# AgKnowledge Forum 2016
# Water Technology Information
# Lake Simcoe

## Farm Phosphorus Loss Reduction Calculation from a Dairy Farm

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# Farm Phosphorus Losses

- P loss factors
- Approach to determine P loss on a farm
  - Farm test site - West Gwillimbury dairy farm
  - Ontario P index (low input requirement)
  - Revised Ontario P index (AAFC)
- P reduction BMPs
- P reduction incentives
  - Pay-for-Performance (Winrock International Project)

# P loss approach

**Inherent** contribution

- Field proximity to surface water
- Erosion (USLE: rain/runoff, soil, slope & length, crop/tillage)
- Soil test P
- Delivery modifier (buffer, tile)

**Application** contribution

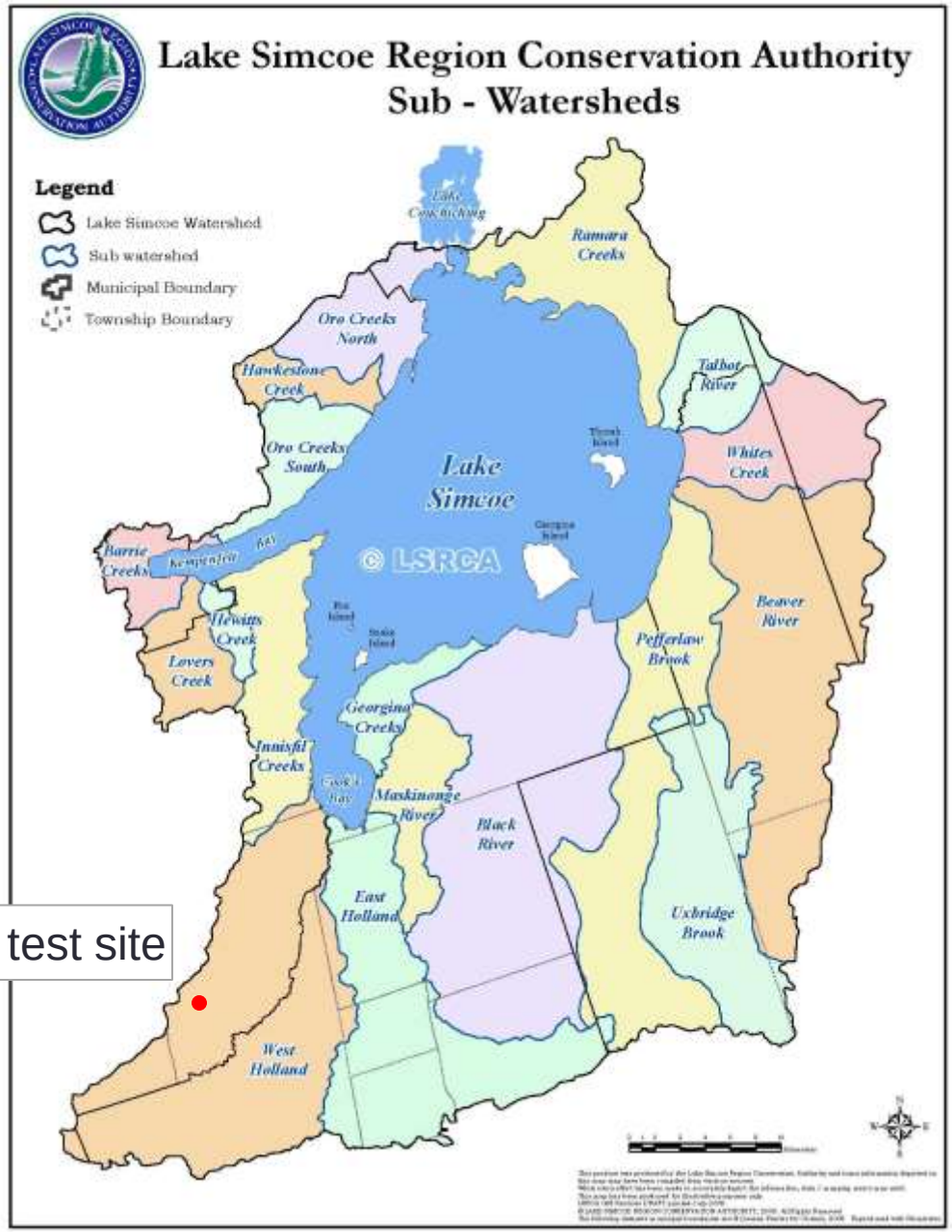
- Application source/method/timing/rate
- 4Rs

# P loss approach

**Source** of farm P loss

- Surface contribution
- Subsurface tile contribution
- Particulate and dissolved portion
- Non point source - several pathways

# Lake Simcoe Watershed




Farm test site

SRG
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# Example Dairy Farm


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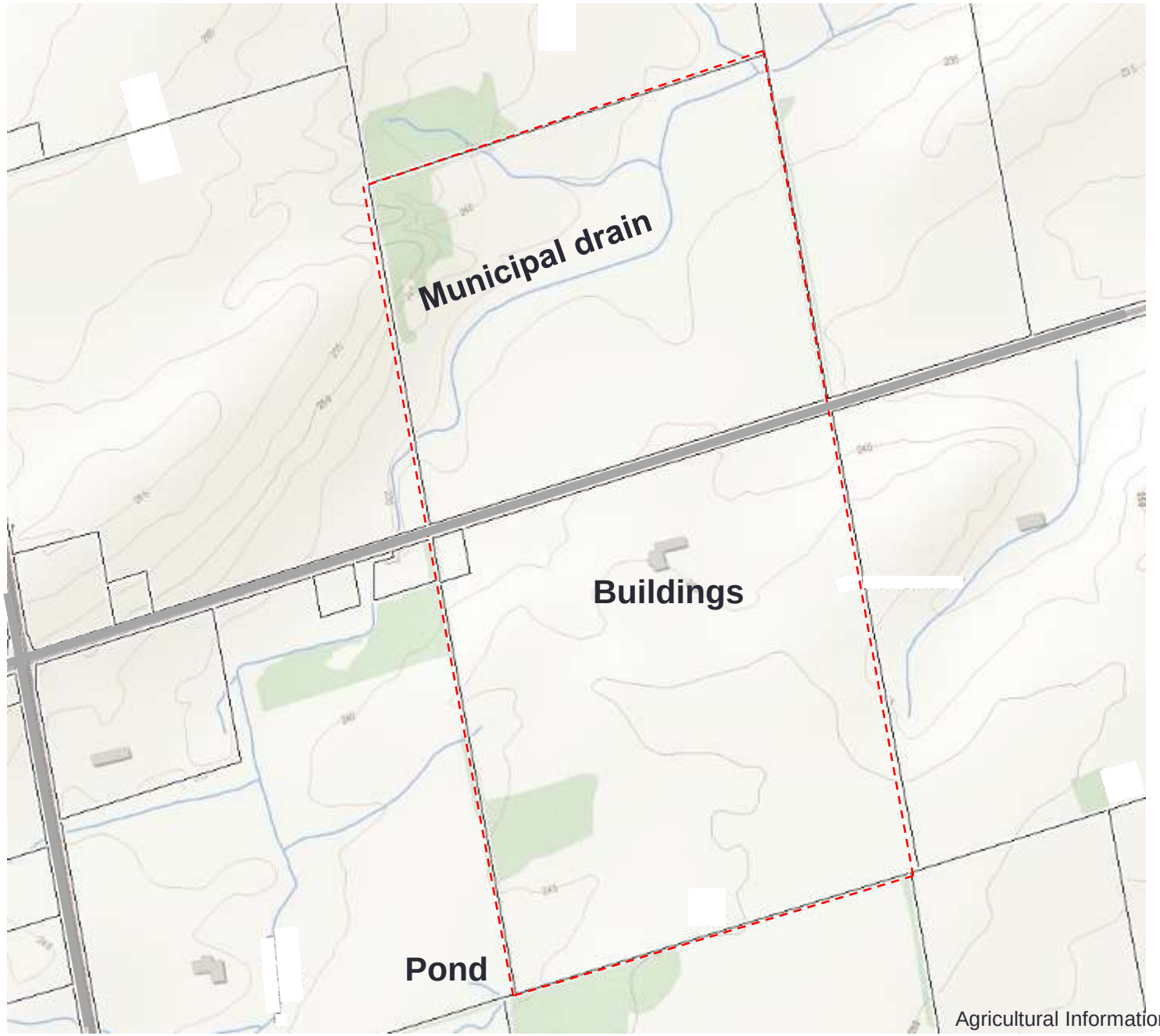
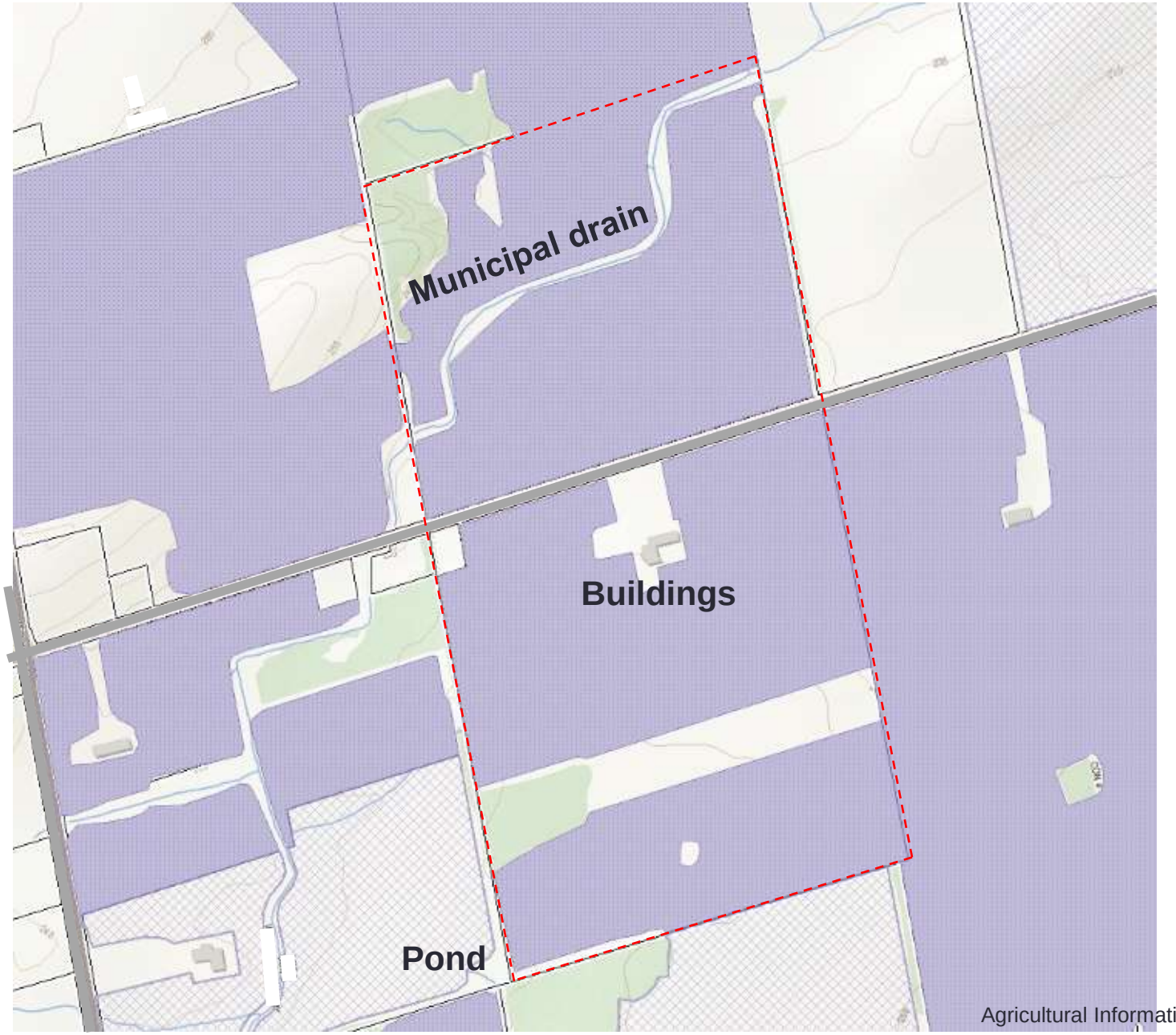
# Topography & Natural Drainage



# Tile Drainage



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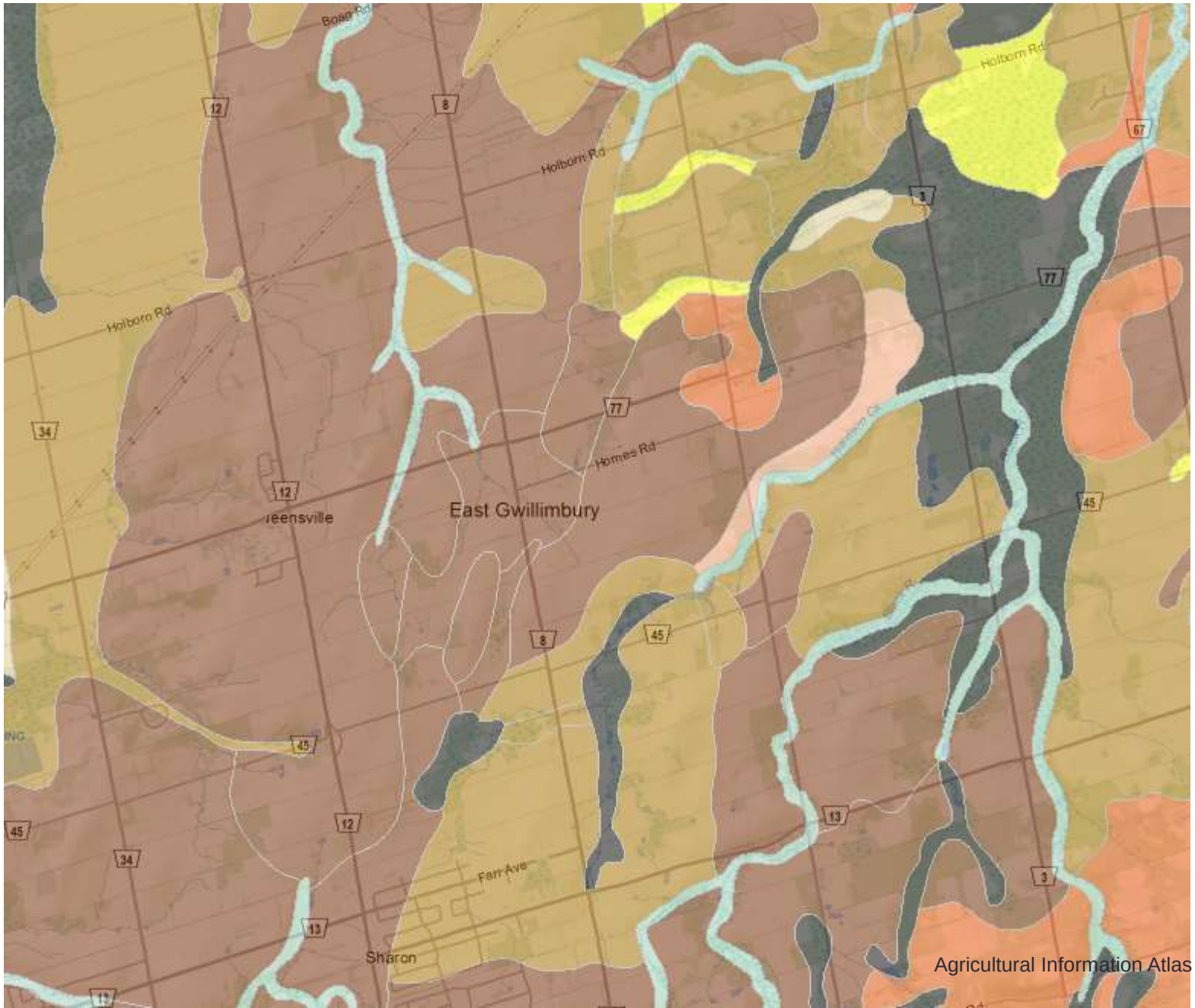
# Soil Type




Agricultural Information Atlas

SRG Soil Resource Group

# Example Farm Fields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# Example Farm

## Input Data:

### NMAN (Erosion)
### Ontario P-index

| Field ID | Slope % | Length ft | Soil type | P test ppm | Crop type | Tillage method | Fertilizer $P_2O_5$ lb/ac | Fertilizer method | Manure $P_2O_5$ lb/ac | Manure method |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 500 | SiCL | 17 | Hay | | | | 26 | sum br x2 |
| 2 | 3 | 600 | SiCL | 17 | Hay | | | | 26 | sum br x2 |
| 3 | 3 | 600 | SiCL | 17 | Corn | fall plow | 78 | spr br | 23 | fall br |
| 4 | 4 | 600 | SiCL | 17 | Pasture | | | | 4 | sum br |
| 5 | 3 | 500 | SiCL | 28 | Hay | | | | 26 | sum br x2 |
| 7 | 3 | 600 | SiCL | 28 | Hay | | | | 26 | sum br x2 |
| 9 | 3 | 500 | SiCL | 28 | Silage corn | fall plow | 78 | spr br | 23 | fall br |

# Example Farm

## Output Data:

### NMAN (Erosion)
### Ontario P-index

| Field ID | Erosion t/ac | Crop type | Soil Erosion | Runoff class | P soil test | Fertilizer rate | Fertilizer method | Manure rate | Manure method | P-index Rating | Setback ft |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.1 | Hay | 2 | 4 | 4 | 0 | 0 | 4 | 6 | 20 | 75 |
| 2 | 0.1 | Hay | 2 | 4 | 4 | 0 | 0 | 4 | 6 | 20 | 75 |
| 3 | 6.6 | Corn | 4 | 4 | 4 | 4 | 12 | 2 | 6 | 36 | 43/75 |
| 4 | 0.1 | Pasture | 2 | 4 | 4 | 0 | 0 | 0.5 | 6 | 16.5 | 20 |
| 5 | 0.1 | Hay | 2 | 4 | 4 | 0 | 0 | 4 | 6 | 20 | 75 |
| 7 | 0.1 | Hay | 2 | 4 | 4 | 0 | 0 | 4 | 6 | 20 | 75 |
| 9 | 7.6 | Silage corn | 4 | 4 | 4 | 4 | 12 | 2 | 6 | 36 | 43/75 |

# Example Farm – Revised Ontario P index P loss

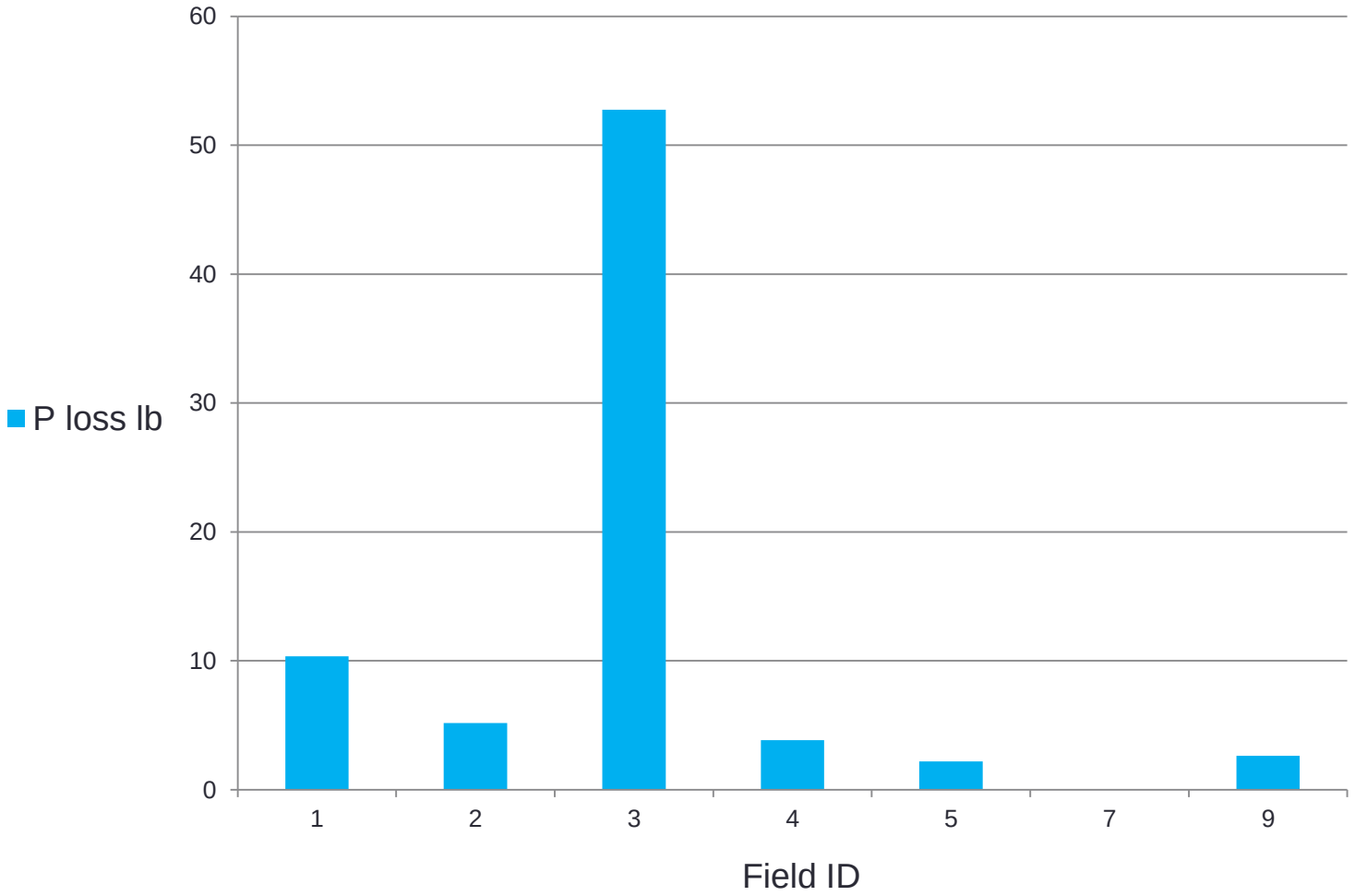
## Input Data

| DATA ENTRY SHEET FOR REVISED ONTARIO P INDEX | | | Field 3 |
|---|---|---|---|
| **Factor** | | | **Units** |
| Distance Factor Distance | | 3.0 | metres |
| Soil Erosion (from USLE) | | 14.7 | t $ha^{-1}$ $yr^{-1}$ |
| Soil Test P (Olsen) | | 17.0 | mg P $kg^{-1}$ soil |
| Planned Crop | | Row | |
| Soil Hydrologic Group | | C | |
| Tile Drainage System | | Random tile | |
| Distance tile extends from stream | | 150.0 | metres |
| Surface Delivery Modifier | | Grassed waterway or riparian buffer 3-10m | |
| **Application Options** | | | |
| Application Method and Timing | | Not incorporated, Nov-Mar (unfrozen soil) | |
| Material Type | 1 | Liquid Dairy Manure | |
| Rate (divide $P_2O_5$ by 2.29) | | 11.4 | kg P $ha^{-1}$ |
| Application Method and Timing | | Not incorporated, Apr-Mid June | |
| Material Type | 2 | Inorganic Fertilizer | |
| Rate (divide $P_2O_5$ by 2.29) | | 38.0 | kg P $ha^{-1}$ |

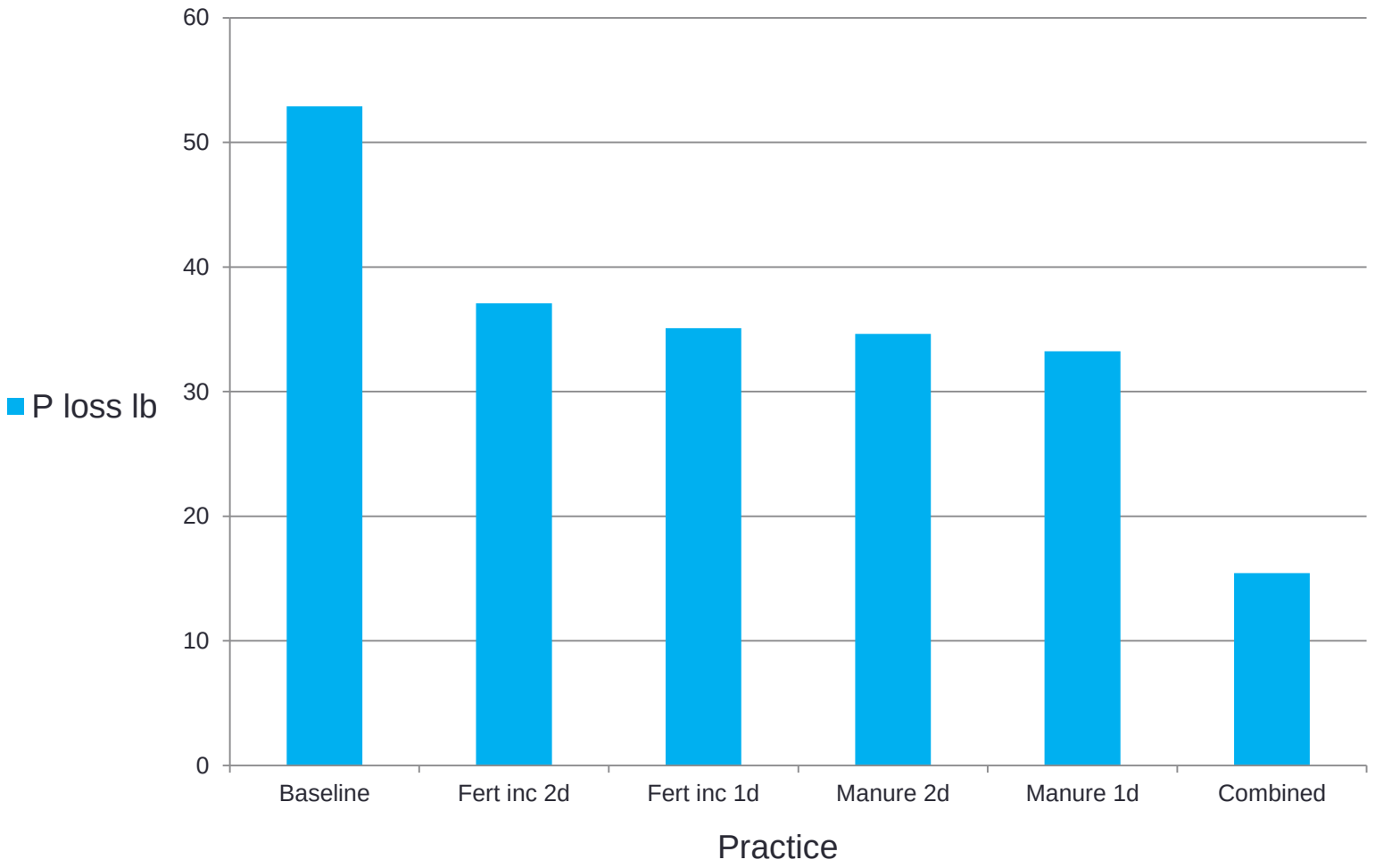
## Output Data

| Calculation Summary (g P per 100m of stream) | |
|---|---|
| | Field 3 |
| Particulate P Delivery | 1054.27 |
| Dissolved P Delivery | 370.10 |
| Tile Drainage P Contribution | 13.24 |
| Inherent P Index | 1437.60 |
| Total Application Contribution | 4,873.37 |
| Total P Index | 6,310.98 |
| ***Length of Stream (m)*** | ***380*** |
| ***Total P Loss (kg)*** | ***23.98*** |

# Amount of Phosphorus Loss from Susceptible Area of dairy farm



# Reduction in the Amount of P Loss from Susceptible Area of dairy farm from BMP Adoption



# Phosphorus BMPs

- Crop rotation: more crops in rotation (response, inputs, soil health)
- Tillage: reducing tillage (erosion, compaction vs. equipment)
- Cover crops: overwinter (uptake, erosion, weeds, soil health)
- Nutrient application: incorporate (use efficiency, runoff vs. equipment)
- 4R nutrient: balance (lower rate, testing, verification, environment)
- Erosion control: within and edge of field (sustainable vs. structure cost)
- Treat water: farm edge (water table, wetland, buffers, environment)

# Phosphorus BMP Incentive program

- BMP adoption cost may be high
- Voluntary - benefits have to outweigh costs
- Paid incentive (cost share) to help with adoption cost
- Pay-for-performance pilot project:
  - Winrock International
  - Revised Ontario P index to calculate P reduction
  - 7 farms in Lake Simcoe subwatershed

# Winrock project - Farmer reaction

- Most were favorable given the model limitations and were willing to continue
- The small contributing areas represented in the calculation were seen as a deterrent
- Payment level of the Pay-for-Performance approach was viewed as being too low. **Conservation Authority grants resulted in higher levels of support. (eg. NVCA)**
- Apparent need to generate larger P loss values or the price of P needed to be higher

# Farmer reaction

- BMPs rated more likely to implement
  - Soil testing
  - Reduced Tillage and No-till
  - Fertilizer placement
  - GPS and yield maps

# Phosphorus Reduction Incentives

- Practice based – adoption of specific practices
  - Limits flexibility and innovation
  - Targeting next to watercourse more cost effective
- Performance based – pollution reduction amount achieved
  - More cost effective than practice-based to meet environmental goal
- Needed
  - Focused management that is effective
  - Measured P reductions by BMP
  - Revised Ontario P index to model and calculate P reduction