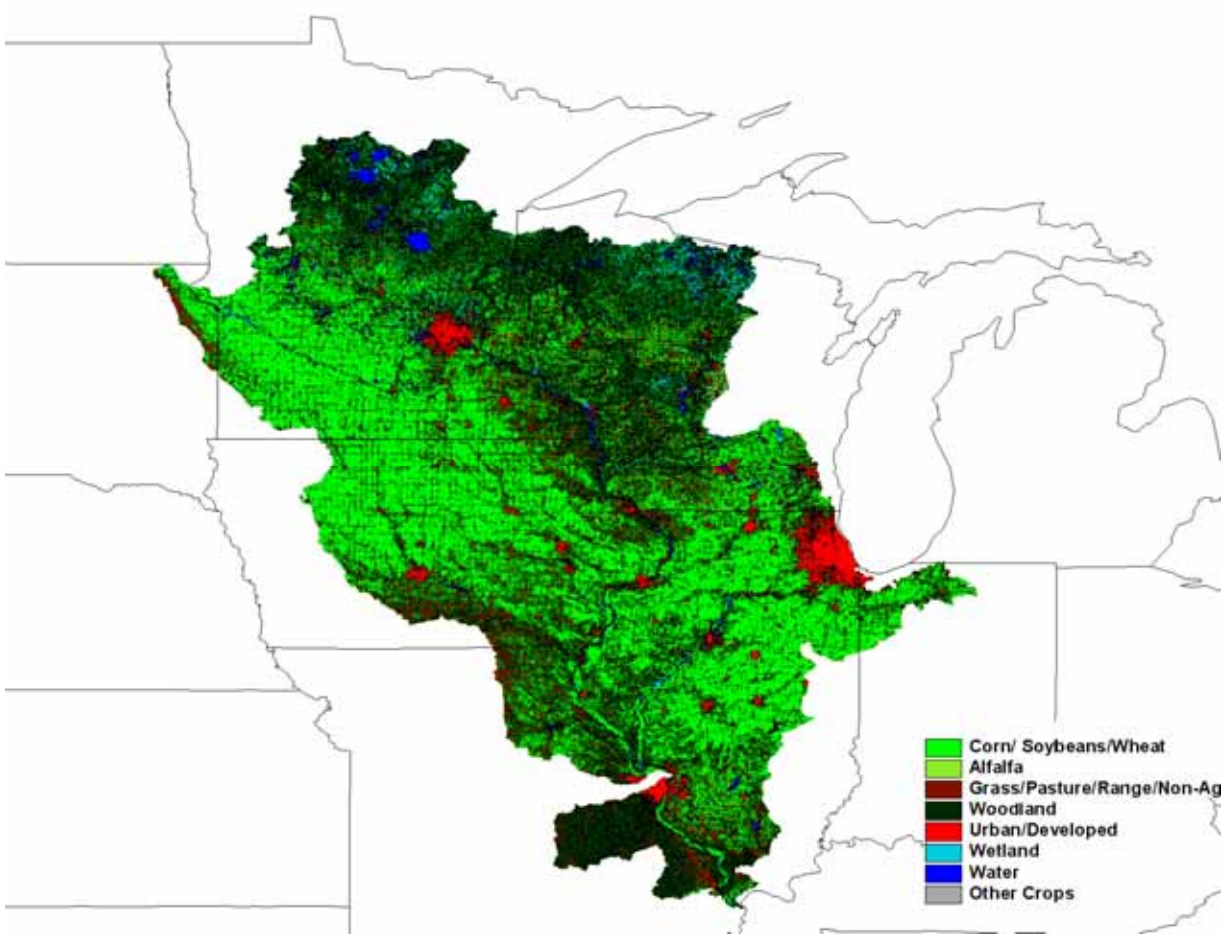
“Acceptable Levels” of Field Loss of Agricultural Pollutants: Insights from a Regional Assessment



"Acceptable Levels" are CRITICALLY important for:

- **Conservation planning for individual fields**
  - **Serves as goal for determining <u>adequate</u> conservation treatment**
  - **Currently, the conservation planner has no benchmark for development of a conservation plan to address sediment and nutrient loss.**
- **Assessment of conservation treatment needs at the regional level**
- **Assessment of status and trends over time**

Two tiers of acceptable levels probably should be considered:

1. **A regional set of acceptable levels for use in assessing status, condition, and trends.**
   - **Provides a basic level of water quality protection for all acres in a region.**
   - **Protects downstream environments against excessive export of agricultural pollutants from the region.**
2. **Watershed-specific sets of acceptable levels that are tailored to protect local water quality resources.**

In a nutshell—what did we do?

- **Sampled—3,703 NRI points were selected and a farmer survey conducted to obtain all the site-specific information needed to run a physical process model:**
  - **Site-specific landscape and soils data from the NRI**
  - **Farming activities from farmer**
  - **Conservation practices from a variety of sources**

In a nutshell—what did we do?

- **Modeled—APEX, HUMUS/SWAT**
  - **Daily time-step models**
  - **Hydrology, carbon cycle, nutrient cycles, erosion**
  - **Used APEX to estimate field-level loss, simulating effects of conservation practices at field level**
  - **Used HUMUS/SWAT to estimate in-stream loads and concentrations**

Modeling Strategy

1. **Estimate a CEAP Baseline using farmer survey information at NRI sample points**

2. **Construct an alternative scenario assuming "no practices"**

Difference between these two scenarios represents the benefits of the accumulation of conservation practices currently in place on the landscape.

What did we find?

- **Conservation practices in the UMRB have:**
  - **Reduced surface water flow from farm fields by 14%, increased subsurface flows by 22%**
  - **Reduced sediment loss from fields by 62%**
  - **Reduced total nitrogen loss from fields by 21%**
  - **Reduced total phosphorus loss from farm fields by 36 percent**
  - **Increased acres maintaining or enhancing soil organic carbon**
    - **Today, only 17% of acres are loosing C at rates greater than 100 pounds per acre per year**
    - **Without practices, 34% would be loosing C at or above this level**

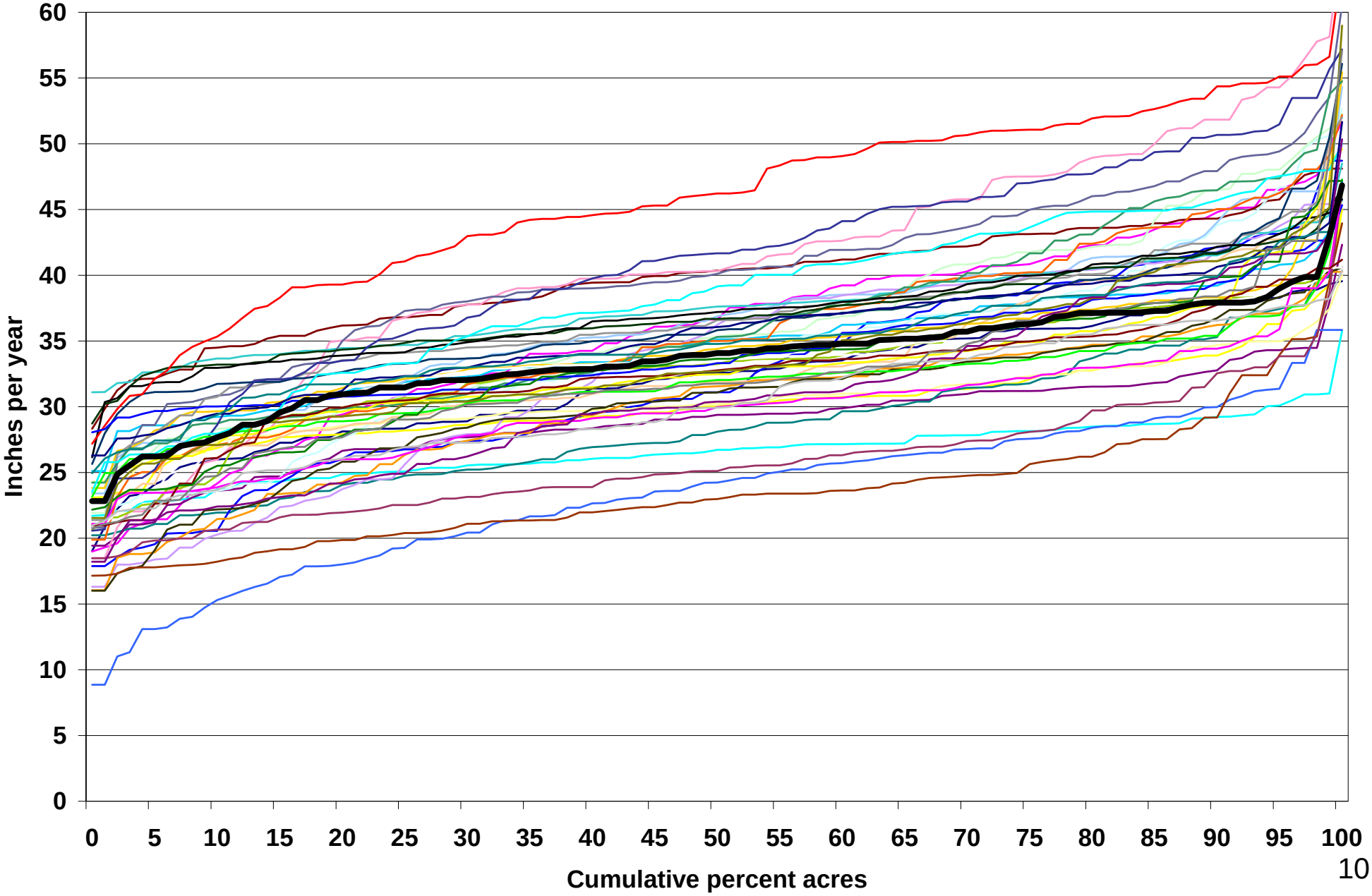
What did we find for off-site effects?

- **In-stream reductions at outlet of UMRB due to conservation practices:**
  - **Reduced sediment loads by 31%**
  - **Reduced total nitrogen loads by 28%**
  - **Reduced total phosphorus loads by 21%**
  - **Reduced atrazine loads by 29%**

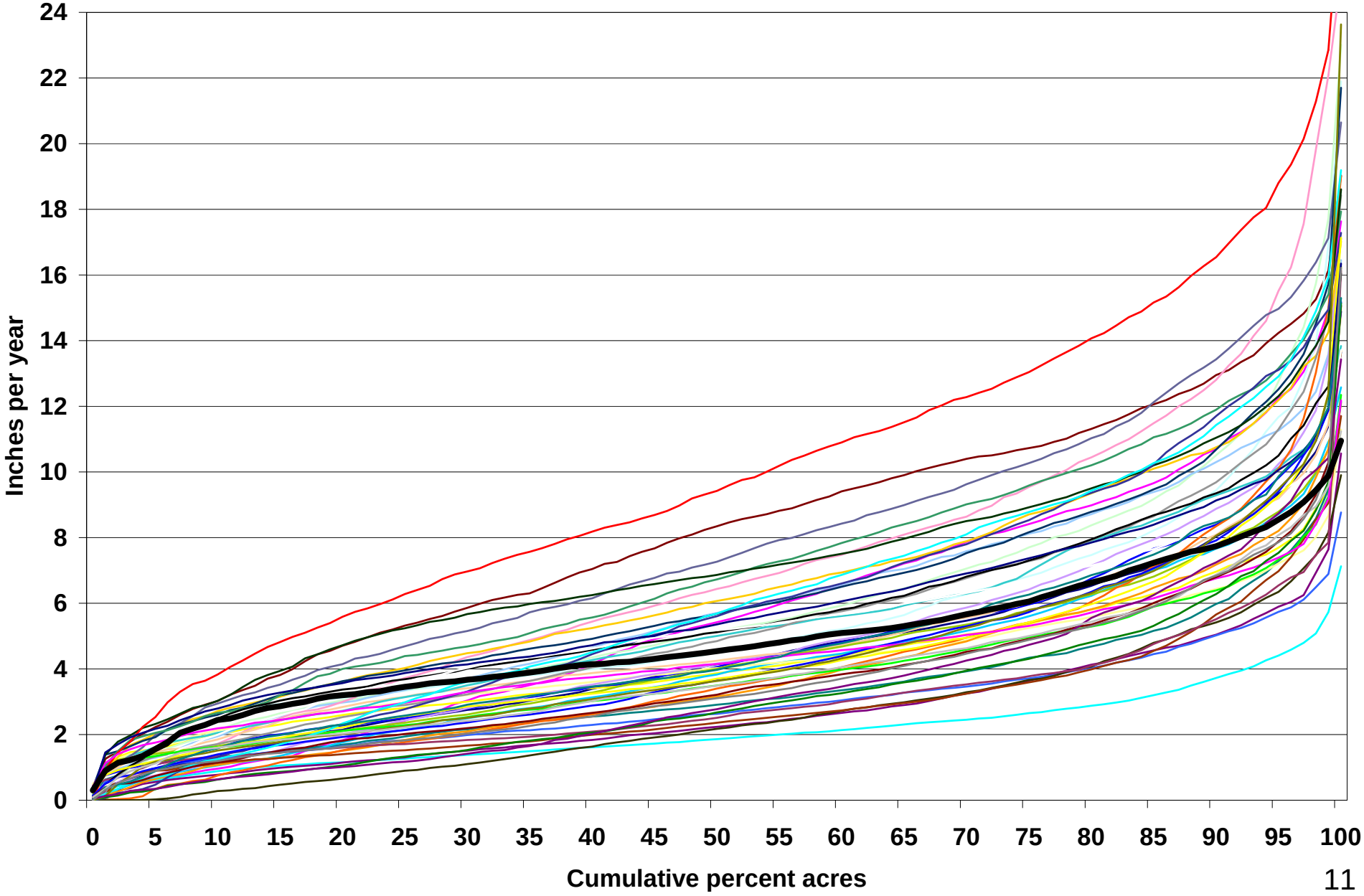
Acceptable levels for UMRB regional assessment

- **Sediment loss <= 2 tons per acre**
- **Total phosphorus <= 3 pounds per acre**
- **Total nitrogen <= 50 pounds per acre**
  - **Individual loss pathways<=20 pounds per acre**

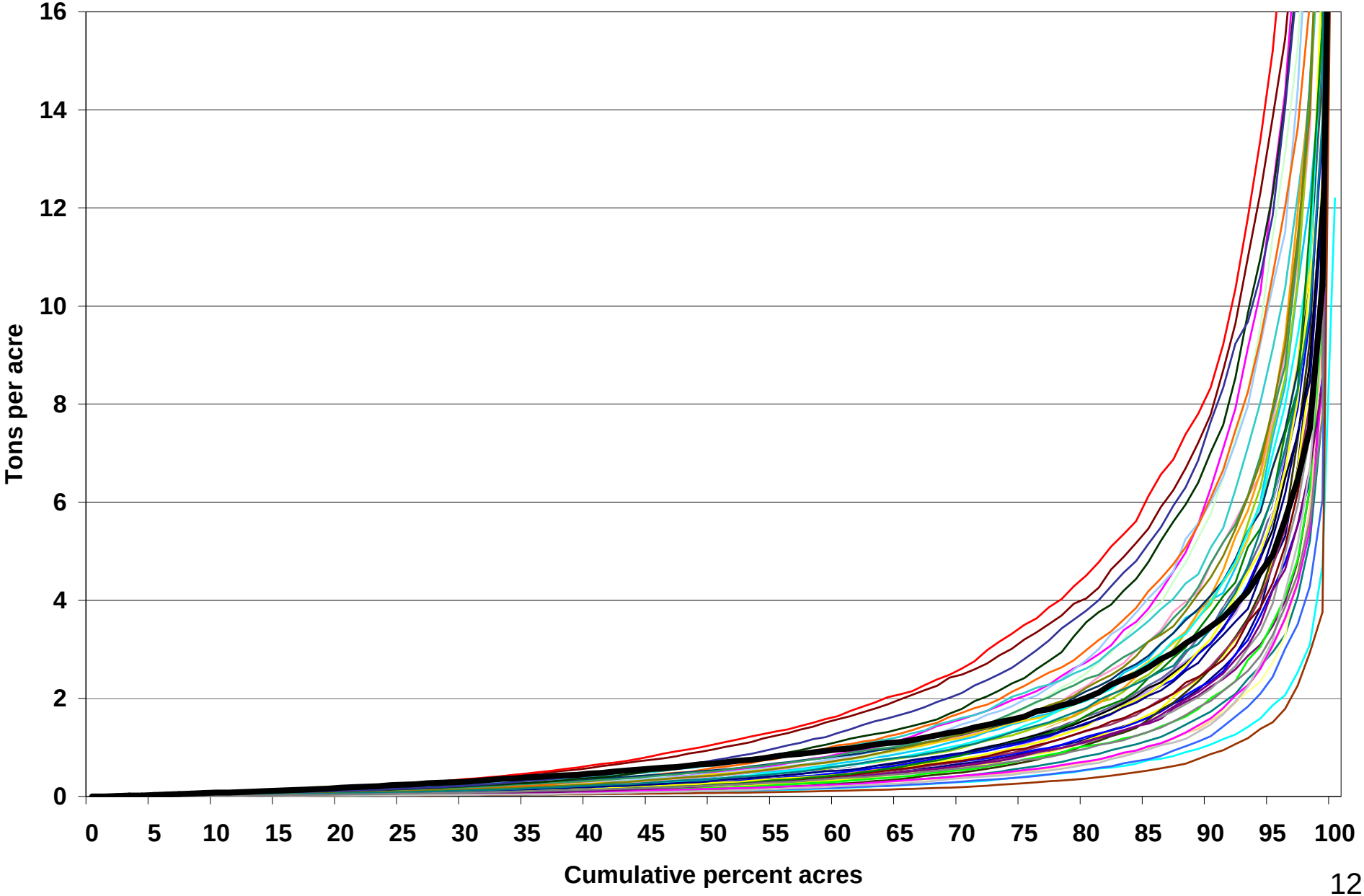
Precipitation



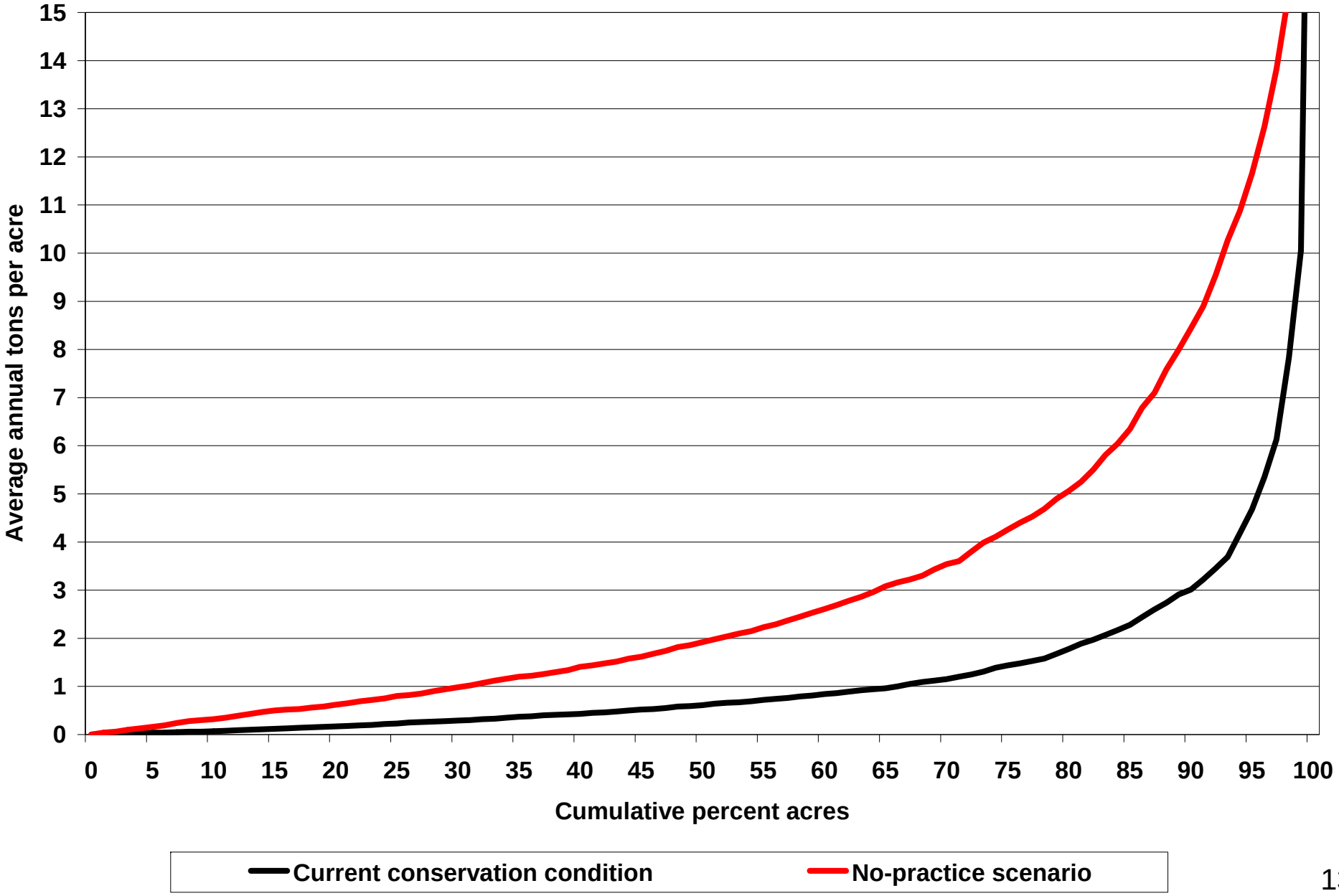
Surface water runoff



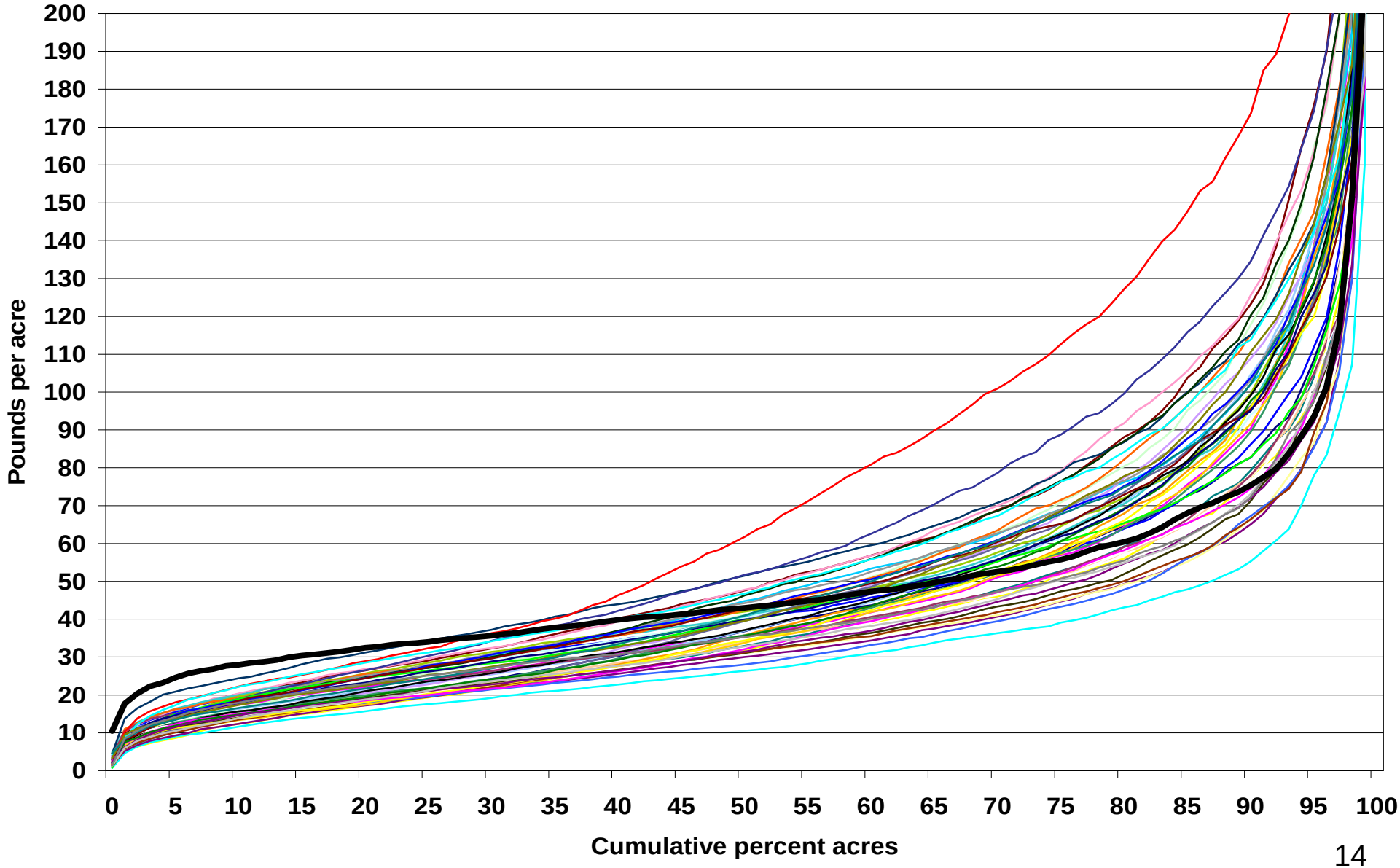
Sediment Loss



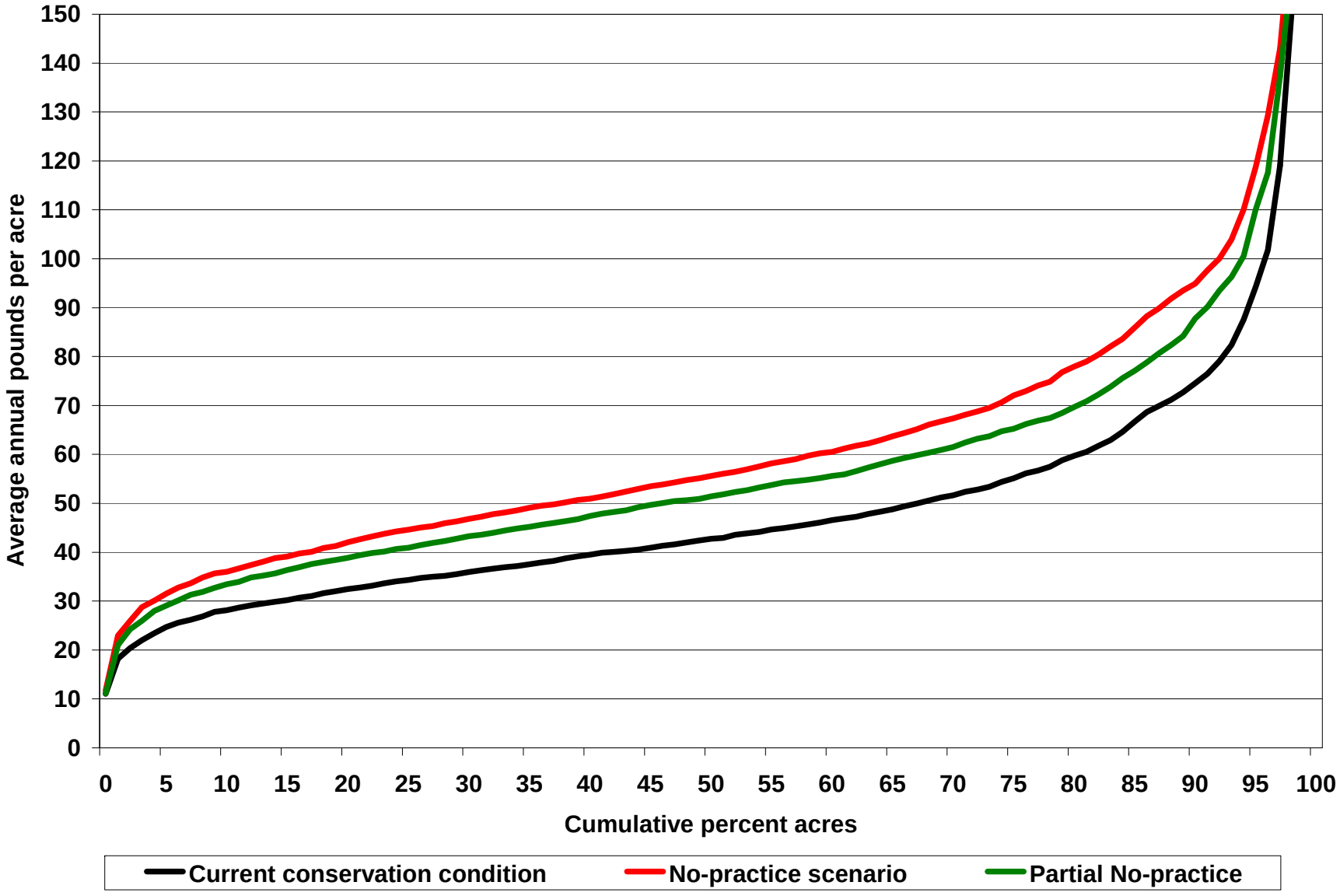
Sediment Loss



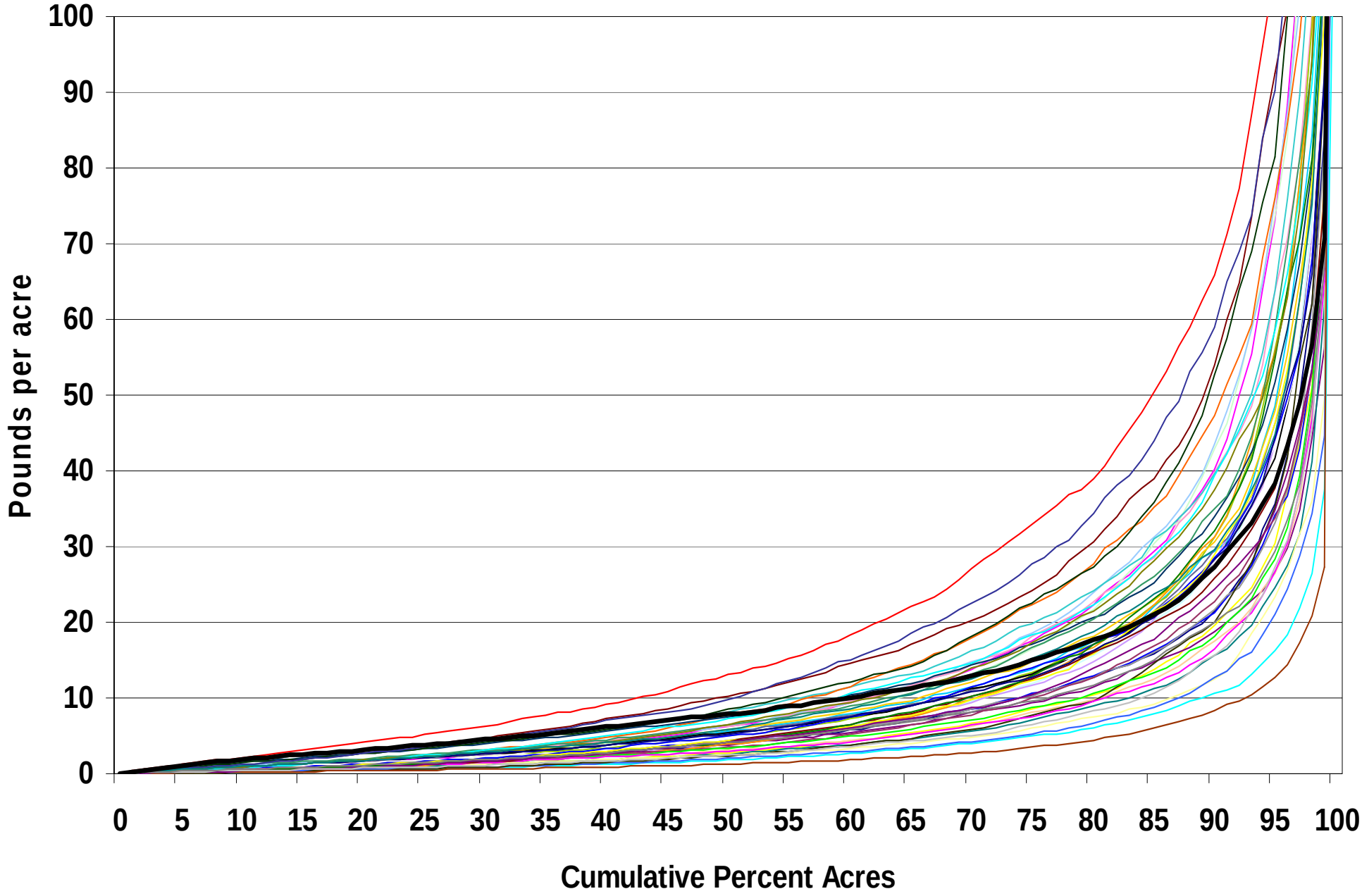
Total Nitrogen Loss



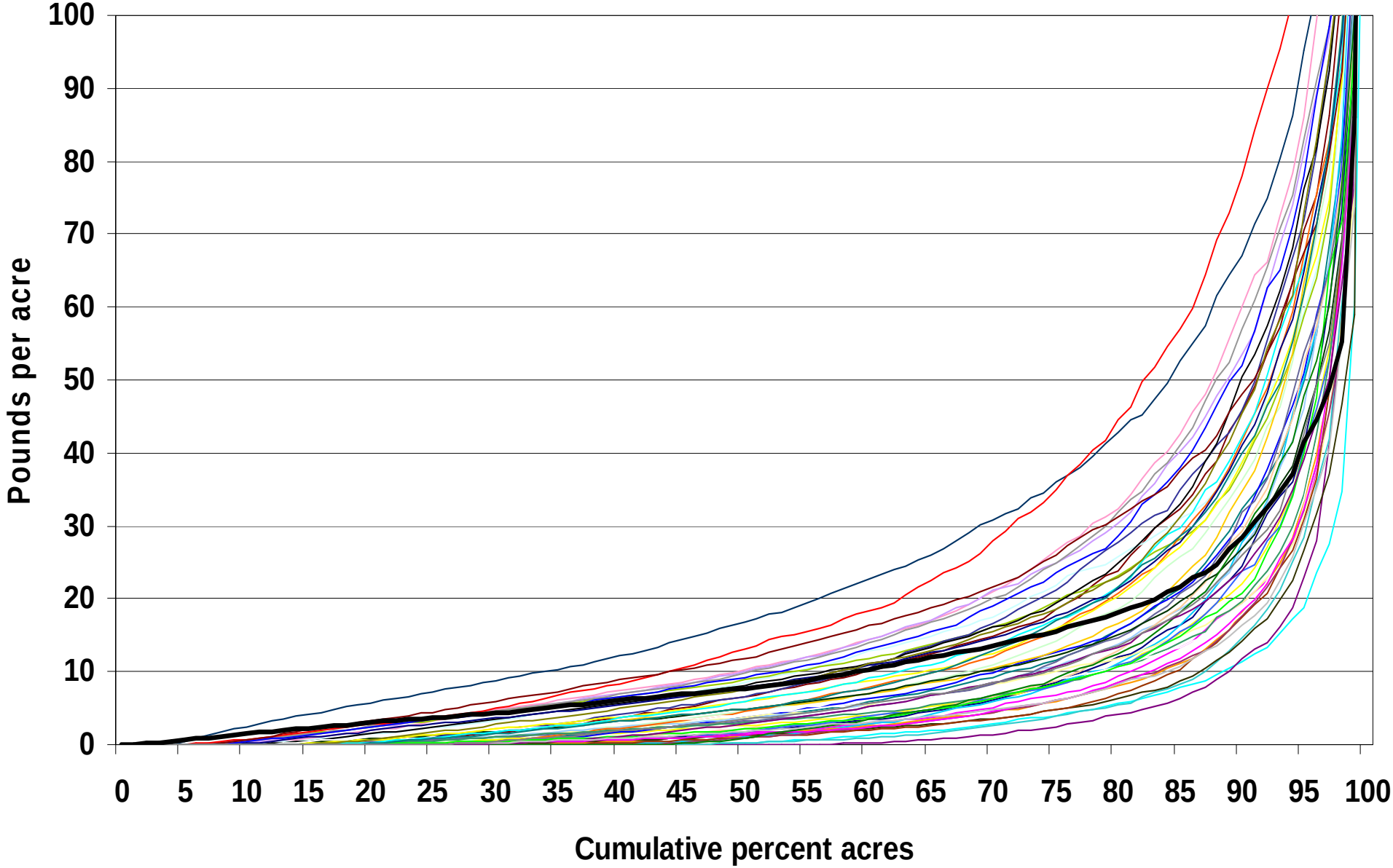
Total Nitrogen Loss



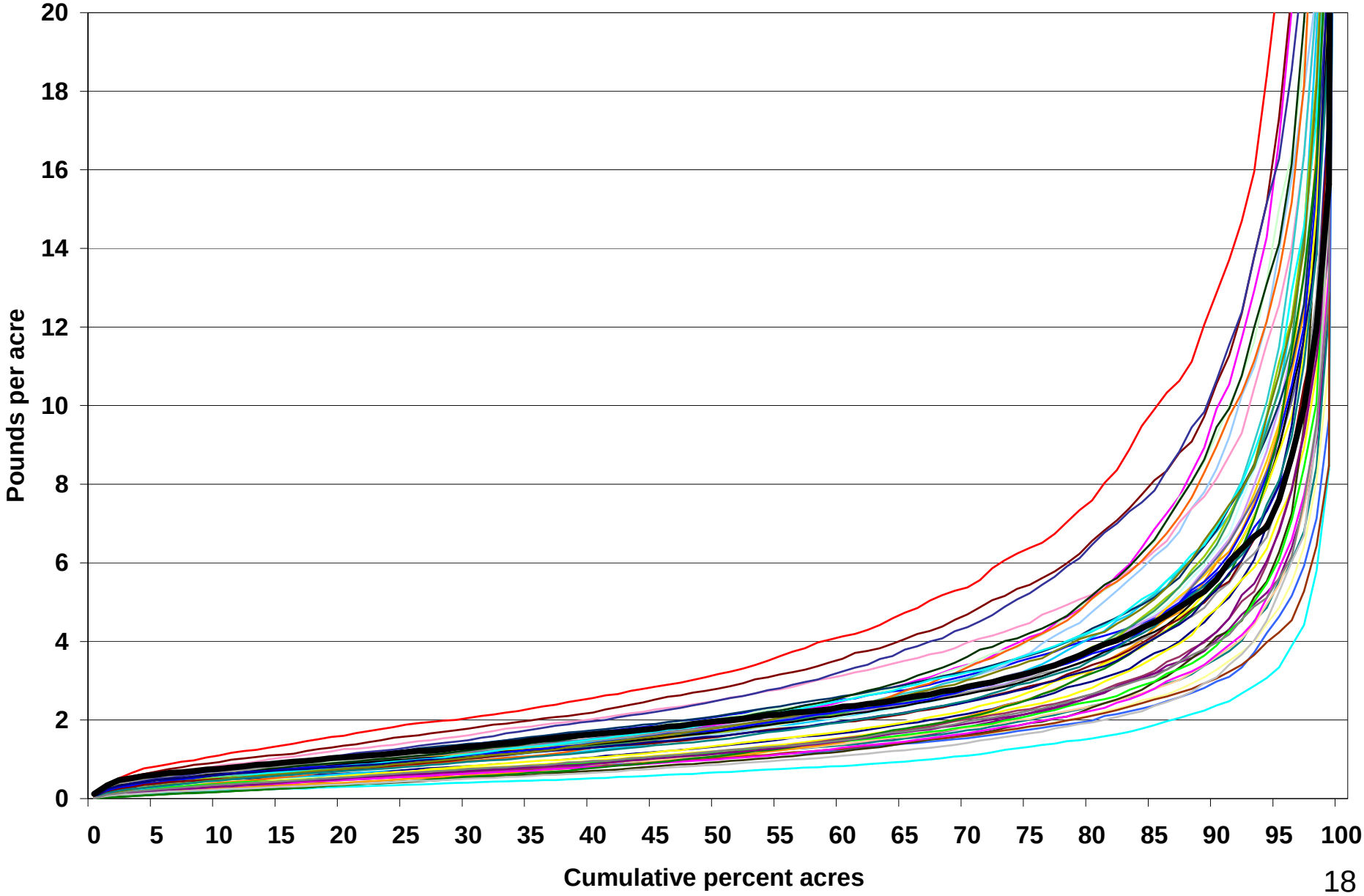
Nitrogen Lost with Surface Water Runoff



Nitrogen Lost in Subsurface Flow



Total Phosphorus Loss



Regional “acceptable levels” were used as a guide in estimating acres in need of additional treatment

- Classes established for current conservation treatment levels
- Classes of soil risk were established
- Acceptable levels used to identify the more vulnerable and under-treated class combinations

Current conservation condition

Sediment loss, tons per acre per year

	Low treatment	Moderate treatment	Moderately high treatment	High treatment
Low risk	0.7	0.3	0.4	<0.1
Moderate risk	2.0	0.9	0.9	<0.1
Moderately high risk	3.3	3.0	2.1	0.1
High risk	7.6	6.8	3.1	0.2

Reductions due to conservation practices

Sediment loss, tons per acre per year

	Low treatment	Moderate treatment	Moderately high treatment	High treatment
Low risk	0.4	0.4	1.2	0.9
Moderate risk	0.9	1.0	2.7	2.5
Moderately high risk	1.7	3.0	5.7	7.4
High risk	3.1	6.1	7.9	12.2

Acres with treatment needs

% acres with sediment loss>2 tons/acre

	Low treatment	Moderate treatment	Moderately high treatment	High treatment
Low risk	5.0	0.5	0.0	0.0
Moderate risk	**33**	11	9	0.0
Moderately high risk	**56**	**47**	**45**	0.0
High risk	**83**	**92**	**56**	0.0

Summary of Conservation treatment needs in UMRB

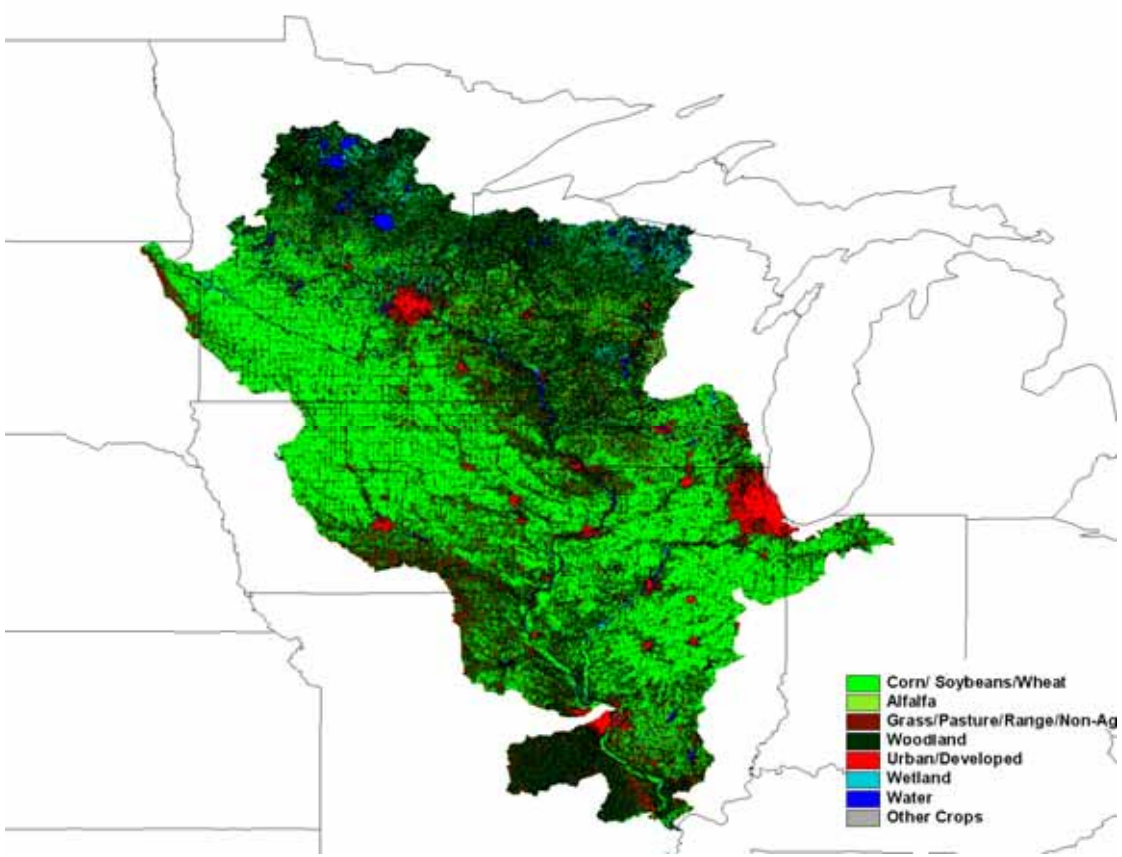
- Vulnerable cultivated cropland acres will benefit by enhancing the treatment level
  - Nitrogen…35% of cult. cropland acres
  - Sediment…26% of cult. cropland acres
  - Phosphorus…22% of cult. cropland acres
  - All together represent 43% (25 million acres)
- 9% of acres are critically under-treated
  - Acres in most need of treatment (highest risk acres, lowest treatment level).
  - 5.2 million acres

Conclusions

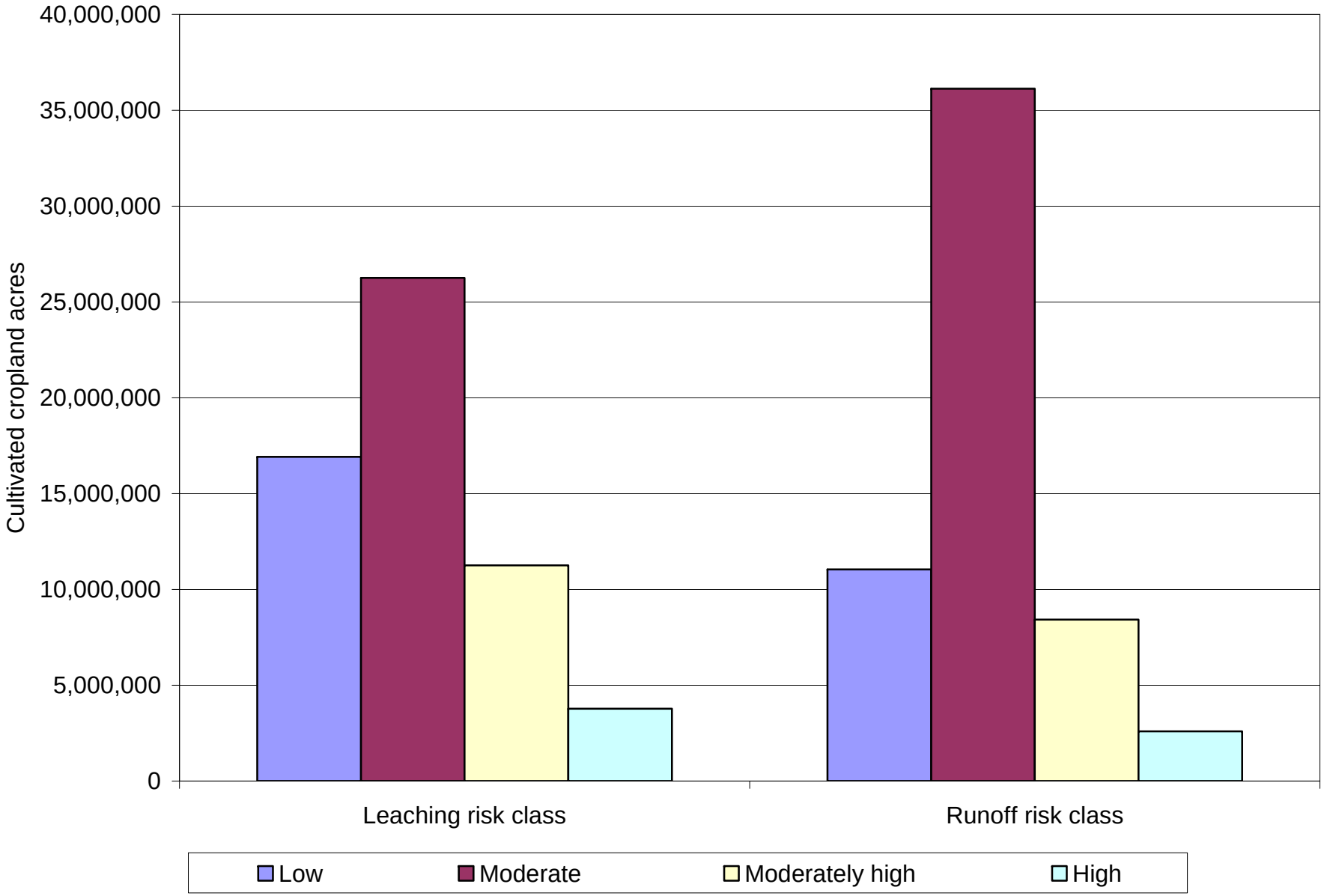
Regional “acceptable levels” are:

- **Critical for use in assessing current condition and tracking progress over time.**
- **Useful in estimating conservation treatment needs.**
- **Feasible, as shown by model simulations.**
- **Can be tailored to meet a particular WQ goal for the region, such as export of sediment and nutrients from the basin.**
- **We need studies/analysis that supports these or alternative “acceptable levels.”**

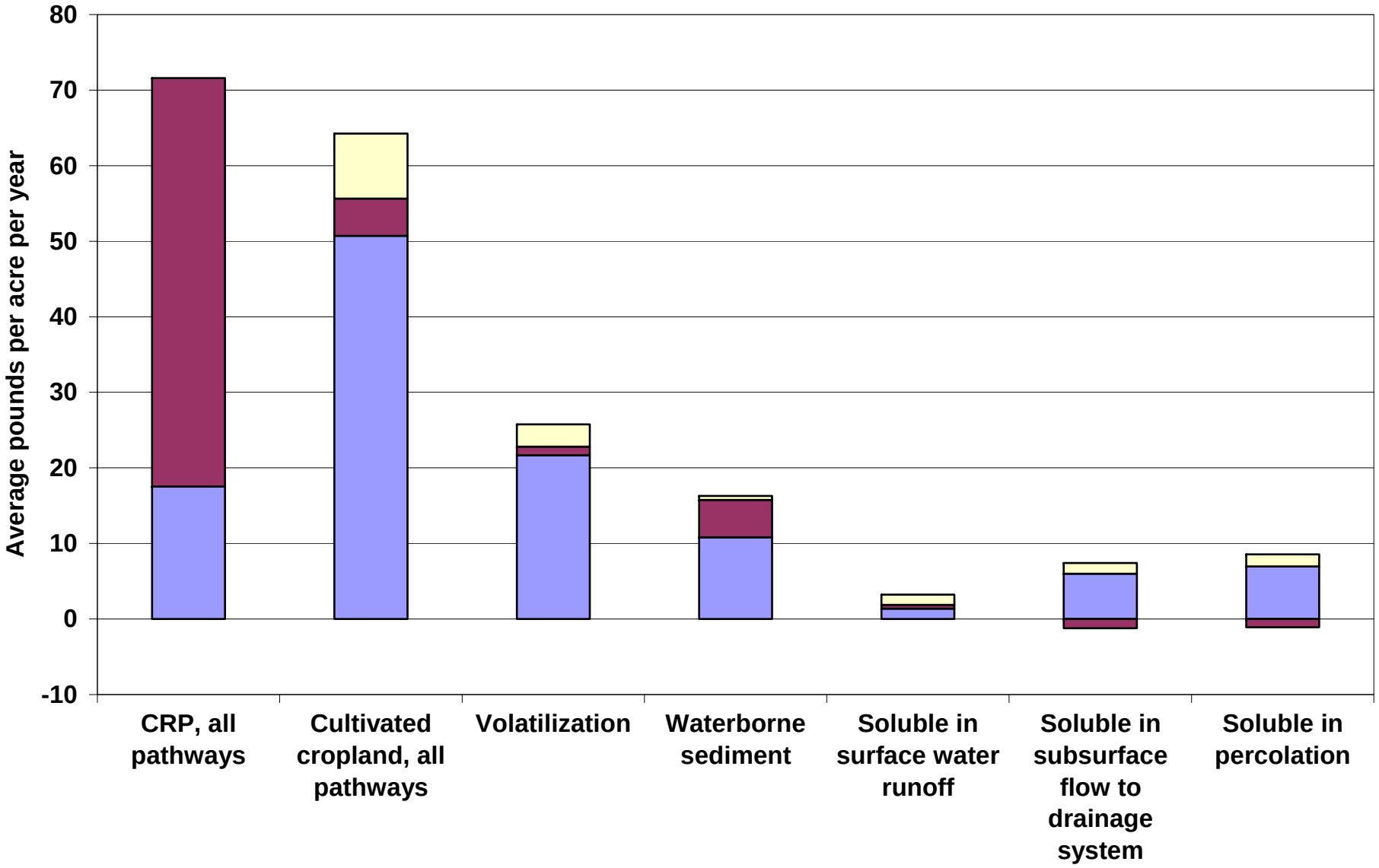
Assessment of the Effects of Conservation Practices on Cultivated Cropland in the Upper Mississippi River Basin



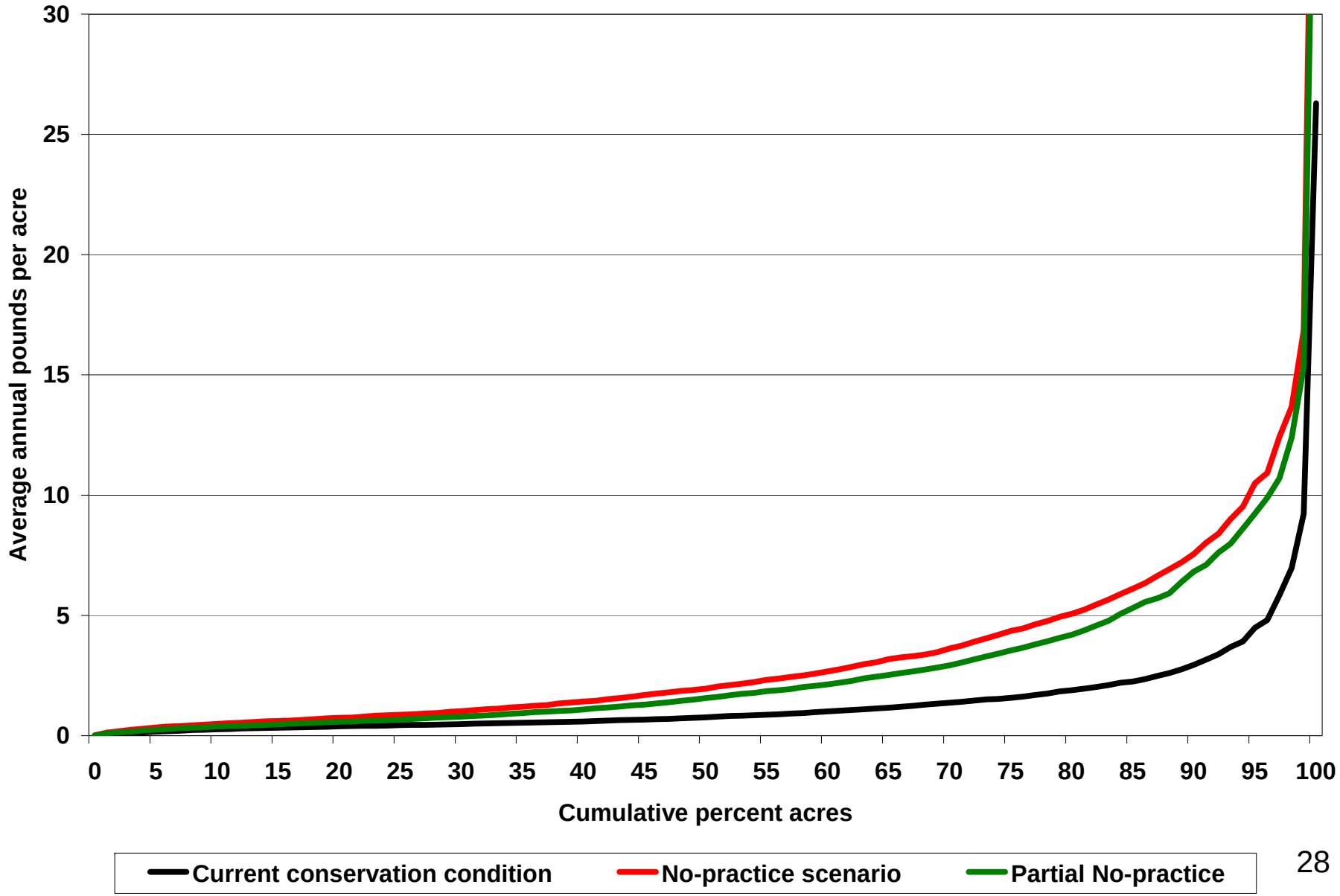
Soil risk classes



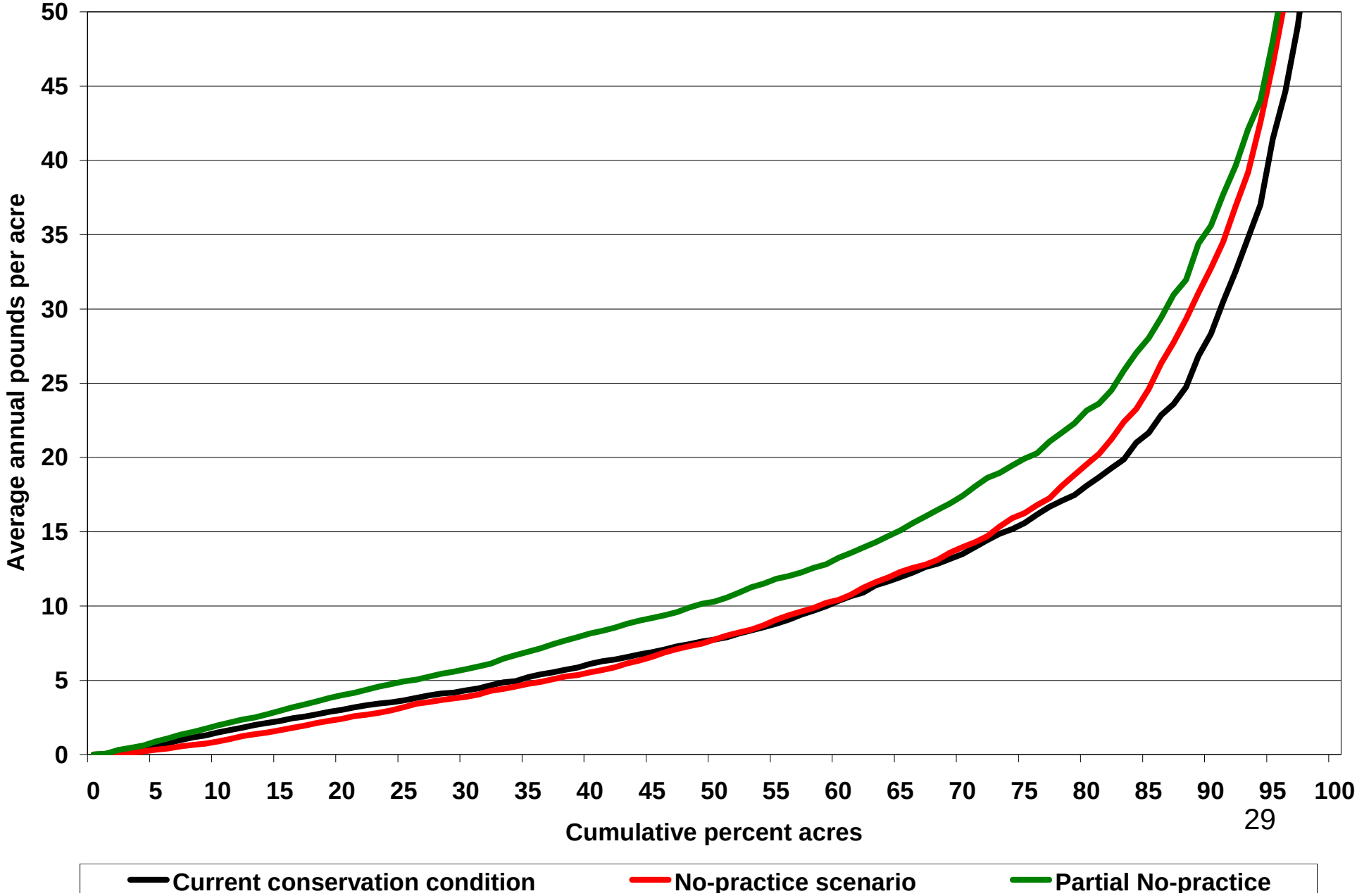
Nitrogen Loss



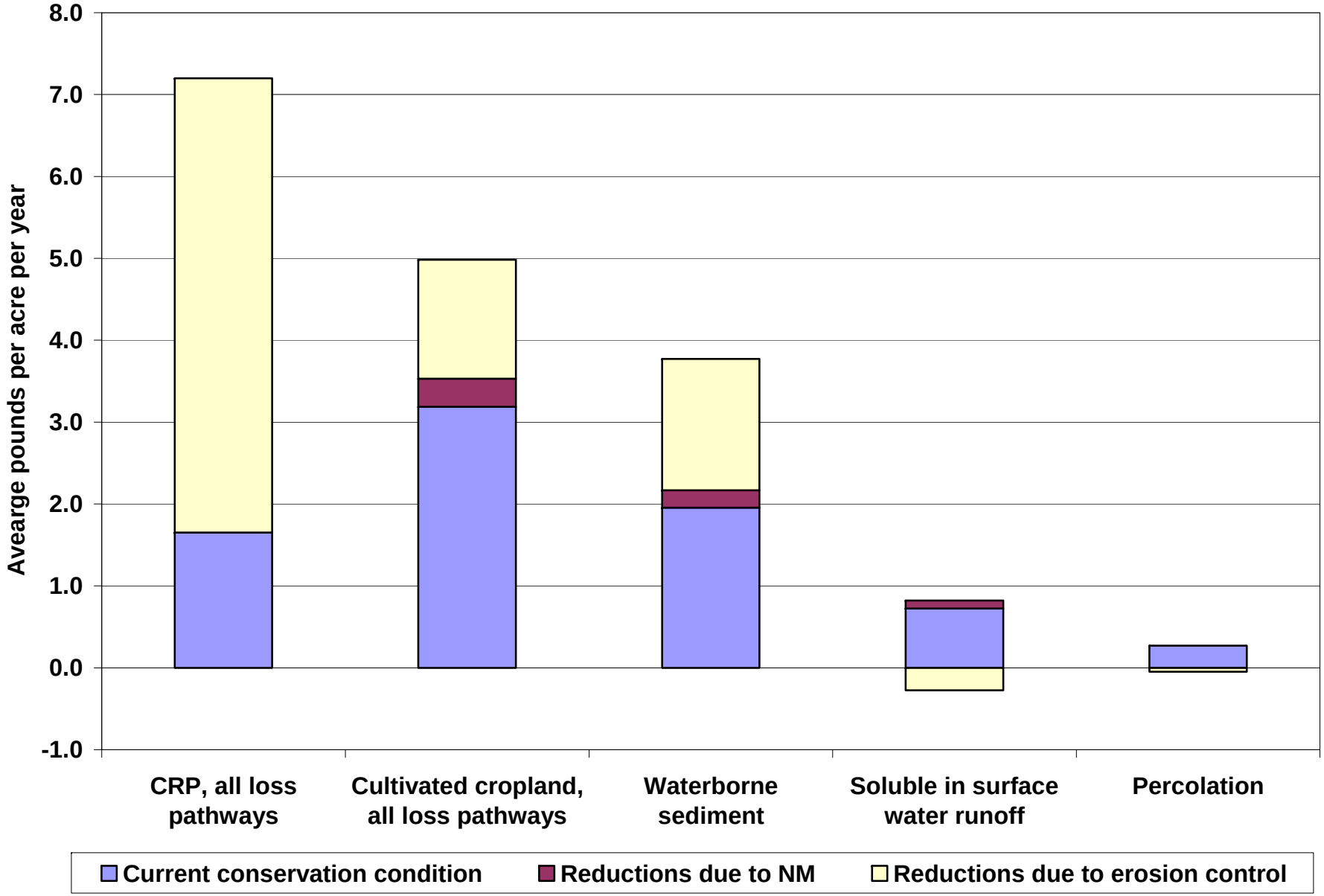
Loss of Soluble Nitrogen in Surface Water Runoff



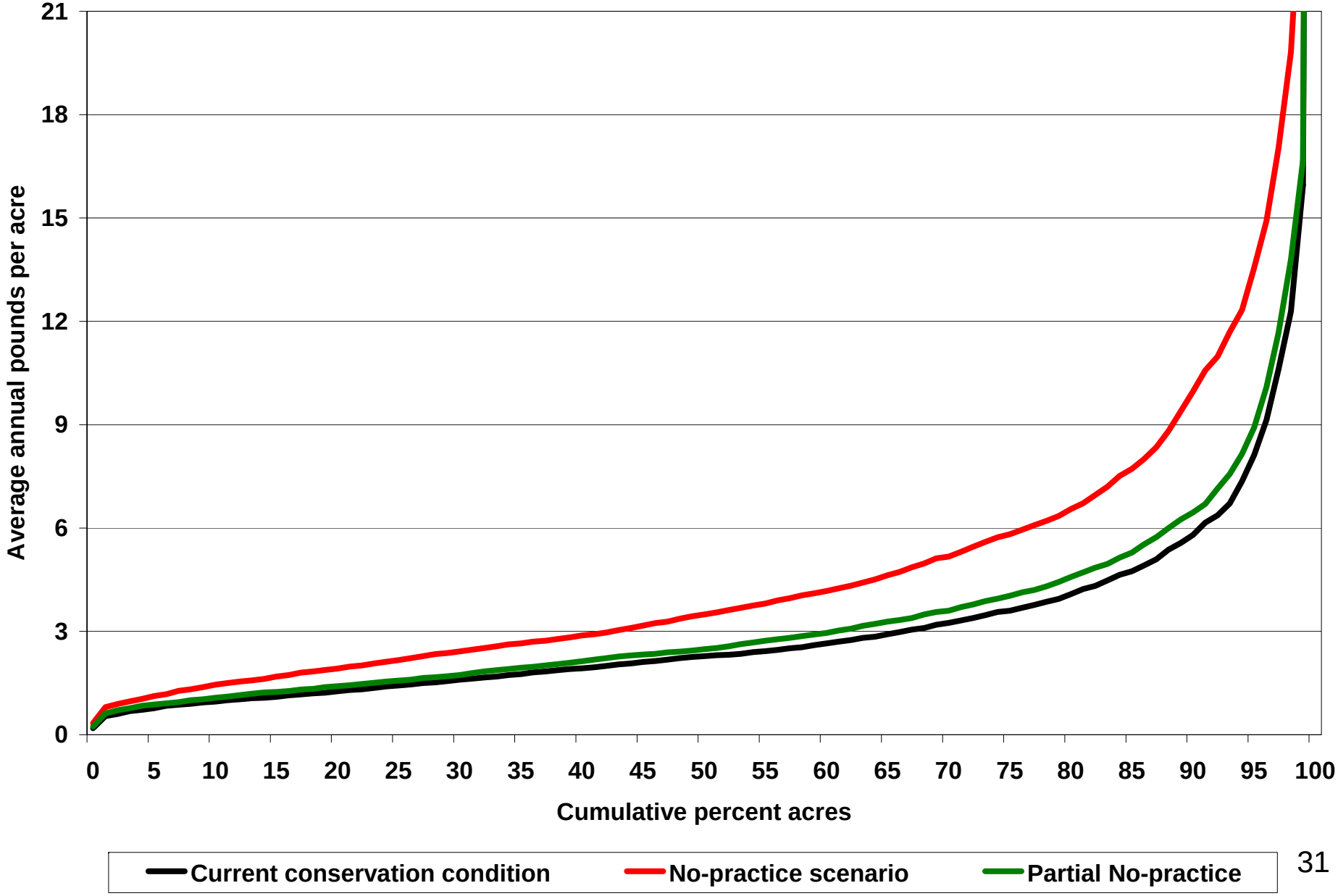
Loss of Nitrogen in Subsurface Flows



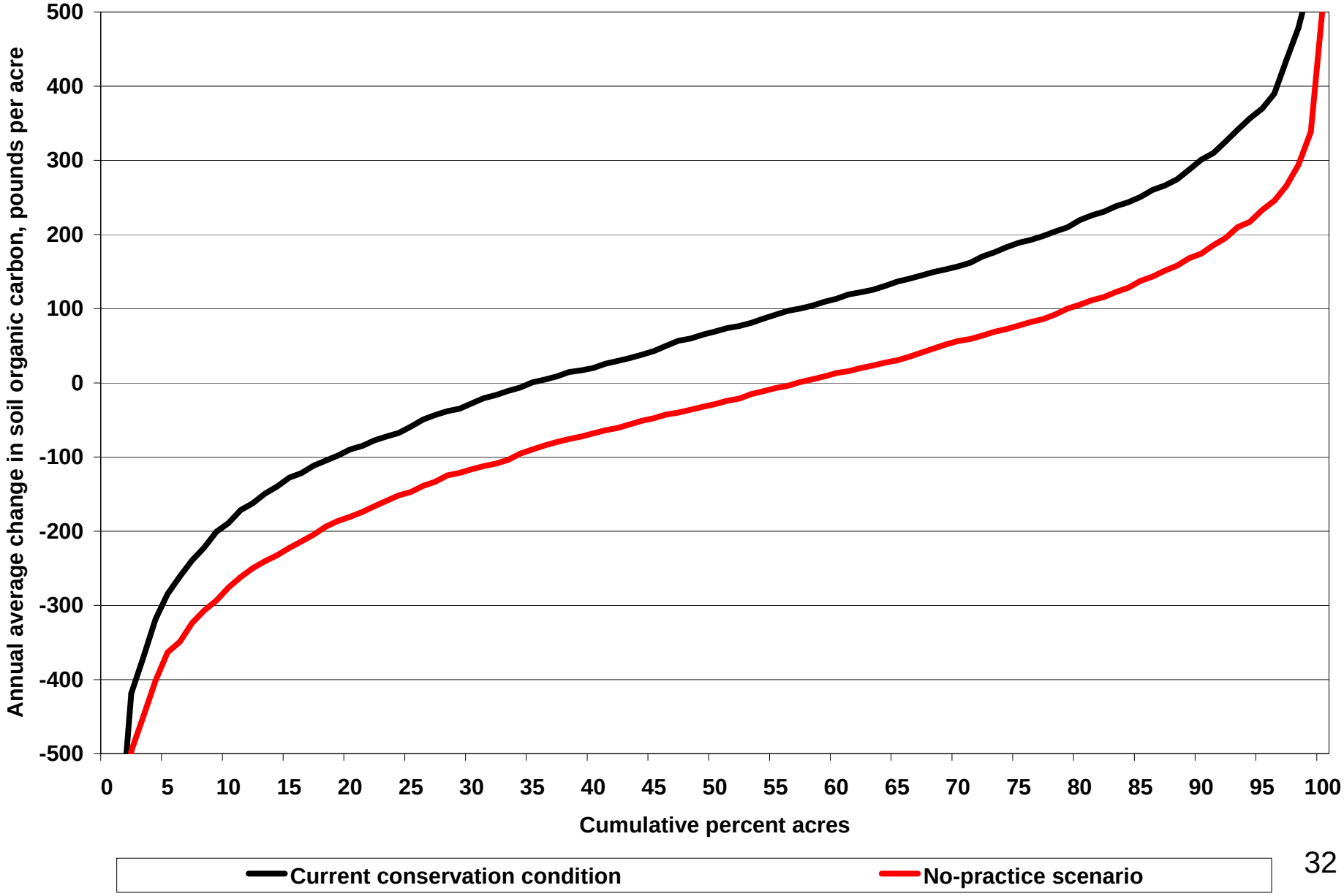
Phosphorus Loss



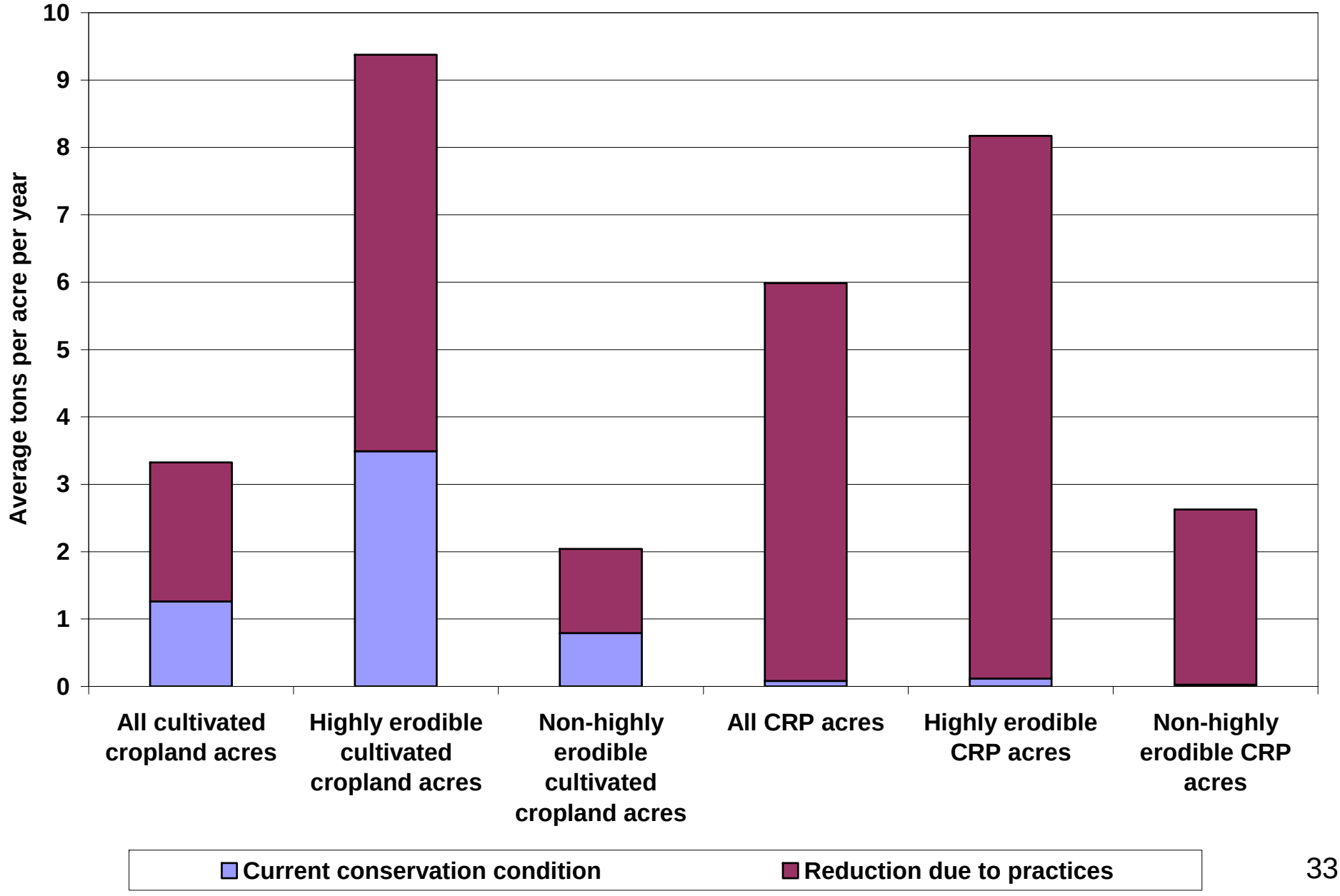
Total Phosphorus Loss



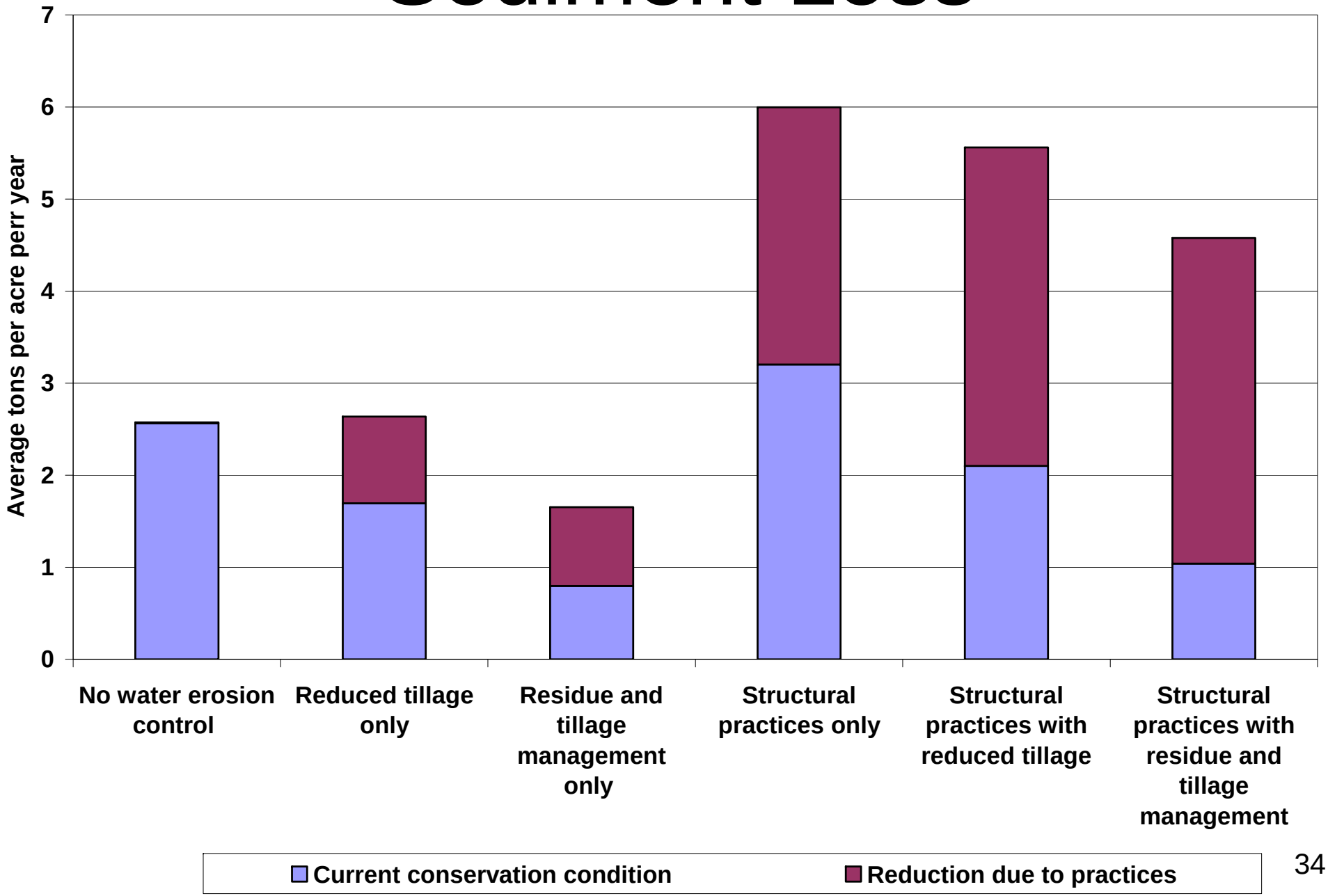
Change in Soil Organic Carbon



Sediment Loss



Sediment Loss



Nitrogen Lost with Subsurface Flows