Cover Crops and Soil Health
Harvesting the Potential:
Environmental Impacts of Cover Crops

February 18, 2014
Omaha, Nebraska

The Role of Winter Cover Crops in the Restoration of Chesapeake Bay

Ken Staver

University of Maryland
College of Agriculture and Natural Resources
Wye Research and Education Center
Queenstown, Maryland

The Main Problem in the Bay

Excessive nutrient inputs are driving algal growth, resulting in low oxygen levels (dead zones) and reduced light availability for rooted vascular plant communities.

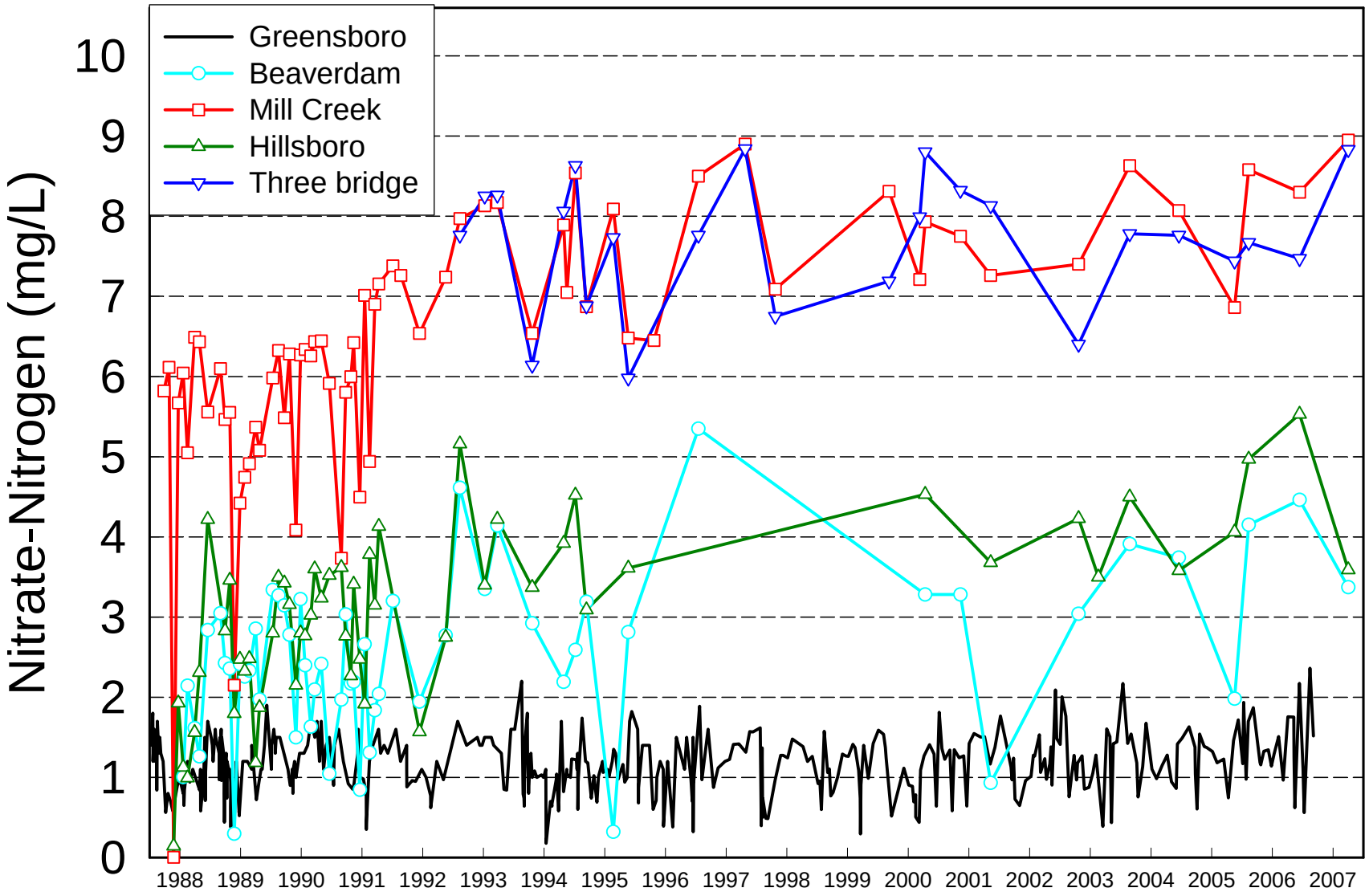

Queenstown
Grasonville
Wye Research Center
Cordova
Centreville Rd
Wye Mills Rd
Queen Anne Hwy
Starr Rd
Lewistown Rd
Tappers Corner Rd
Cordova Rd
Ocean Gateway
Blue Star Memorial Hwy
Main St
Google

The Restoration Strategy

In the late 1980's agreements were signed by states in the watershed with the primary goal being to cut nutrient inputs to Chesapeake Bay by approximately 40%. Lots of updates!

The Problem on the Land

Groundwater under cropland is highly enriched in nitrate-N and results in high nitrate levels in stream flow and high loading rates of algal available N to tidal waters.


Greensboro
Beaverdam
Mill Creek
Hillsboro
Three bridge
Nitrate-Nitrogen (mg/L)
0
1
2
3
4
5
6
7
8
9
10
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007

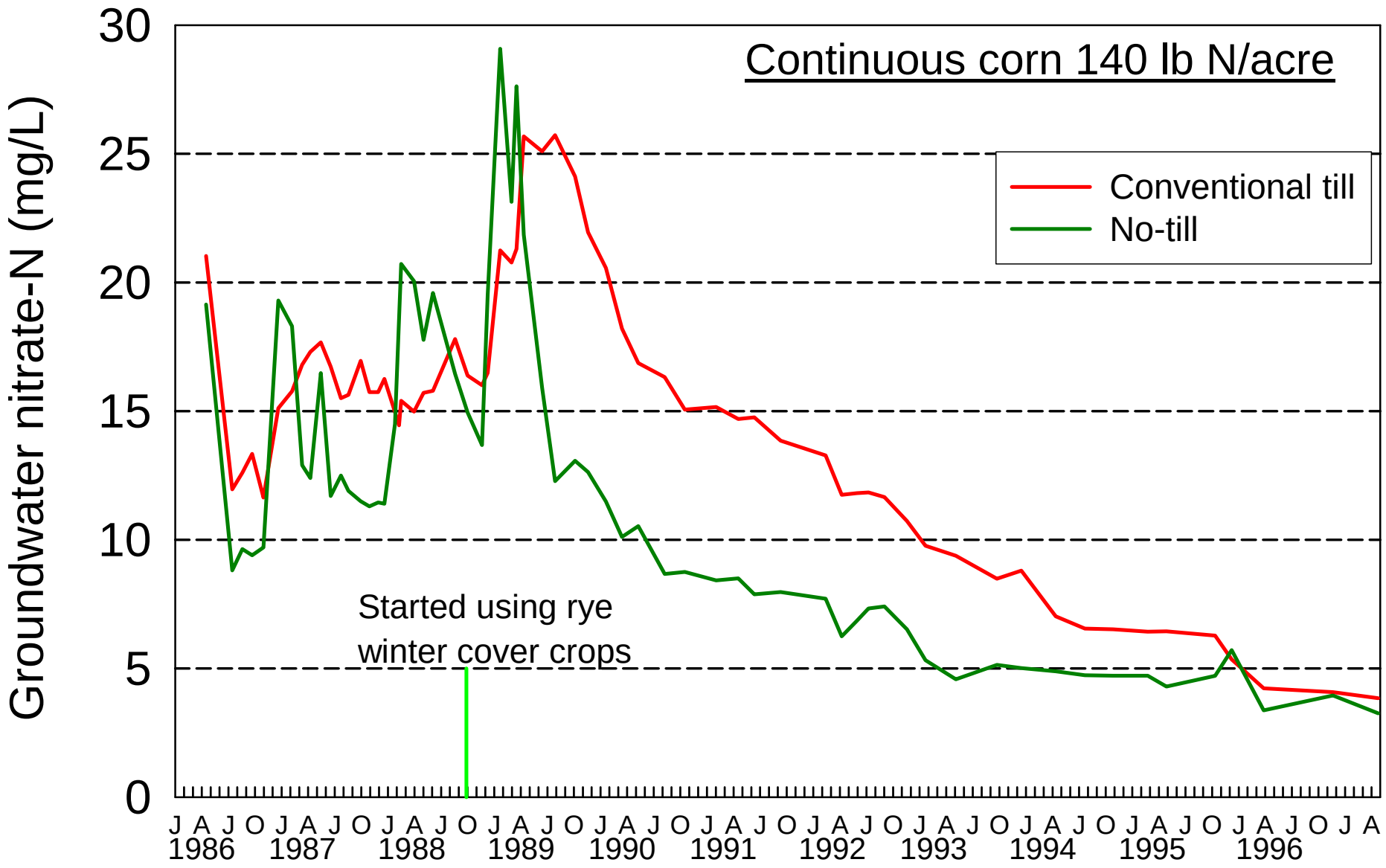
Some Rough Numbers

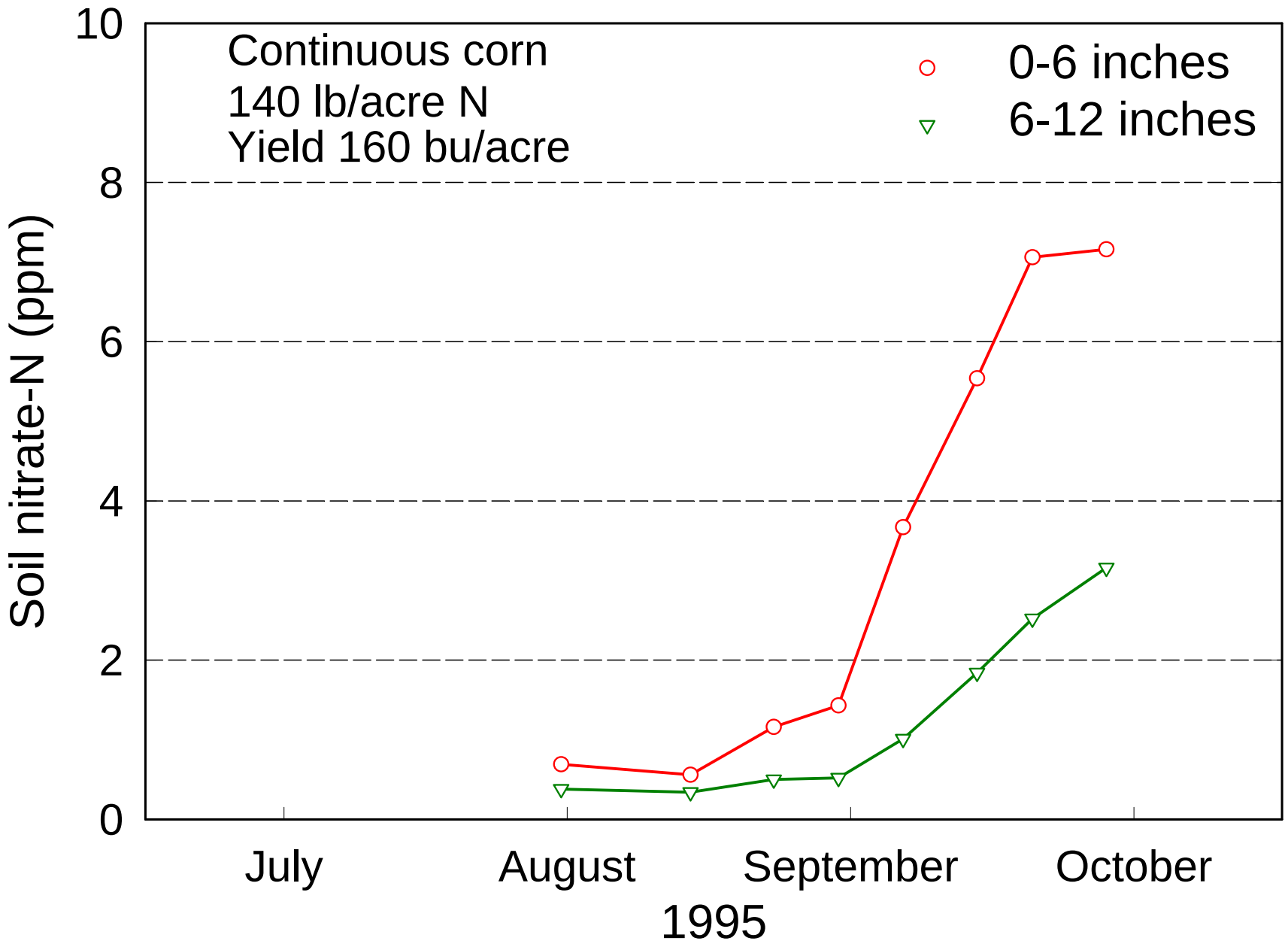
In the Coastal Plain, approximately 80 % of the N delivered to Chesapeake Bay from crop land moves through groundwater flow paths.

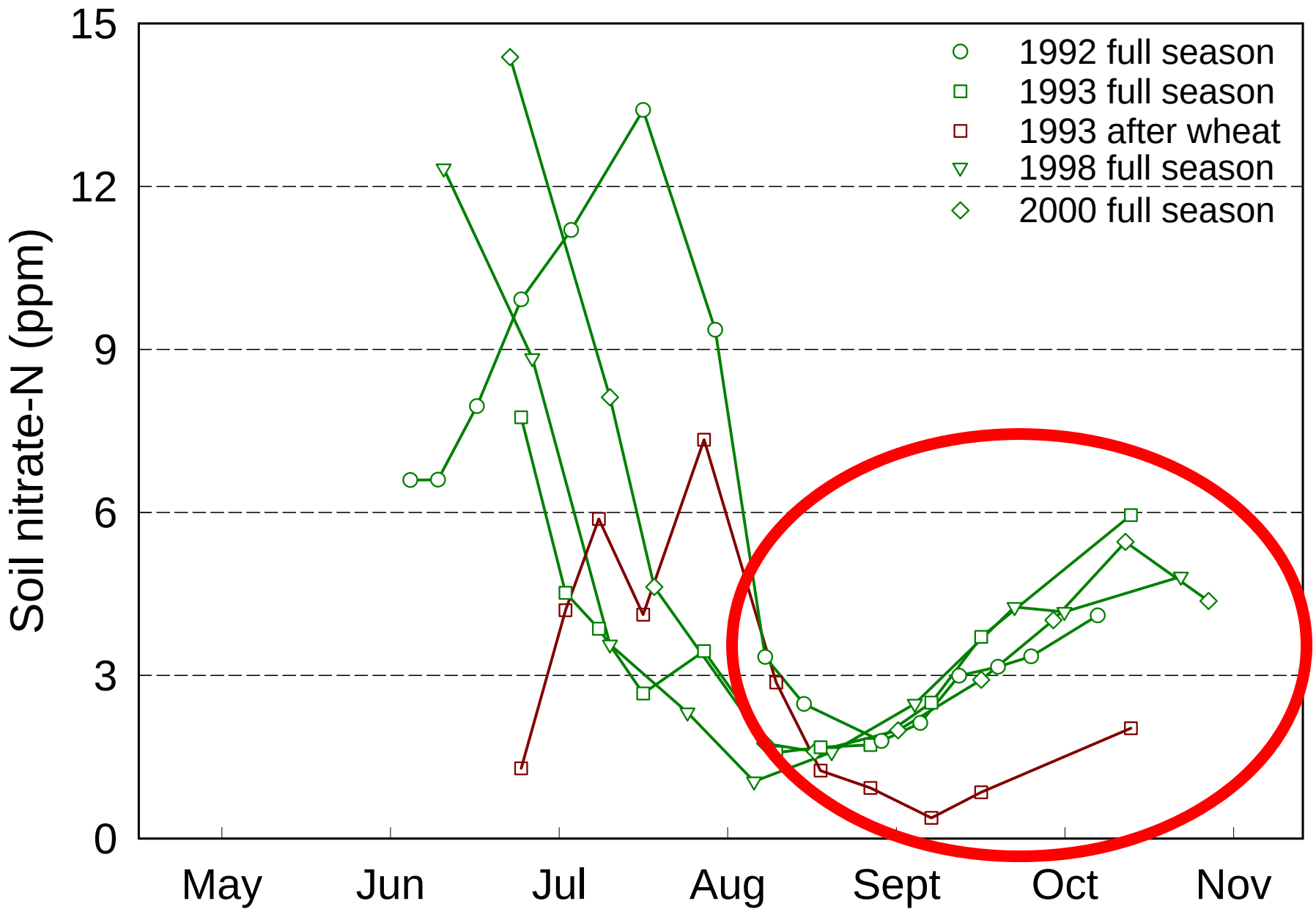
~20-30 lb/acre

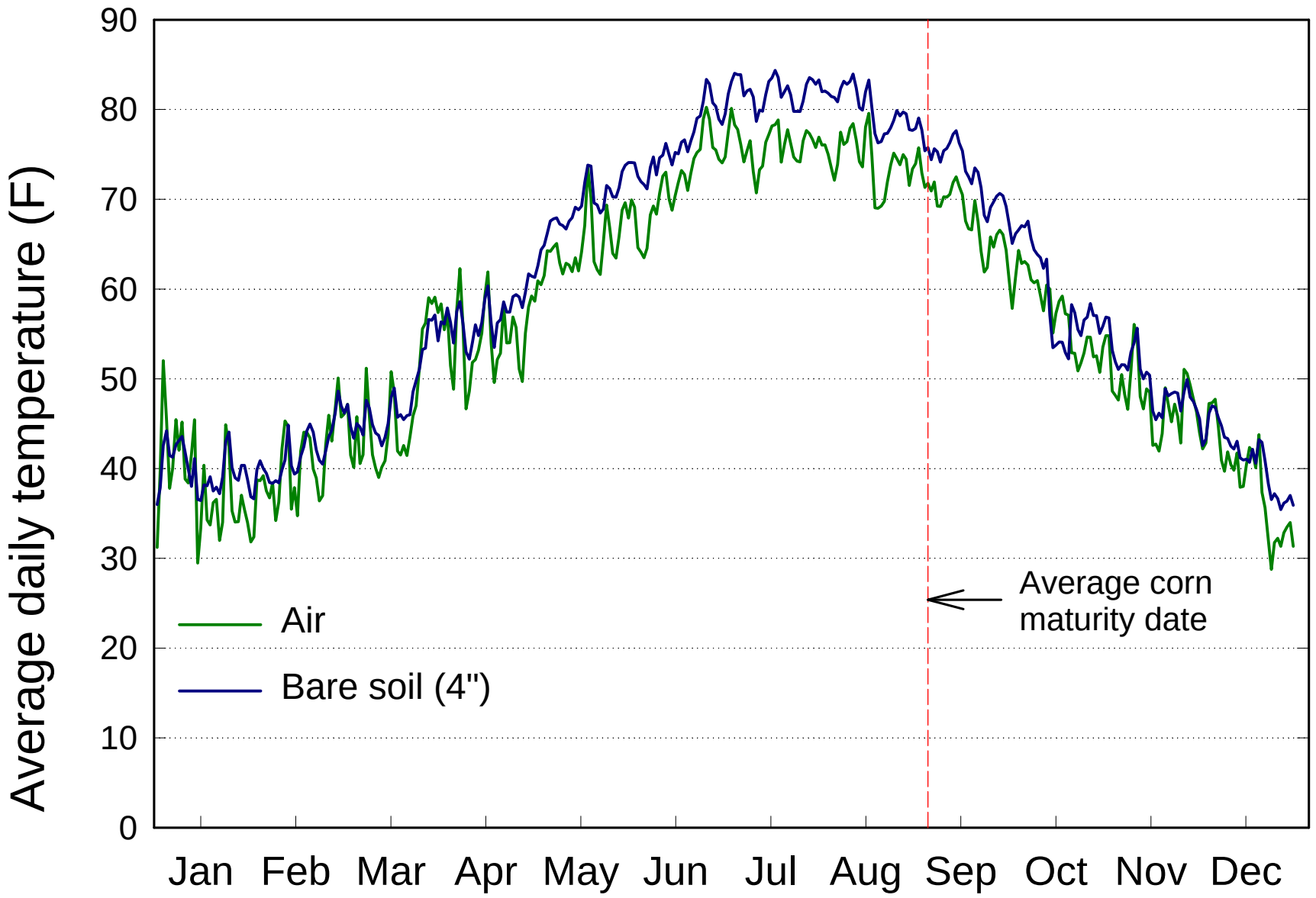
It All Starts in the Root Zone

Achieving significant reductions in N losses from cropland will require reductions in nitrate leaching rates which will lead to lower groundwater and stream nitrate concentrations. Winter cereal cover crops do this very well!


Continuous corn 140 lb N/acre
Conventional till
No-till
Started using rye
winter cover crops
Groundwater nitrate-N (mg/L)
0
5
10
15
20
25
30
J A J O J A J O J A J O J A J O J A J O J A J O J A J O J A J O J A J O J A J O J A J O J A J O J A
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996


Continuous corn
140 lb/acre N
Yield 160 bu/acre
0-6 inches
6-12 inches
Soil nitrate-N (ppm)
10
8
6
4
2
0
July
August
September
October
1995


Soil nitrate-N (ppm)
15
12
9
6
3
0
May
Jun
Jul
Aug
Sept
Oct
Nov
1992 full season
1993 full season
1993 after wheat
1998 full season
2000 full season

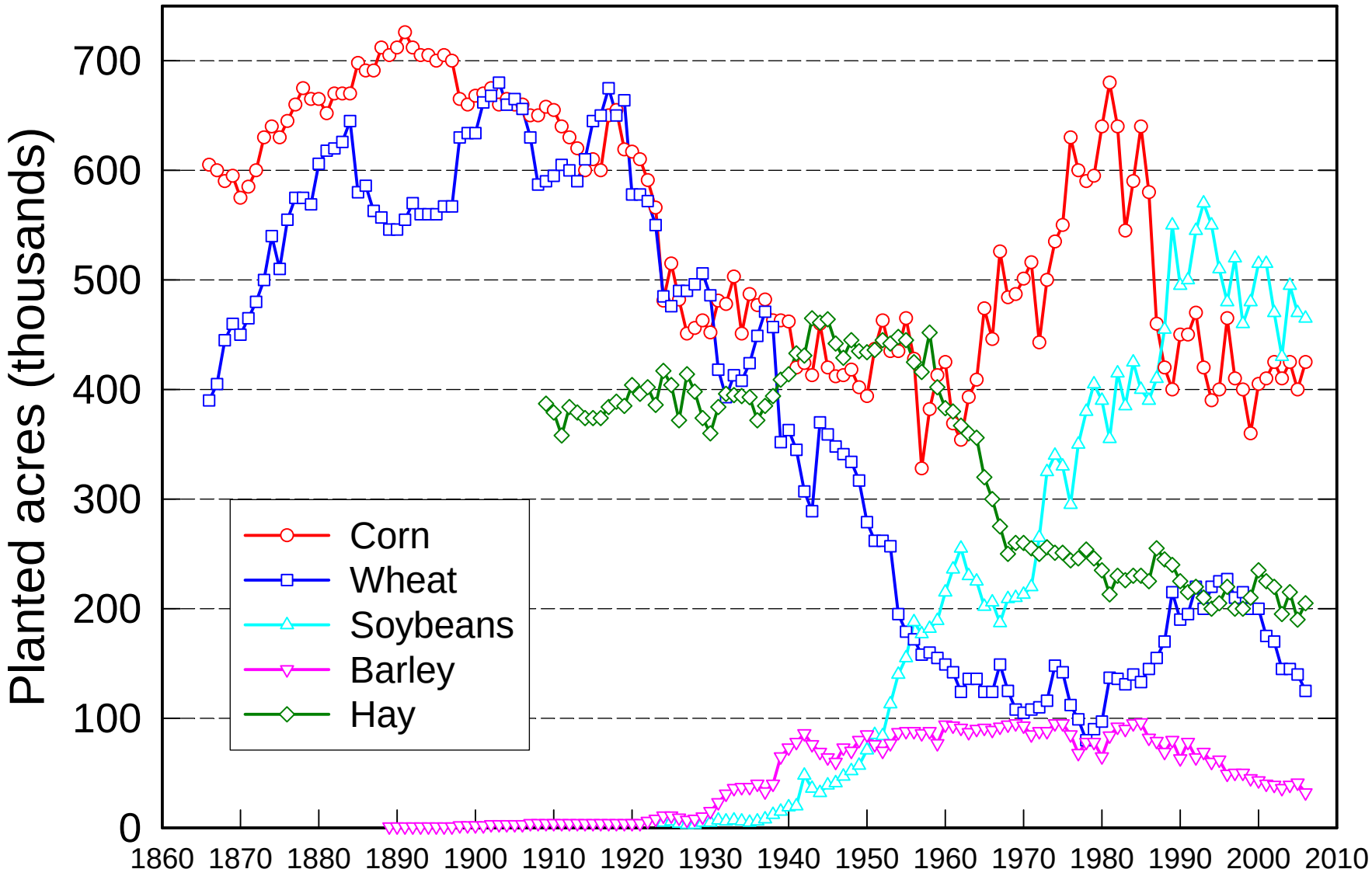

Average daily temperature (F)
90
80
70
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Air
Bare soil (4")
Average corn
maturity date

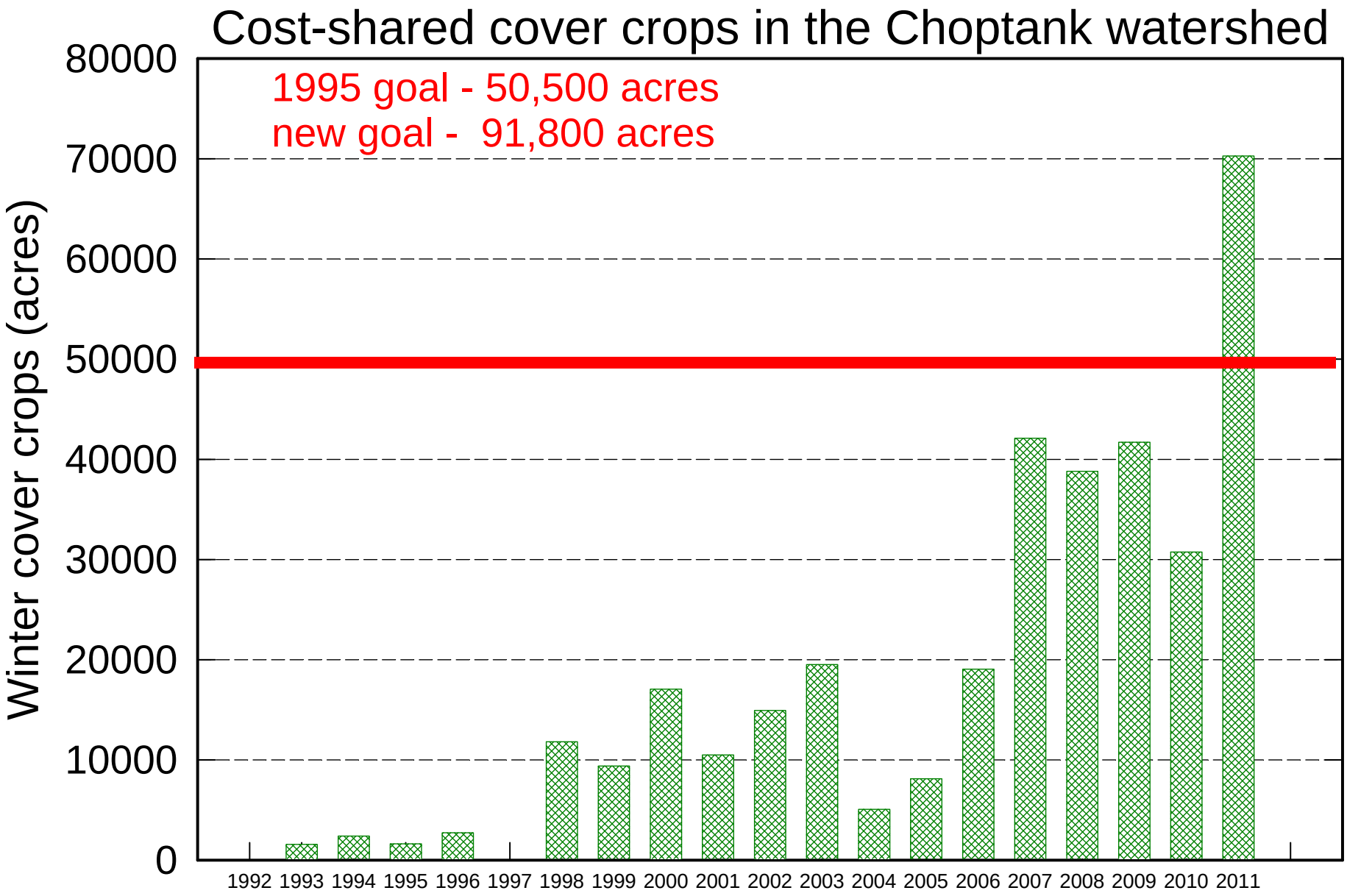
Forty Percent Nutrient Reduction Strategy for Choptank Watershed (Table 2 1995)

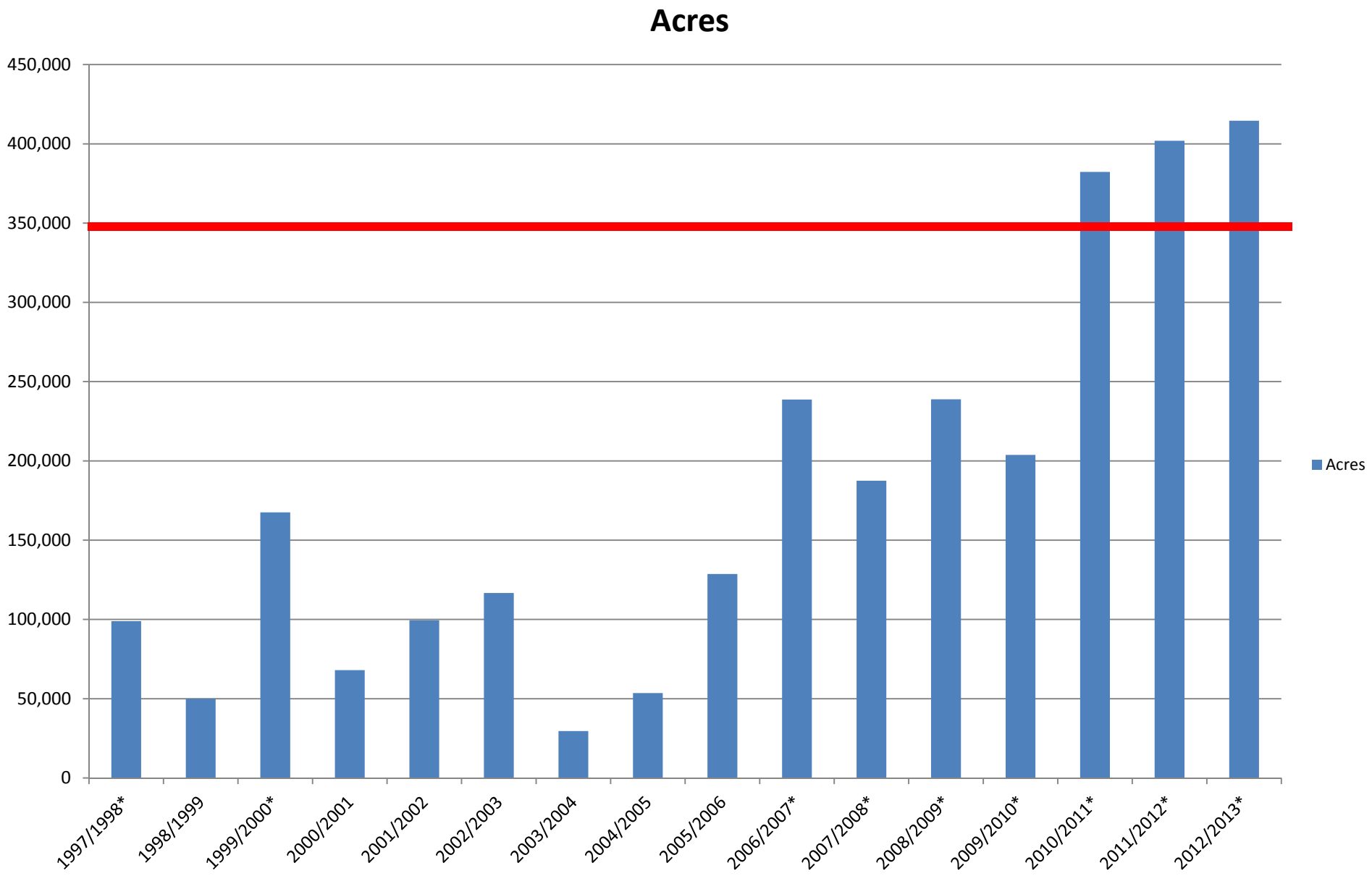
Practice	Coverage (acres)	N Load Reduction	P Load Reduction
Soil Cons./Water Quality Plan	35,893	73,222	6,820
Conservation Tillage	27,134	103,923	8,412
Nutr. Mngmt. – Fertilizer	129,806	192,113	7,788
Nutr. Mngmt – Organic	20,443	90,768	3,680
Cover Crops	50,586	437,063	8,094

Implementation is the Challenge

Although cover crops were recognized as a potential solution to N losses from cropland decades ago, the problem has been getting them on the land.

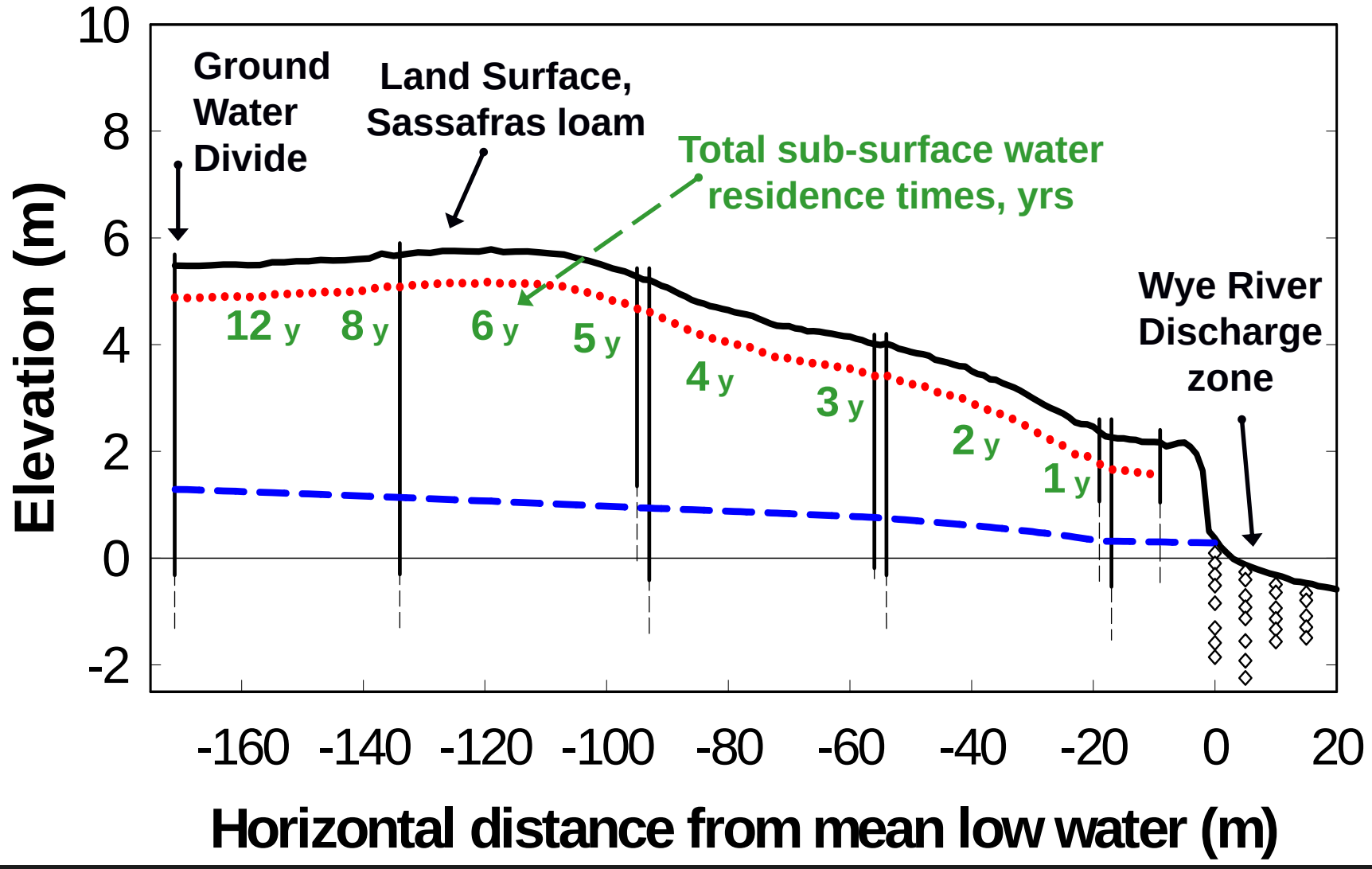

Planted acres (thousands)
700
600
500
400
300
200
100
0
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Corn
Wheat
Soybeans
Barley
Hay

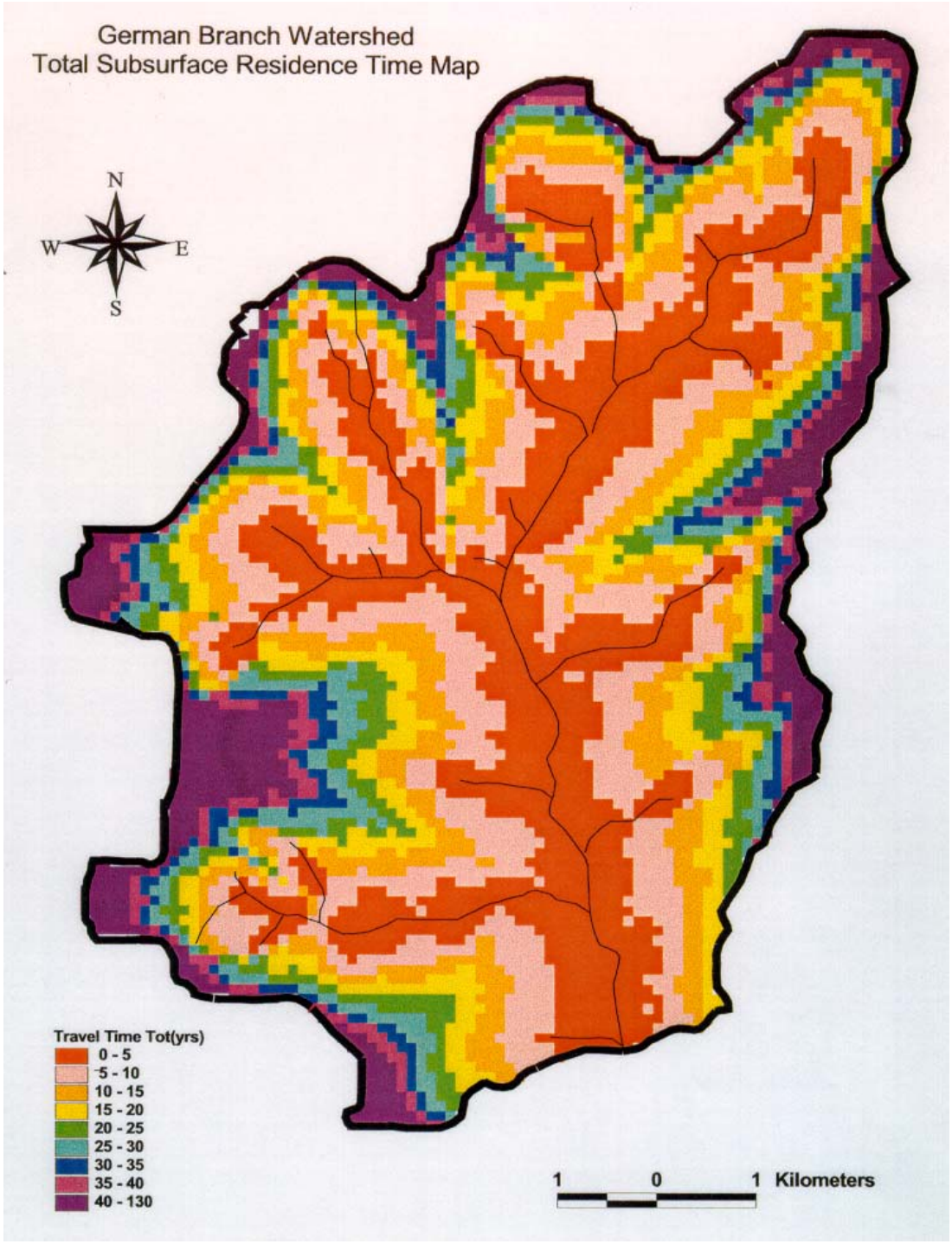

Cost-shared cover crops in the Choptank watershed
1995 goal - 50,500 acres
new goal - 91,800 acres
Winter cover crops (acres)
80000
70000
60000
50000
40000
30000
20000
10000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011


Acres
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1997/1998*
1998/1999
1999/2000*
2000/2001
2001/2002
2002/2003
2003/2004
2004/2005
2005/2006
2006/2007*
2007/2008*
2008/2009*
2009/2010*
2010/2011*
2011/2012*
2012/2013*
Acres

Cover crop effects over a landscape

(Staver and Brinsfield, 2000, DNR Final Project Rpt.)

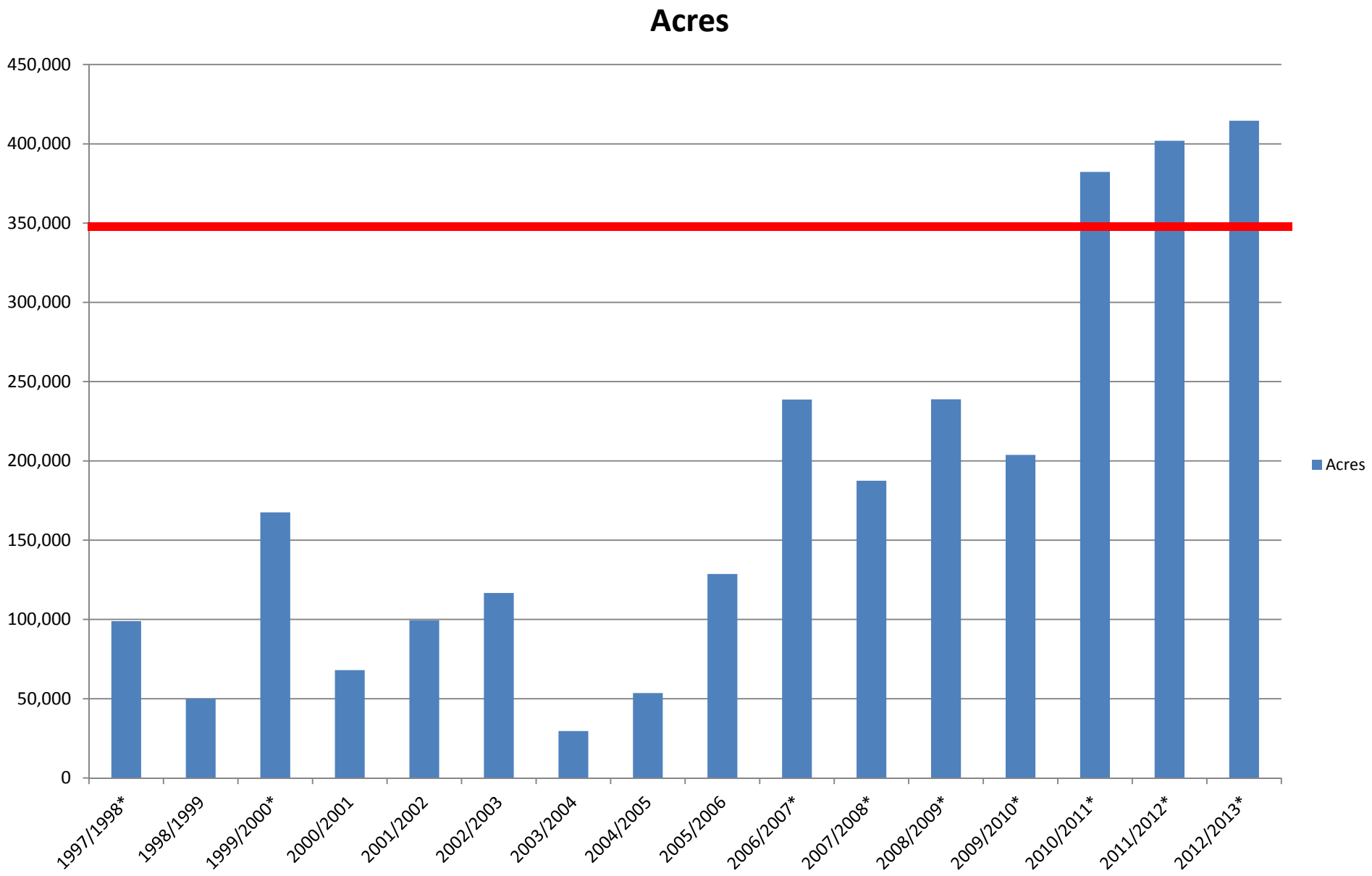


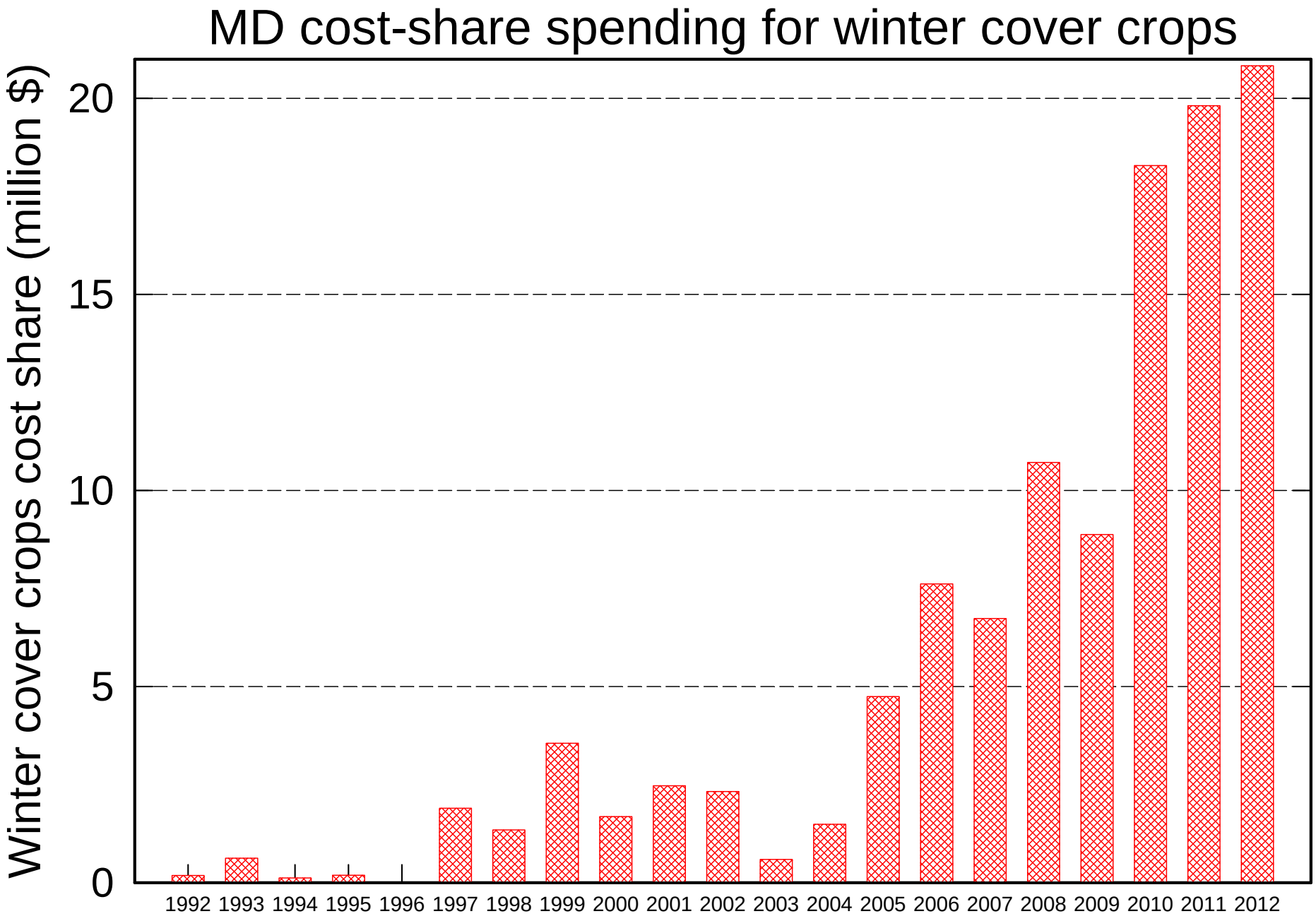

German Branch Watershed
Total Subsurface Residence Time Map
N
W
E
S
Travel Time Tot(yrs)
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 35
35 - 40
40 - 130
1 0 1 Kilometers

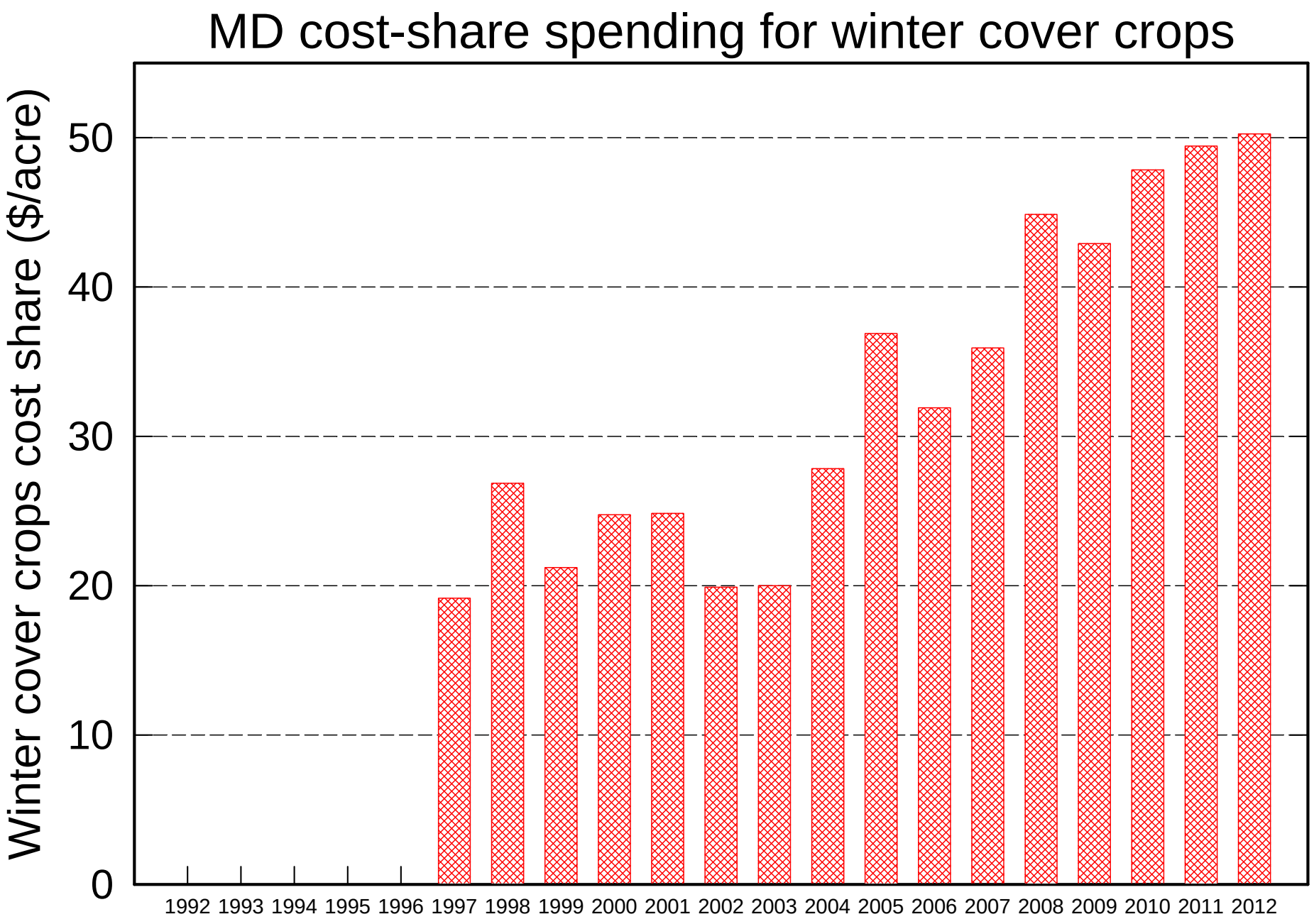
Carrots or Sticks?

So far Maryland has had an all carrots approach focused totally on reducing N losses. Cover crops add an extra layer of management and farmers do not perceive a positive bottom line.


MARYLAND DEPARTMENT OF AGRICULTURE
Cover Crops... Protecting the Bay


Acres
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1997/1998*
1998/1999
1999/2000*
2000/2001
2001/2002
2002/2003
2003/2004
2004/2005
2005/2006
2006/2007*
2007/2008*
2008/2009*
2009/2010*
2010/2011*
2011/2012*
2012/2013*
Acres


MD cost-share spending for winter cover crops
Winter cover crops cost share (million $)
0
5
10
15
20
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012


MD cost-share spending for winter cover crops
Winter cover crops cost share ($/acre)
0
10
20
30
40
50
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

Cost-share is directed to high risk acres

- Corn
- Vegetables
- Manure
- Priority watersheds

Cost-share is directed to most effective cover crop practices

- Early planting
- No-till drilling
- Rye

To reach acre goals many options are in the program

- All crops
- Aerial seeding
- Radishes
- Vertical tillage
- Mixtures
- Keep tweaking

Lessons Learned

- Farmers like to be good stewards but the bottom line rules
- Implementation has to be high
- Be clear about objectives – water quality probably the simplest
- Match credits to incentives – the TMDL problem


JOHN DEERE