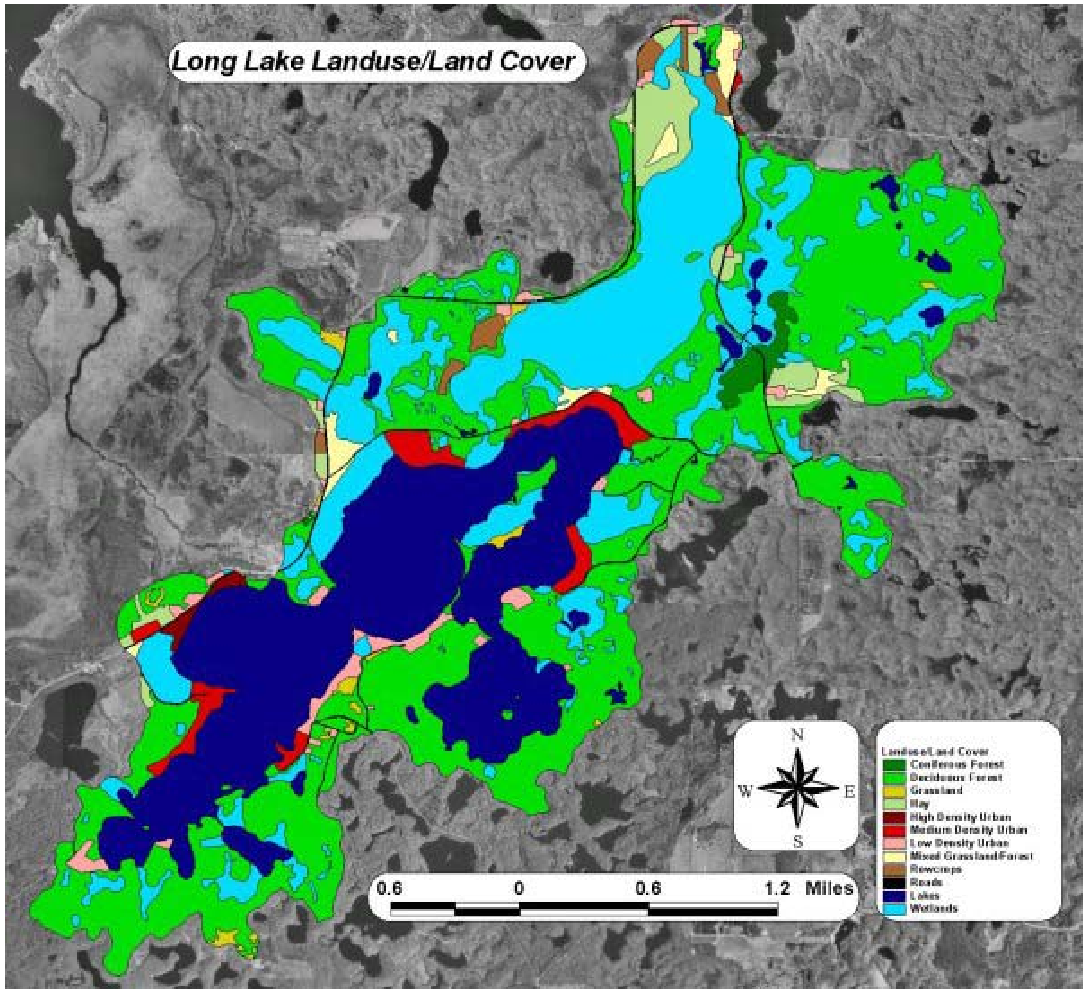
# LAND USE AND WATERSHED IMPACTS

# *RESIDENTIAL DEVLOPMENT*


FERTILIZER

# AGRICULTURE IMPACTS


# Watershed Landuse 2001




Applied Data Consultants, Inc.

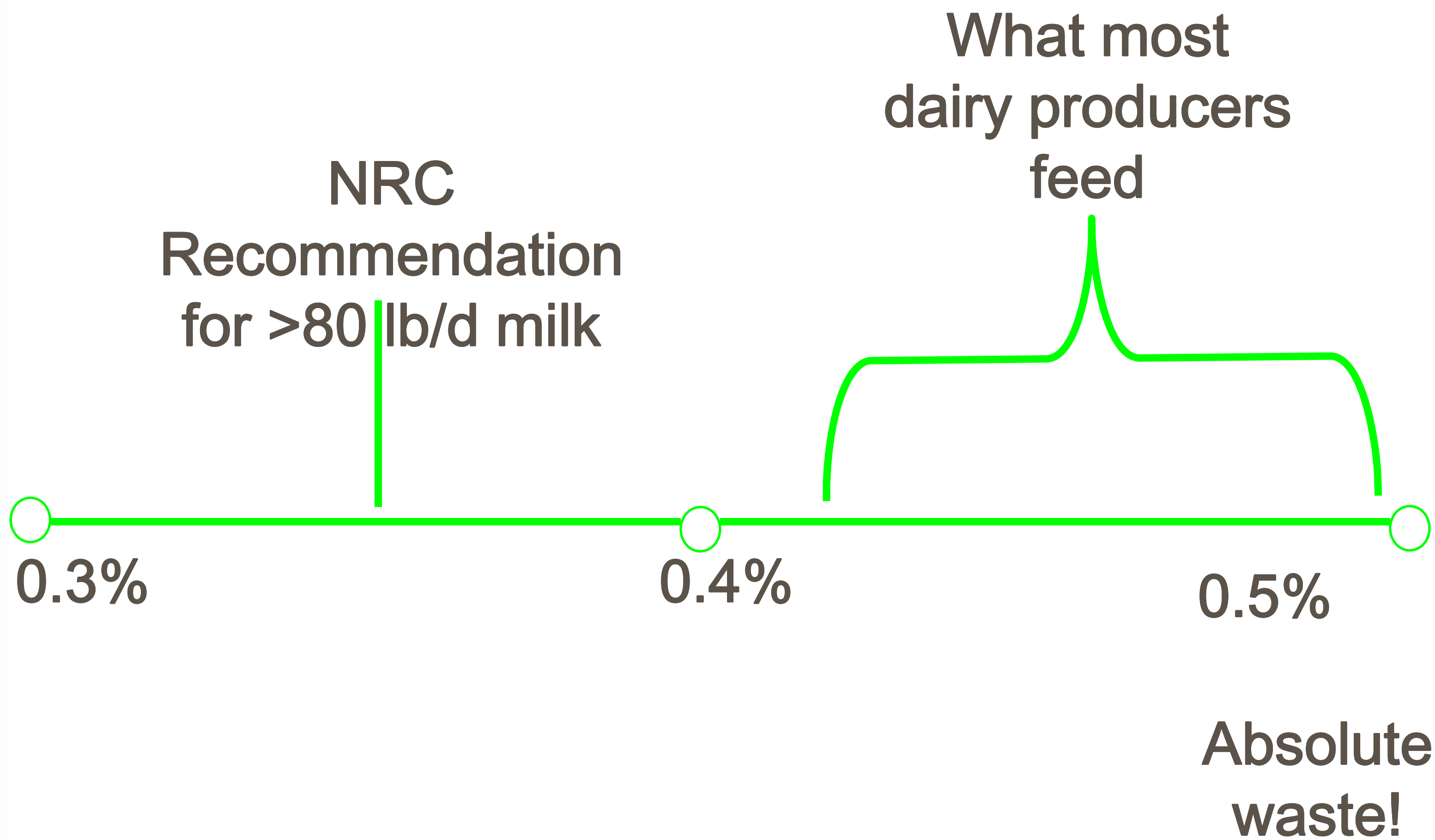
# Empirical Watershed Models

Phosphorus export coefficients - developed based using monitoring data.

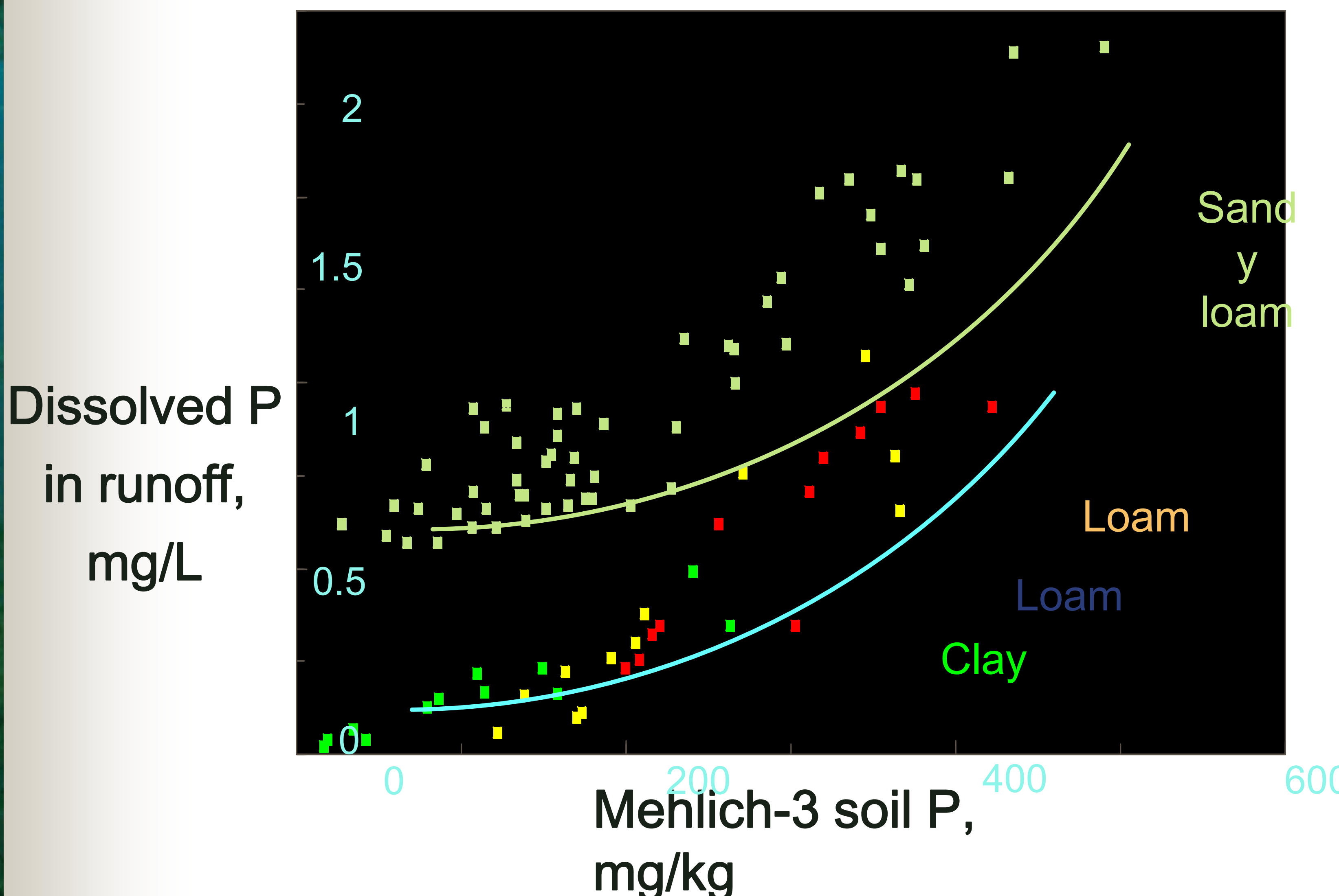
WISCONSIN VALUES

| Land Cover | TP Export kg/ha/yr |
|---|---|
| High Density Urban | 1.5 |
| Row Crop Agriculture | 1.0 |
| Mixed Agriculture | 0.8 |
| Grass / Pasture | 0.3 |
| Medium Density Urban | 0.5 |
| Low Density Urban | 0.1 |
| Forested | 0.09 |

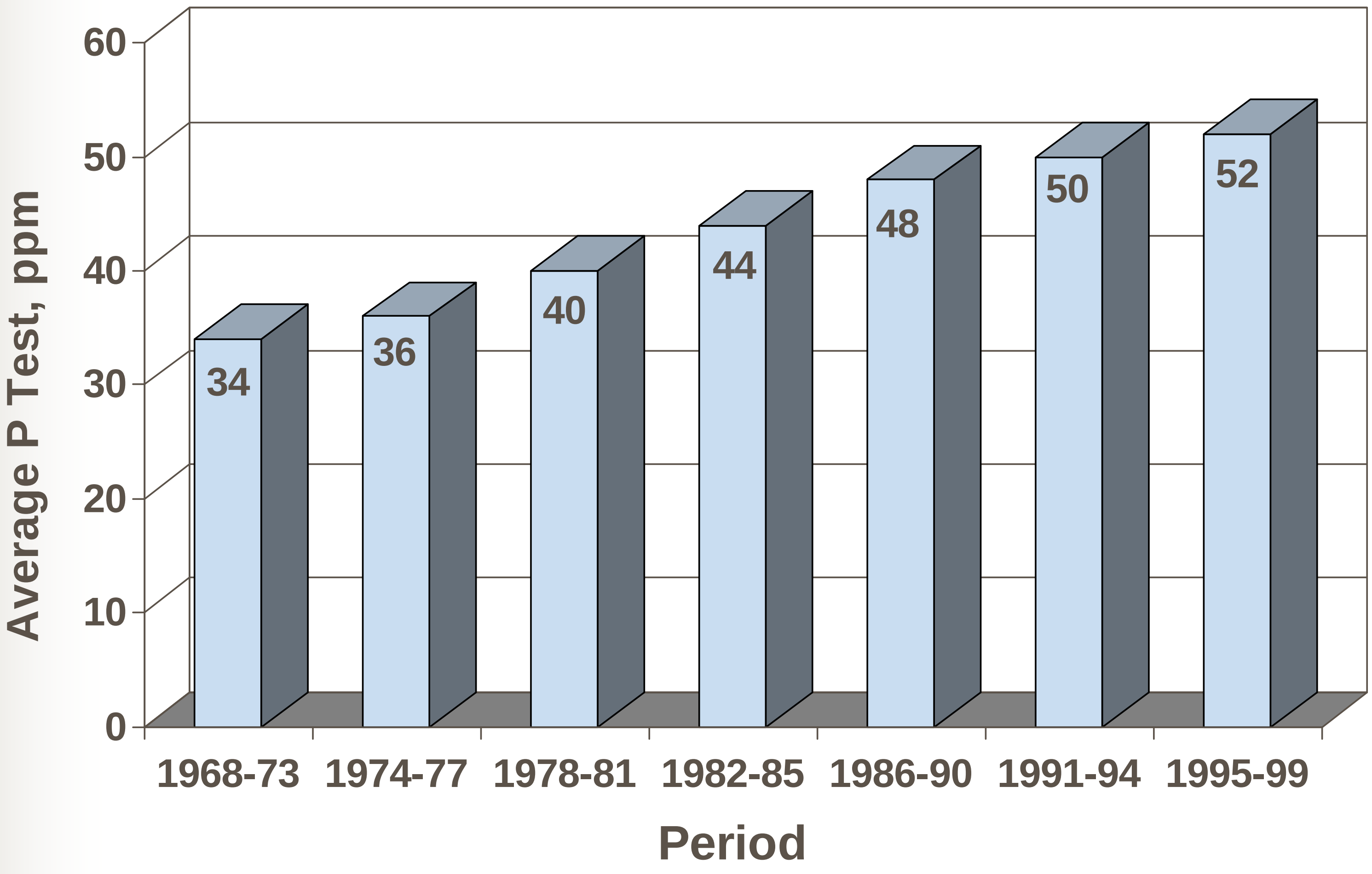
# *How Much Phosphorus feeding?*



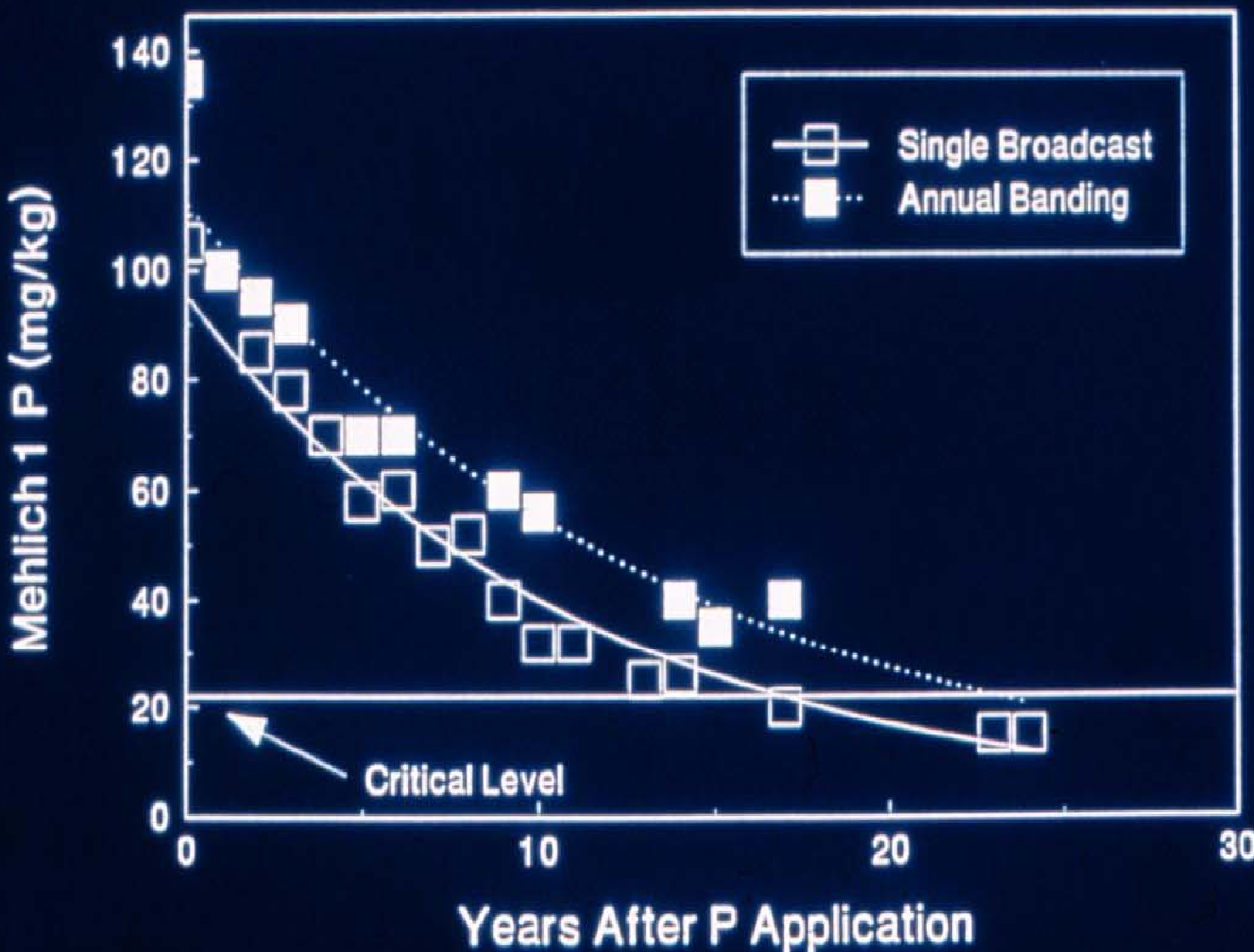
# Runoff P Increases with soil P



# Average Soil Test P in Wisconsin

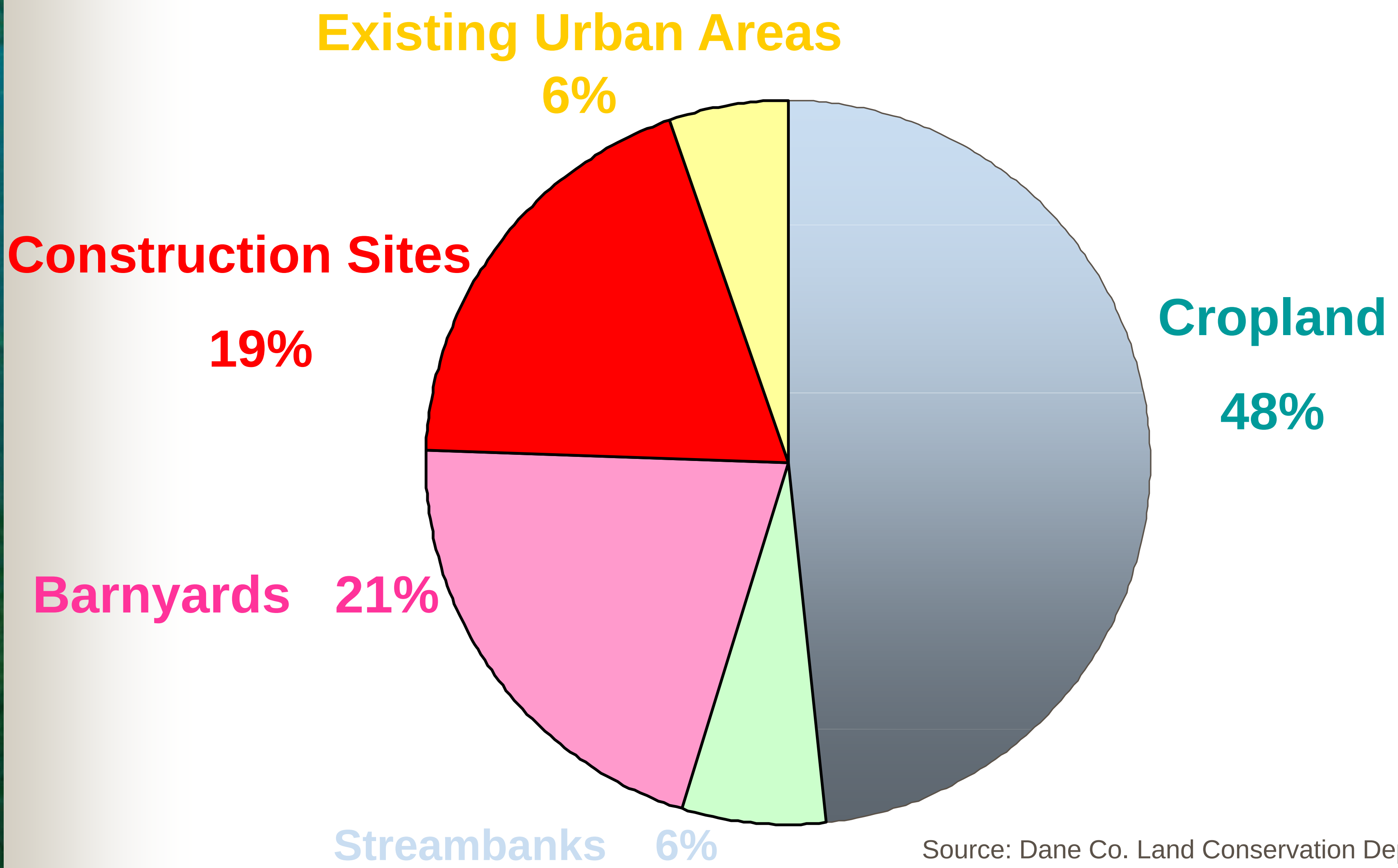


## Decrease in soil test P in a corn-soybean rotation for 26 years. (McCollum, 1991)




Nonpoint Pollution
to Lake Mendota

# P Loading Sources to Lake Mendota




Source: Dane Co. Land Conservation Dept.

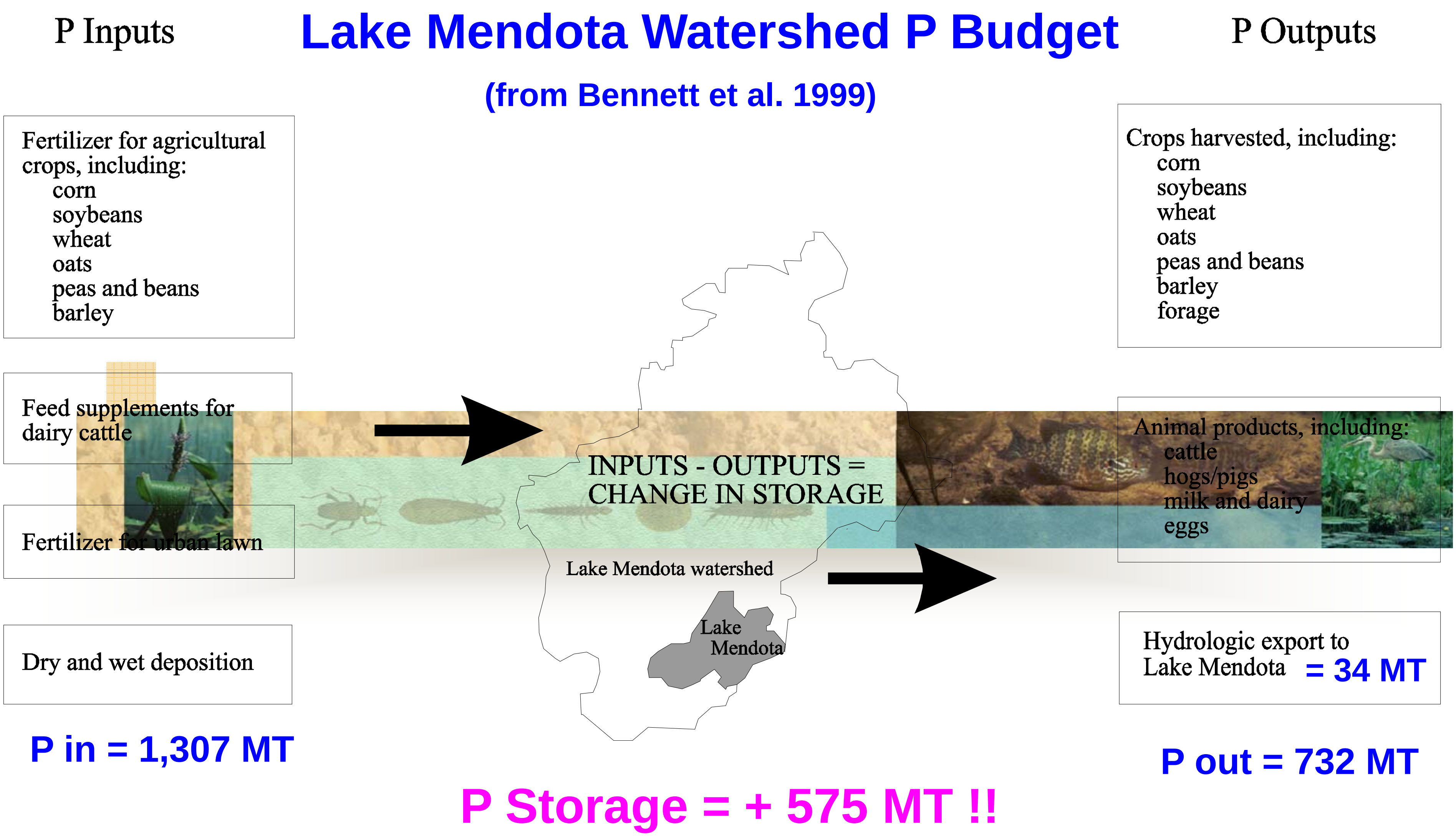
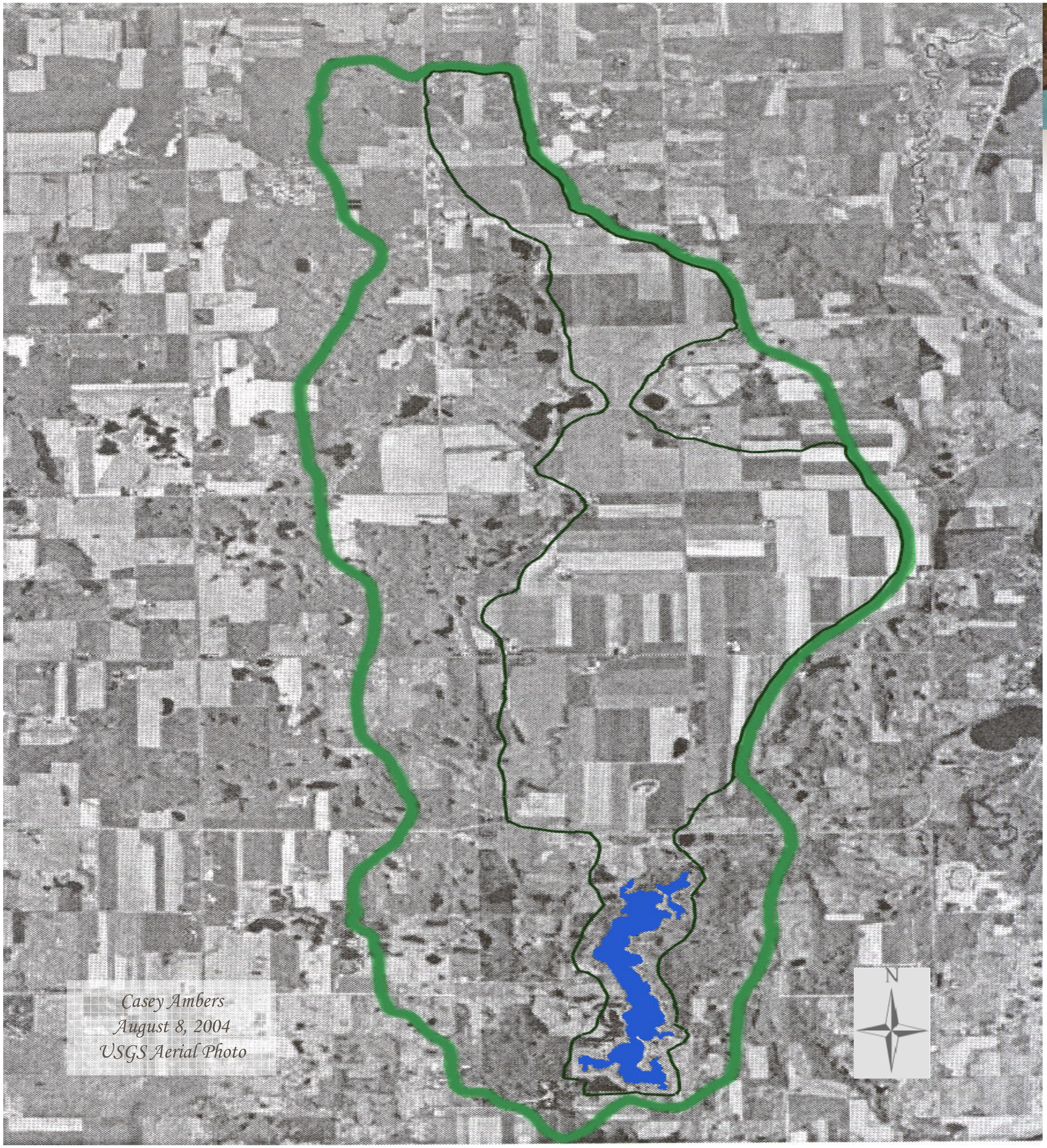



Figure 1. Schematic diagram of inputs and outputs used to calculate a P budget for the Lake Mendota watershed for 1995.




## Squaw Lake Watershed

Total Land Area: 5760 a

Direct Drainage: 2438 a

Nine Farms

- Dairy
- Beef
- Cash grain

# Squaw Lake P Balance

<u>Phosphorus Inputs</u>

Commercial fertilizer
Mineral
Animals
Crops
Manure

<u>Phosphorus Outputs</u>

Crops
Animals
Milk

# Squaw Lake P Balance

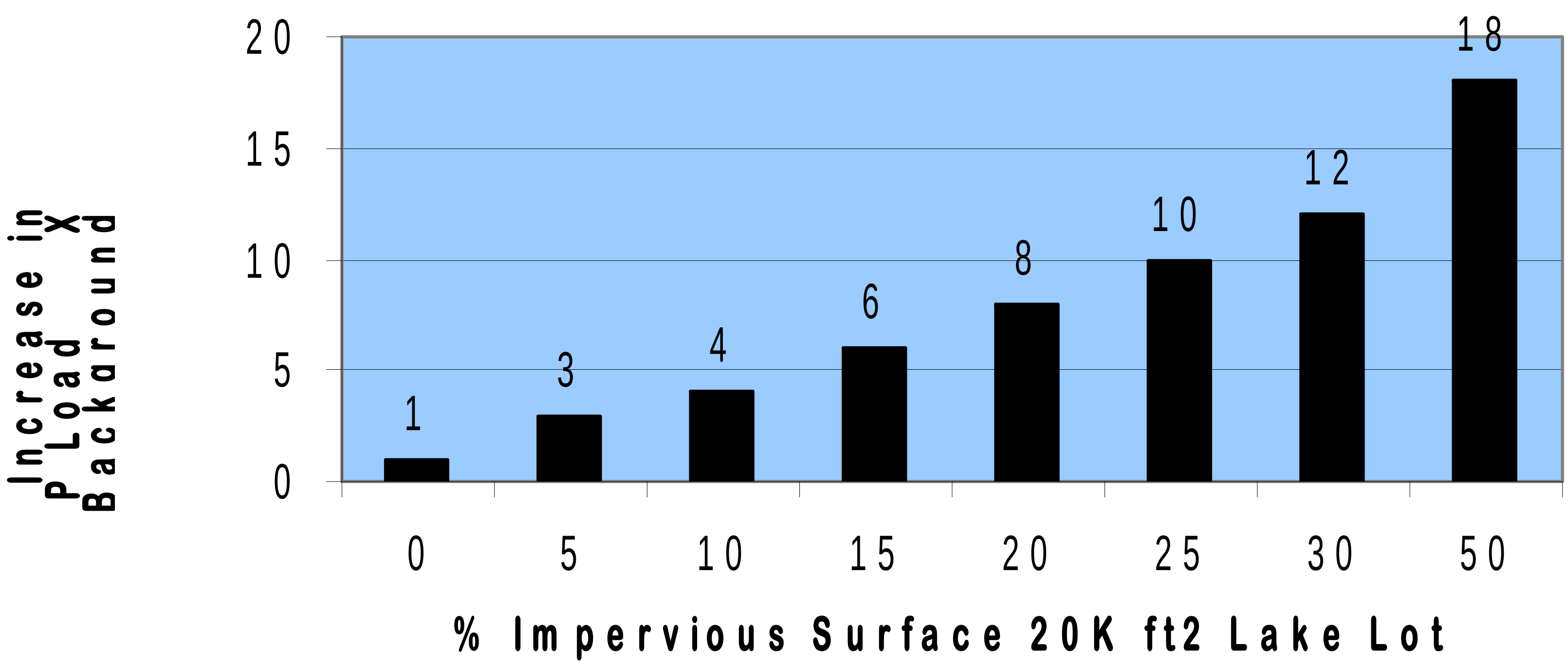
-Elemental P-

Total Inputs = 44,282 lbs P

Total Outputs = 46,364 lbs P

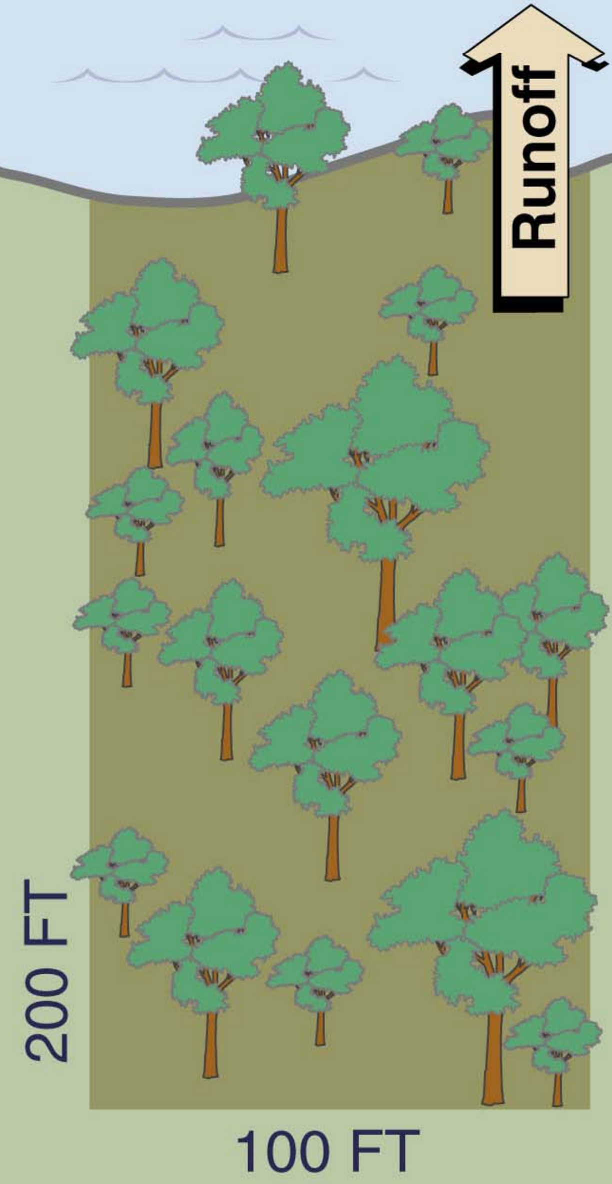
Balance = -2,082 lbs P

# Impacts from Impervious Surfaces on Phosphorous Loading




# Undeveloped – Apr.-Oct. phosphorus/sediment runoff model

- maple-beech forest
- 6% slope to lake
- sandy loam soil

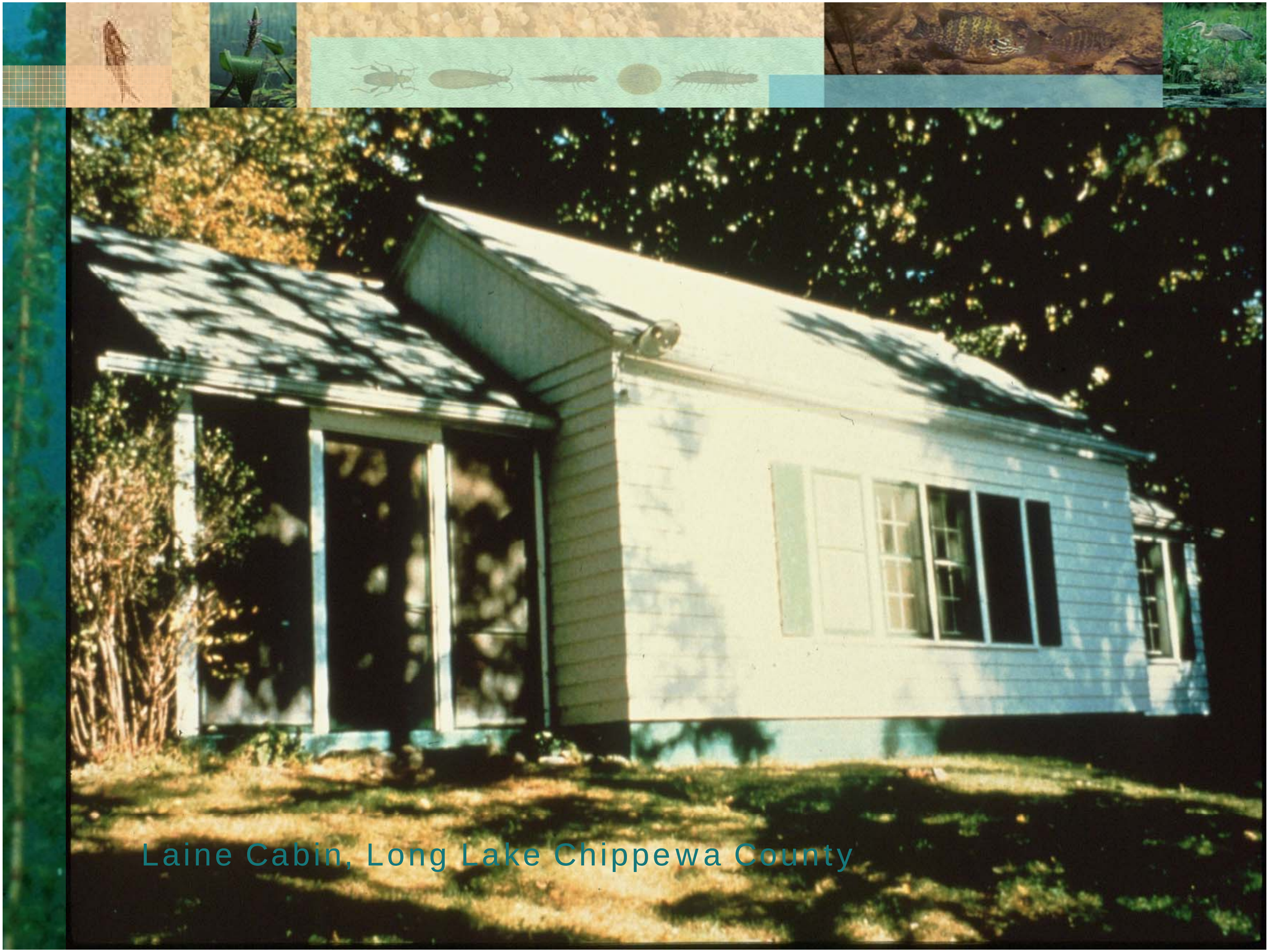



**IMPACT ON LAKE**
(April - Oct.)

- 1,000 $ft^3$ runoff to lake
- 0.03 lbs. phos. to lake
- 5 lbs. sediment to lake

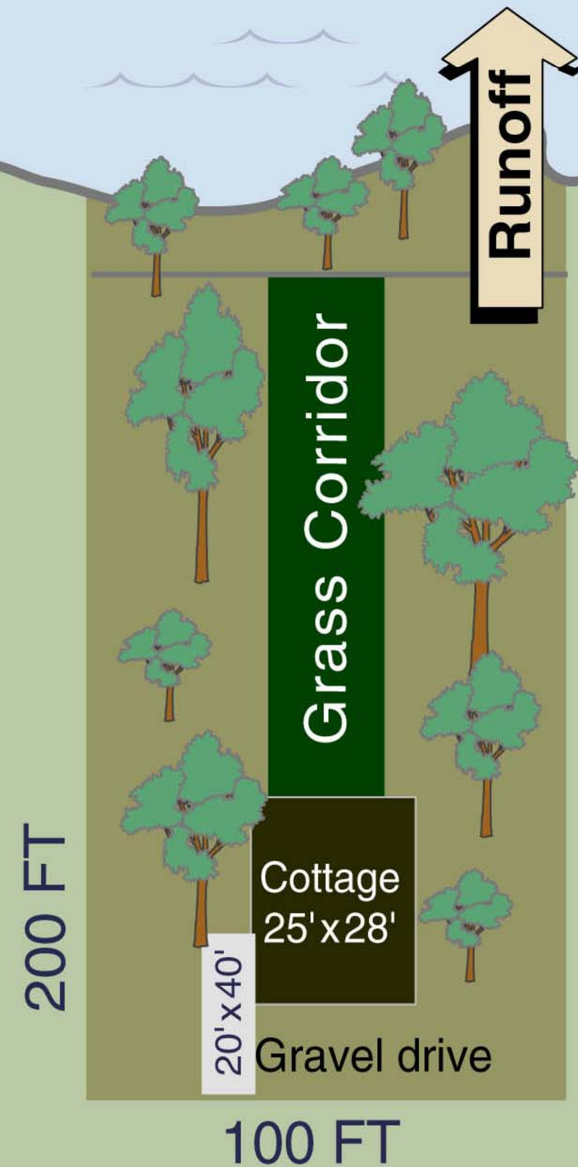
Source: Wisconsin Dept. of Natural Resources

The Wisconsin Lakes Partnership


Laine Cabin, Long Lake Chippewa County

# 1940s development – Apr.-Oct. phosphorus/sediment runoff model

- maple-beech forest
- 6% slope to lake
- grass corridor 20'-wide
- cottage 700 ft²
  perimeter
- gravel drive 800 ft²
- 35'-wide buffer strip




**IMPACT ON LAKE**
**(April - Oct.)**

- 1,000 ft³ runoff to lake
- 0.03 lbs. phos. to lake
- 20 lbs. sediment to lake

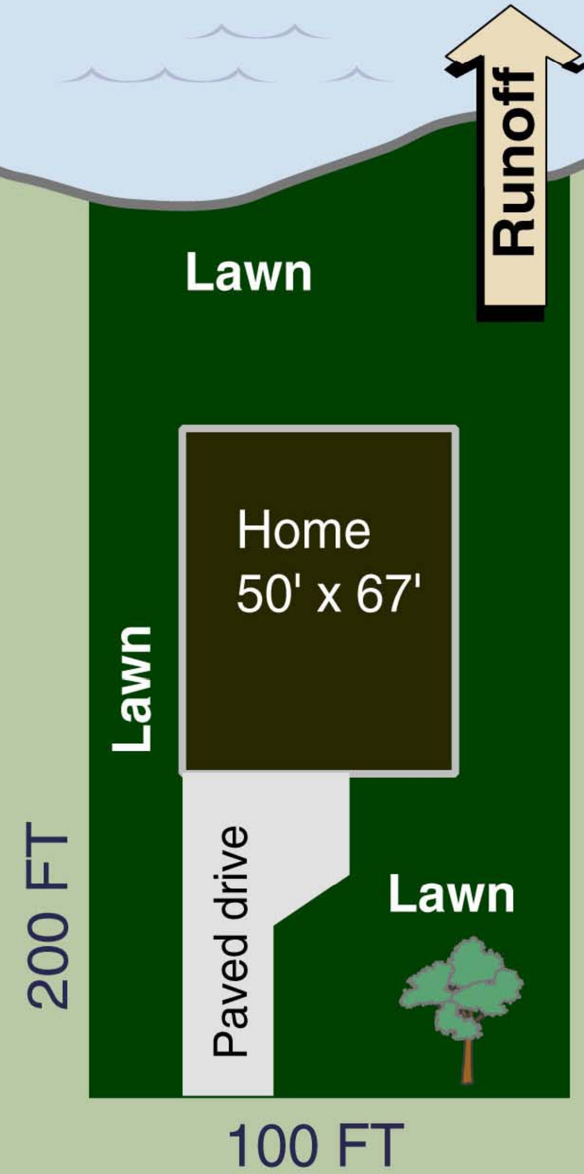
Source: Wisconsin Dept. of Natural Resources

The Wisconsin Lakes Partnership


Redevelopment Long Lake Chippewa County

# 1990s development – Apr.-Oct. phosphorus/sediment runoff model

- maintained lawn, soil graded
- 6% slope to lake
- home 3,350 $ft^2$ perimeter
- paved drive 770 $ft^2$




**IMPACT ON LAKE**
**(April - Oct.)**

- 5,000 $ft^3$ runoff to lake
- 0.20 lbs. phos. to lake
- 90 lbs. sediment to lake

Source: Wisconsin Dept. of Natural Resources

The Wisconsin Lakes Partnership

Gussick's residence, Lower Ninemile Lake

Pfefferkorn Residence, Butternut Lake

## Comparison of Median Nutrient Yields with Past Studies (kg/ha/yr)

| Citation | Landuse | TKN | T-P |
|---|---|---|---|
| King et.al.(2001) | Stream draining turf | | 0.33 |
| Dennis (1996) | Residential | | 1.75 |
| Rechow et.al.(1980) | | 5.5 | 1.1 |
| Panuska,Lillie (1995) | Urban | | 0.52 |
| Thomann (1987) | Urban | 5.0 | 1.0 |
| Panuska, WiLMS | Rural Res. | | 0.1 |
| Rechhow et.al.(1980) | Residential | 2.46 | 0.2 |
| Barten (2001) | Lawn | | |
| **Our Study** | **Lawn** | **0.16** | **0.025** |

| | | | |
|---|---|---|---|
| Panuska,Lillie (1995) | Forest | | 0.09 |
| Thomann (1987) | Forest | 3.0 | 0.4 |
| Dennis (1996) | Forest | | 0.19 |
| Panuska (WiLMS) | Forest | | 0.08 |
| **Our Study** | **Forest** | **0.015** | **0.003** |

# Effect of a Phosphorus Fertilizer Ordinance on Runoff Water Quality

*Image courtesy of the Washington State Water Quality Consortium*

## *EMPACT: Lake Access 2*

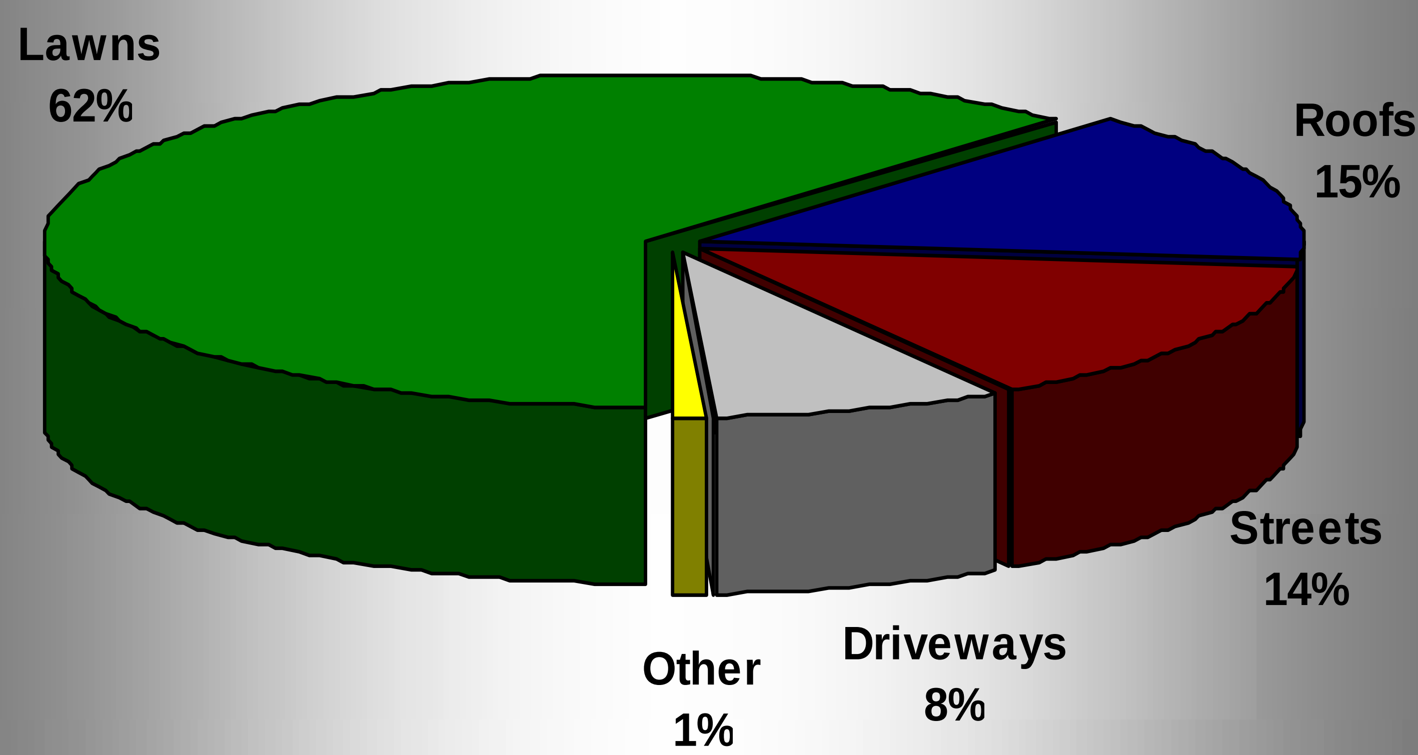

***Three Rivers Park District** (formerly Hennepin Parks)*

***University of Minnesota: Natural Resources Research Institute***

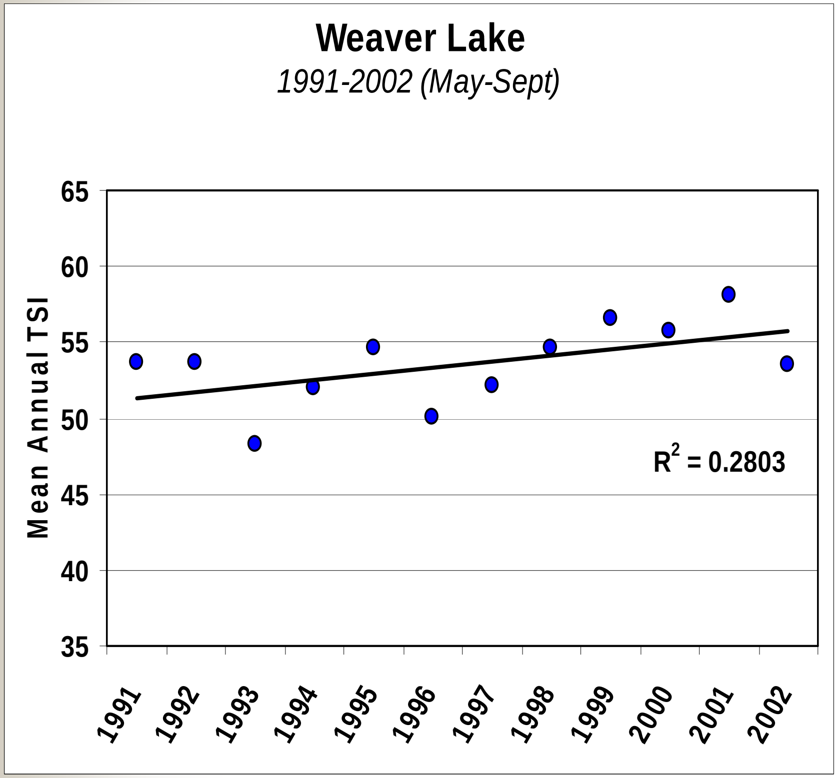
***Minnesota Sea Grant***

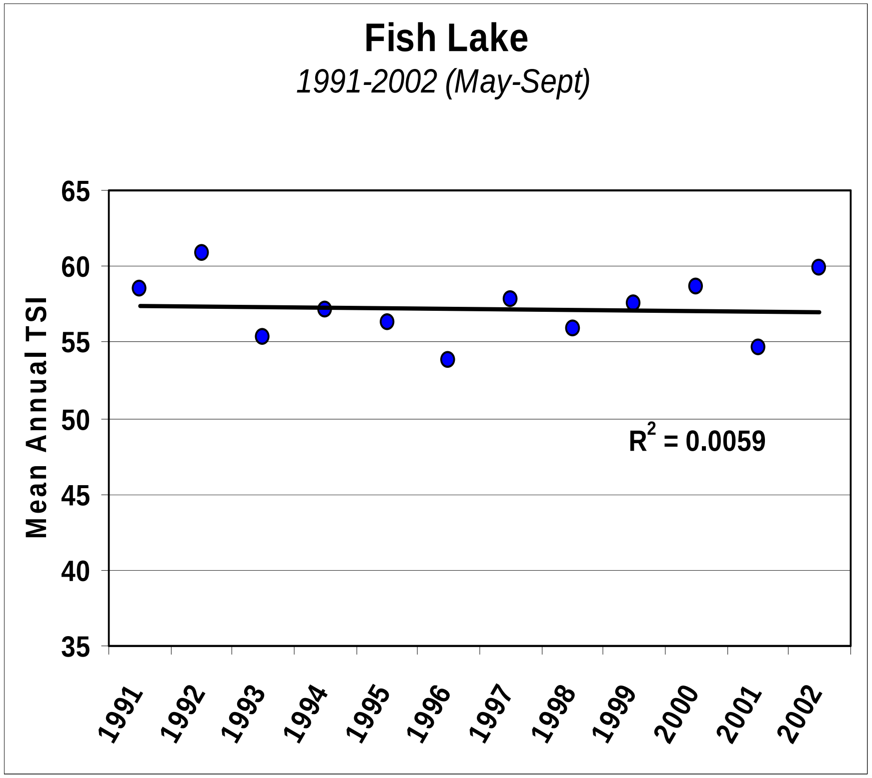
***Minnehaha Creek Watershed District***

# Residential Land Surfaces

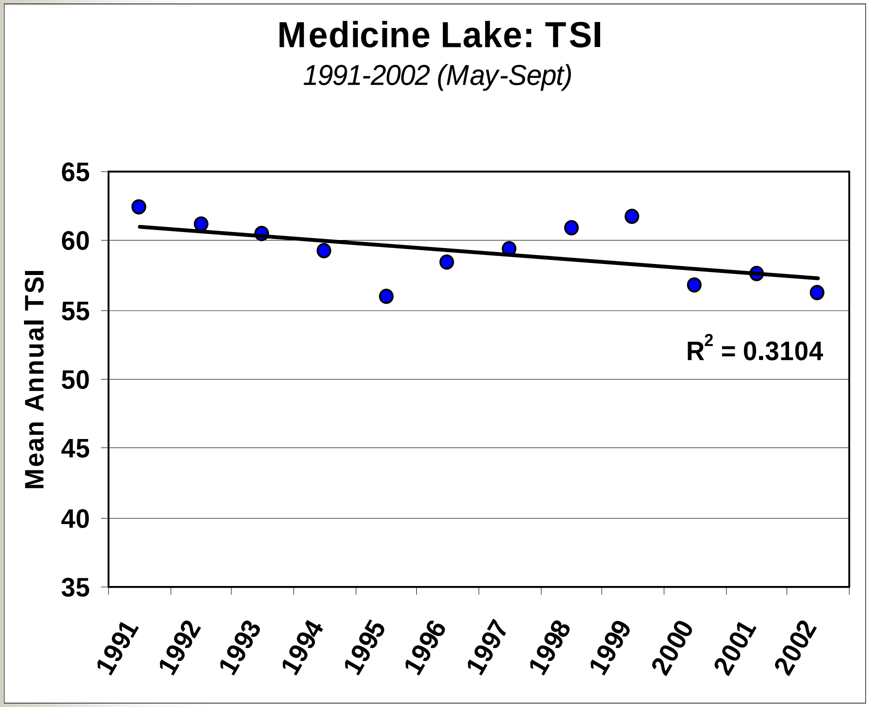


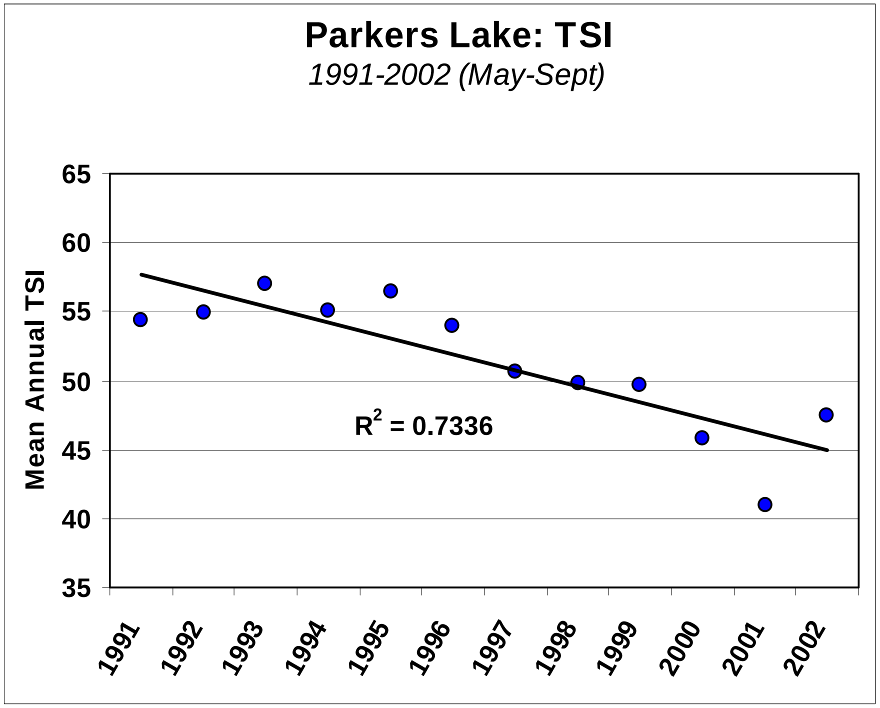
# Maple Grove Lake Trends: 1991-2002



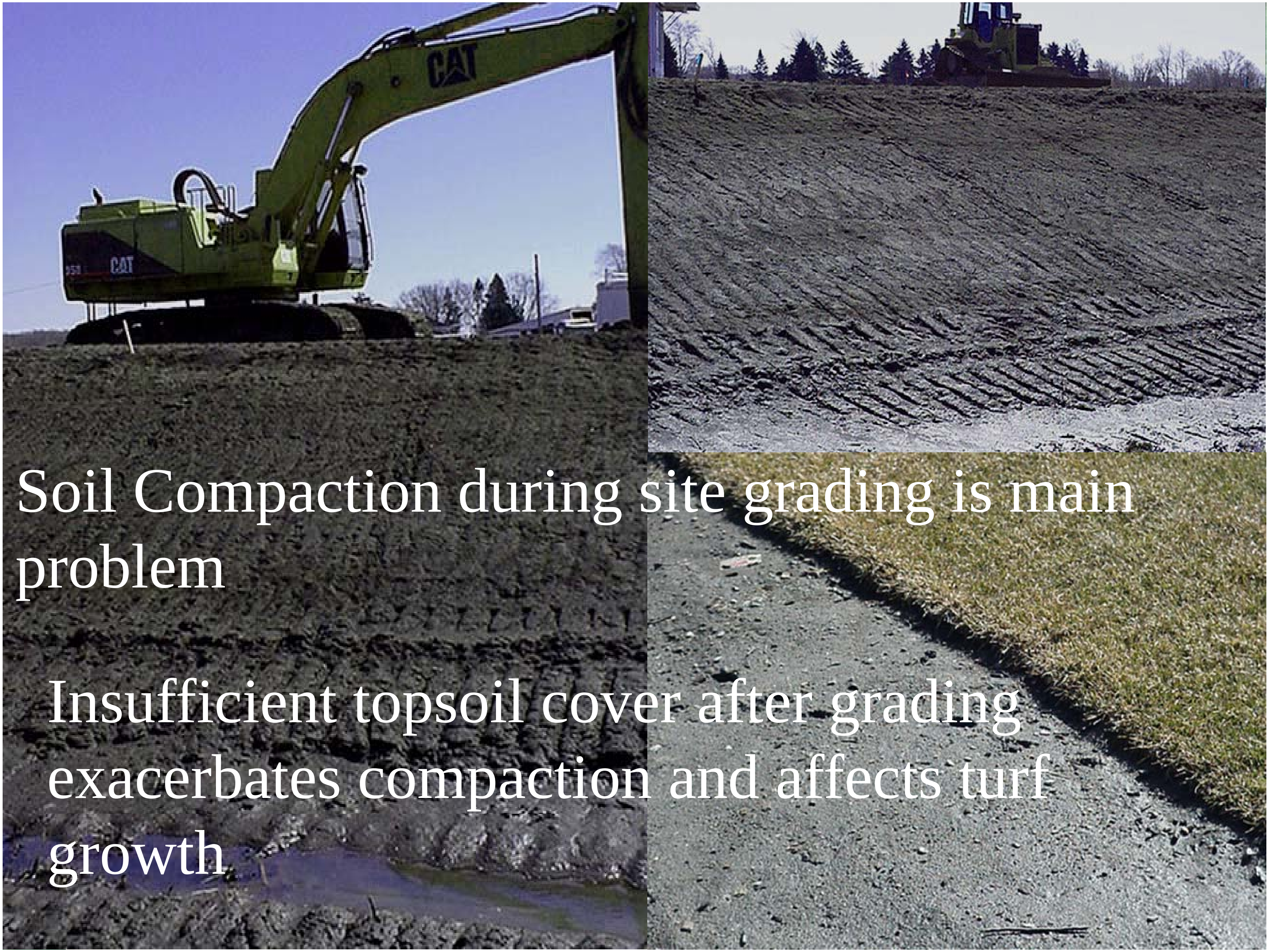
# Plymouth Lake Trends: 1991-2002



# Median Area-Weighted Loading for Paired Rain Events

| | TP | | | SRP | | |
|---|---|---|---|---|---|---|
| | new | mid | old | new | mid | old |
| **Maple Grove** *(g/ha)* | **7.58** | **6.69** | **12.0** | **4.34** | **3.99** | **5.31** |
| **Plymouth** *(g/ha)* | **4.89** | **4.12** | **4.75** | **1.77** | **1.38** | **1.88** |
| ***Difference*** *(g/ha)* | **2.69** | **2.57** | **7.25** | **2.57** | **2.61** | **3.43** |
| ***% "Reduction"*** | **35%** | **38%** | **60%** | **59%** | **65%** | **65%** |

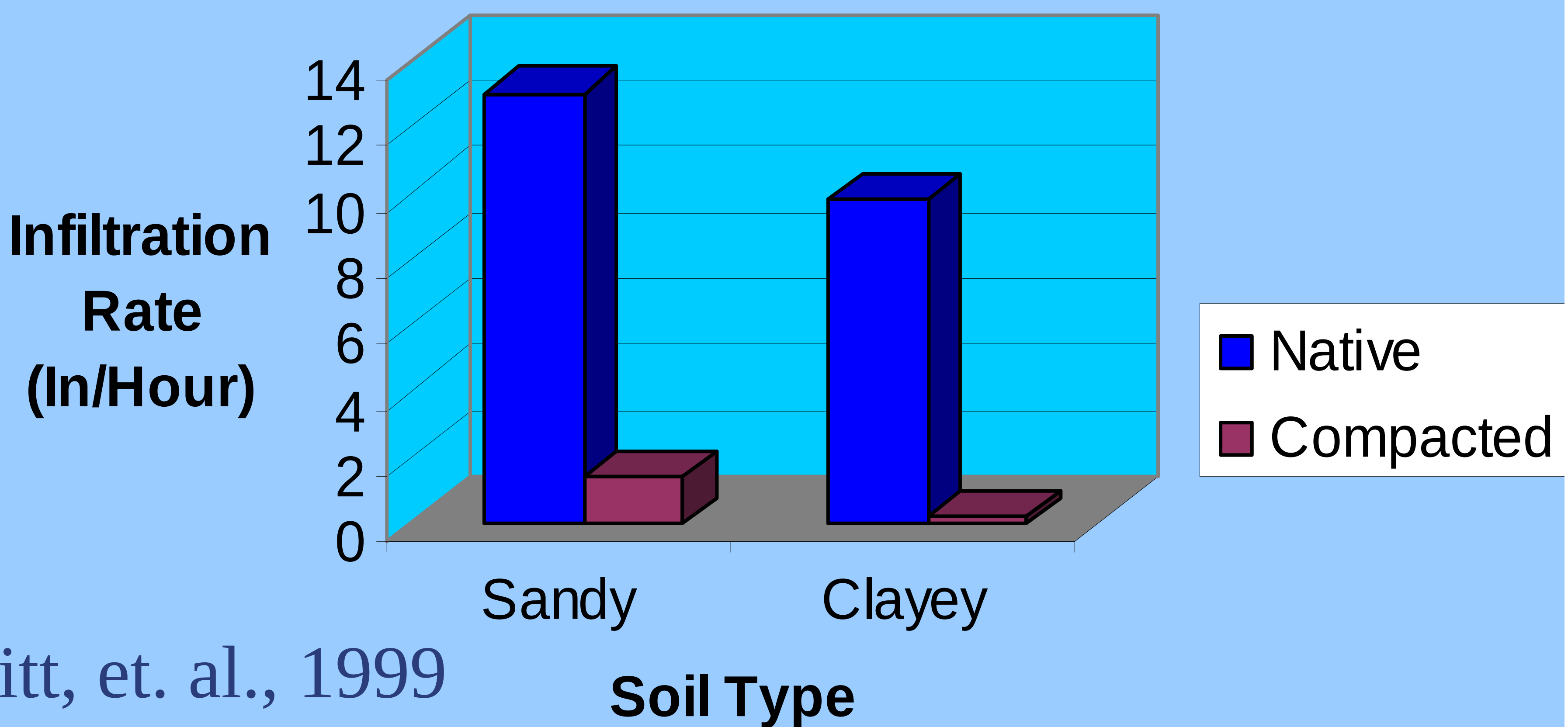


Soil Compaction during site grading is main problem

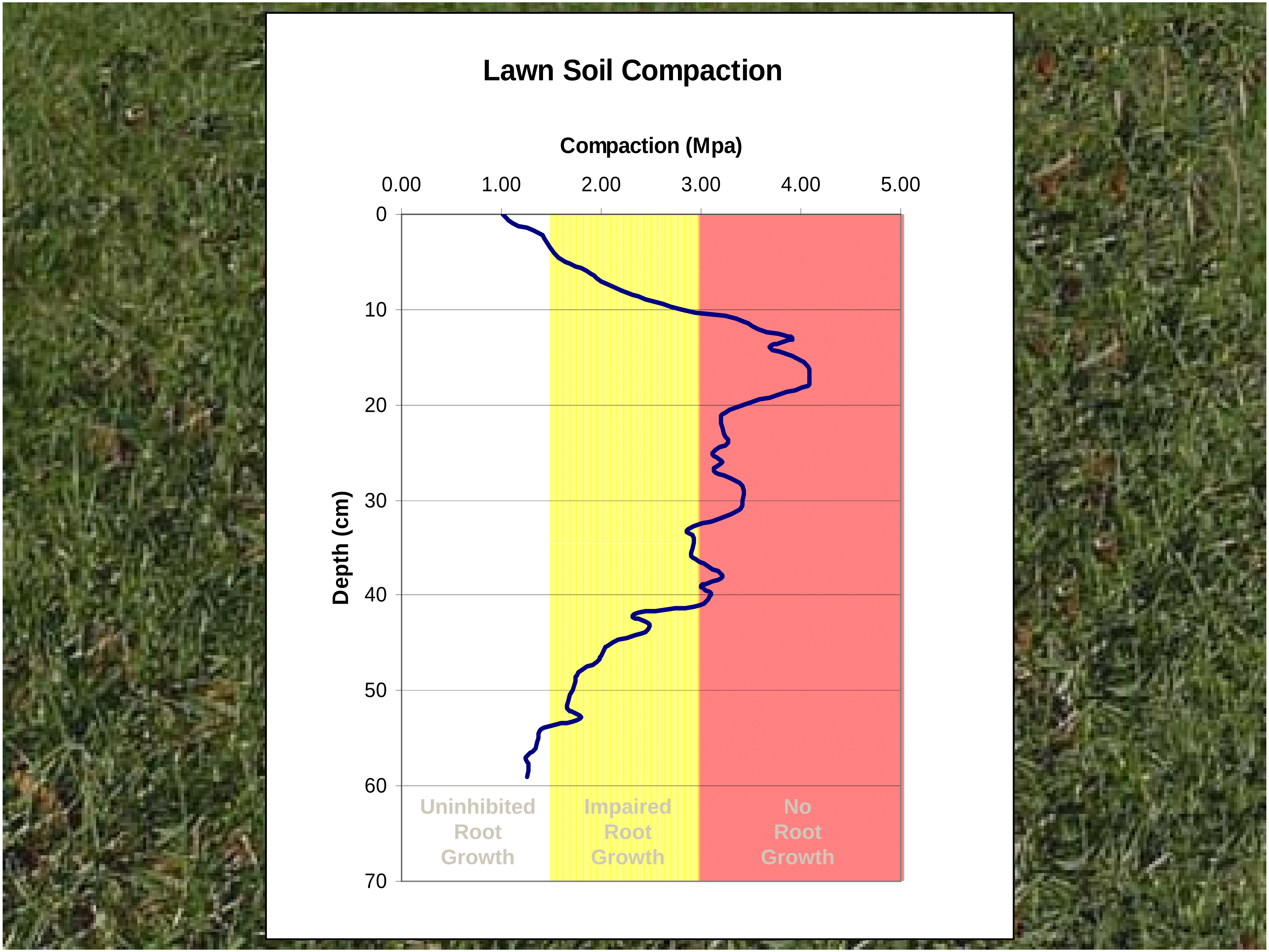
Insufficient topsoil cover after grading exacerbates compaction and affects turf growth


Soil Compaction is increased during building construction
Spoil from basements placed on adjacent soils
Building crews and material suppliers drive on soils

# Effect of Compaction on Infiltration Rate

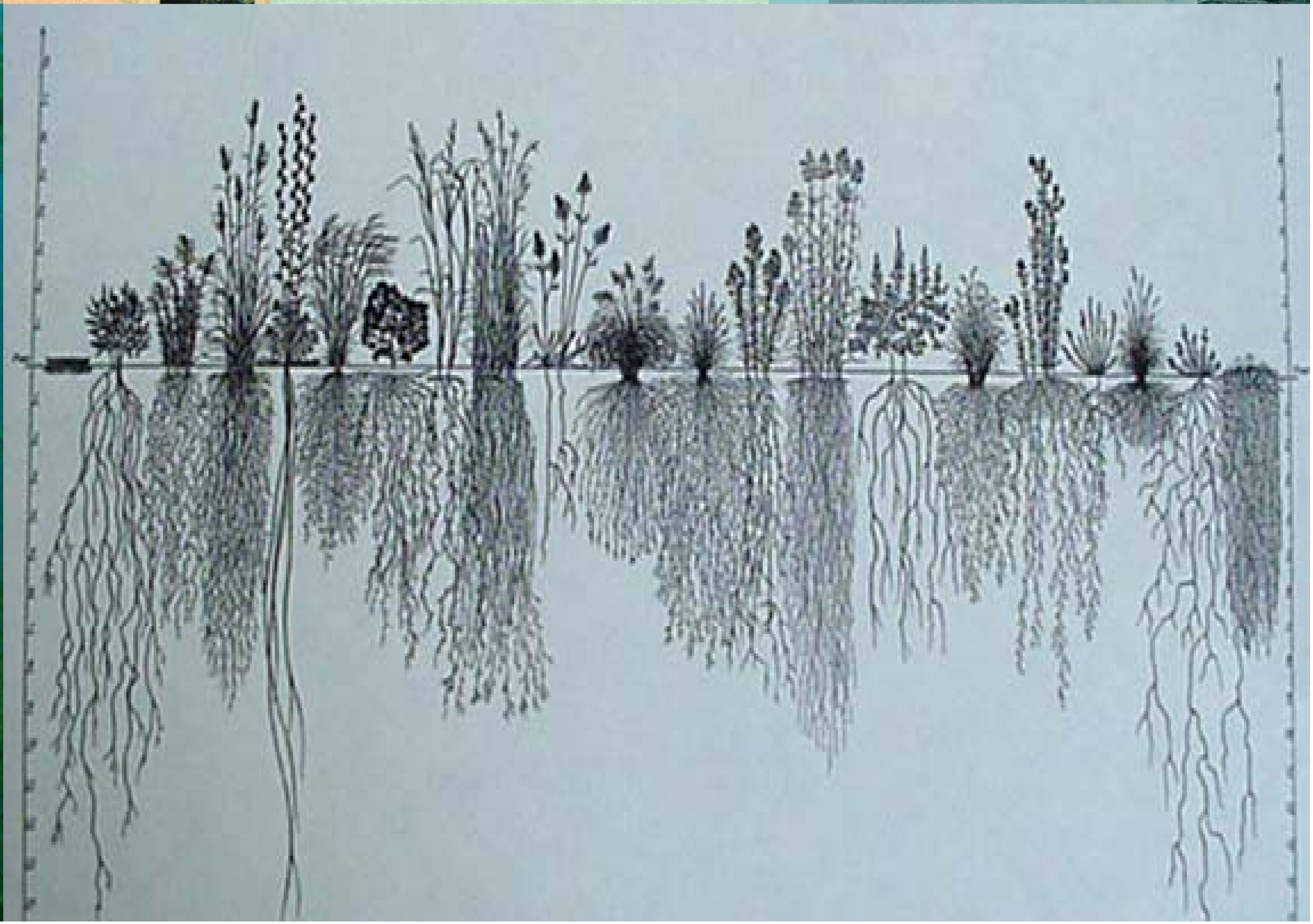



Pitt, et. al., 1999


Lawn Soil Compaction
Compaction (Mpa)
0.00
1.00
2.00
3.00
4.00
5.00
Depth (cm)
0
10
20
30
40
50
60
70
Uninhibited Root Growth
Impaired Root Growth
No Root Growth

# Reducing Soil Compaction

- Avoid during construction - compaction is forever
- Till compacted areas around buildings
- Apply adequate topsoil prior to seeding
- Add organic matter - minimum of 5%
- Aerate turf areas annually



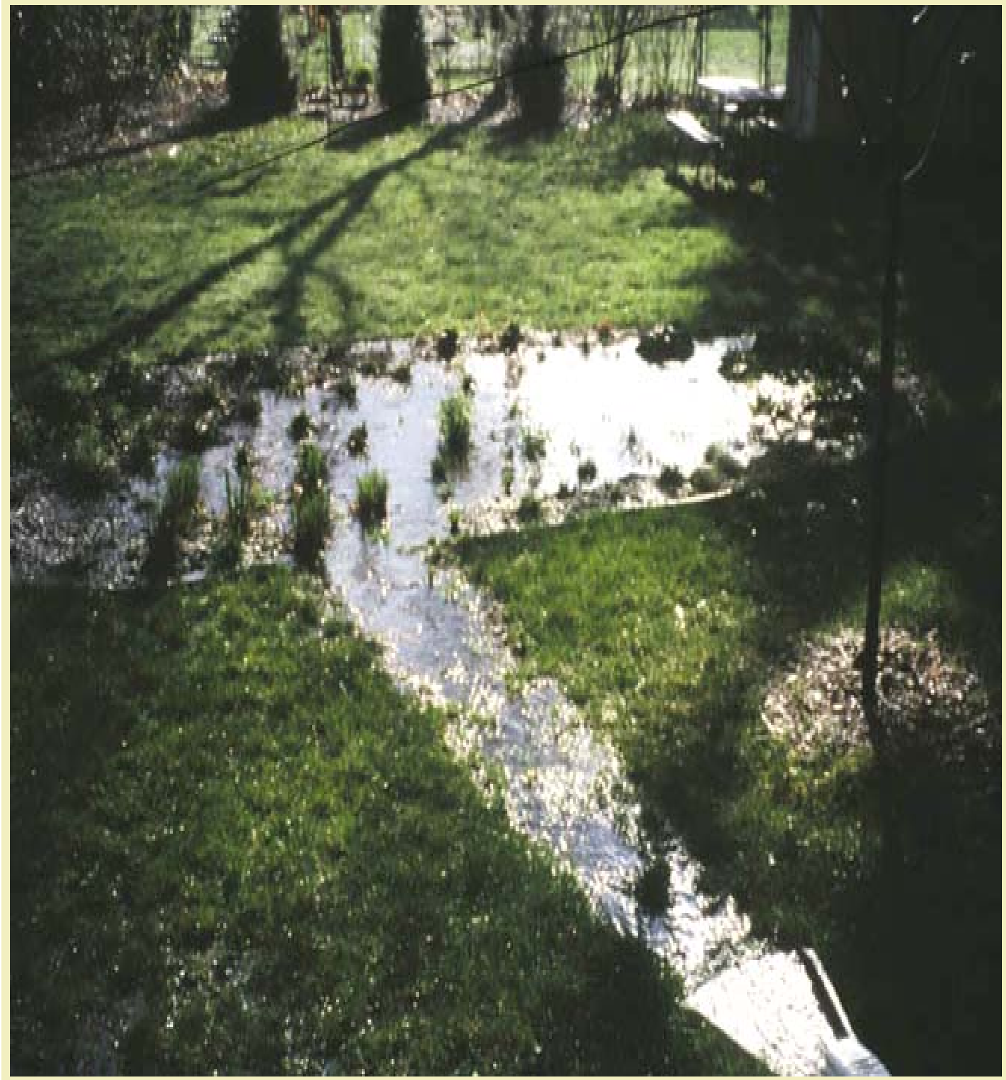

Till soils around building sites prior
to adding topsoil

One year later…

# Rain Garden Depth & Size

Balance between:

- drainage area
- slope
- soil
- desired garden size





# LEAVING A LEGACY

*Help Protect Wisconsin's…*

**WATER RESOURCES.**