Lake Watershed Assessment in Wisconsin

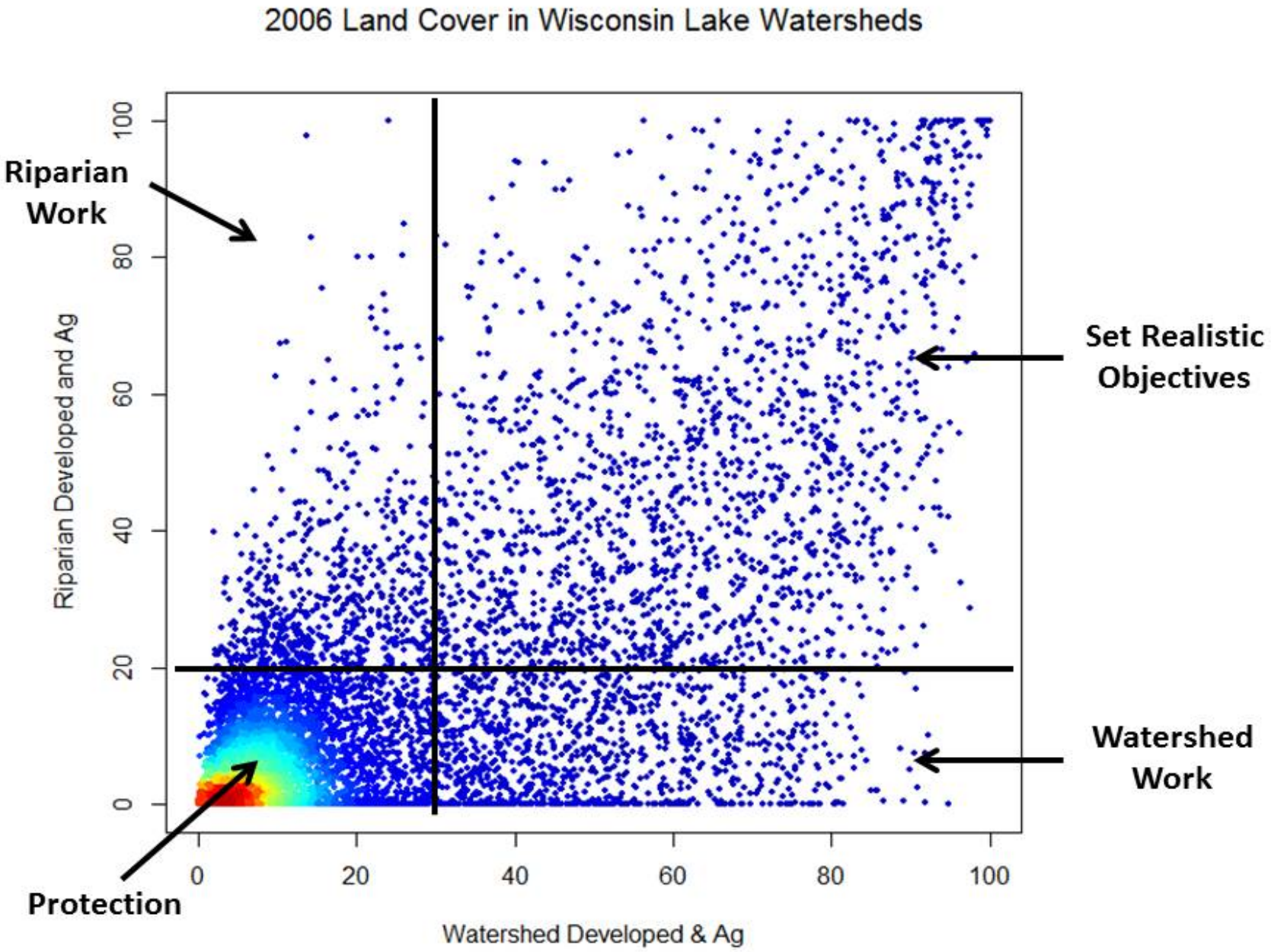
Matt Diebel

WISCONSIN
DEPT. OF NATURAL RESOURCES

Take Home Messages

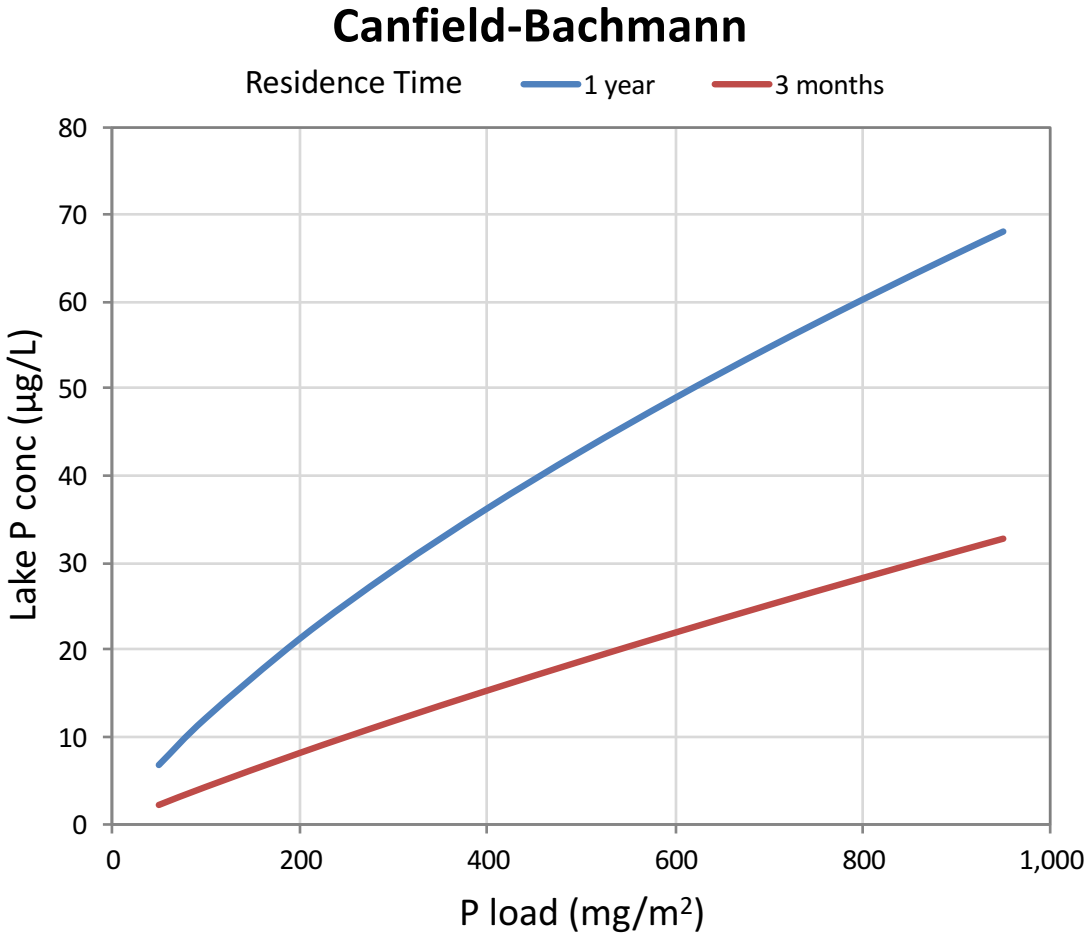
- Some lakes don't need a detailed watershed assessment.
- Estimating watershed nutrient loading with models is difficult – monitoring is a better approach in many cases.
- Identifying hot spots for nutrient loading may be more valuable than estimating the total nutrient load.
- DNR is developing lake and watershed fact sheets that can help with lake nutrient modeling.

“All happy families are alike; each unhappy family is unhappy in its own way.”
— Leo Tolstoy, Anna Karenina



Common Lake Management Questions

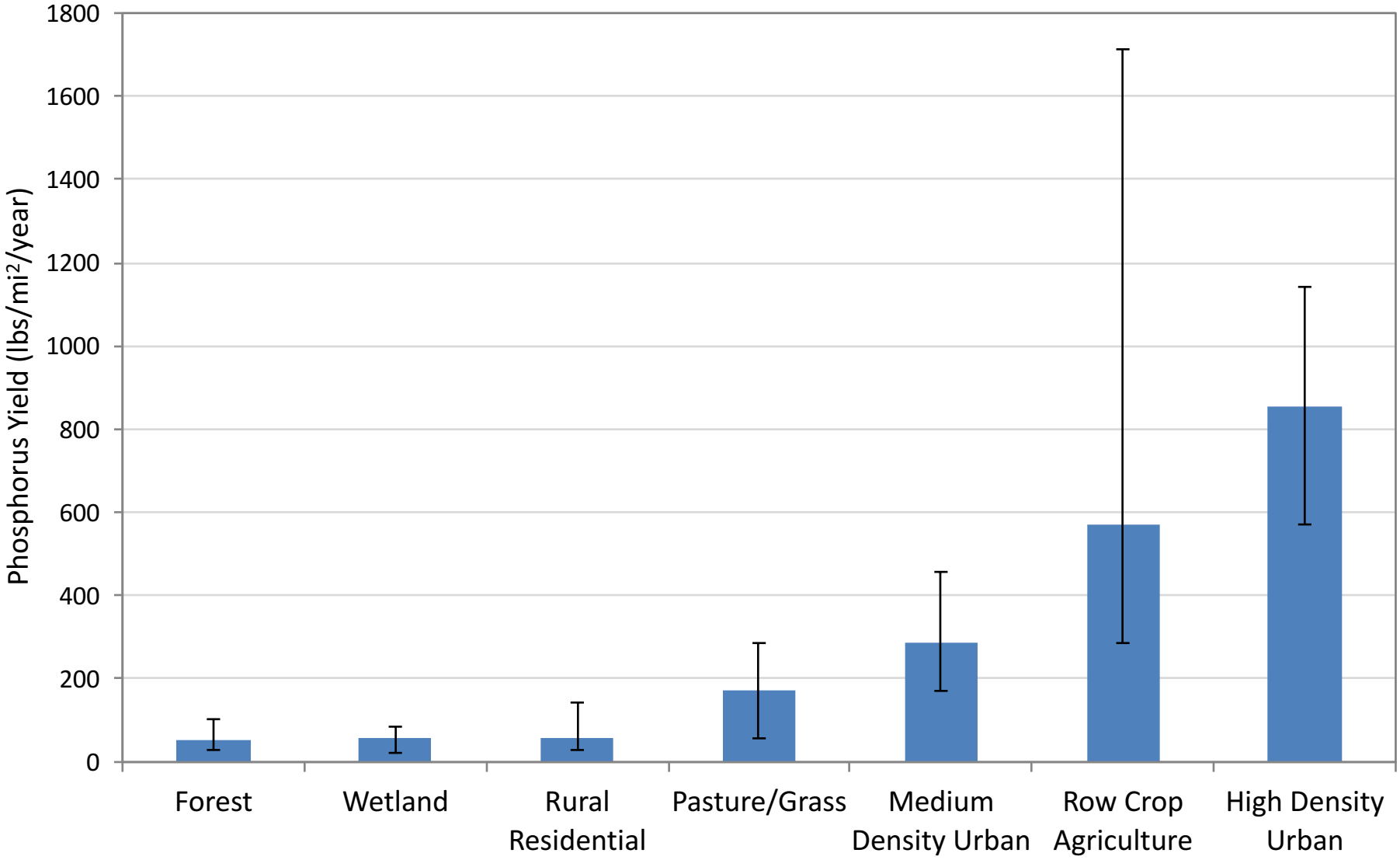
1. How much phosphorus is going into the lake?
2. Where is the phosphorus coming from?
3. How will the lake respond to changes in phosphorus inputs?



Model Inputs

- Morphometry
- Hydrology
- Phosphorus load

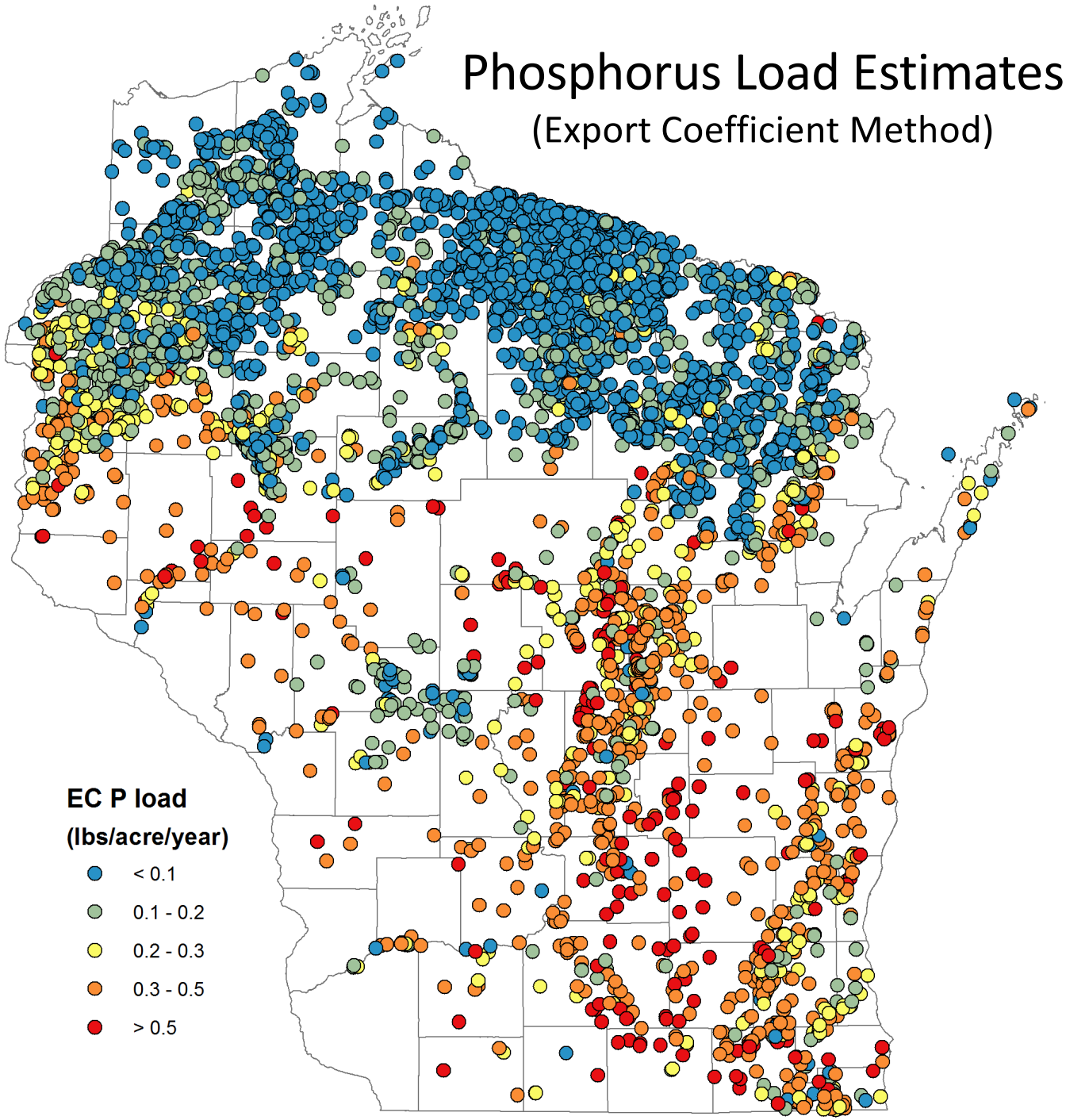
Land Use Phosphorus Export Coefficients



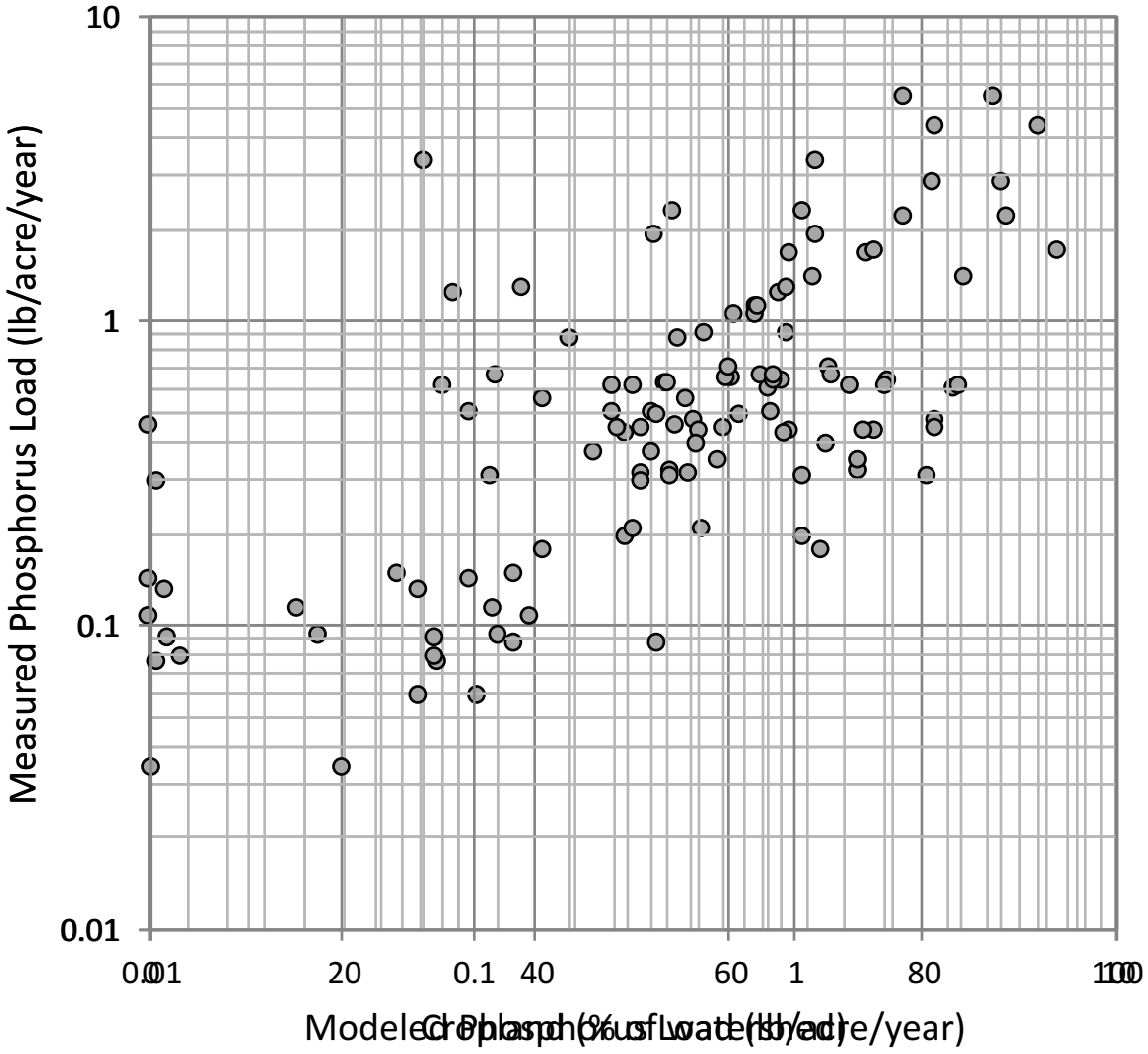
Panuska, J.C. and R.A. Lillie. 1995. Phosphorus Loadings from Wisconsin Watersheds: Recommended Phosphorus Export Coefficients for Agricultural and Forested Watersheds. WDNR Research Findings Report No. 38. PUBL-RS-738 95. 8p.

Phosphorus Load Estimates

(Export Coefficient Method)



Why is phosphorus loading so hard to predict?



- Land management vs. land cover
- Legacy of historic conditions
- Transport capacity (soils, topography)
- Weather

Diebel, M. W., J. T. Maxted, S. Han, D. M. Robertson, and M. J. Vander Zanden. 2009. Landscape planning for agricultural non-point source pollution reduction III: Assessing phosphorus and sediment reduction potential. Environmental Management 43:69-83.

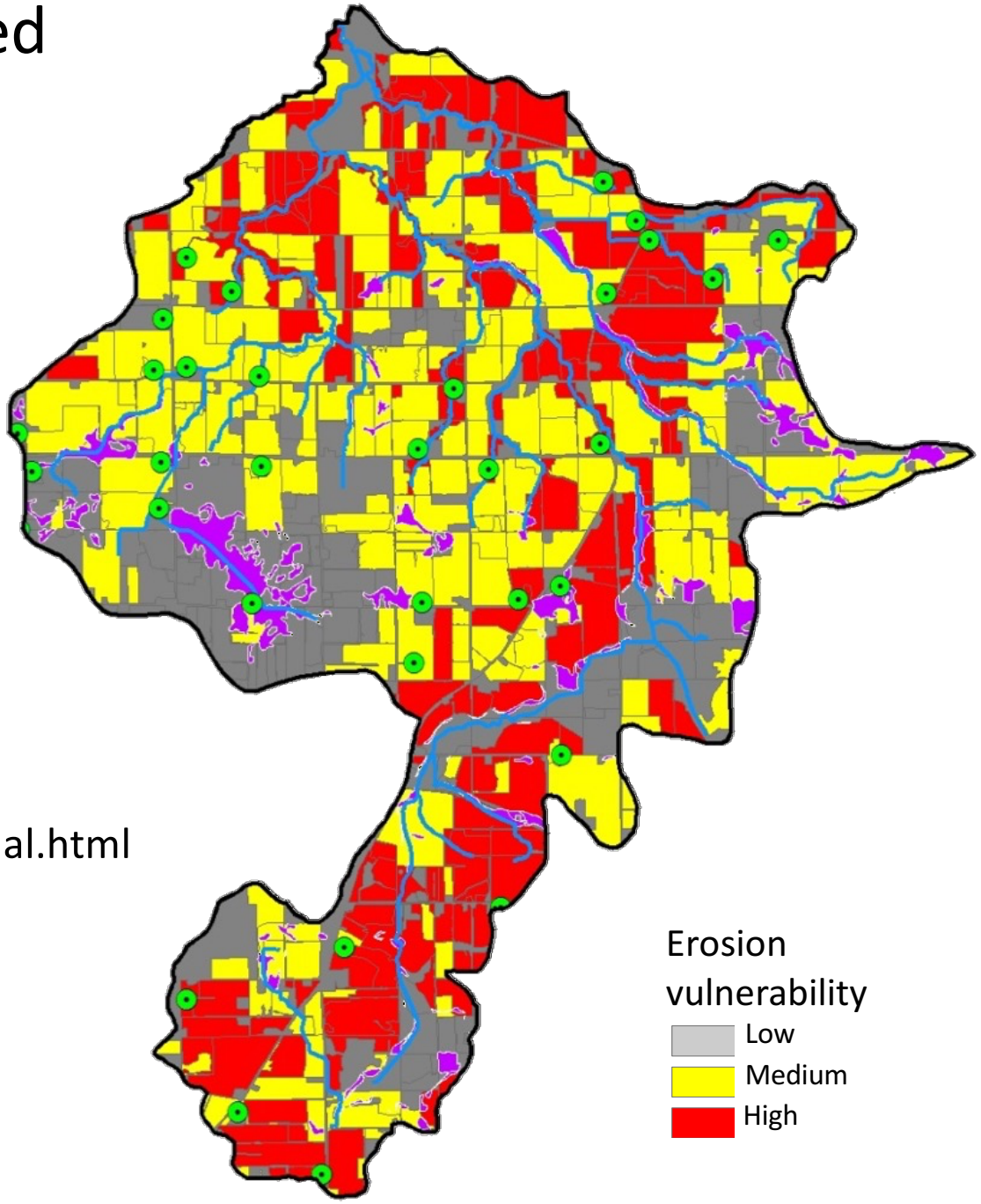
Kankapot Creek Watershed

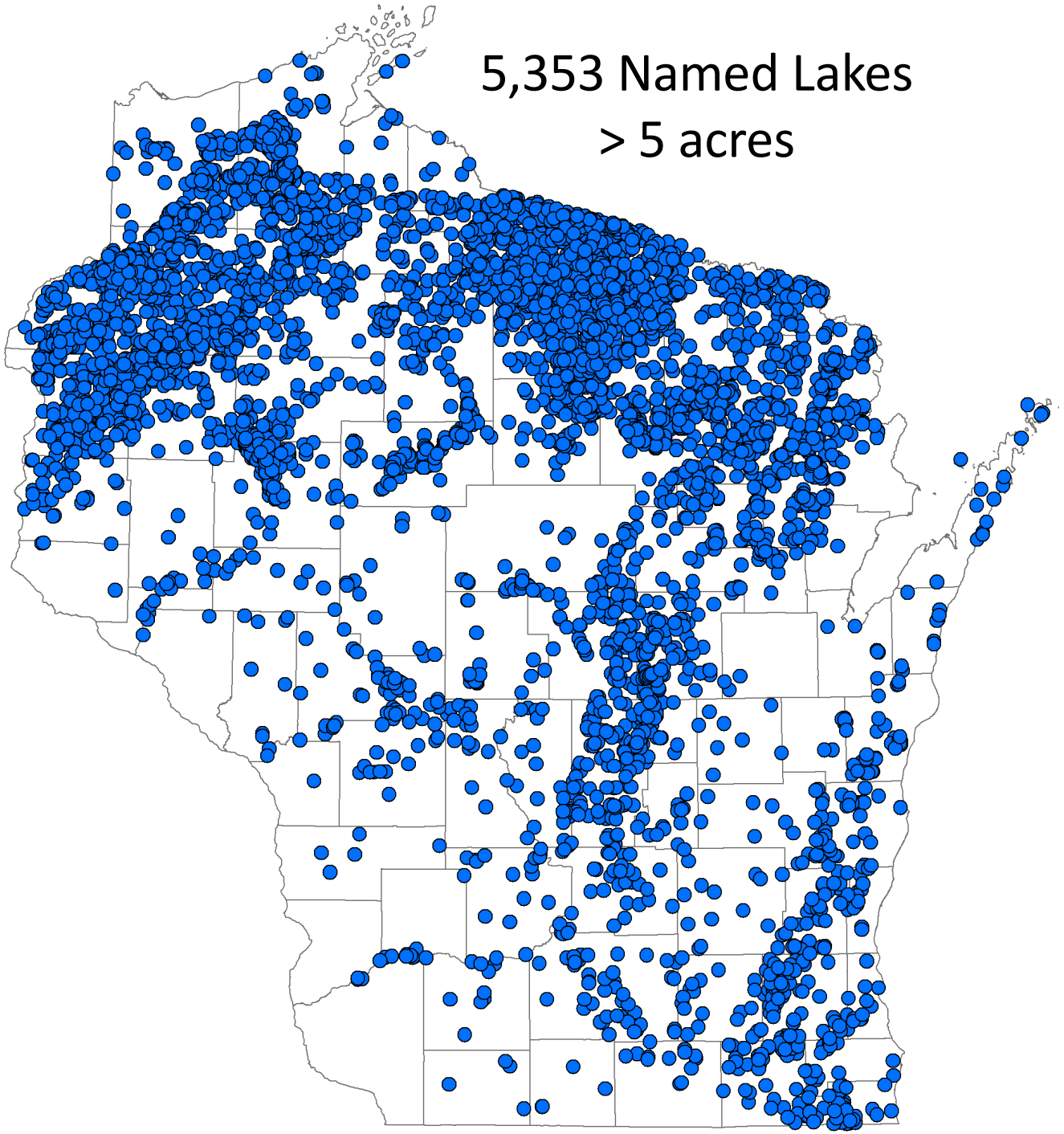
- 23 square miles
- 187 farms
- 1,129 fields

EVAAL

Erosion Vulnerability Assessment for Agricultural Lands

http://dnr.wi.gov/topic/nonpoint/evaal.html




5,353 Named Lakes
> 5 acres

Identification

Morphometry

Hydrology

Watershed

Phosphorus Load

Field	Value	Description
WBIC	805400	water body identification code (primary ID)
HYDROID	600091109	water body ID code in DNR hydrography database
OFFICIAL_NAME	Lake Mendota	official name
LOCAL_NAME	Fourth Lake, Lake Mendota 254	local name (if applicable)
WATERBODY_TYPE	LAKE OR POND	waterbody type (lake/pond or reservoir/flowage)
COUNTY	Dane	county where largest fraction of lake is located

Identification

Morphometry

Hydrology

Watershed

Phosphorus Load

Field	Value	Description
LAKE_AREA_ACRES	9,781	lake surface area (acres)
MAX_DEPTH_FT	83	maximum lake depth (ft) (95% of lakes)
MEAN_DEPTH_FT	42	mean lake depth (ft) (30% of lakes)
VOLUME_ACRE_FT	413,231	lake volume (acre-ft) (27% of lakes)

Field	Value	Description
Q_MEAN_CFS	130	mean annual discharge into lake (cfs) predicted by regression model
RESIDENCE_TIME_LOW_DAY*	1,000	mean summer (June-Sept) water residence time (days), lower 90% confidence limit
RESIDENCE_TIME_MED_DAY*	1,600	mean summer (June-Sept) water residence time (days), median estimate
RESIDENCE_TIME_HIGH_DAY*	2,400	mean summer (June-Sept) water residence time (days), upper 90% confidence limit

*drainage lakes only (31%)

Field	Value	Description
DRAINAGE_AREA_ACRES	149,247	lake drainage area (acres), includes lake area and internally drained areas that do not drain to another water body > 5 acres or a stream
NPS_ACRES_RURAL_RES	23,639	area of rural residential land cover (categories 21 and 22) in NLCD 2006 (acres)
NPS_ACRES_MED_URB	4,709	area of medium density urban land cover (category 23) in NLCD 2006 (acres)
NPS_ACRES_HIGH_URB	1,200	area of high density urban land cover (category 24) in NLCD 2006 (acres)
NPS_ACRES_PAST_GRASS	28,588	area of pasture/grassland land cover (categories 52, 71, 81) in NLCD 2006 (acres)
NPS_ACRES_ROW_CROP	68,202	area of cropland land cover (category 82) in NLCD 2006 (acres)
NPS_ACRES_FOREST	6,758	area of forest land cover (categories 41, 42, 43) in NLCD 2006 (acres)
NPS_ACRES_WETLAND	5,116	area of wetland land cover (categories 90 and 95) in NLCD 2006 (acres)
NPS_ACRES_WATER	10,907	area of open water (category 11) in NLCD 2006 (acres)
RIP_GRASS_PCT	19.2	percent pasture/grassland land cover (categories 52, 71, 81) within 60 m of streams in NLCD 2006
DRAINAGE_DENSITY	0.57	total tributary stream length / drainage area (km/km^2)

Identification

Morphometry

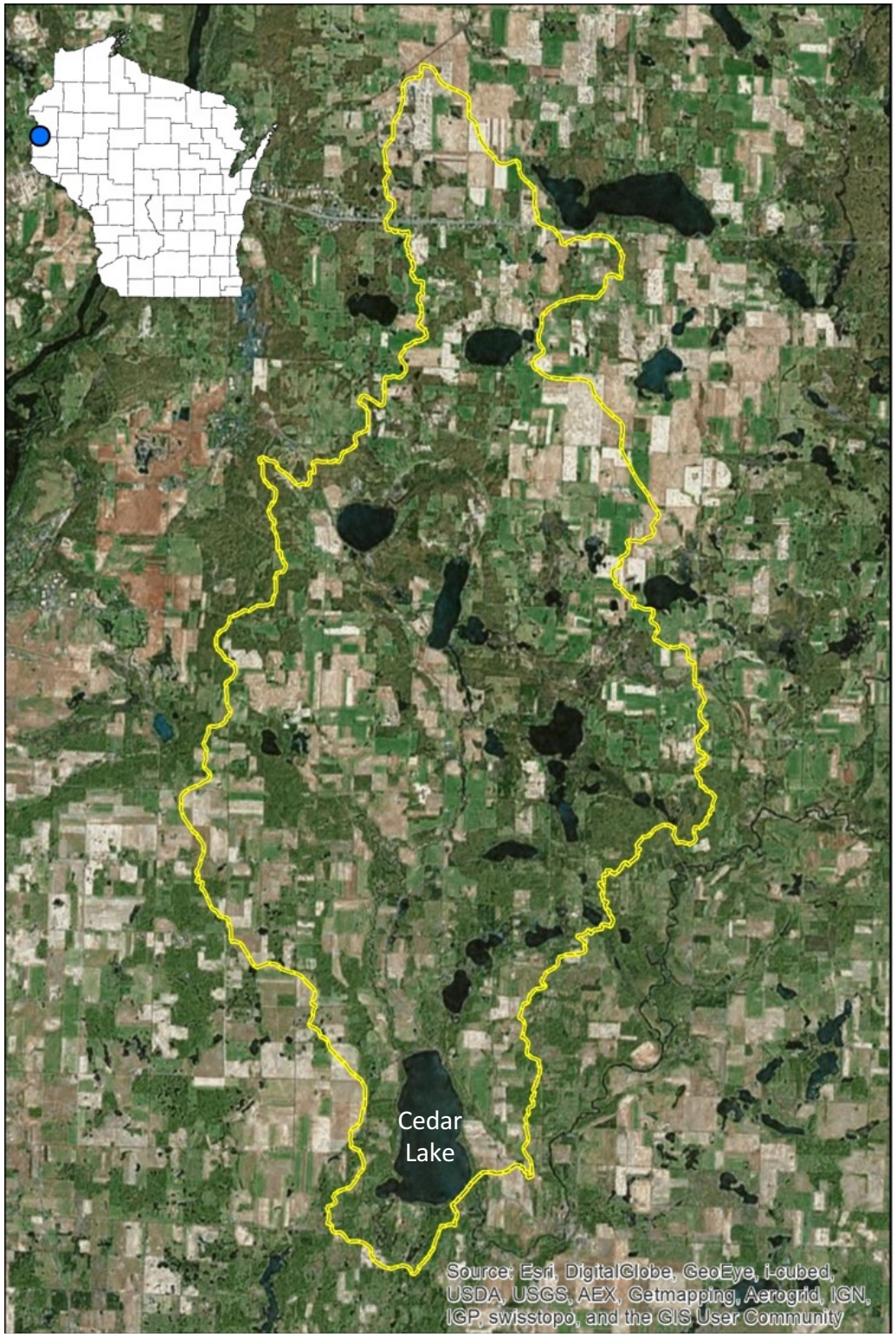
Hydrology

Watershed

Phosphorus Load

Field	Value	Description
P_LOAD_MR1_LOW*	36,646	average annual total phosphorus load (lbs) to lake predicted by regression model #1, lower 90% confidence limit (PRESTO)
P_LOAD_MR1_MED*	89,874	average annual total phosphorus load (lbs) to lake predicted by regression model #1, most likely value (PRESTO)
P_LOAD_MR1_HIGH*	220,416	average annual total phosphorus load (lbs) to lake predicted by regression model #1, upper 90% confidence limit (PRESTO)
P_LOAD_MR2_LOW*	12,407	average annual total phosphorus load (lbs) to lake predicted by regression model #2, lower 90% confidence limit (PRESTO)
P_LOAD_MR2_MED*	35,810	average annual total phosphorus load (lbs) to lake predicted by regression model #2, most likely value (PRESTO)
P_LOAD_MR2_HIGH*	103,360	average annual total phosphorus load (lbs) to lake predicted by regression model #2, upper 90% confidence limit (PRESTO)
P_LOAD_EC_LOW	36,906	average annual total phosphorus load (lbs) to lake predicted by land cover export coefficients, low estimate
P_LOAD_EC_MED	75,320	average annual total phosphorus load (lbs) to lake predicted by land cover export coefficients, median estimate
P_LOAD_EC_HIGH	207,875	average annual total phosphorus load (lbs) to lake predicted by land cover export coefficients, high estimate

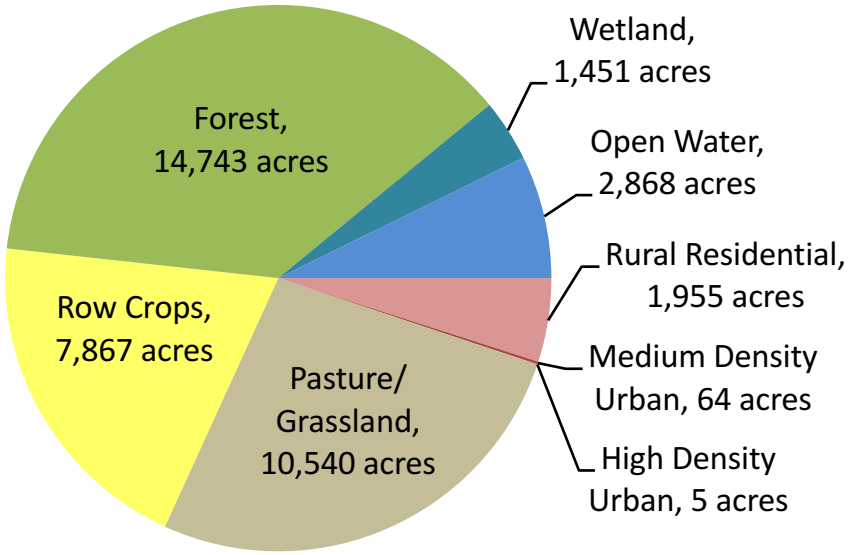
*drainage lakes with drainage density >0.3 and <1.7 (18%)



Cedar Lake

Polk County

WBIC	2615100
Surface area	1,120 acres
Max depth	32 ft
Mean outflow	33.7 cfs
Summer water residence time	280 days
Drainage area	39,495 acres
Phosphorus load (most likely)	13,600 lb/yr
Phosphorus load (range)	6,300 - 35,000 lb/yr



Advice and Limitations

- Read documentation linked to spreadsheet for more details.
- Watershed boundaries include internally drained areas.
- Phosphorus loads and water residence time are estimates – pay attention to confidence intervals.
- If you have tributary monitoring data, find a way to use it to estimate loads.
- When using these data in eutrophication models, assess the sensitivity of results to uncertainty in variables.

Data Access

- Spreadsheet: http://dnr.wi.gov/topic/surfacewater/models.html
- Surface Water Data Viewer: http://dnrmaps.wi.gov/sl/?Viewer=SWDV

  Water Resources -> WI Hydro Data-Plus Catchments
- Water Condition Viewer: http://dnr.wi.gov/topic/surfacewater/wcv/
- Watershed Restoration Viewer: http://dnr.wi.gov/topic/surfacewater/restorationviewer/
- Geodatabase: ftp://dnrftp01.wi.gov/geodata/hydro_va_24k/

  Spatial data and many other attributes (requires GIS software)

Questions: matthew.diebel@wisconsin.gov