The University of Maryland Phosphorus Management Tool (PMT)

A Revision of the Phosphorus Site Index (PSI)

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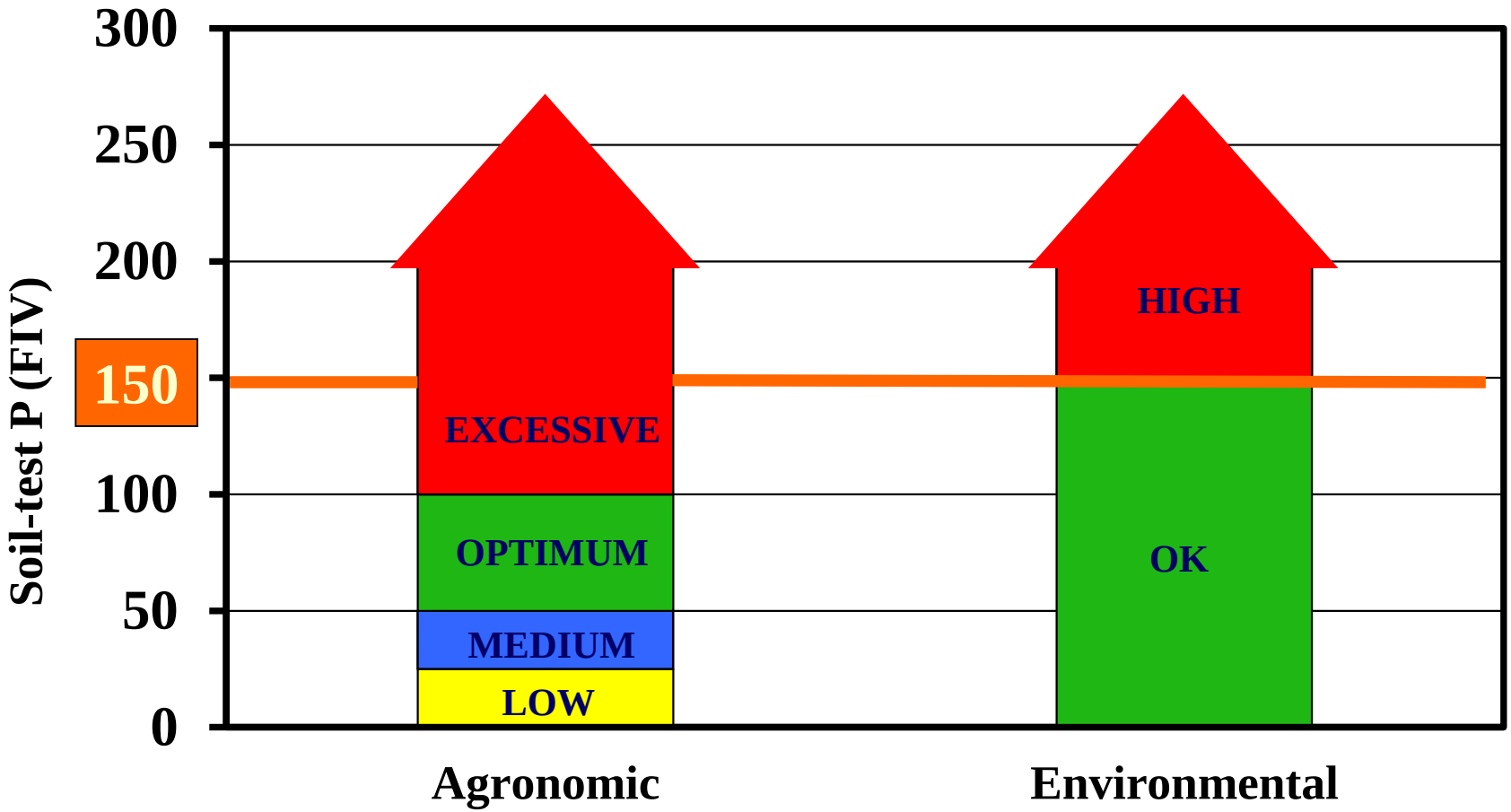
Timeline of PMT Development

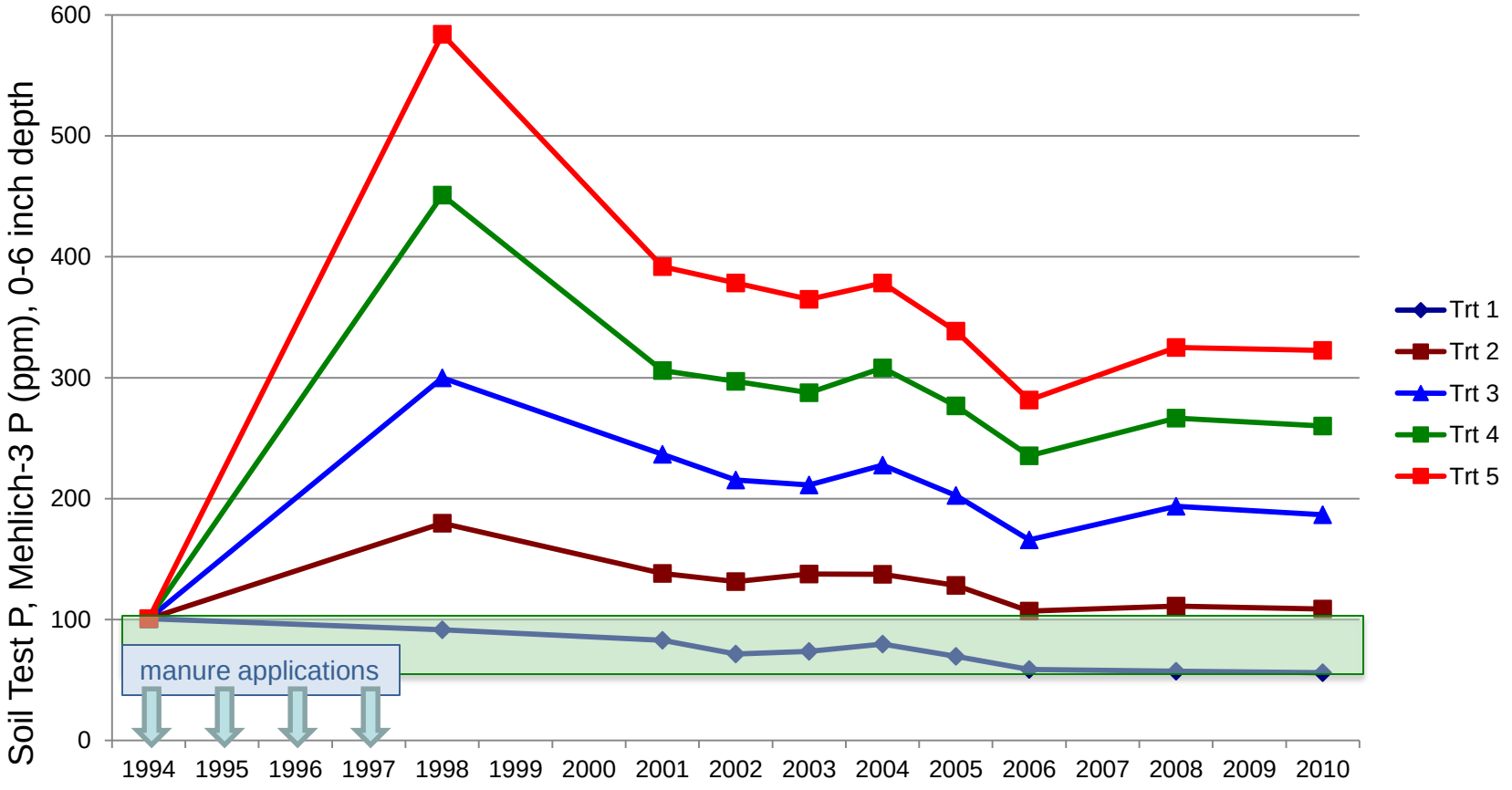
1990	A national workgroup of scientists strategizes plans for a P Index tool.
1991	…
1992	…
1993	Publication of the first framework for development of P Index assessment tools (Lemunyon and Gilbert, JPA 6:483-486).
1994	Begin research and development of a P Index specifically tailored to Maryland's soils, agricultural practices, hydrology, etc. (Coale et al.).
1995	…
1996	…
1997	Pfiesteria hysteria
1998	Water Quality Improvement Act of 1998 requires incorporation of a P Index into Maryland nutrient management plans.
1999	"The Mule Barn Group" begins formal collaboration on regional P Indexes.
2000	Publication of the Maryland Phosphorus Site Index (Coale, SFM-7, UME) *and* P Index tool requirement codified in COMAR 15.20.08.05.E(4)(a).
2001	…
2002	Journal publication of the Maryland Phosphorus Site Index (Coale, et al., JEQ 31:1471-1476).

Conventional soil-test phosphorus

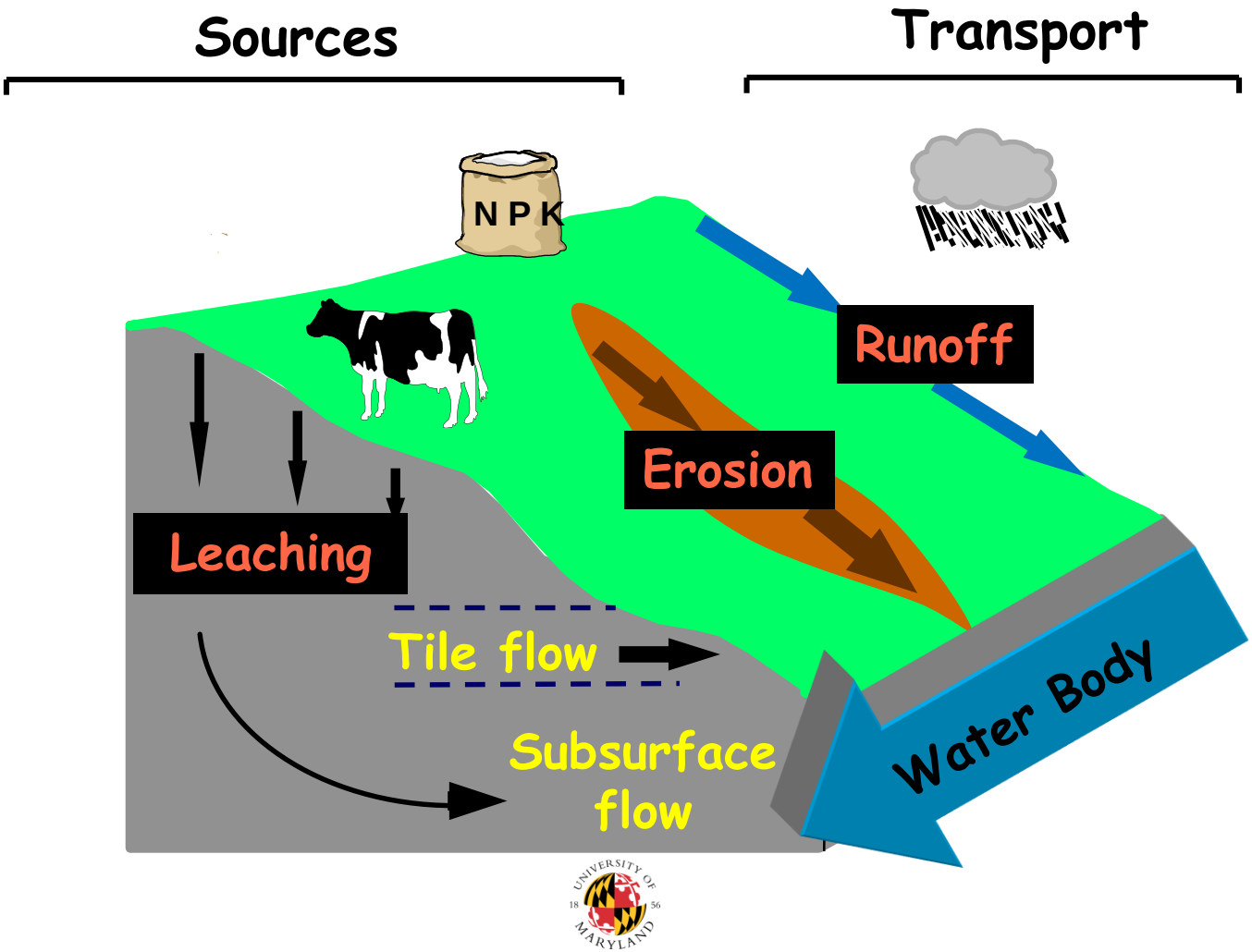
….. the first hurdle to clear



Soil P drawdown is very, very slow

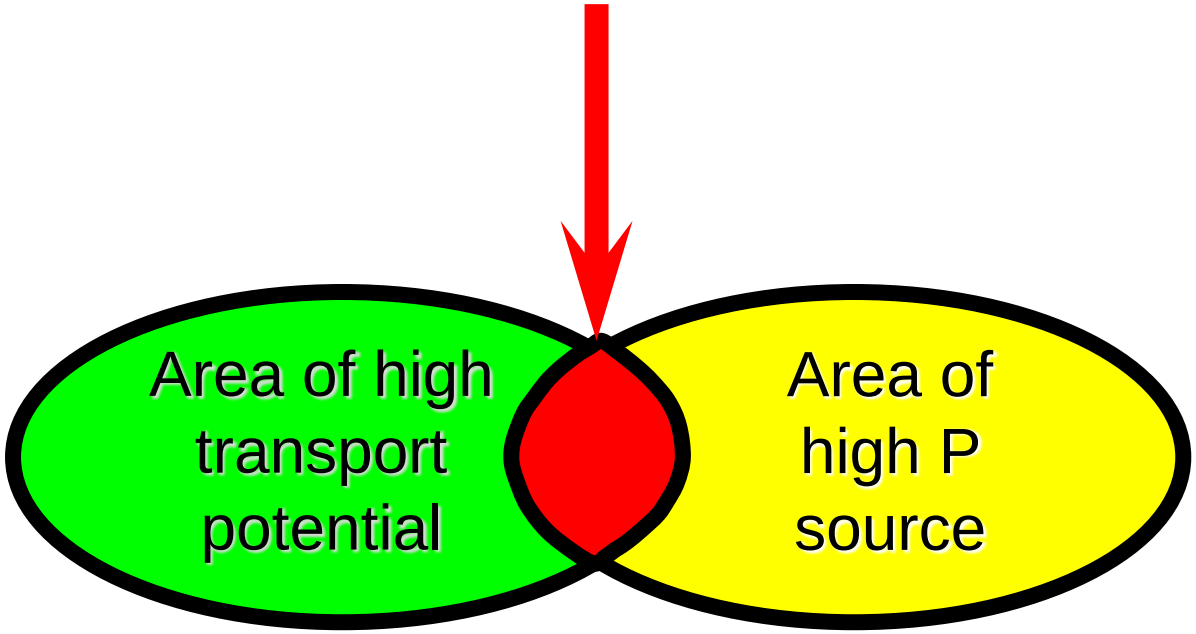


Phosphorus Losses: Source and Transport



Phosphorus Site Index (PSI)

Averaged P loss risk across pathways



Average P transport potential **x** Average P source quantity

Factors evaluated in PSI assessments

	PSI
Soil erosion loss estimation	✓
Surface runoff potential of site	✓
Subsurface drainage potential of site	✓
P leaching potential of site	✓
Distance from edge of field to surface water	✓
Buffer type and width	✓
Receiving water body priority status	✓
Agronomic soil test P level	✓
P fertilizer application rate	✓
P fertilizer application method, placement, tillage & timing	✓
Manure P application rate and P solubility	✓
Manure P application method, placement, tillage & timing	✓

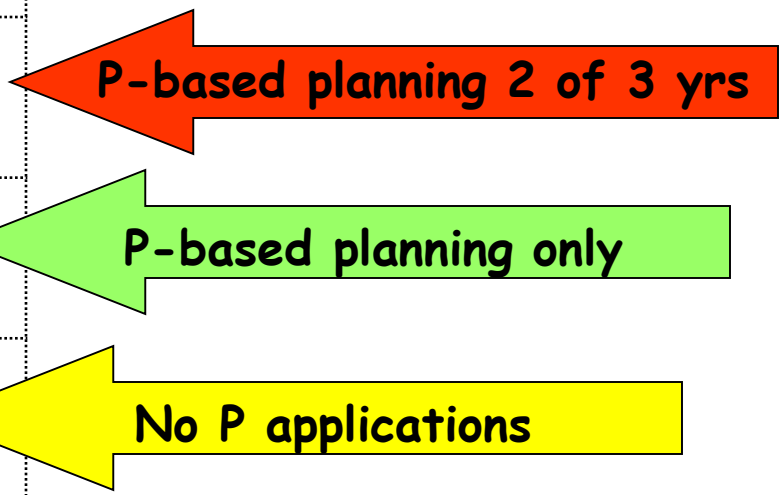
Phosphorus Site Index (PSI)
Final Score Interpretation

P Loss Rating	Interpretation
0 – 50	LOW potential for P movement from site. N-based nutrient management planning is satisfactory.
51 – 75	MEDIUM potential for P movement from site. Limit P applications to amount expected to be removed from field by harvest or to soil test P recs. N-based planning 1 year of 3. P-based planning 2 years of 3.
76 – 100	HIGH potential for P movement from site. Use P-based nutrient management planning. Limit P applications to expected crop removal or soil test P recommendations.
> 100	VERY HIGH potential for P movement from site. No P should be applied to this site. Implement active remediation techniques to reduce P loss potential.

Maryland PSI Performance

1999- 2000: 646 fields

PSI Loss Rating	1999 - 2000
Low	69%
Medium	19%
High	8%
Very High	4%

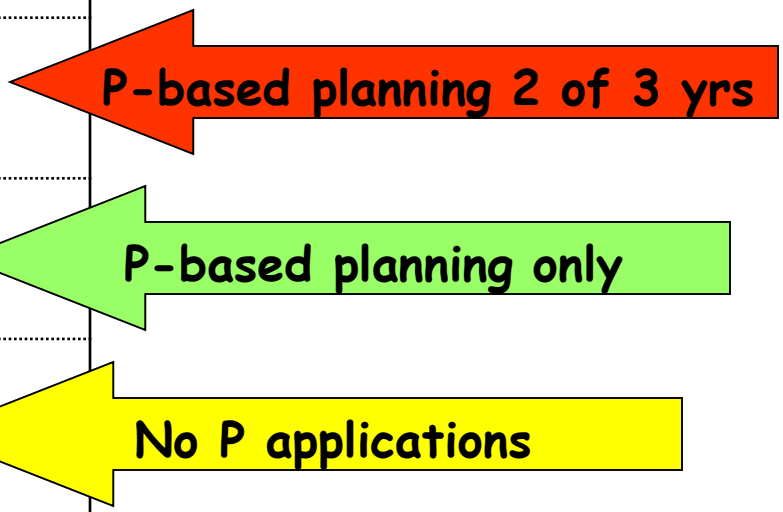


Maryland PSI Performance

1999- 2000: 646 fields

2001–2008: 8,728 fields

PSI Loss Rating	1999 - 2000	2001-2008
Low	69%	64%
Medium	19%	25%
High	8%	9%
Very High	4%	2%



Timeline of PMT Development

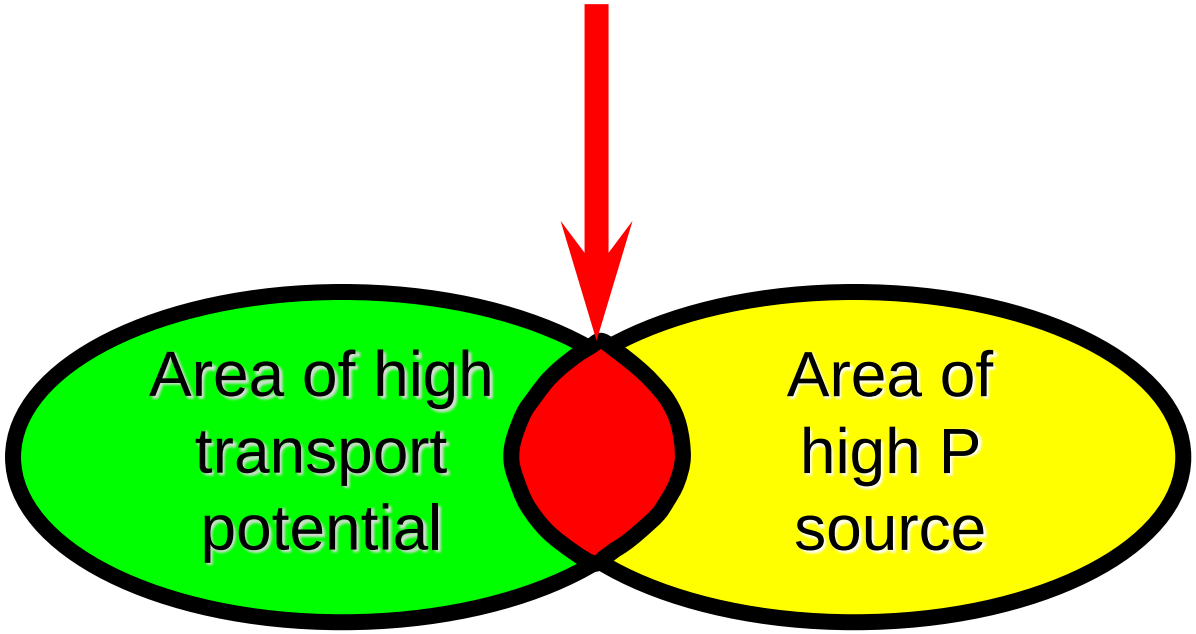
2002	Journal publication of the Maryland Phosphorus Site Index (Coale, et al., JEQ 31:1471-1476).
2003	…
2004	Mule Barn Group meets to discuss P Site Index revisions.
2005	Revision of the Maryland Phosphorus Site Index (Coale, SFM-7, UME).
2005	…
2006	…
2007	…
2008	…
2010	The State of Maryland includes “revision of the Phosphorous Index” in the State’s WIP developed to satisfy EPA’s Chesapeake Bay TMDL.
2011	MDA funds a project to support revising and updating the P site index.
2012	…
2013	Publication of the University of Maryland Phosphorus Management Tool (McGrath et al., Extension Bulletin EB-405, UME)

PMT Development Objectives

- Accurately assess relative risk of P transport across diverse landscapes
- Include new science, specifically regarding P transport on the Coastal Plain
- Increased emphasis on the impact of farm management decisions

Phosphorus Site Index (PSI)

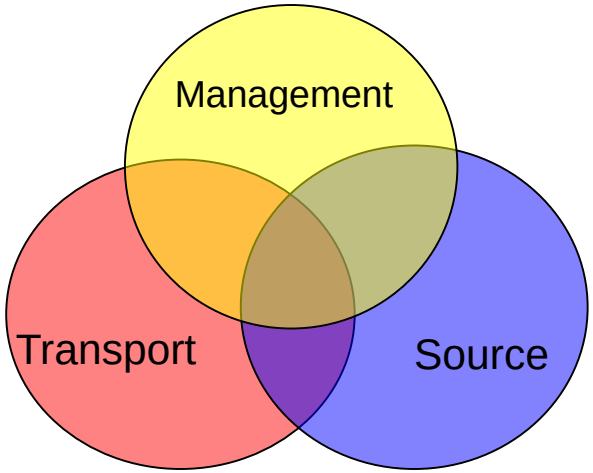
Averaged P loss risk across pathways



Average P transport potential **x** Average P source quantity

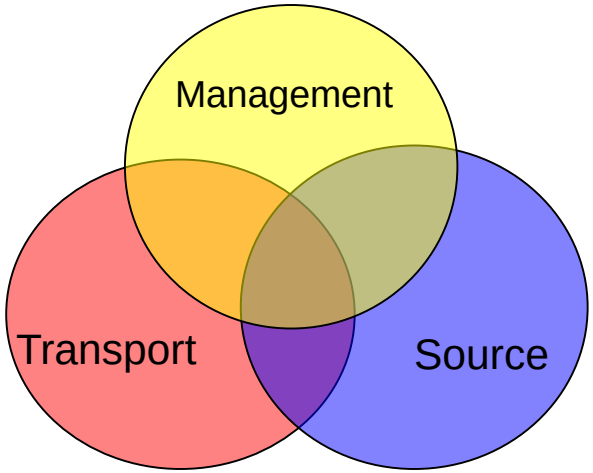
Phosphorus Management Tool (PMT)

Additive P loss risk across pathways



P loss risk by surface runoff of dissolved P

+



P loss risk by erosion of particulate P

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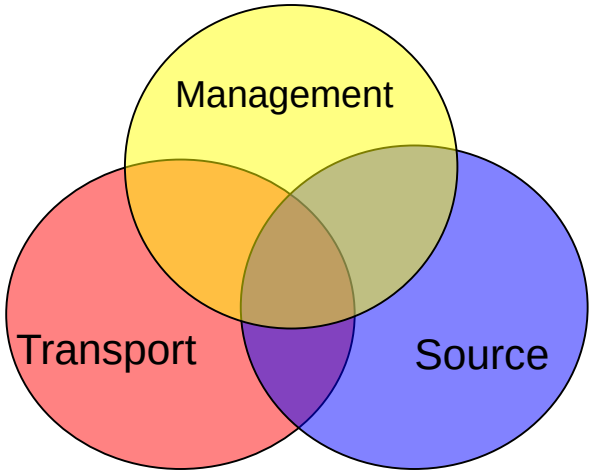


P loss risk by subsurface drainage of dissolved P

Factors evaluated in old PSI and new PMT assessments

	PSI	PMT
Soil erosion loss estimation	✓	✓
Surface runoff potential of site	✓	✓
Subsurface drainage potential of site	✓	✓
P leaching potential of site	✓	✗
Distance from edge of field to surface water	✓	✓
Buffer type and width	✓	✓
Receiving water body priority status	✓	✗
Agronomic soil test P level	✓	✓
Soil P saturation ratio	✗	✓
P fertilizer application rate	✓	✓
P fertilizer application method, placement, tillage & timing	✓	✓
Manure P application rate and P solubility	✓	✓
Manure P application method, placement, tillage & timing	✓	✓

Phosphorus Management Tool (PMT)
Final Score Interpretation

P Loss Rating	Interpretation
0 – 50	**LOW potential for P movement from this site given current management practices and site characteristics. Total phosphorus applications should be limited to no more than one three-year crop removal rate applied over a three year period.**
51 – 100	**MEDIUM potential for P movement from this site given current management practices and site characteristics. Phosphorus applications should be limited to the amount expected to be removed from the field by crop harvest.**
> 100	**HIGH potential for P movement from this site given current management practices and site characteristics. No phosphorus should be applied to this site. Active remediation techniques should be implemented in an effort to reduce the P loss potential from this site.**

Major Changes Found in Current PMT

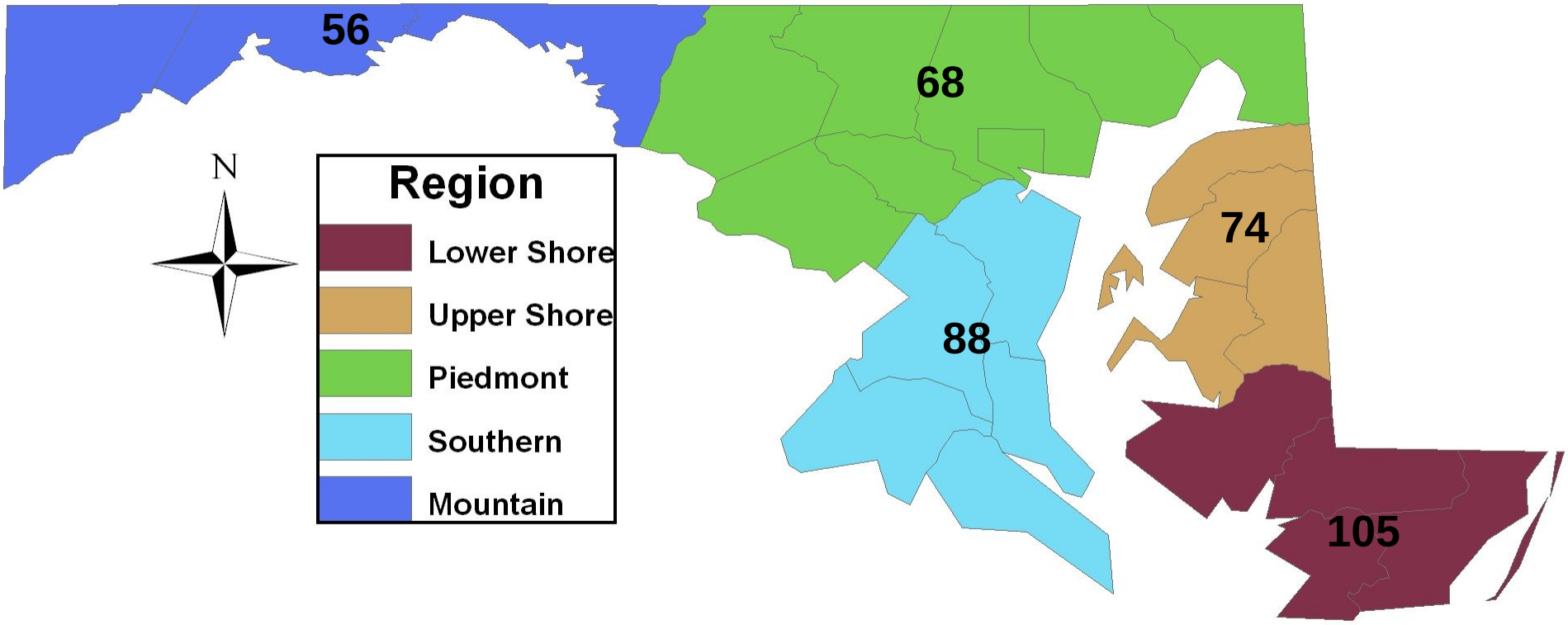
- New Name: University of Maryland – Phosphorus Management Tool (UM-PMT)
- 3 interpretative categories (eliminated “Very High”)
- All recommendations now based on P management
- Three major transport pathways separated arithmetically

PMT vs. PSI Performance Scenario

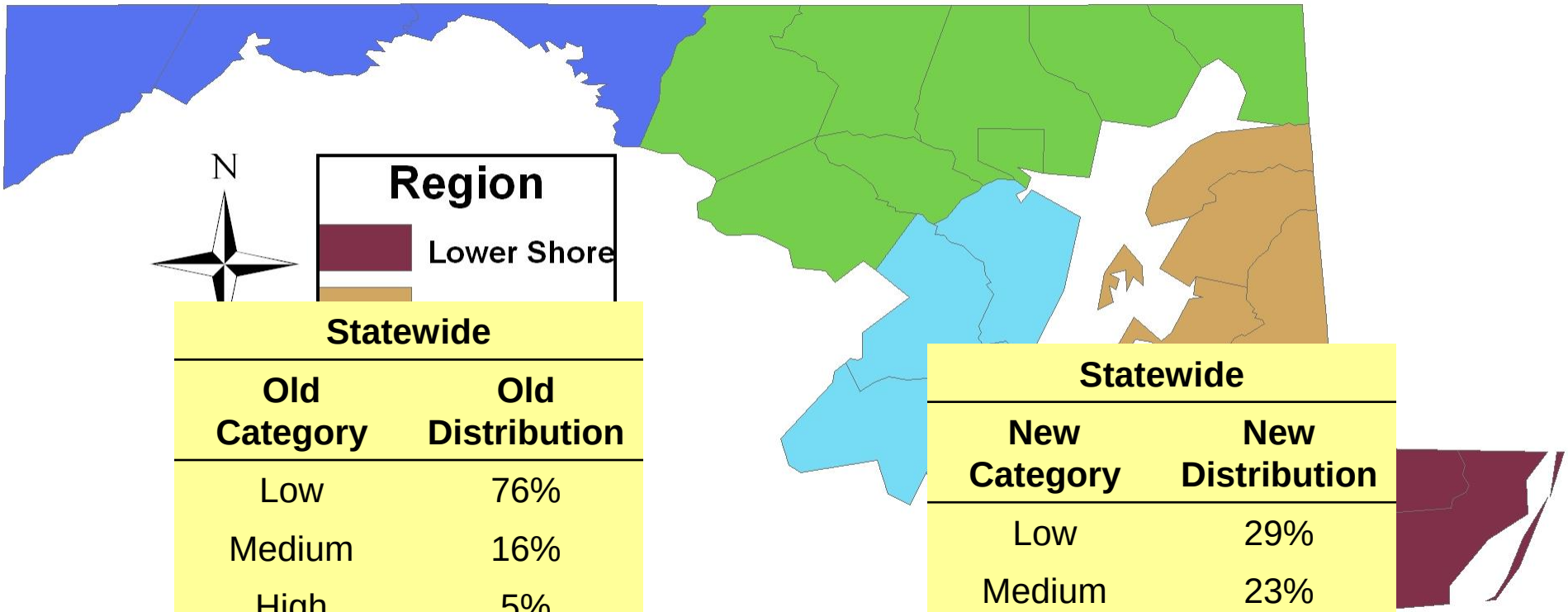
- We cannot predict real-world outcomes of PMT evaluations across Maryland – only time will tell
- Side-by-side scenario comparison of PSI and PMT evaluations
- The following data represent 391 real farm fields evaluated across Maryland
  - Field physical characteristics are real
  - Farm management practices are real
  - Soil-test P concentrations are modeled (not real)
    - All fields given FIV > 150
  - Manure P application rates are modeled (not real)
    - All fields evaluated for planned manure application
- Extreme-case scenario

Number of Fields Sampled in Each Region

Statewide total = 391



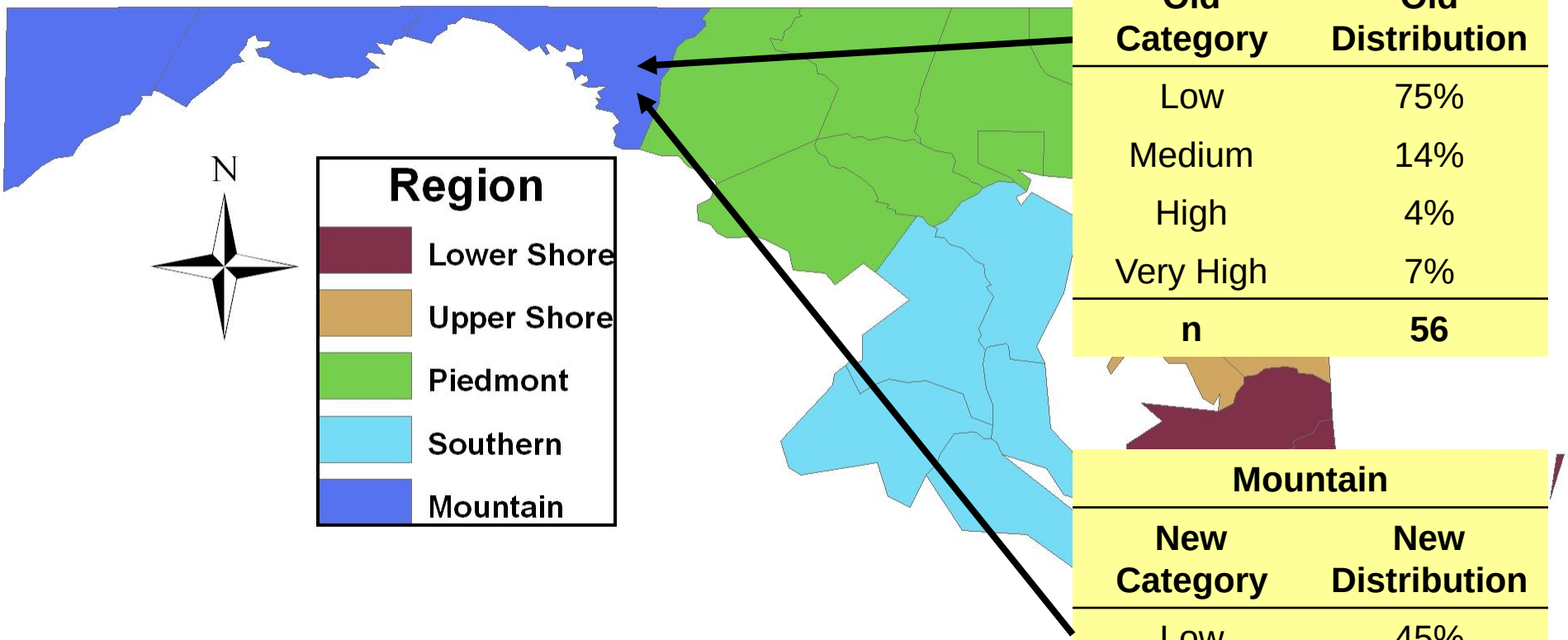
Statewide Distribution



Statewide	
Old Category	**Old Distribution**
Low	76%
Medium	16%
High	5%
Very High	3%
n	**391**

Statewide	
New Category	**New Distribution**
Low	29%
Medium	23%
High	48%
n	**391**

Mountain

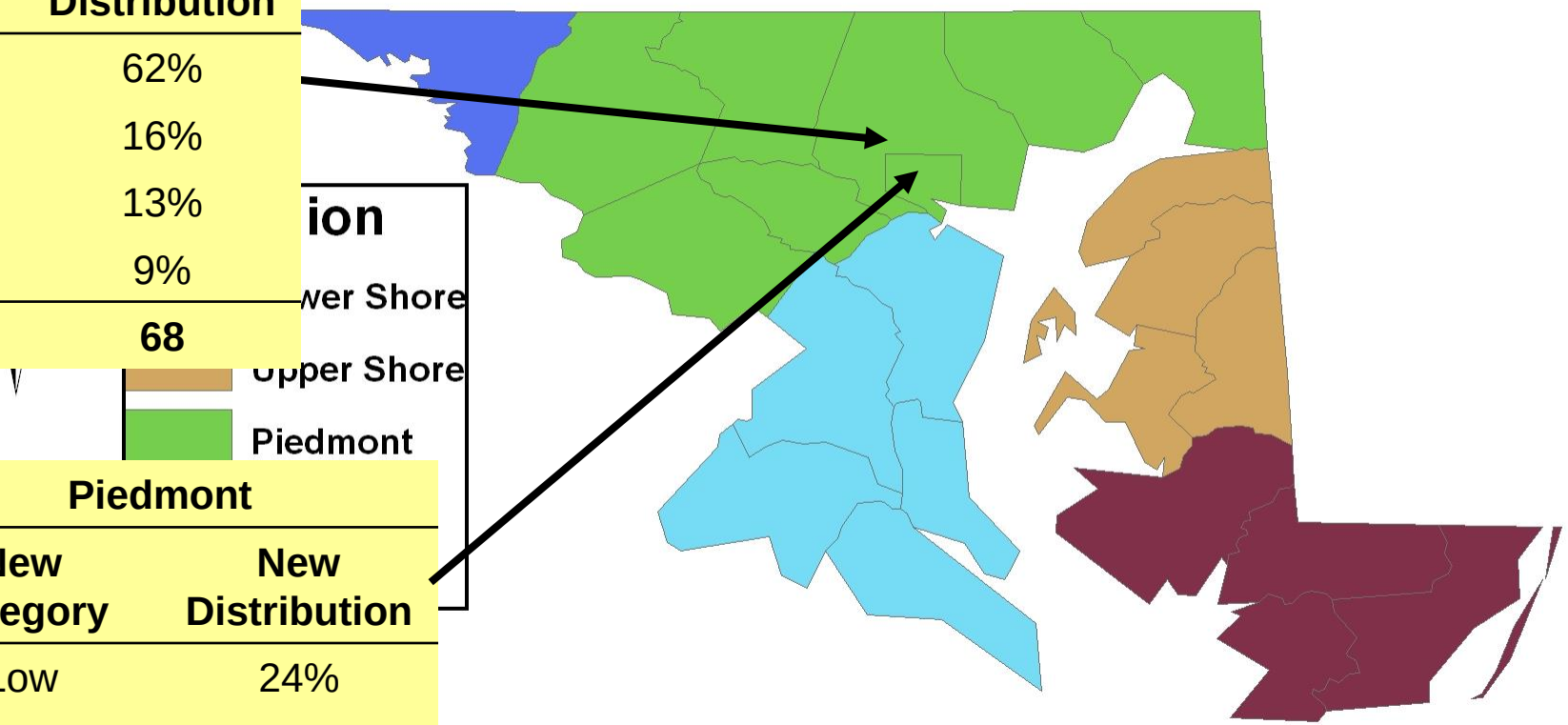


Mountain	
Old Category	**Old Distribution**
Low	75%
Medium	14%
High	4%
Very High	7%
n	**56**

Mountain	
New Category	**New Distribution**
Low	45%
Medium	25%
High	30%
n	**56**

Piedmont

Piedmont	
Old Category	**Old Distribution**
Low	62%
Medium	16%
High	13%
Very High	9%
n	**68**

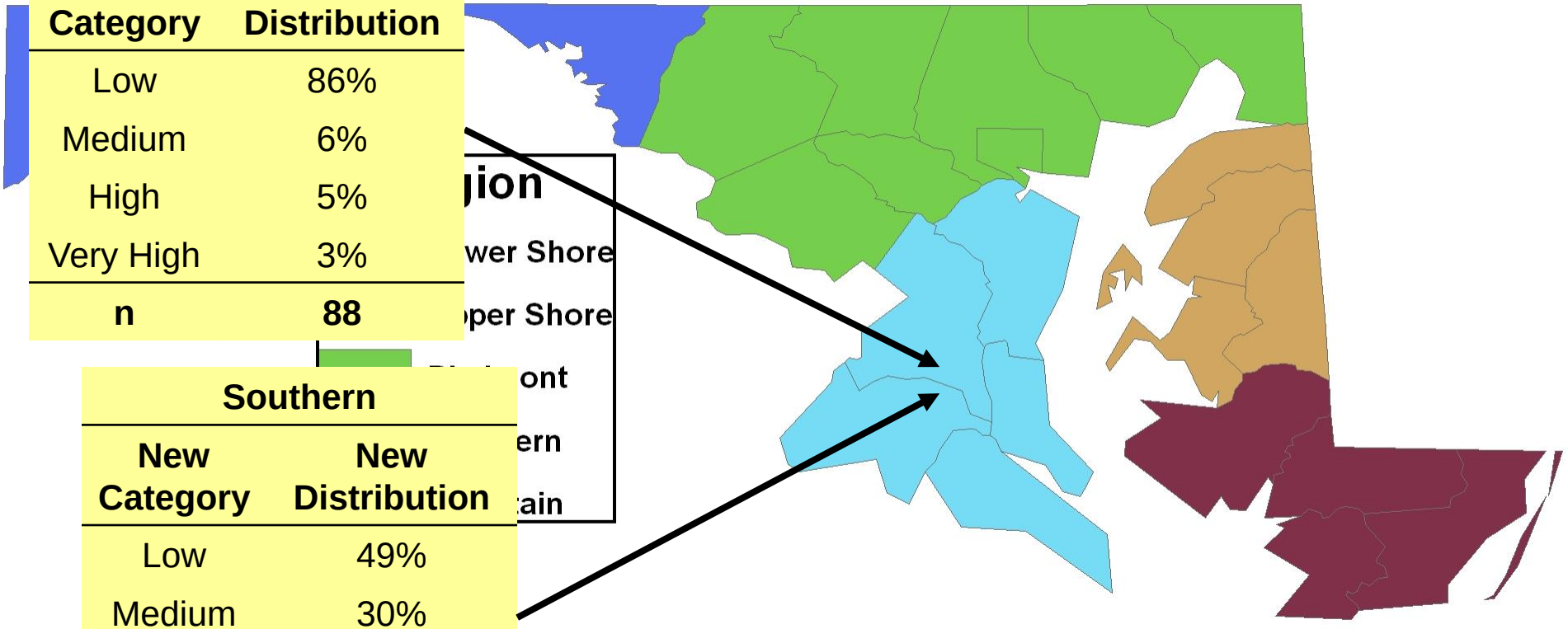


Piedmont	
New Category	**New Distribution**
Low	24%
Medium	25%
High	51%
n	**68**

Southern Maryland

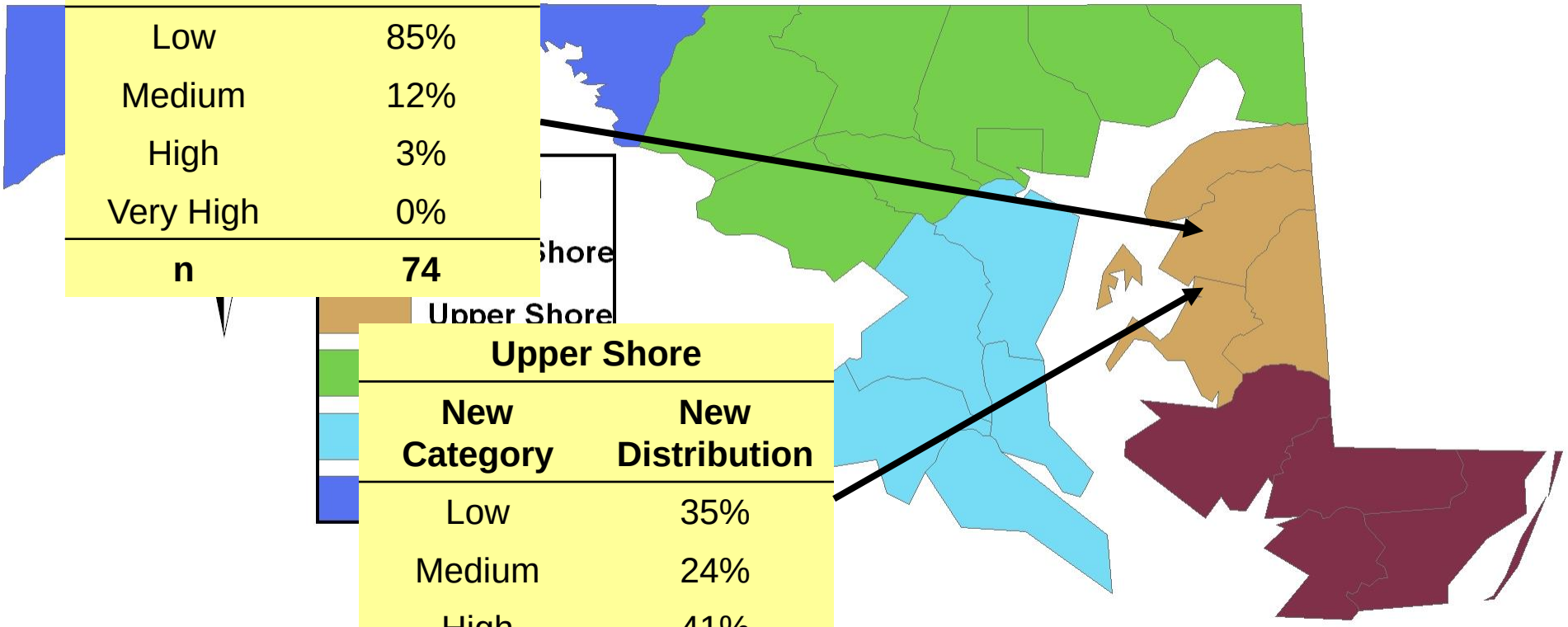
Southern	
Old Category	**Old Distribution**
Low	86%
Medium	6%
High	5%
Very High	3%
n	**88**

Southern	
New Category	**New Distribution**
Low	49%
Medium	30%
High	22%
n	**88**



Upper Eastern Shore

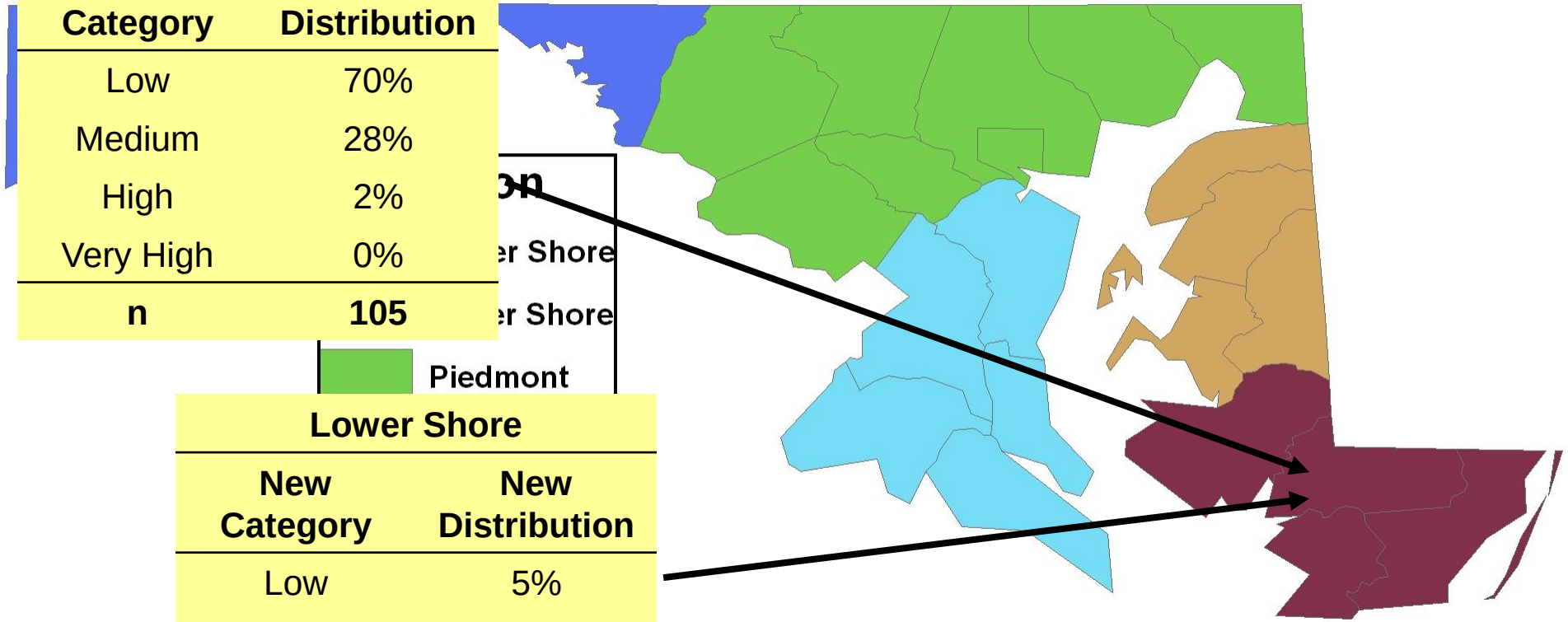
Upper Shore	
Old Category	**Old Distribution**
Low	85%
Medium	12%
High	3%
Very High	0%
n	**74**



Upper Shore	
New Category	**New Distribution**
Low	35%
Medium	24%
High	41%
n	**74**

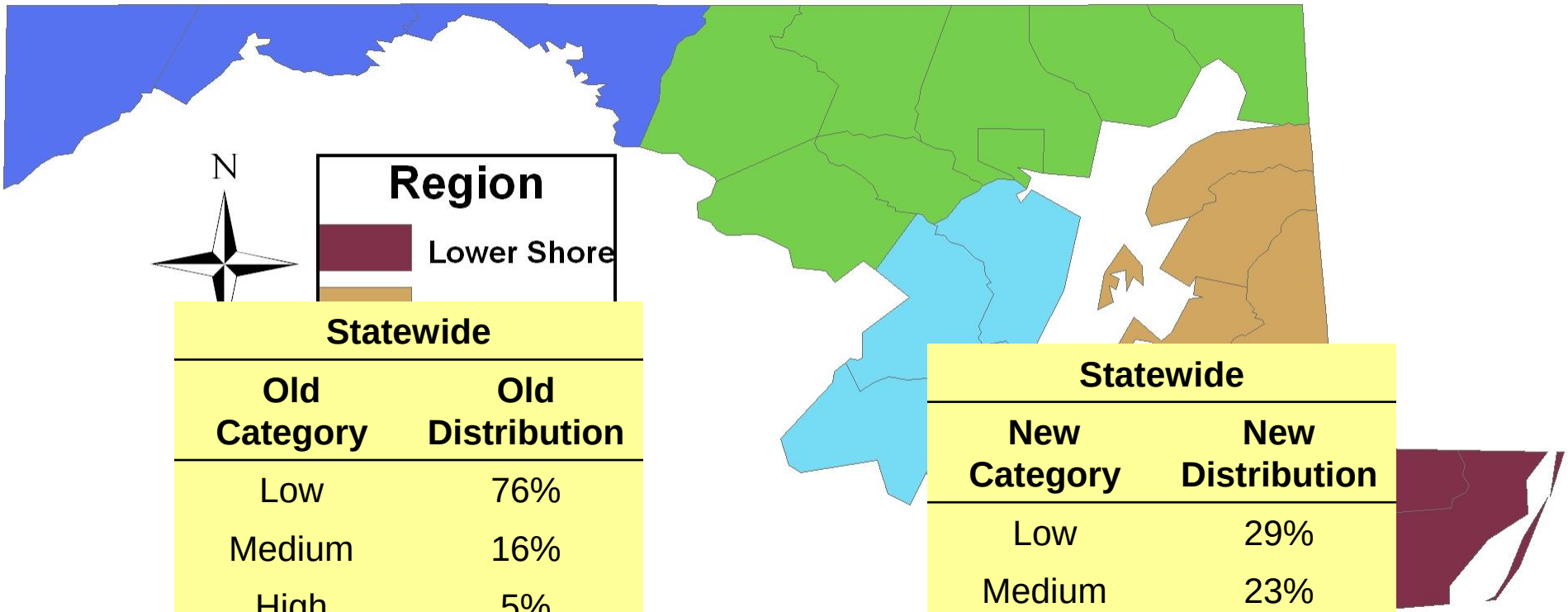
Lower Eastern Shore

Lower Shore	
Old Category	**Old Distribution**
Low	70%
Medium	28%
High	2%
Very High	0%
n	**105**



Lower Shore	
New Category	**New Distribution**
Low	5%
Medium	14%
High	81%
n	**105**

Statewide Distribution



Statewide	
Old Category	**Old Distribution**
Low	76%
Medium	16%
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Very High	3%
n	**391**

Statewide	
New Category	**New Distribution**
Low	29%
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High	48%
n	**391**

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Extension Bulletin EB-405
2013

University of Maryland Phosphorus Management Tool: Technical Users Guide

The Phosphorus Index Concept

In 1990, a national cooperative workgroup of scientists from numerous universities and the United States Department of Agriculture (USDA) was organized to develop a procedure that could identify soils, farm management practices, and specific locations within a farm where phosphorus (P) losses in field drainage water may pose the potential for negative environmental impacts on nearby surface waters. The goals of this national work group were:

- To develop an easily used field rating system that rates farm fields according to the potential for P loss to surface water (the Phosphorus Index).
- To relate the P Index to the sensitivity of receiving surface waters to eutrophication and degradation resulting from nonpoint source P enrichment.
- To facilitate adaptation and modification of the P Index to regional and site-specific conditions.
- To develop agricultural management practices that will minimize the buildup of soil P to excessive levels and the transport of P from soils to sensitive water bodies.

The Objective of the University of Maryland Phosphorus Management Tool

Our objective was to develop a phosphorus site index (PSI) that uses readily available information to evaluate the relative risk of P transport from agricultural fields, including vegetable and row crop production and pasture based systems where P may be applied either as inorganic or organic fertilizer. Furthermore, the PSI should be applicable within all physiographic provinces present in Maryland. Phosphorus transport is controlled by site characteristics (e.g. hydrology and slope), climate, and P sources (e.g. manure, inorganic fertilizer, and soil P). The revised PSI, or the University of Maryland – Phosphorus Management Tool (UM-PMT), seeks to include new science relative to site and source factors and highlight management decisions so that the learning opportunities associated with performing a P index are more pronounced. The overall objective is to identify critical areas where there is a high P loss potential due to both a high transport potential and a large source of P, and also to encourage the use of management practices in those critical source areas that protect water quality.

Development of the University of Maryland – Phosphorus Management Tool

In 1994, we began the development of a P Index tool specifically tailored to Maryland's soils, agricultural management practices, climate, topography, hydrology, and surface water characteristics. The Maryland PSI

The PMT calculations are available at www.extension.umd.edu.

Extension Bulletin EB-405

Search for Phosphorus Management Tool


Questions ?