Best Management Practices for Lawns and Landscapes

Marty Petrovic, Ph.D
Professor of Turfgrass Science
Dept. of Horticulture
Cornell University

Concerns

- Some areas on NY with high phosphorus (P) levels causing poor surface water quality and loss of drinking water supply

Phosphorus loading of P-limited water bodies accelerates eutrophication

Background

- **Urban-suburban watershed sampling (37 NY cities)**

  Pesticides: 2,4-D, dicamba, MCPP

  glyphosate, simazine, diazinon, chlorpyrifos, pendimethalin

  Nitrate: 0.6 mg/L (ave. 37 watersheds)

  Phosphate: 0.3 mg/L

Background:

- **Rochester-suburban watershed (Brookside Meadows, Pittsford, NY)**

  38 acre subdivision with 65 homes, built 1980 to 1990. USGS has been testing surface water quality since 1995.

  Phosphate: average 0.6 mg/L which is the highest in the Irondequoit Bay watershed (composed of agriculture to heavily urban sites)

What about stream water quality?

Average concentration of water entering the golf course was 0.08 mg/L

Average concentration of water leaving the golf course was 0.10 mg/L

Northland Country Club, Duluth, MN.

King, Balogh and Kohlbry, 2006

What about golf courses streams?

Average total P concentration of streams in background areas was 0.24 mg/L

Average total P concentration of streams during construction of 3 golf courses was 0.32 mg/L

Average total P concentration of streams on 7 golf course under operation was 0.25 mg/L

Muskoka, Ontario (120 miles north of Toronto)

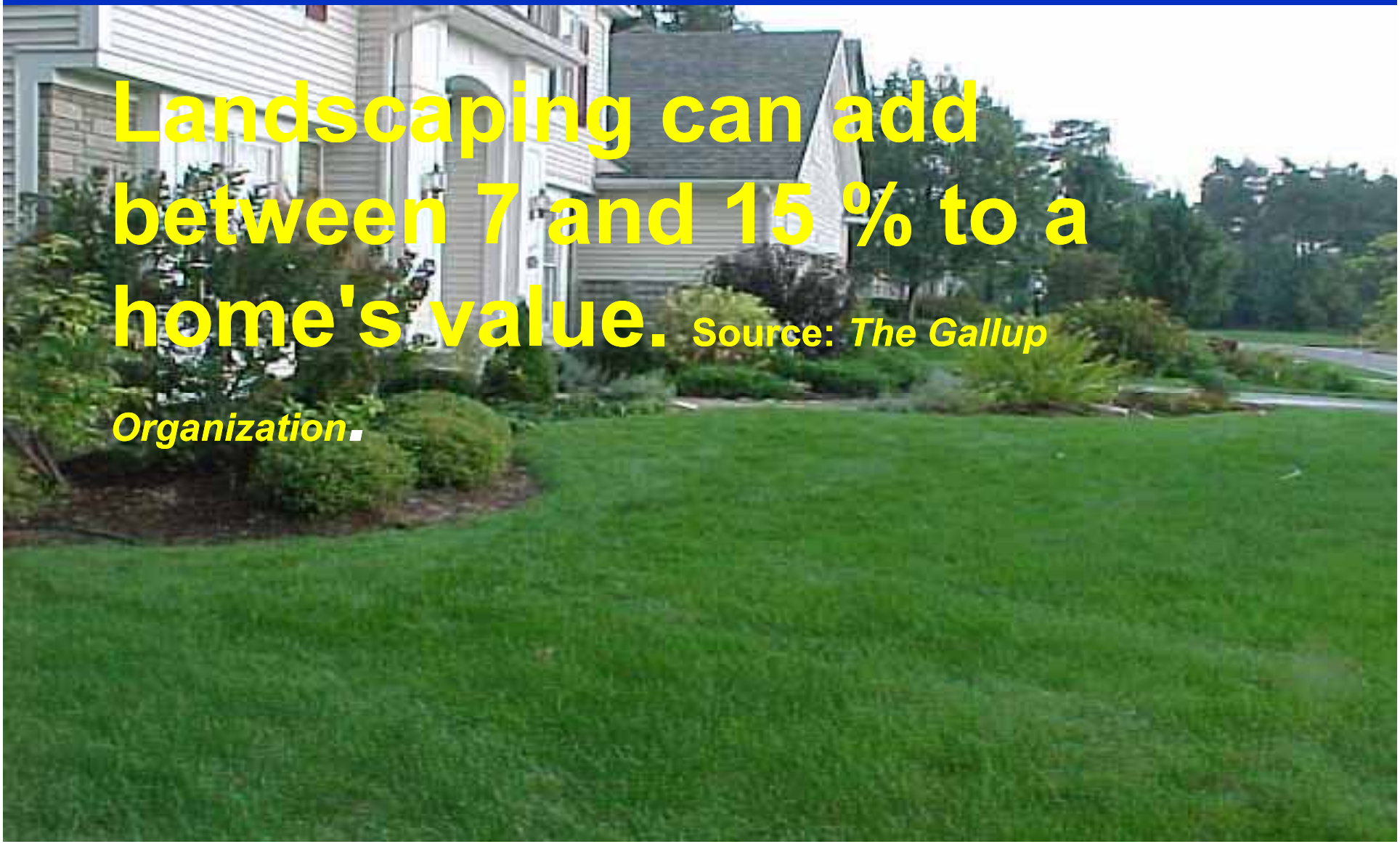
Winter et al., 2003

Purposes of Turfgrass and Landscapes

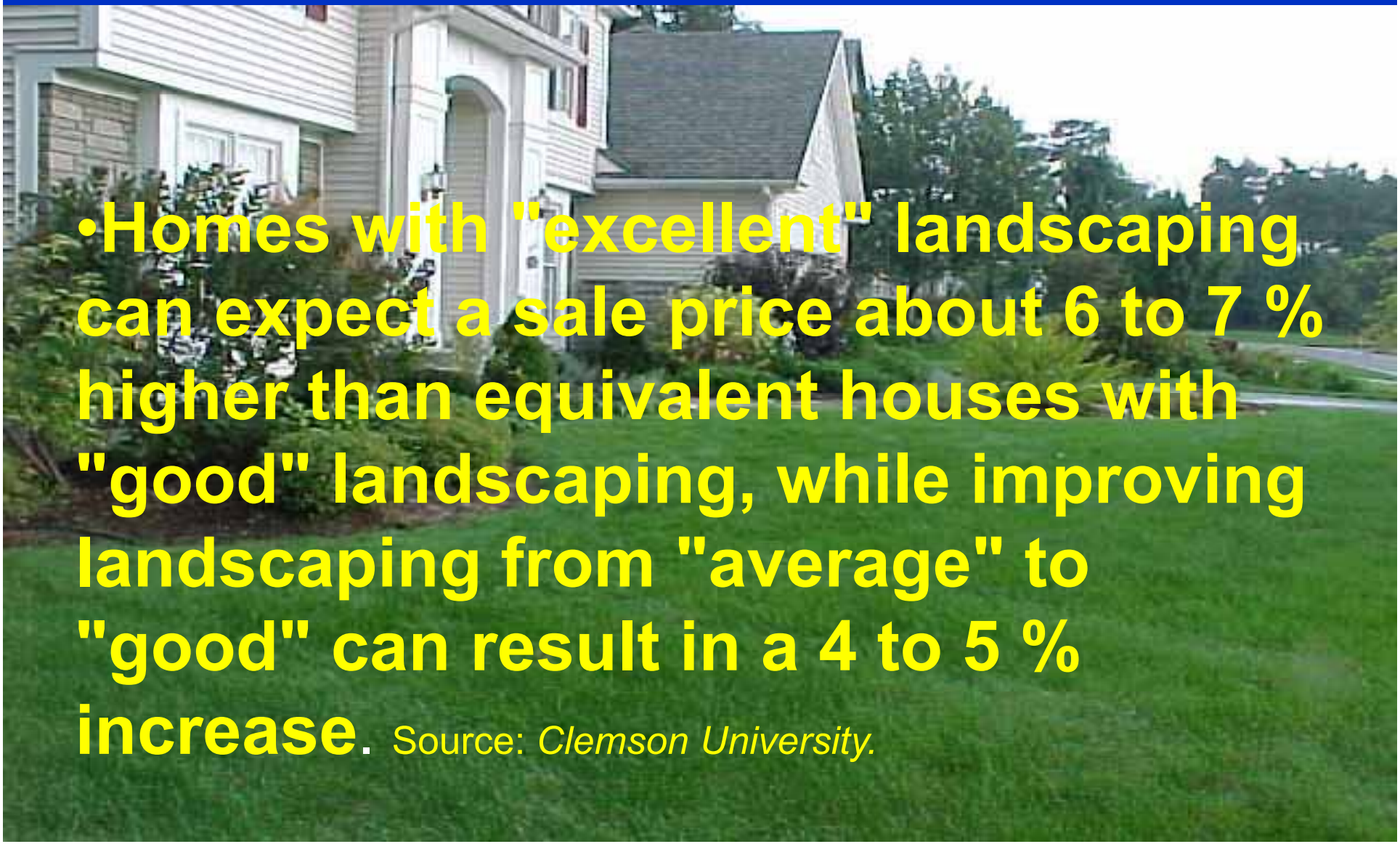
- **Aesthetic & Financial**
- **Recreational**
- **Functional**

Aesthetic and financial: the green carpet of a landscape that adds enjoyment and value

Aesthetic and financial: the green carpet of a landscape that adds enjoyment and value



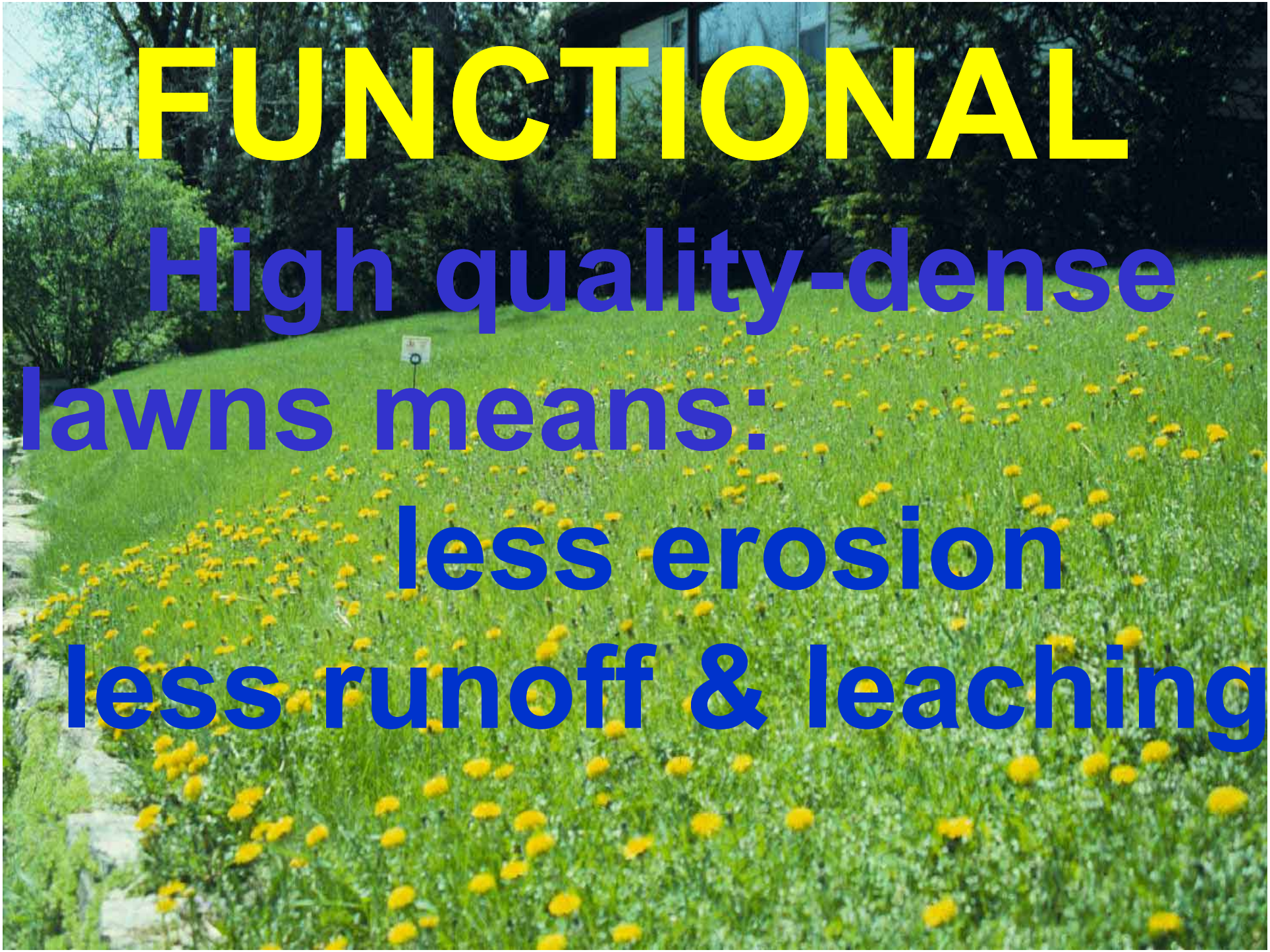
Aesthetic and financial: the green carpet of a landscape that adds enjoyment and value



- **Homes with "excellent" landscaping can expect a sale price about 6 to 7 % higher than equivalent houses with "good" landscaping, while improving landscaping from "average" to "good" can result in a 4 to 5 % increase.** Source: *Clemson University.*

Recreational uses


Recreational uses
675 schools in NY
55,000 acres of turf
$200 million/yr on maintenance
4,000 employees
2003 NYS Turf Survey
3.4 million school kids in NY


FUNCTIONAL
High quality-dense lawns means:
less erosion
less runoff & leaching

Turfgrass Density and Runoff:

Double the amount of turf shoots in a lawn (32 to 64/sq.inch) and reduce the amount of runoff by 2/3

(Easton, Z.M., and A.M. Petrovic. 2004. Fertilizer source effect on ground and surface water quality in drainage from turfgrass. J Environ Qual 33: 645-656.)

Turfgrass Density and Surface Water Quality:

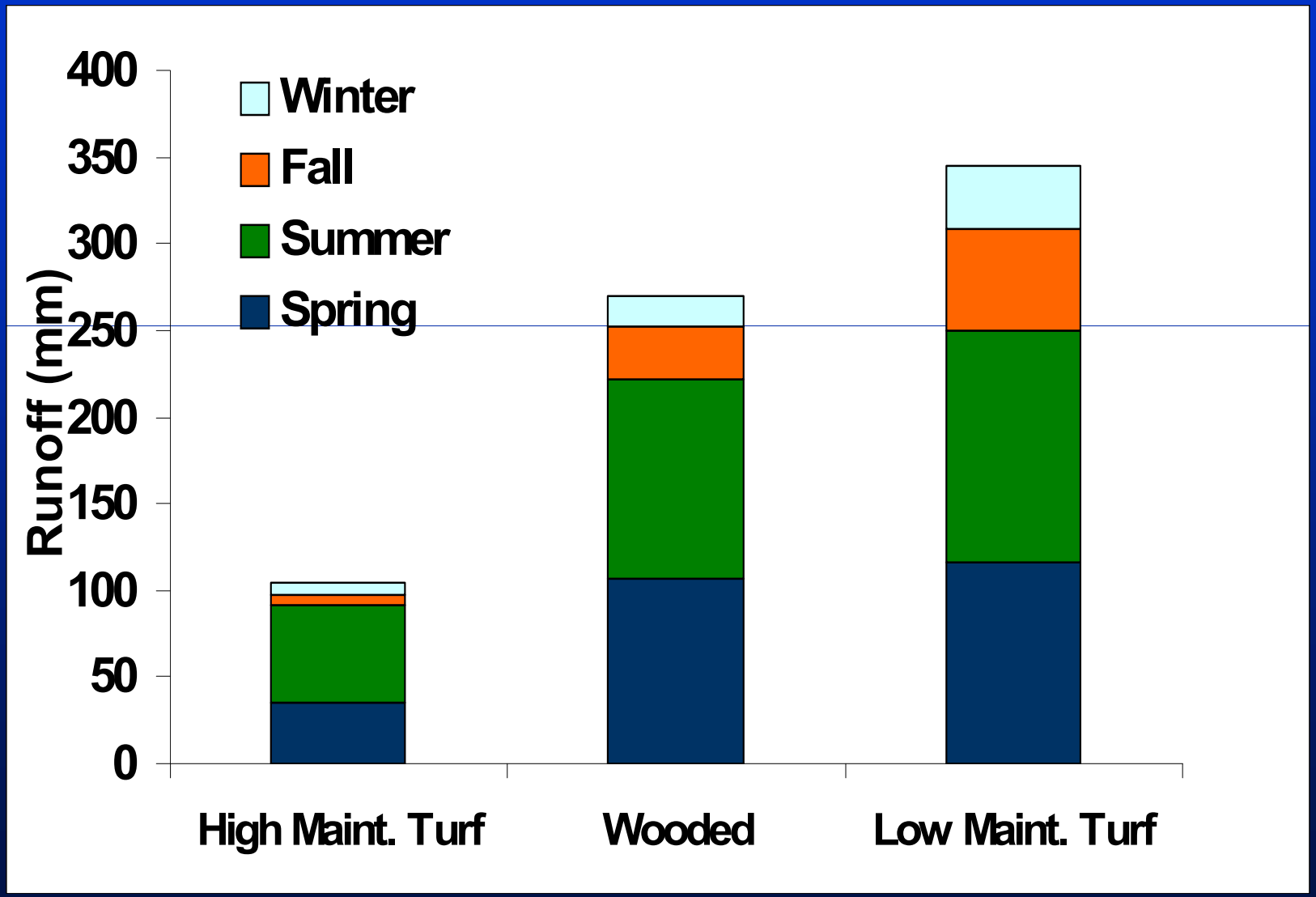
Weedy-low quality lawns and wooded sites had 3 times more nitrogen runoff than a dense-treated lawn and overall had no more phosphorus runoff!

(Easton and Petrovic, 2008)

- **Nine runoff collection plots installed on three landscapes-inflow and out flow from a 340 acre watershed-Ithaca, NY**

- **Runoff collected from all events >0.1 mm (77 events)**
  - **Dissolved reactive P (DRP)**
  - **Nitrate N (NO_3^--N)**
  - **Ammonium N (NH_4^+–N)**
  - **Mass loss calculated (vol*conc)**

Landscape type and runoff



On sites with moderate to low potential for runoff, high maintenance lawns had about half the amount of total P runoff compared to unfertilized low maintenance lawns and wooded sites

On sites with high potential for runoff, high maintenance lawns had:

*** about 3 times the amount of dissolved P**

*** ¼ the amount of particulate P**

***the same amount of total P in runoff compared to unfertilized low maintenance lawns and wooded sites**

Suburbanization increased the average concentration of P in a perennial stream while reducing the N concentration

The amount of phosphorus runoff (loading rate) for fertilized and unfertilized lawns is small, averaging 0.5 lbs of P/acre/yr

Lawns Management and the environment

Sources of phosphorus in suburban and urban watersheds

- **Lawns and other turf areas including golf courses**
- **Other vegetation**
- **Impervious surfaces including road runoff**
- **Pet wastes**
- **Waterfowl**

Sources of phosphorus in suburban and urban watersheds

- **Golf courses, lawns and other turf areas**
- Other vegetation
- Impervious surfaces including road runoff
- Pet wastes
- Waterfowl

Turf Situations that Could Impact Water Quality

- **Some turf sites like sports fields (golf and athletic fields) are used in wet weather, thus requiring good surface and internal drainage.**
- **Some sites are compacted (during or after construction).**
- **Some sites are irrigated**
- **Some sites are directly adjacent to surface water or overlay critical groundwater recharge areas**

Situations: traffic-compaction

Situations: compaction-poor drainage and more runoff

Turf not near surface water but on critical ground water recharge area

Turf near surface water

Lawns and the environment (mine)

Factors affecting phosphorus runoff from turf

- **Soil conditions: construction and P soil level**
- **Fertilization: sources and rates of P**
- **Clipping management**
- **Time of year, rainfall intensity**
- **Site factors**
- **Grass types**
- **Turf density**

Factors affecting phosphorus runoff from turf

- Soil conditions: construction and P soil level

Soil conditions: construction

Does it matter if during establishment of turf that the topsoil is worked into the soil or the subsoil is compacted on the amount of P runoff?

Soil conditions: construction

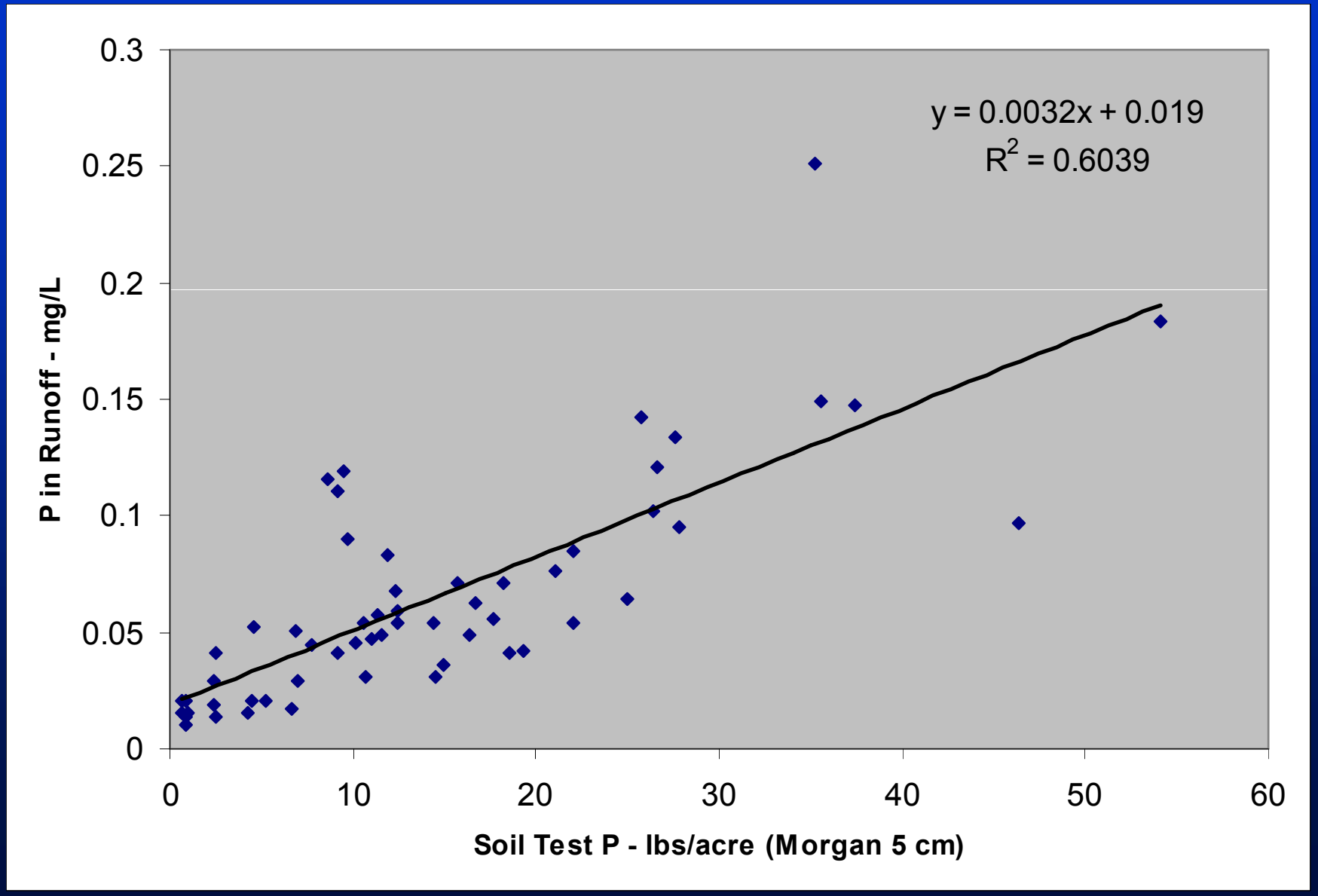
Soil Treatment	Amount of P runoff*
	lbs/acre/yr.
Topsoil layered	0.28
Topsoil mixed	0.27
Subsoil compacted	0.27
Subsoil not compacted	0.31

*Not significant, Kussow, 2008

Does the level of phosphorus in the soil matter?

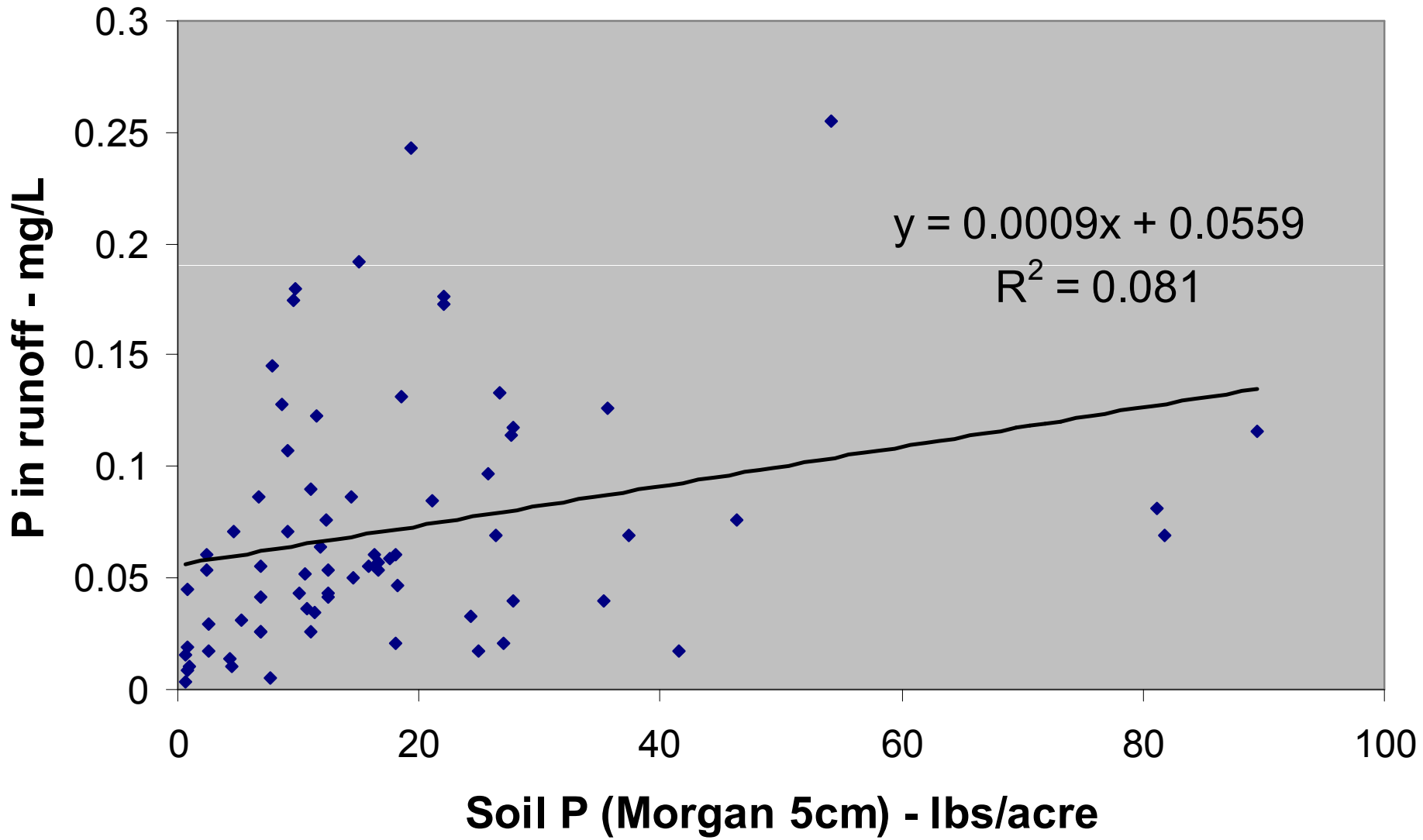
When runoff occurs on bare soil, soil phosphorus level influences the amount of phosphorus in the runoff

Runoff from Bare Soil-no turf



When turf is growing on the surface this relationship is much weaker, and is not statistically significant

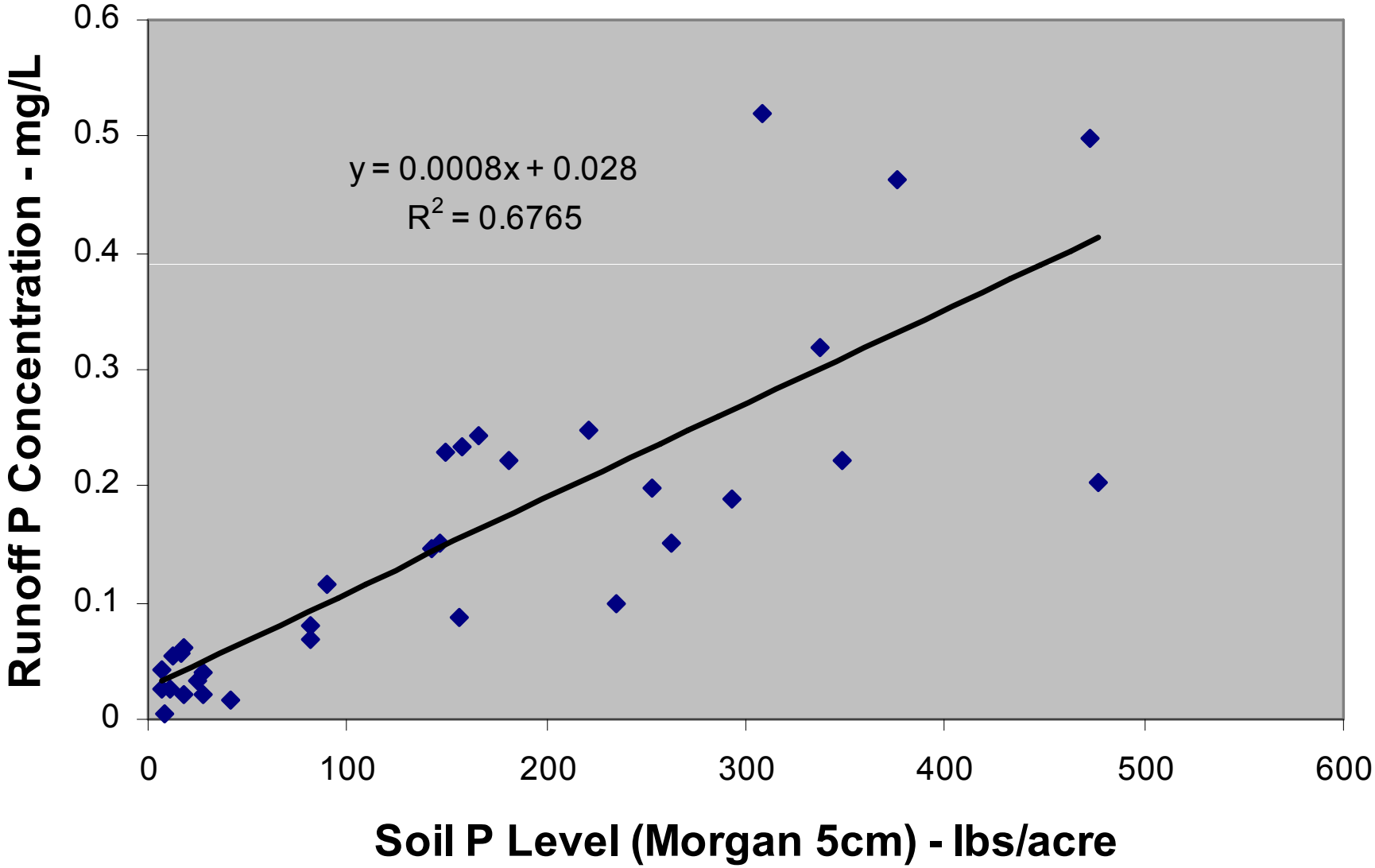
Runoff From Turfgrass



Turf that receives high amount of manure-based compost containing P can elevate soil levels to the point where soil P level influences P runoff from turf

(1,300 to 2,600 lbs of P/acre was applied each application of ¼” to ½” of dairy compost)

Effect of compost on runoff P concentration



Factors affecting phosphorus runoff from turf

- Soil conditions: construction and P soil level
- **Fertilization: sources and rates of P**

Sources of P

Kussow, 2008

Fertilizer Source	Amount	
	Runoff	P
	in/yr	lbs/acre/yr
None	1.6	0.62
Synthetic	1.1	0.27
Organic	0.7	0.24
LSD	0.2	0.12

Rate of P applied

Kussow, 2003

P rate applied	Amount of P in Runoff	% of applied
lbs/10000 sq.ft./yr	lbs/acre/yr	
None	0.37	0
0.46	0.49	0.5
0.80	0.50	0.3
1.30	0.51	0.3

Once established, fertilized turf had less runoff and less P in runoff than unfertilized turf

Table 2. Time by treatment interactions shown for mean phosphate concentration and mass loss, nitrate mass loss, and runoff depth from turfgrass by treatment (fertilizer source and rate of application) for establishment (Year 1, July–December 2000) and post-establishment (Year 2, December 2000–January 2002) (Easton and Petrovic, 2004).

Source†	Rate‡	Year	*n*	Runoff		PO_4^{3-}–P	NO_3^-–N
	kg N ha_			mm	mg L_	1 kg ha_1	
Swine compost	50	1	24	1.09	2.4	0.8	8.2
Swine compost	50	2	58	2.40	0.9	1.0	2.9
Swine compost	100	1	24	1.30	0.9	1.2	6.0
Swine compost	100	2	62	2.18	0.7	1.2	3.2
Dairy compost	50	1	23	0.81	0.9	0.4	2.6
Dairy compost	50	2	59	2.81	0.5	0.7	2.9
Dairy compost	100	1	21	0.54	0.9	0.4	4.1
Dairy compost	100	2	54	1.85	0.7	0.7	2.5
Biosolid	50	1	24	1.06	0.8	0.4	8.7
Biosolid	50	2	59	2.44	0.6	1.0	4.4
Biosolid	100	1	23	0.87	0.3	0.2	8.5
Biosolid	100	2	52	2.14	0.6	0.6	2.5
Readily available	50	1	23	0.94	0.3	0.2	11.2
Readily available	50	2	64	2.26	0.3	0.6	3.1
Readily available	100	1	23	0.91	0.5	0.3	15.9
Readily available	100	2	52	2.45	0.5	0.6	4.1
Controlled-release	50	1	24	1.44	0.4	0.5	7.6
Controlled-release	50	2	60	2.36	0.4	0.6	4.3
Controlled-release	100	1	24	1.70	0.3	0.6	10.5
Controlled-release	100	2	61	2.54	0.3	0.7	2.8
Control	0	1	32	1.05	0.3	0.2	5.6
Control	0	2	91	3.34	0.5	1.3	3.8
Fisher's LSD§				1.78	0.8	0.1	1.2

† All treatments except the unfertilized control received a total of 200 kg N ha_1 yr_1.

‡ Single fertilizer application rate.

§ Treatments are significantly different if the difference between column means is greater than Fisher's protected LSD at _ 0.05.

Factors important in P runoff from lawns and other turf sites

- Soil conditions: construction and P soil level
- Fertilization: sources and rates of P
- **Clipping management**

Clipping Management and runoff P

Kussow, 2008

Clipping Management	Amount of Runoff	Amount of P in Runoff
	in/yr.	lbs/acre/yr
Removed	0.9	0.38
Mulched	0.7	0.32
	ns	ns

Factors affecting phosphorus runoff from turf

- Soil conditions: construction and P soil level
- Fertilization: sources and rates of P
- Clipping management
- **Time of year-wet summers can cause a lot of runoff**

Factors affecting phosphorus runoff from turf

- Soil conditions: construction and P soil level
- Fertilization: sources and rates of P
- Clipping management
- Time of year
- **Site conditions: soil texture, depth of soil, infiltration rate and soil moisture level**

High runoff on:

- **fine textured soils**
- **lower infiltration rate**
- **wetter soils**
- **shallower water table**

Factors affecting phosphorus runoff from turf

- Soil conditions: construction and P soil level
- Fertilization: sources and rates of P
- Clipping management
- Time of year
- **Site conditions: soil texture, depth of soil, infiltration rate and soil moisture level**
- **Grass type**

Grass types

- Fine texture (Creeping bentgrass) verses coarser texture (perennial ryegrass)
- fairway turf

  Creeping bentgrass had 1/2 the volume of runoff by twice the amount of P runoff (1.6 lbs P/a/yr) than perennial ryegrass fairway turf

(Linde & Watschke, 1997)

Geese,water and turf

Potential Environmental Impacts

- **Sandy site more prone to nutrient and pesticide leaching.**
- **Site conditions increases runoff.**
- **Higher soil moisture levels in late fall, winter and spring results in faster and greater runoff volumes.**

Phosphorus Management

- **Produce dense turf to reduce runoff (keep out weeds, insects and diseases!)**

Phosphorus Management

- Dense turf reduce runoff
- **Avoid treating impervious surfaces (driveways, sidewalks and roads don't need to be fertilized!!)**

When You're Putting Fertilizer on Your Lawn,

Remember to Keep it on Your Lawn.

We put fertilizers and pesticides on our lawns. Sprinklers and rain wash them away, and they can wind up in our lakes, streams and the ocean. Fertilizers in water can cause too much algae to grow. Algae use up the oxygen that fish need to survive. If used improperly, pesticides can harm plants and animals in water.

It's a pattern that you can help prevent. Consider alternatives to these products. Use pesticides and fertilizers sparingly. Please visit www.epa.gov/region2 to find out what else you can do.

EPA United States Environmental Protection Agency

Thanks to the Washington State Department of Ecology, King County and the cities of Bellevue, Seattle and Tacoma for the use of this image.

Phosphorus Management

- Dense turf reduce runoff
- Avoid treating impervious surfaces
- **A good fertilization program often reduces P runoff**

Phosphorus Management

- Dense turf reduce runoff
- Avoid treating impervious surfaces
- Fertilization often reduces P runoff, soil test to determine P need
- **Soil testing tells you if you need to fertilize- many lawns do not need phosphorus**

Phosphorus Management

- Dense turf reduce runoff
- Avoid treating impervious surfaces
- Fertilization often reduces P runoff
- Soil test to determine if a phosphorus application is needed!

Phosphorus Management

- Soils below 4 lbs/acre (Cornell soil test), phosphorus is needed
- Soil above 100 lbs/acre (Cornell soil test) could result in extensive phosphorus runoff

Phosphorus Management

- Dense turf reduce runoff
- Avoid treating impervious surfaces
- Fertilization often reduces P runoff
- Soil testing
- **Remove tree litter (leaves and flowering parts) from storm drain system**

Phosphorus Management

- Dense turf reduce runoff
- Avoid treating impervious surfaces
- Fertilization often reduces P runoff
- Soil testing
- Remove tree litter (leaves and flowering parts) from storm drain system
- **Care in not over applying compost**

Phosphorus Management

- Dense turf reduce runoff
- Avoid treating impervious surfaces
- Fertilization often reduces P runoff
- Soil testing for P level many not be an effective tool in reducing P runoff
- Remove tree litter from storm drain system
- **Use low P winter deicing materials**