nutrients are applied). However, the requirements are designed to compel the transport of excess nutrient materials to farther, less fertile fields over time.

The requirements indirectly address the regional nutrient excesses in the Lower Fraser Valley (LFV). If LFV farms overall significantly reduced their acceptance of manure to meet the requirements, there would be increased pressure for (poultry) farms to find alternatives that are costlier than supplying or selling to neighbours nearby. However, Ministry of Environment intends to apply the requirements only to farms in "high risk areas," which may shift excess nutrients to those areas determined to not be "high risk."

In the Lower Fraser Valley, field vegetable, blueberry and raspberry fields are among the majority of fields with the highest soil test P levels. Orchards in the Okanagan also have high soil test P levels. Although the soil test P limits apply to the farms with these fields, these farms should be able to reduce unnecessary chemical P fertilizer to meet the proposed requirements with no burden, since they do not generate manures. If requirements were followed through, the fertilizer industry would effectively sell less chemical P fertilizer.

IMPLICATIONS FOR THE REGULATORY AUTHORITY (ACCOUNTABILITY AND EFFECTIVENESS)

The regulatory authority must determine how it would decide require a farmer to demonstrate they are meeting the policy intention of not allowing excessive nutrient accumulation. Would the requirements be enforced like speeding laws might be: targeting black spots ("high risk areas") and worst offenders? (Whereas drivers have the option of slowing down at any time, some farmers with nutrient excesses may not be able to reduce nutrient surpluses without some burden).

Compared to nutrient management plans and the determination of agronomic N rates, the Field P balance report (template shared on March 10, 2015) has the most realistic chance of being verified for plausibility with the least amount of subjectivity and involvement (by a regulatory authority or qualified professional). By comparing animal numbers with spreadable acres and crops grown, it is possible to verify whether the P balance for all of the fields (collectively) on a farm is realistic. If manure is exported or treated to separate and export P from the farm, laboratory analyses would also be needed of the exported material along with some evidence of the exported amount. The proposed P-based limits become de facto limits on animal densities (relative to crop types and areas) of livestock farms if reliable information is not collected for P analyses and exported amounts of (treated) nutrient sources, imported P including manures and chemical fertilizers, and how nutrients are distributed among fields. Meanwhile, limits that are strictly based on animal densities ignore non-animal farms and lack flexibility to accommodate variations among farms in P use efficiency or technologies to export P. Thus, while the proposed P-based requirements could apply to all farms, there are limits to what the regulatory authority can verify with confidence without significant effort.

Nonetheless, in cases where great effort is warranted to address an environmental issue(s) associated with the land application of nutrients, the framework of the P-based requirements is recommended to minimize red tape while offering some means of accountability to meet Ministry of Environment's intentions of limiting nutrient application rates.