Step 5. MAKE DECISIONS

Before finalizing decisions, consider the need for new application equipment.

By completing the NMAN software portion of the nutrient management plan, you've completed most of the analysis (Step 3). And by developing options to address the implications of this analysis, you've completed the fourth step.

It's decision-making time. The prime focus for this step is to figure out how the prescribed application rates will work, considering all of the other variables affecting the operation. Your NMP should reflect decisions in all aspects of livestock and crop management.

On paper, your plan may make sense. But making it work means that the infrastructure must be in place, or resources available to allow the decisions to be implemented. Can you get the job done – considering the combined constraints of weather, labour and time?

Many of these decisions are not a direct part of the plan, but are important in carrying out the plan. You may have similar questions or issues to those of the case study farm, as outlined in the following chart.

CASE STUDY FARM	
QUESTION OR ISSUE	**CONSIDERATIONS FOR DECISION-MAKING**
Will changing my crop rotation provide adequate feed?	• Including wheat and soybeans in the rotation will increase overall corn yield average • Could substitute wheat into ration? • Will have to purchase additional corn to meet feed needs (this was required anyway due to small acreage)
Will the 3000-gallon tanker with 30-ft spread width along with 175-hp tractor be adequate to apply 138,000 gallons of manure in one week in spring?	• Approximately 50 loads • 20 minutes (avg) between loads • 17 hours to spread spring manure (~ 2 days) • 8 hrs/day for field work (rest for barn work)
Will the landowner(s) with whom case study farm has manure agreement expect that case study farm landowner will apply manure?	• Green Acres – November, applied 163,000 gal • Wiley Farm – May, injected 350,000 gal • Approximately 120 loads (5-6 days) • Will likely require custom applicator or custom corn planting
How will the application rate of 6000 gal/ac be applied to a field that is 1740 ft (530 m) long and is 681 ft (208 m) wide and tank must go to the fence row and back?	• At 6000 gal/ac, one load would go about 700 ft • One load could be spread going width-wise across the field instead of lengthwise
How will manure be incorporated on the same day it is applied?	• 25-ft cultivator on a 125-hp tractor with hired help as driver • Using EFP financial incentive program, could purchase an incorporation tool for behind tanker

Two key decisions that affect the overall development and implementation of the NMP are:

- ▶ rate to be applied
- ▶ setback and/or separation distance(s).

One of the key decisions driving the development of NMPs is a proposed new or upgraded manure storage.

DETERMINING THE MAXIMUM RATE OF MANURE TO SPREAD

The maximum rate of manure application can be limited by one of the following factors to reduce environmental impact:

- ▶ soil absorption capacity – manure should infiltrate cropland, not run off
- ▶ phosphorus requirements – rates should reflect crop P needs and account for P buildup
- ▶ nitrogen requirements – rates should reflect no more than 75% of crop N needs.

The following section describes how these factors limit application rates for manure.

SOIL ABSORPTION CAPACITY

- ▶ liquid manure must be applied at rates that "stick" to the soil surface – rather than run off of it
- ▶ in some cases, soils will become saturated and manure will run off before desired nutrient application rates are reached
- ▶ the ability for cropland to absorb liquids is referred to as **liquid loading** – the **liquid loading limit** is the maximum rate of applied liquid before the soil becomes saturated and runs off
- ▶ liquid loading varies with existing soil moisture levels, soil texture, drainage class and slope steepness and length
- ▶ in the Runoff Potential table on page 80, soil (i.e., Hydrologic Soil Groups) and slope combinations are ranked in terms of their risk for runoff (note: no application is recommended for steeply sloping lands with slow to very slow drainage)
- ▶ in the second table on page 80, maximum rates for each runoff potential ranking are provided for both surface-applied or incorporated / pre-tilled soils

TABLE 1: RUNOFF POTENTIAL

HYDROLOGIC SOIL GROUP (DRAINAGE CLASS)	MAXIMUM FIELD SLOPE WITHIN 150 M (492 FT) OF SURFACE WATER <3%	3–<6 %	6–<9%	9–12%
A (RAPID)	Very low	Very low	Low	High
B (MODERATE)	Very low	Low	Moderate	High
C (SLOW)	Low	Moderate	High	No application
D (VERY SLOW)	Moderate	High	High	No application

Hydrologic Soil Group source: *Drainage Guide for Ontario* Pub. 29
Group A is often associated with sand, Group B with loam, Group C with clay loam and Group D with clay soil textures.

TABLE 2: MAXIMUM RATE PER APPLICATION

RUNOFF POTENTIAL	SURFACE-APPLIED m^3/ha (gal/ac)	INCORPORATED OR PRE-TILLED m^3/ha (gal/ac)
HIGH	50 (4450)	75 (6700)
MODERATE	75 (6700)	100 (8900)
LOW	100 (8900)	130 (11600)
VERY LOW	130 (11600)	150 (13400)

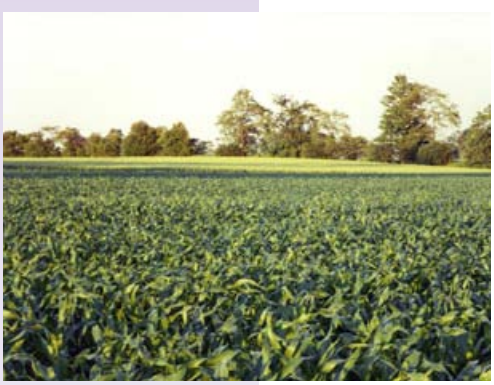
STOP ARRÊT The application rate should not exceed the numbers in Table 2 Note: $1m^3$ = 1000 L

Here's an example of how the liquid loading concept could be used.

A single application of 10,000 gal/ac of a very diluted (low nutrient content) liquid, such as those from a runoff storage or manure from a dairy barn with earthen storages

- ▶ would not be recommended for surface applications to anything heavier than a loam soil with less than 3% slope, or
- ▶ injected applications to anything heavier than a loam soil with less than 6% slope.

However, two applications of 5,000 gal/ac at least 24 hours apart may work on heavier soils with steeper slopes depending upon soil conditions.



To improve absorption capacity, apply manure several times a year. Plan crop rotations accordingly.

To improve absorption capacity:

✔ apply liquid manure several times a year – instead of all at once
✔ pre-cultivate soil before application – to increase surface area for absorption
✔ apply manure on residues, cover crops or forages before plowdown to reduce runoff

To ensure that suitable volumes of liquid manure are applied:

✔ address crop fertility needs
✔ calibrate equipment to ensure targeted rate will be applied
✔ monitor field surface following first 30 minutes of application – if you see surface movement or tile runoff, reduce the application rate

Precultivate soil before application to improve infiltration rates of applied manure.

Apply manure into crop residues to increase soil absorption capacity.

As you determine application rates, remember that **phosphorus** that goes unused by the crop remains in the soil and builds up. Take care to avoid accumulation of excess P over time, especially in areas prone to erosion.

In determining application rates to meet **nitrogen** needs, remember that nitrate is mobile and, if not *quickly* used by the crop, will be lost to the air or groundwater. It's recommended that no more than 75% of the crop needs for N should come from manure. Include some nitrogen from mineral fertilizers, for the following reasons:

▸ N release from organic materials depends on the weather, and in cool, damp seasons, the crop may not have enough N available at the required time from organic sources for optimum growth and yield

▸ manure application is often uneven, so parts of the field receive insufficient manure to meet crop requirements – a uniform application of mineral N fertilizer helps to increase overall yields in areas missed by the spreader

▸ reducing the N application rate from manure also reduces the amount of P and K being applied – in situations where P doesn't exceed current recommendations, use manure P to furnish all P requirements, provided N requirements are not exceeded.

Where manure is applied once in a rotation (i.e., once every three years) or onto legume crops such as forages or soybeans, manure applications should not exceed total P removal for the rotation *and* should not exceed 200 lbs/ac N.

Separation distances for manure application should take all surface water sources, including surface water inlets, into account.

DETERMINING SETBACK DISTANCES FOR MANURE APPLICATION

Separation distances for manure application should take all surface water sources into account. Include surface water inlets such as catchbasins.

The most effective setback from any surface water is a vegetated buffer. The broader the buffer, the more effective it is in preventing nutrients and pathogens from entering the water. Vegetated buffers have many purposes, ranging from streambank stabilization to sediment filtration.

For more information about vegetated buffers, see another title in this Best Management Practices series: *Buffer Strips*, Order no. BMP-15.

The following two methods provide recommended distances for separation between manure application and surface water sources. Selection for the more appropriate method depends on the soil test P value.

POTENTIAL FOR SURFACE WATER CONTAMINATION FROM MANURE RUNOFF

Manure contains nutrients and pathogens, both of which should stay out of water. Determining how far from watercourses manure should be applied depends on many factors: soil moisture absorption capacity at the time of application, slope near the watercourse, soil texture and manure type, application method and volume.

When manure is incorporated a few days before planting, the separation distance may not need to be as wide as surface-applied manure in early spring (assuming same slope and texture). Where surface water enters a watercourse as a stream of concentrated flow, a separation distance that includes the path of flow would be more logical than a constant width along a watercourse.

The following method will provide some general guidance in determining what distance should be left between watercourses (including surface inlets) and manure application. Site-specific characteristics of your farm at time of application should, of course, be taken into account.

Cropland buffers help to keep runoff – soil, nutrients and pathogens – from entering surface waters. Wider buffer strips are more effective.

To determine a site's potential for surface water contamination from manure runoff, use the runoff potential rating from the upper table on page 80. Then, using the table below, determine the recommended separation distance between surface water and manure application.

MINIMUM SEPARATION DISTANCES BETWEEN SURFACE WATER AND MANURE APPLICATION

	MINIMUM SEPARATION DISTANCE (with established buffer zone)			
RUNOFF POTENTIAL	SURFACE-APPLIED LIQUID	SOLID	IMMEDIATELY INCORPORATED OR PRE-TILLED LIQUID	SOLID
HIGH	30.5 m (100 ft)	15.2 m (50 ft)	18.3 m (60 ft)	9.1 m (30 ft)
MODERATE	22.9 m (75 ft)	13 m (43 ft)	13.7 m (45 ft)	6.1 m (20 ft)
LOW	15.2 m (50 ft)	13 m (43 ft)*	9.1 m (30 ft)	4.6 m (15 ft)
VERY LOW	13 m (43 ft)*	13 m (43 ft)*	3.0 m (10 ft)	3.0 m (10 ft)

*Application can be made within the same distance as the incorporated values, if applied to a living crop or to greater than 30% residue cover.

Farms should have a minimum 3 metre (10 ft) vegetated buffer adjacent to all surface water if nutrients are to be applied to adjacent fields.

Note: NMAN software will generate separation distances for each field. Red flags will be generated where problems arise.

For soils with lower P soil test results (< 30 ppm)

Soils with a soil test phosphorus result of <30 ppm are limited to P applications of crop removal plus 78 kg/ha (70 lbs/ac) to facilitate planned P buildup. Although the manure separation distance must be observed, commercial P sources can be applied.

For soils with higher P soil test results (> 30 ppm)

Use the Phosphorus Index to determine separation distances based on the risk of surface water contamination when applying P, either as manure or as commercial fertilizers. The P Index can also be used as a management tool to help determine how to reduce the risk of P runoff. High soil test phosphorus combined with high risk of soil erosion gives the highest P Index values.

To determine the P Index for each field with a soil test result for P of >30 ppm, refer to any one of these publications from the Ontario Ministry of Agriculture, Food and Rural Affairs: the *NMAN Workbook* (Publication 818), *Determining the Phosphorus Index for a Field,* Order No. 03-109, or the *Agronomy Guide for Field Crops,* Publication 811.

Try strip cropping to reduce P Index results.

Use your P Index rating and note the recommended separation distances from the table below.

NUTRIENT APPLICATION LIMITATION AS DETERMINED BY P INDEX AND PROXIMITY OF TILLABLE LAND TO SURFACE WATER SOURCES

P INDEX	<3 m (<10 ft)	3–30.5 m (10–100 ft)	>30.5–61 m (>100–200 ft)	>61 m (>200 ft)
LOW <15	no application	crop removal	no restriction	no restriction
MEDIUM 15–30	no application	crop removal	no restriction	no restriction
HIGH 31–50	no application	crop removal	crop removal	no restriction
VERY HIGH >50	no application	no application	crop removal	crop removal

Note: Where separation distances, in combination with the P Index, restrict nutrient application, consider changing management practices (application rates, application methods, and soil and water conservation practices), to decrease your P Index value.