# Tracking Post-Harvest Soil Nitrate in Agricultural Fields in the Hullcar Valley in 2017-18

Progress Report

Growing Forward 2

British Columbia

Canada

# Tracking Post-Harvest Soil Nitrate in Agricultural Fields in the Hullcar Valley in 2017-18

Short title: 2017-18 Post-Harvest Nitrate Study: Hullcar Valley

**Progress Report**

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## Summary

To minimize the amount of nitrate that can leach down through the soil profile, it is important to understand the amount of excess soil nitrate relative to crop needs in agricultural fields. These excesses can be measured by the post-harvest nitrate test (PHNT). The year-to-year trends in a field's PHNT values are an indicator of the effectiveness of adjustments to nitrogen (N) management practices over time. In the fall of 2017, residual nitrate in 39 agricultural fields in the Hullcar Valley of the North Okanagan was measured in the 0-90 cm soil layer using the PHNT. Nine of these fields were split for a total of 48 sampling areas. Of the 39 fields, 34 (or 87%) had low or medium average PHNT values (less than 100 kg N $ha^{-1}$) and 5 (or 13%) had high or very high average PHNT values. In 2016, 54% of these 39 fields had low or medium PHNT values and 46% were in the high or very high range. Overall, crop N management was close to optimal in most fields in 2017 and there was less post-harvest (residual) soil nitrate in 2017 than in 2016.

In a separate analysis, weather conditions between the 2017 and 2018 growing seasons are being assessed for their effect on soil nitrate movement. Three rounds of sampling were completed for each of six 'benchmark' sites in the Hullcar Valley from the beginning of October to mid-November. During each round, soil nitrate was measured in each of the 0-30, 30-60, and 60-90 cm soil layers. Three more sampling events are planned for each site in the spring of 2018.

A final report is expected in the summer of 2018. The final report will include analysis and discussion of the PHNT results in greater detail. Results of the benchmark testing will also be included. Expected outcomes include an improved understanding of the PHNT as a management tool. The goal is to make better use of N inputs and minimize the potential for nitrate leaching in the North Okanagan of B.C.

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# 1 Introduction

In recent years, the drinking water quality in Aquifer 103 in the Hullcar Valley in the North Okanagan of British Columbia (B.C.) has been compromised by elevated levels of nitrate[1]. Agricultural fields in the Hullcar Valley, dominated by forage crops grown for livestock feed, are possible sources of nitrate. For nitrate to leach from agricultural fields to an aquifer, nitrate must be present in the soil, and water must be moving down or percolating through the soil. The post-harvest nitrate test (PHNT) is a soil test that was developed to guide decisions about nitrogen (N) management. A PHNT is meant to measure the amount of excess soil nitrate not used by the recently harvested crop (i.e. post-harvest soil nitrate). Relative differences in PHNT values help guide decisions about N management, no matter what the crop-specific target values for PHNT are or should be. For a given field, monitoring PHNT, crop yield and crop quality year-to-year provides information to minimize excess nitrate over time without compromising crop production objectives (BC AGRI 2010). In the fall of 2016, baseline measurements of PHNT were taken in agricultural fields that represent most of the cropped area in the Hullcar Valley (Poon and Code 2017). The 2016 results suggested an opportunity to reduce excess N in roughly half of the fields sampled, after which efforts continued to improve N management practices[1]. Fall 2017 was the first opportunity to repeat the PHNT testing in the previously sampled fields and monitor year-to-year trends.

In regions with freezing temperatures and dry winters like the Okanagan, any soil nitrate remaining in the soil at the end of the growing season is most vulnerable to leaching during the fall and spring thaw periods when evapotranspiration and crop nutrient uptake rates are lowest. However, nitrate leaching during these periods is limited by freezing conditions and the amount of soil water. Thus, despite a wet and warm fall followed by an above-average snow accumulation during the winter of 2016/17, the leaching of soil nitrate in the Hullcar Valley was limited during the winter of 2016/17 and before crop growth in 2017: nitrate leached from the 0-30 cm soil layer to the 30-60 cm layer but not deeper even in coarse-textured and well-drained soil (Poon and Code 2017). These results were consistent with those previously observed in the Okanagan Valley (Kowalenko et al. 2009).

While the results were insightful, the depth to which nitrate leaches between crop growing seasons may depend both on the amount of soil nitrate and the amount of percolating water. Therefore, additional monitoring of the movement of soil nitrate is needed for the non-growing season in the North Okanagan.

This report addresses the need to better understand 1) the distribution of fields with different levels of PHNT, to help guide producers' decisions about crop N management in the Hullcar Valley and 2) the movement of soil nitrate through the top 90 cm of the agricultural soils between growing seasons in the Hullcar Valley, to determine what, if any environmental interpretations, can be made of the PHNT soil test in the North Okanagan.

[1] http://www2.gov.bc.ca/gov/content/environment/air-land-water/site-permitting-compliance/hullcar-aquifer

**Primary Questions**

1. Overlying Aquifer 103 and the nearby area, how many agricultural fields had elevated levels of post-harvest soil nitrate in the 0-90 cm layer of soil in 2017?
2. How did PHNT levels compare between 2016 and 2017 in these fields?
3. Does nitrate leach through and below the 0-90 cm layer of soil between growing seasons in the area overlying Aquifer 103? [to be addressed in the final report in 2018]

**Hypotheses**

1. Most agricultural fields in the area had less than 100 kg N $ha^{-1}$ of post-harvest soil nitrate (0-90 cm soil layer) in 2017.
2. PHNT levels were lower in 2017 than in 2016.
3. Soil nitrate leached within but not below the 90 cm depth of soil between growing seasons. [to be addressed in the final report in 2018]

Out of scope

- Measure N leaching from non-cropped areas, such as manure storage areas
- Measure nitrate leaching during the growing season, possibly due to over-irrigation
- Measure N transformations (e.g., mineralization and denitrification) that influence soil and water nitrate concentrations
- Measure soil water movement
- Update nutrient management plans, including assessing relationships between nitrogen management practices and PHNT results

# 2 Materials and Methods

**Study area**

The study area was in the North Okanagan, mostly overlying Aquifer 103 and centred at about 50.5, -119.3 degrees, south of Grindrod, B.C. Poon and Code (2017) described the area including the agricultural activity, crops, and soils. Mean annual precipitation is 480 mm and daily mean temperatures range from -2.3°C in January to 20.2°C in July (Wang et al. 2016). In 2017, air temperatures were close to normal throughout the spring to fall, with a wetter-than-normal spring and dry September, excluding irrigation (Fig. 1). In 2016, air temperatures were close to normal from the spring until the fall sampling period, when October and November were warmer and wetter than normal (Fig. 1). In 2017, precipitation from May to October was less than half of that which fell during the same months in 2016 (Fig. 1), although all fields in the study area were irrigated.

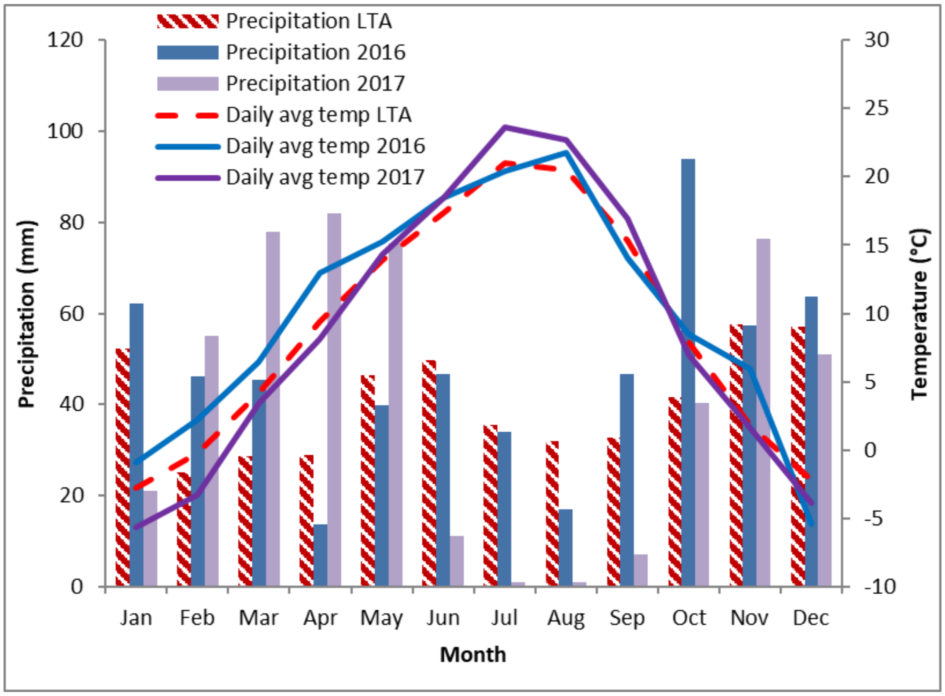


**Figure 1.** Average daily air temperature and total precipitation by month, compared to the long-term average (1980-2010, LTA) at the North Vernon weather station (50.34, -119.27, 538 m elevation) from January 2016 to December 2017. Source: Environment and Climate Change Canada 2017.

## 2.1 Post-Harvest Soil Testing

### Field Selection and Sampling Methodology

Thirty-nine fields that were sampled in 2016 for PHNT were re-sampled in the fall of 2017. Each field was managed uniformly (e.g., even manure application rates), and nine of the larger fields were split in two sampling areas for 2017 sampling. The splits were made according to differences in soil types or simply to divide large areas in half so that no sampling area was larger than 25 ha in size. Thus, 48 sampling areas were sampled, and numbered from 1 to 48, to represent the 39 fields in 2017 (Fig. 2). The numbering system differed from the one used in the report by Poon and Code (2017).

The sampling methodology for each sampling area was the same in 2017 as in 2016 (Poon and Code 2017). One composite soil sample was taken per field at the 0-15, 15-30, 30-60, and 60-90 cm soil layers. In 2017, PHNT sampling started on September 13 and ended on October 20. In 2016, PHNT sampling started on September 30 and ended on November 4 (Poon and Code 2017).

### Analyses

The laboratory and data analyses were the same for the 2017 data as the 2016 data (Poon and Code 2017). Extractable-nitrate concentrations were converted to kg N $ha^{-1}$ for each layer, assuming a soil bulk density of 1300 kg $m^{-3}$ for the 0-30 cm soil layer and 1500 kg $m^{-3}$ for the 30-60 and 60-90 cm soil layers. The 0-90 cm nitrate results were categorized into 4 general agronomic categories (0-49 kg N $ha^{-1}$, Low; 50-99 kg N $ha^{-1}$, Medium; 100-200 kg N $ha^{-1}$, High; and ≥200 kg N $ha^{-1}$, Very High), based on the categories proposed by Kowalenko et al. (2009).

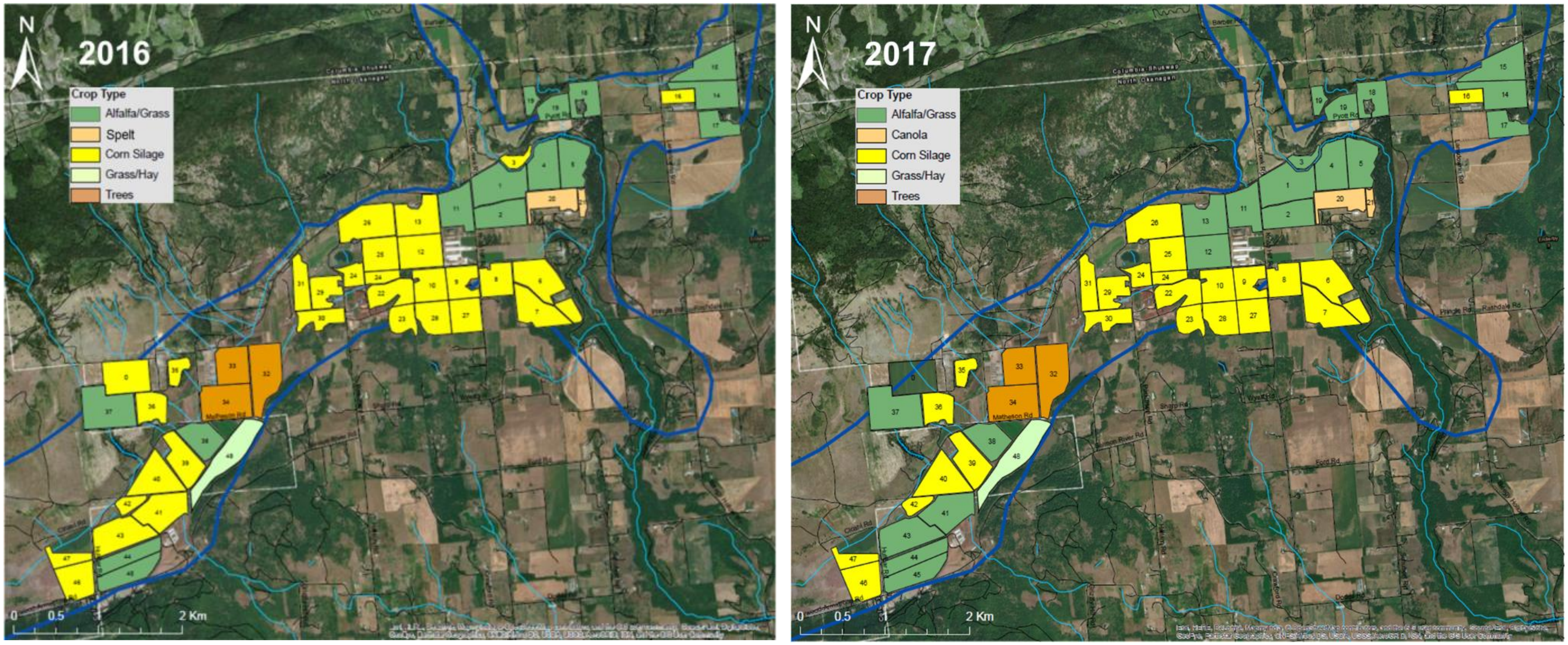


**Figure 2.** Crop types during the 2016 and 2017 growing seasons in the study area, in relation to Aquifer 103 (blue outline). The numbers represent the sampling areas that were sampled in 2017, and the numbering system differs from that used by Poon and Code (2017) in 2016. "Field 0" was sampled only in 2016.

## 2.2 Benchmark Testing (in progress)

Six rounds of soil sampling were planned in each of six 'benchmark' sites in three soil layers (0-30, 30-60, and 60-90 cm). Each benchmark site had an area of 60 to 100 $m^2$, established in one of the 39 fields sampled for PHNT. At the time of writing, three rounds of soil sampling were completed from October 6, 2017 to November 15, 2017. Three additional rounds are expected, from after spring thaw in 2018 until the end of May 2018, before the first manure application of the season to corn fields. Methods will be described in the Final Report.

# 3 Results and Discussion

### 2017 Results

There were differences among crop types in the 2017 PHNT results (Table 1). Among the 48 sampling areas, the area-weighted average PHNT values were highest for the fields that were in annual crops (canola, corn) and lowest in the fields with the perennial crops (alfalfa/grass, grass hay, and nursery trees). These differences were consistent with relative differences in N uptake efficiency between the crop types and previous results in the study area in 2016 (Poon and Code 2017) and the larger Okanagan Valley (Kowalenko et al. 2009).

**Table 1**. 2017 Post-Harvest Nitrate Test (PHNT) values by crop type.

| Crop type | Area sampled (ha) | Number of sampling areas | Area-weighted average PHNT[a] (kg N $ha^{-1}$) | Median PHNT (kg N $ha^{-1}$) | Minimum PHNT value (kg N $ha^{-1}$) | Maximum PHNT value (kg N $ha^{-1}$) |
|---|---|---|---|---|---|---|
| Alfalfa/grass | 344 | 19 | 47 | 45 | 21 | 69 |
| Corn, silage | 323 | 23 | 83 | 83 | 21 | 233 |
| Other perennial[b] | 92 | 4 | 28 | 23 | 19 | 45 |
| Canola | 17 | 2 | 91 | 91 | 91 | 91 |
| All | 776 | 48 | 60 | 50 | 19 | 233 |

a. In an area-weighted average, sampling areas that were larger contributed more to the average PHNT value compared to areas that were smaller. In contrast, all areas contribute equally to a simple average regardless of the acreage of the area.
b. 'Other perennial' is fields in nursery trees or a field in grass hay.

Of the nine fields that were split in 2017, six had PHNT levels that were similar between the two sampling areas of each field (Table 2). These similarities suggest that these six fields could be sampled and managed as one unit. In the three other fields (9&10, 22&23 and 27&28), all planted to corn in 2016, the PHNT level differed between the sampling areas. These differences suggest that these 3 fields should continue to be split as in 2017 for PHNT monitoring, and if differences persist, N management practices may also need to differ between the two areas of a given field.

**Table 2**. 2017 Post-Harvest Nitrate Test (PHNT) levels in fields that were split into two sampling areas.

| Paired Sampling Areas | | | | Fields (Combined Sampling Areas[a]) | | |
|---|---|---|---|---|---|---|
| Sampling Area # | Area (ha) | PHNT kg $NO_3$-N $ha^{-1}$ | Agronomic PHNT rating[b] | Field | PHNT kg $NO_3$-N $ha^{-1}$ | Agronomic PHNT rating |
| 9 | 13 | 131 | High | 9&10 | 94 | Medium |
| 10 | 15 | 62 | Medium | | | |
| 12 | 20 | 54 | Medium | 12&13 | 49 | Low |
| 13 | 21 | 45 | Low | | | |
| 14 | 20 | 48 | Low | 14&15 | 38 | Low |
| 15 | 21 | 28 | Low | | | |
| 18 | 14 | 45 | Low | 18&19 | 40 | Low |
| 19 | 15 | 36 | Low | | | |
| 22 | 15 | 93 | Medium | 22&23 | 71 | Medium |
| 23 | 10 | 40 | Low | | | |
| 27 | 15 | 74 | Medium | 27&28 | 47 | Low |
| 28 | 15 | 20 | Low | | | |
| 33 | 17 | 25 | Low | 33&34 | 22 | Low |
| 34 | 24 | 20 | Low | | | |
| 44 | 14 | 40 | Low | 44&45 | 29 | Low |
| 45 | 16 | 20 | Low | | | |
| 46 | 17 | 97 | Medium | 46&47 | 92 | Medium |
| 47 | 8 | 82 | Medium | | | |

a. The PHNT results are area-weighted averages of the two sampling areas of a field

b. Ratings: 0-49 kg N $ha^{-1}$, Low; 50-99 kg N $ha^{-1}$, Medium; and 100-200 kg N $ha^{-1}$, High

Results support the hypothesis that most (87%) of the 39 fields had less than 100 kg N $ha^{-1}$ PHNT (0-90 cm soil layer) in 2017. More fields had a low PHNT rating (less than 50 kg N $ha^{-1}$) than any other rating. Only 13% of the fields, representing 64 ha of the 776-ha study area, had greater than 100 kg N $ha^{-1}$. Only one field had greater than 200 kg N $ha^{-1}$, although this field was small (5.5 ha; Fig. 3). Overall, crop N management was close to optimal in most fields and most of the study area in 2017, assuming there were no crop N deficiencies.

## Comparisons between 2017 and 2016

Overall, PHNT levels were lower in 2017 than in 2016 (Figs. 3 and 4). In 2016, 54% of the 39 fields had low or medium PHNT values and 46% were in the high or very high range. Year-to-year trends in PHNT levels can be compared directly for a given field if the cropping system is the same between years. All fields that were in alfalfa in both study years, and most fields that were in corn in both study years, had similar or lower PHNT values in 2017 than in 2016 (Figs. 5 and 6; Appendix A). Of the corn fields, three had medium PHNT values in 2017 that were greater than in 2016 (Figs. 3 and 4). The field with more than 200 kg N $ha^{-1}$ in 2017 had 52 kg $NO_3$-N $ha^{-1}$ in 2016, although this field was small (5.5 ha). Although unseasonably warm and wet weather conditions during the post-harvest sampling period in 2016 may have increased the PHNT soil nitrate levels in 2016, the results suggest that producers improved crop nitrogen management practices in 2017 in most fields compared to 2016.

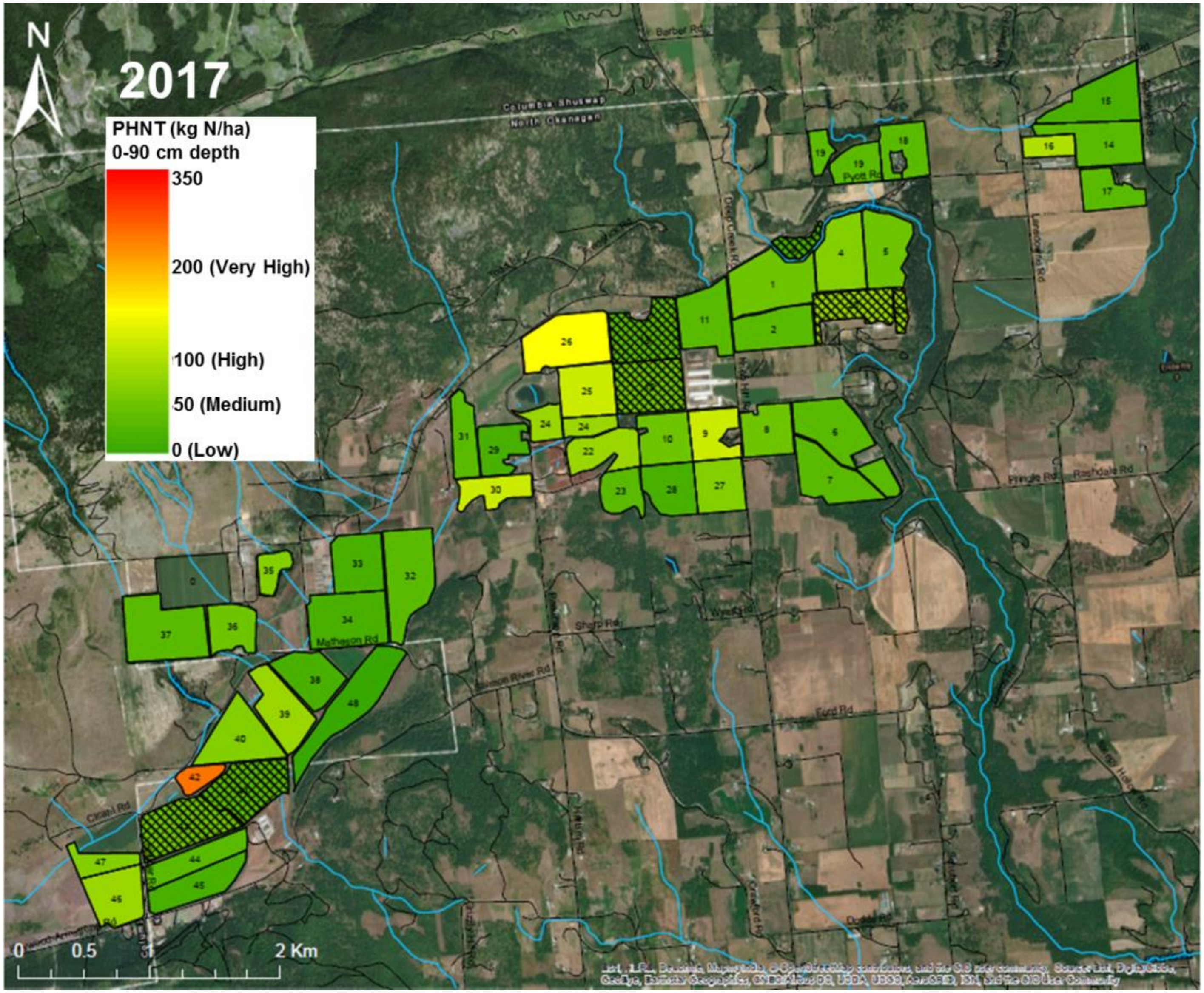


**Figure 3.** Post-Harvest Nitrate Test (PHNT) levels in fall of 2017. Sampling areas with a cross-hatch pattern had a different crop type in 2016 than in 2017. The polygons (and numbers) indicate the sampling areas in 2017.

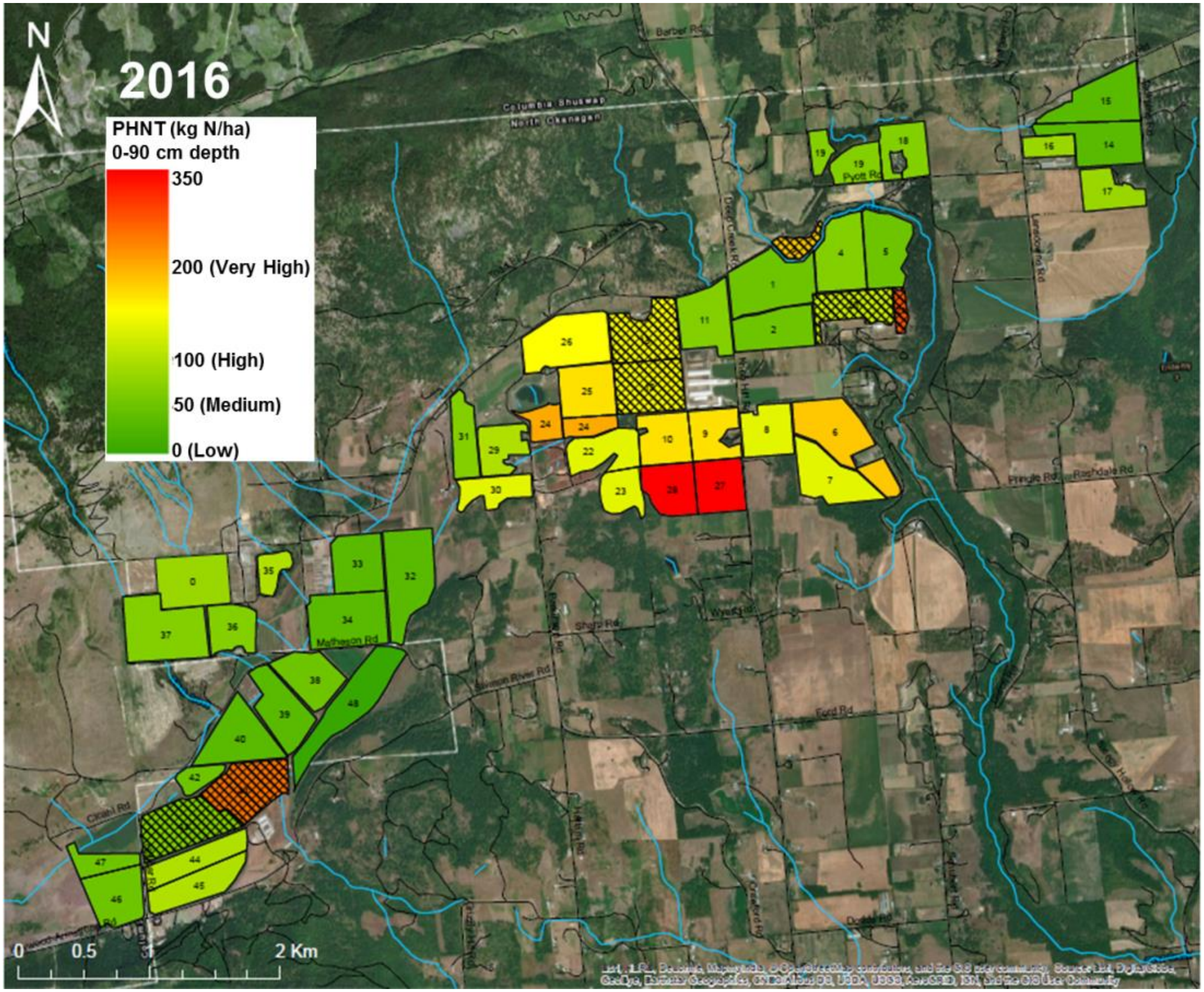


**Figure 4.** Post-Harvest Nitrate Test (PHNT) levels in fall of 2016. Sampling areas with a cross-hatch pattern had a different crop type in 2017 than in 2016. The polygons (and numbers) indicate the sampling areas in 2017.

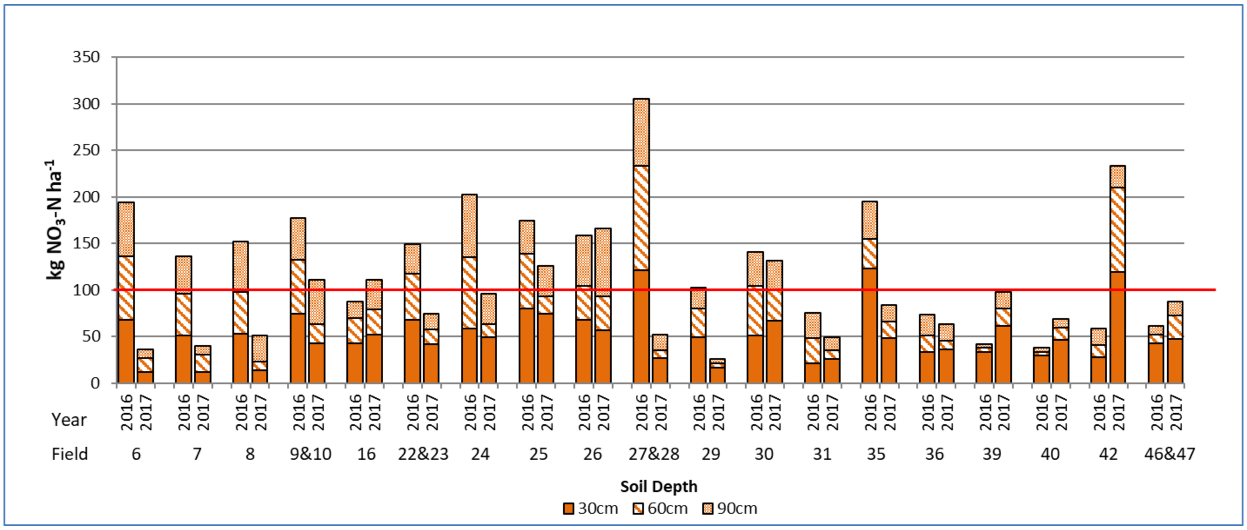


**Figure 5.** The distribution of post-harvest soil nitrate by soil layer, in 19 fields that were in silage corn in 2016 and 2017. The red line is the lower limit (100 kg N ha$^{-1}$) of the 'high' category of the post-harvest nitrate test.

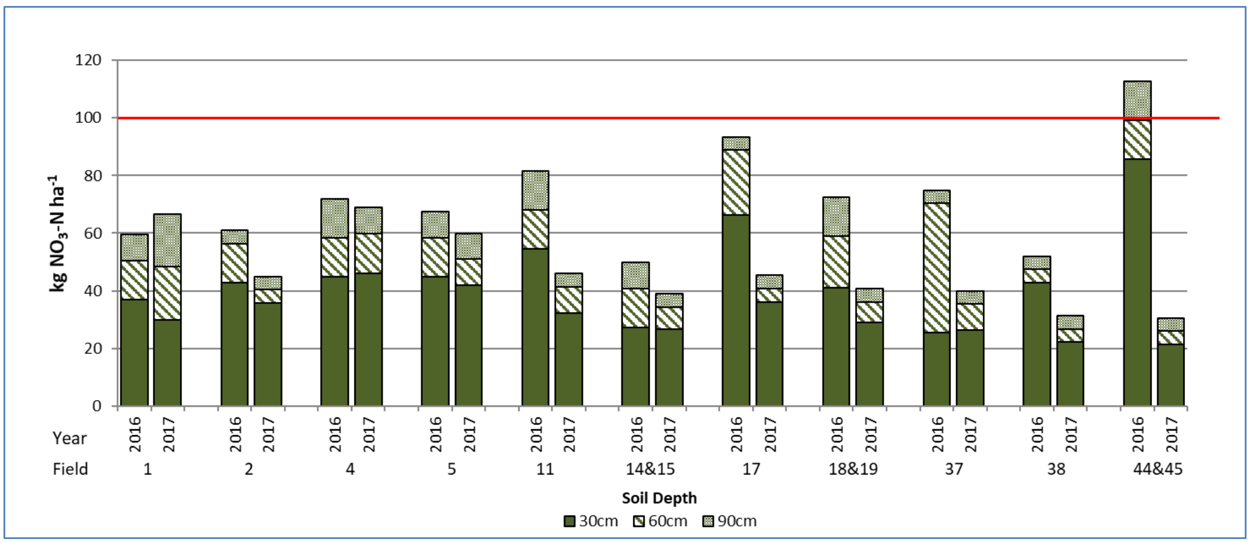


**Figure 6.** The distribution of post-harvest soil nitrate ($NO_3$-N) by soil layer, in 11 fields that were in alfalfa or an alfalfa/grass mix in 2016 and 2017. The red line indicates the lower limit (100 kg N ha$^{-1}$) of the 'high' category of the post-harvest nitrate test.

# 4 Next Steps

In the forthcoming final report, results from Post-Harvest Soil Testing will be discussed more thoroughly. The Benchmark Testing analysis for the 2017/18 period is expected to continue until mid-May 2018, and the results will be. In the meantime, cooperating producers should consider the 2017 PHNT results in their decisions about 2018 nutrient management practices.

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# Appendix A: Post-Harvest Nitrate Test Results in 2016 and 2017

**Table 3.** Post-Harvest Soil Nitrate (expressed as nitrate-nitrogen) by soil layer (depth) in fields that were in silage corn in 2016 and 2017. Nitrate values for fields with two sampling areas are simple averages, not area-weighted averages.

| | | 2016 | | | | | 2017 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2017 Field #** | **Sampling Depth** | **$NO_3$ ppm** | **$NO_3$ kg ha$^{-1}$** | **Total $NO_3$ (0-90cm) kg ha$^{-1}$** | **PHNT Rating** | **Crop** | **$NO_3$ ppm** | **$NO_3$ kg ha$^{-1}$** | **Total $NO_3$ (0-90cm) kg ha$^{-1}$** | **PHNT Rating** | **Crop** |
| 6 | 0-30 cm | 18 | 70 | | | | 3 | 12 | | | |
| | 30-60 cm | 15 | 68 | 196 | **High** | Corn silage | 3 | 14 | 34 | **Low** | Corn silage |
| | 60-90 cm | 13 | 59 | | | | 2 | 9 | | | |
| 7 | 0-30 cm | 13 | 51 | | | | 3 | 12 | | | |
| | 30-60 cm | 10 | 45 | 136 | **High** | Corn silage | 4 | 18 | 39 | **Low** | Corn silage |
| | 60-90 cm | 9 | 41 | | | | 2 | 9 | | | |
| 8 | 0-30 cm | 14 | 55 | | | | 4 | 16 | | | |
| | 30-60 cm | 10 | 45 | 154 | **High** | Corn silage | 2 | 9 | 52 | **Medium** | Corn silage |
| | 60-90 cm | 12 | 54 | | | | 6 | 27 | | | |
| 9/10 | 0-30 cm | 19 | 74 | | | | 12 | 47 | | | |
| | 30-60 cm | 13 | 59 | 178 | **High** | Corn silage | 4 | 18 | 101 | **Medium** | Corn silage |
| | 60-90 cm | 10 | 45 | | | | 8 | 36 | | | |
| 16 | 0-30 cm | 11 | 43 | | | | 13 | 51 | | | |
| | 30-60 cm | 6 | 27 | 88 | **Medium** | Corn silage | 6 | 27 | 109 | **High** | Corn silage |
| | 60-90 cm | 4 | 18 | | | | 7 | 32 | | | |
| 22/23 | 0-30 cm | 18 | 70 | | | | 10 | 39 | | | |
| | 30-60 cm | 11 | 50 | 151 | **High** | Corn silage | 3 | 14 | 66 | **Medium** | Corn silage |
| | 60-90 cm | 7 | 32 | | | | 3 | 14 | | | |
| 24 | 0-30 cm | 15 | 59 | | | | 13 | 51 | | | |
| | 30-60 cm | 17 | 77 | 203 | **Very High** | Corn silage | 3 | 14 | 96 | **Medium** | Corn silage |
| | 60-90 cm | 15 | 68 | | | | 7 | 32 | | | |
| 25 | 0-30 cm | 21 | 82 | | | | 19 | 74 | | | |
| | 30-60 cm | 13 | 59 | 176 | **High** | Corn silage | 4 | 18 | 124 | **High** | Corn silage |
| | 60-90 cm | 8 | 36 | | | | 7 | 32 | | | |
| 26 | 0-30 cm | 18 | 70 | | | | 15 | 59 | | | |
| | 30-60 cm | 8 | 36 | 160 | **High** | Corn silage | 8 | 36 | 167 | **High** | Corn silage |
| | 60-90 cm | 12 | 54 | | | | 16 | 72 | | | |
| 27/28 | 0-30 cm | 31 | 121 | | | | 7 | 27 | | | |
| | 30-60 cm | 25 | 113 | 305 | **Very High** | Corn silage | 2 | 9 | 50 | **Low** | Corn silage |
| | 60-90 cm | 16 | 72 | | | | 3 | 14 | | | |
| 29 | 0-30 cm | 13 | 51 | | | | 4 | 16 | | | |
| | 30-60 cm | 7 | 32 | 105 | **High** | Corn silage | 1 | 5 | 25 | **Low** | Corn silage |
| | 60-90 cm | 5 | 23 | | | | 1 | 5 | | | |
| 30 | 0-30 cm | 13 | 51 | | | | 17 | 66 | | | |
| | 30-60 cm | 12 | 54 | 141 | **High** | Corn silage | 7 | 32 | 129 | **High** | Corn silage |
| | 60-90 cm | 8 | 36 | | | | 7 | 32 | | | |
| 31 | 0-30 cm | 6 | 23 | | | | 7 | 27 | | | |
| | 30-60 cm | 6 | 27 | 77 | **Medium** | Corn silage | 2 | 9 | 50 | **Low** | Corn silage |
| | 60-90 cm | 6 | 27 | | | | 3 | 14 | | | |
| 35 | 0-30 cm | 20 | 78 | | | | 12 | 47 | | | |
| | 30-60 cm | 3 | 14 | 105 | **High** | Corn silage | 4 | 18 | 83 | **Medium** | Corn silage |
| | 60-90 cm | 3 | 14 | | | | 4 | 18 | | | |
| 36 | 0-30 cm | 9 | 35 | | | | 9 | 35 | | | |
| | 30-60 cm | 4 | 18 | 76 | **Medium** | Corn silage | 2 | 9 | 62 | **Medium** | Corn silage |
| | 60-90 cm | 5 | 23 | | | | 4 | 18 | | | |
| 39 | 0-30 cm | 9 | 35 | | | | 16 | 62 | | | |
| | 30-60 cm | 1 | 5 | 44 | **Low** | Corn silage | 4 | 18 | 98 | **Medium** | Corn silage |
| | 60-90 cm | 1 | 5 | | | | 4 | 18 | | | |
| 40 | 0-30 cm | 8 | 31 | | | | 12 | 47 | | | |
| | 30-60 cm | 1 | 5 | 40 | **Low** | Corn silage | 3 | 14 | 69 | **Medium** | Corn silage |
| | 60-90 cm | 1 | 5 | | | | 2 | 9 | | | |
| 42 | 0-30 cm | 7 | 27 | | | | 31 | 121 | | | |
| | 30-60 cm | 3 | 14 | 59 | **Medium** | Corn silage | 20 | 90 | 233 | **Very High** | Corn silage |
| | 60-90 cm | 4 | 18 | | | | 5 | 23 | | | |
| 46/47 | 0-30 cm | 11 | 43 | | | | 13 | 51 | | | |
| | 30-60 cm | 2 | 9 | 61 | **Medium** | Corn silage | 6 | 27 | 96 | **Medium** | Corn silage |
| | 60-90 cm | 2 | 9 | | | | 4 | 18 | | | |

**Table 4.** Post-Harvest Soil Nitrate (expressed as nitrate-nitrogen) by soil layer (depth) in fields that were in alfalfa or alfalfa/grass mix in 2016 and 2017. Numbers in the crop column represent the age of the stand (e.g., Alfalfa 4 was an alfalfa stand in its fourth year). Nitrate values for fields with two sampling areas are simple averages, not area-weighted averages.

| | | 2016 | | | | | 2017 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2017 Field #** | **Sampling Depth** | **$NO_3$ ppm** | **$NO_3$ kg $ha^{-1}$** | **Total $NO_3$ (0-90cm) kg $ha^{-1}$** | **PHNT Rating** | **Crop** | **$NO_3$ ppm** | **$NO_3$ kg $ha^{-1}$** | **Total $NO_3$ (0-90cm) kg $ha^{-1}$** | **PHNT Rating** | **Crop** |
| 1 | 0-30 cm | 10 | 39 | | | | 8 | 31 | | | |
| | 30-60 cm | 3 | 14 | 62 | **Medium** | Alfalfa 3 | 4 | 18 | 67 | **Medium** | Alfalfa 4 |
| | 60-90 cm | 2 | 9 | | | | 4 | 18 | | | |
| 2 | 0-30 cm | 11 | 43 | | | | 9 | 35 | | | |
| | 30-60 cm | 3 | 14 | 61 | **Medium** | Alfalfa 3 | 1 | 5 | 44 | **Low** | Alfalfa 4 |
| | 60-90 cm | 1 | 5 | | | | 1 | 5 | | | |
| 4 | 0-30 cm | 12 | 47 | | | | 12 | 47 | | | |
| | 30-60 cm | 3 | 14 | 74 | **Medium** | Alfalfa 3 | 3 | 14 | 69 | **Medium** | Alfalfa 4 |
| | 60-90 cm | 3 | 14 | | | | 2 | 9 | | | |
| 5 | 0-30 cm | 12 | 47 | | | | 11 | 43 | | | |
| | 30-60 cm | 3 | 14 | 69 | **Medium** | Alfalfa 3 | 2 | 9 | 61 | **Medium** | Alfalfa 4 |
| | 60-90 cm | 2 | 9 | | | | 2 | 9 | | | |
| 11 | 0-30 cm | 14 | 55 | | | | 8 | 31 | | | |
| | 30-60 cm | 3 | 14 | 82 | **Medium** | Alfalfa 1 | 2 | 9 | 45 | **Low** | Alfalfa 2 |
| | 60-90 cm | 3 | 14 | | | | 1 | 5 | | | |
| 14/15 | 0-30 cm | 7 | 27 | | | | 7 | 27 | | | |
| | 30-60 cm | 3 | 14 | 50 | **Low** | Alfalfa (mature) | 2 | 9 | 41 | **Low** | Alfalfa (mature) |
| | 60-90 cm | 2 | 9 | | | | 1 | 5 | | | |
| 17 | 0-30 cm | 17 | 66 | | | | 9 | 35 | | | |
| | 30-60 cm | 5 | 23 | 93 | **Medium** | Alfalfa 1 | 1 | 5 | 44 | **Low** | Alfalfa 2 |
| | 60-90 cm | 1 | 5 | | | | 1 | 5 | | | |
| 18/19 | 0-30 cm | 11 | 43 | | | | 8 | 31 | | | |
| | 30-60 cm | 4 | 18 | 74 | **Medium** | Alfalfa 3 | 2 | 9 | 45 | **Low** | Alfalfa 4 |
| | 60-90 cm | 3 | 14 | | | | 1 | 5 | | | |
| 37 | 0-30 cm | 7 | 27 | | | | 7 | 27 | | | |
| | 30-60 cm | 10 | 45 | 77 | **Medium** | Alfalfa/ grass | 2 | 9 | 41 | **Low** | Alfalfa/ grass |
| | 60-90 cm | 1 | 5 | | | | 1 | 5 | | | |
| 38 | 0-30 cm | 11 | 43 | | | | 6 | 23 | | | |
| | 30-60 cm | 1 | 5 | 52 | **Medium** | Alfalfa/ grass | 1 | 5 | 32 | **Low** | Alfalfa/ grass |
| | 60-90 cm | 1 | 5 | | | | 1 | 5 | | | |
| 44/45 | 0-30 cm | 22 | 86 | | | | 6 | 23 | | | |
| | 30-60 cm | 3 | 14 | 113 | **High** | Alfalfa/ grass 1 | 1 | 5 | 32 | **Low** | Alfalfa/ grass 2 |
| | 60-90 cm | 3 | 14 | | | | 1 | 5 | | | |

**Table 5.** Post-Harvest Soil Nitrate (expressed as nitrate-nitrogen) by soil layer (depth) in fields that were in nursery trees or different crops in 2016 and 2017. Nitrate values for fields with two sampling areas are simple averages, not area-weighted averages.

| | | 2016 | | | | | 2017 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 Field # | Sampling Depth | $NO_3$ ppm | $NO_3$ kg ha$^{-1}$ | Total $NO_3$ (0-90cm) kg ha$^{-1}$ | PHNT Rating | Crop | $NO_3$ ppm | $NO_3$ kg ha$^{-1}$ | Total $NO_3$ (0-90cm) kg ha$^{-1}$ | PHNT Rating | Crop |
| 32 | 0-30 cm | 4 | 16 | | | | 8 | 31 | | | |
| | 30-60 cm | 3 | 14 | 52 | **Medium** | Trees | 2 | 9 | 45 | **Low** | Trees |
| | 60-90 cm | 5 | 23 | | | | 1 | 5 | | | |
| 33/34 | 0-30 cm | 3 | 12 | | | | 4 | 16 | | | |
| | 30-60 cm | 2 | 9 | 43 | **Low** | Trees | 1 | 5 | 25 | **Low** | Trees |
| | 60-90 cm | 5 | 23 | | | | 1 | 5 | | | |
| 3 | 0-30 cm | 24 | 94 | | | | 4 | 16 | | | |
| | 30-60 cm | 9 | 41 | 197 | **High** | Corn silage | 2 | 9 | 29 | **Low** | Grass |
| | 60-90 cm | 14 | 63 | | | | 1 | 5 | | | |
| 12/13 | 0-30 cm | 18 | 70 | | | | 8 | 31 | | | |
| | 30-60 cm | 11 | 50 | 160 | **High** | Corn silage | 3 | 14 | 54 | **Medium** | Alfalfa 1 |
| | 60-90 cm | 9 | 41 | | | | 2 | 9 | | | |
| 20 | 0-30 cm | 23 | 90 | | | | 12 | 47 | | | |
| | 30-60 cm | 5 | 23 | 121 | **High** | Spelt | 6 | 27 | 92 | **Medium** | Canola |
| | 60-90 cm | 2 | 9 | | | | 4 | 18 | | | |
| 21 | 0-30 cm | 35 | 137 | | | | 10 | 39 | | | |
| | 30-60 cm | 14 | 63 | 267 | **Very High** | Spelt | 7 | 32 | 89 | **Medium** | Canola |
| | 60-90 cm | 15 | 68 | | | | 4 | 18 | | | |
| 43 | 0-30 cm | 10 | 39 | | | | 6 | 23 | | | |
| | 30-60 cm | 4 | 18 | 84 | **Medium** | Corn silage | 3 | 14 | 55 | **Medium** | Alfalfa/ grass 1 |
| | 60-90 cm | 6 | 27 | | | | 4 | 18 | | | |
| 41 | 0-30 cm | 29 | 113 | | | | 8 | 31 | | | |
| | 30-60 cm | 17 | 77 | 248 | **Very High** | Corn silage | 2 | 9 | 49 | **Low** | Alfalfa/ grass 1 |
| | 60-90 cm | 13 | 59 | | | | 2 | 9 | | | |
| 48 | 0-30 cm | 1 | 4 | | | | 3 | 12 | | | |
| | 30-60 cm | 1 | 5 | 13 | **Low** | Grass | 1 | 5 | 21 | **Low** | Grass |
| | 60-90 cm | 1 | 5 | | | | 1 | 5 | | | |