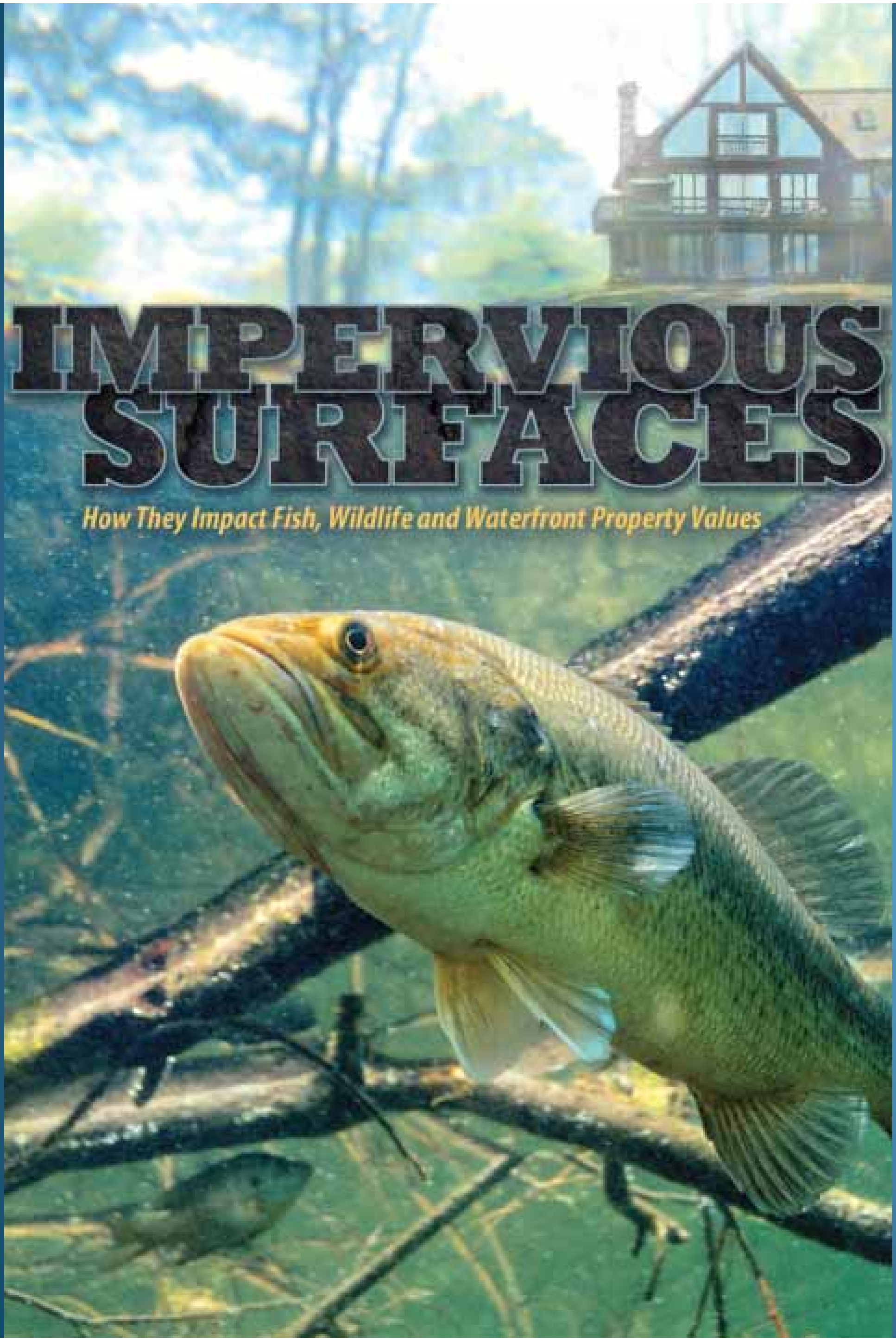


Wisconsin Lakes Convention
April 11, 2013

Mike Meyer

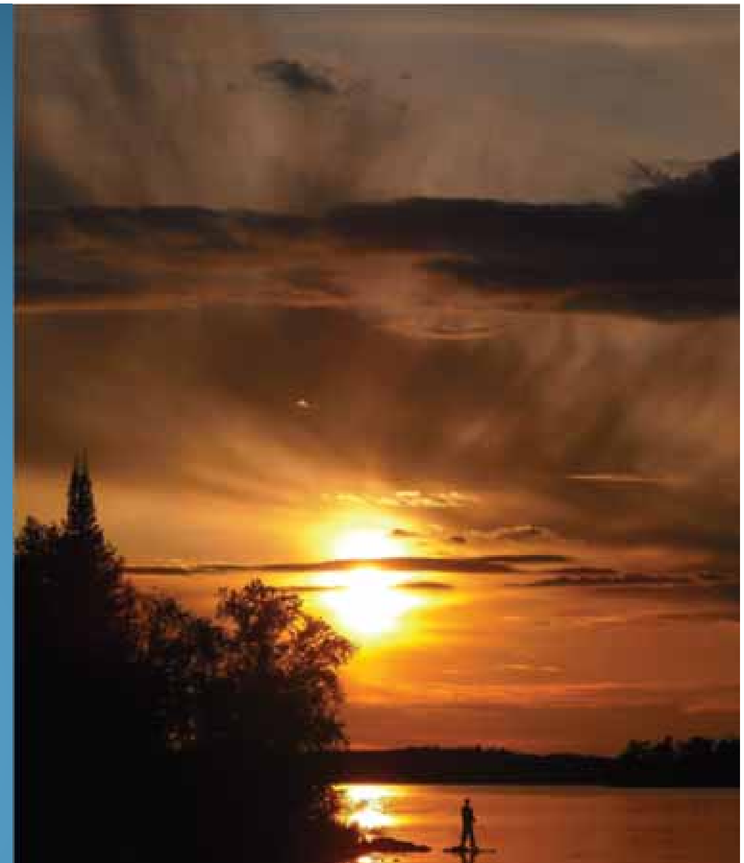
WISCONSIN DEPT. OF NATURAL RESOURCES

Lynn Markham
UW-Extension

Center for Land Use Education

Healthy lakes and rivers are the basis for creating fond memories of time spent near the water

Healthy fish, abundant wildlife and clear water all depend on how waterfront properties are developed

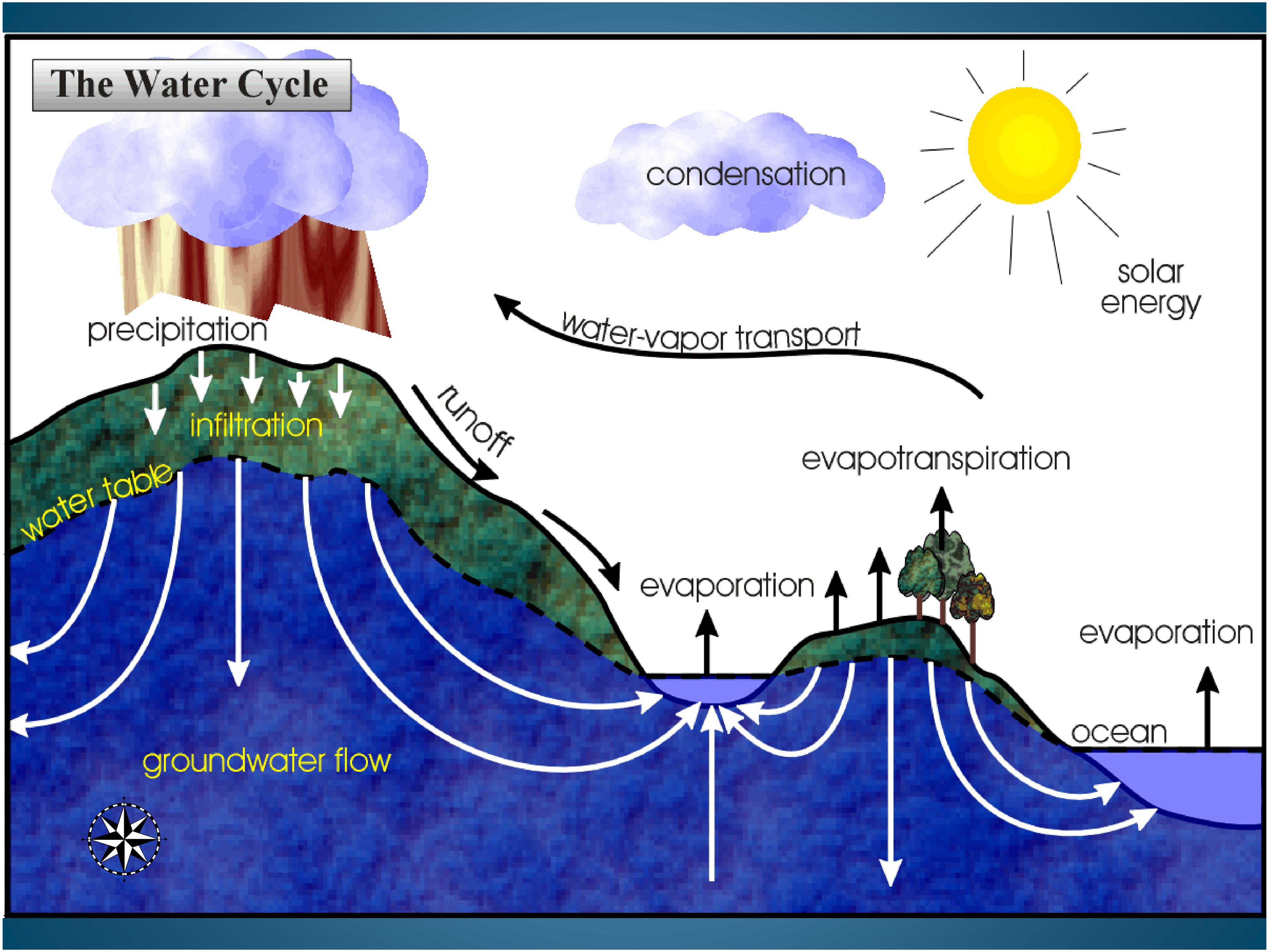


How do impervious surfaces IMPACT lakes and streams?

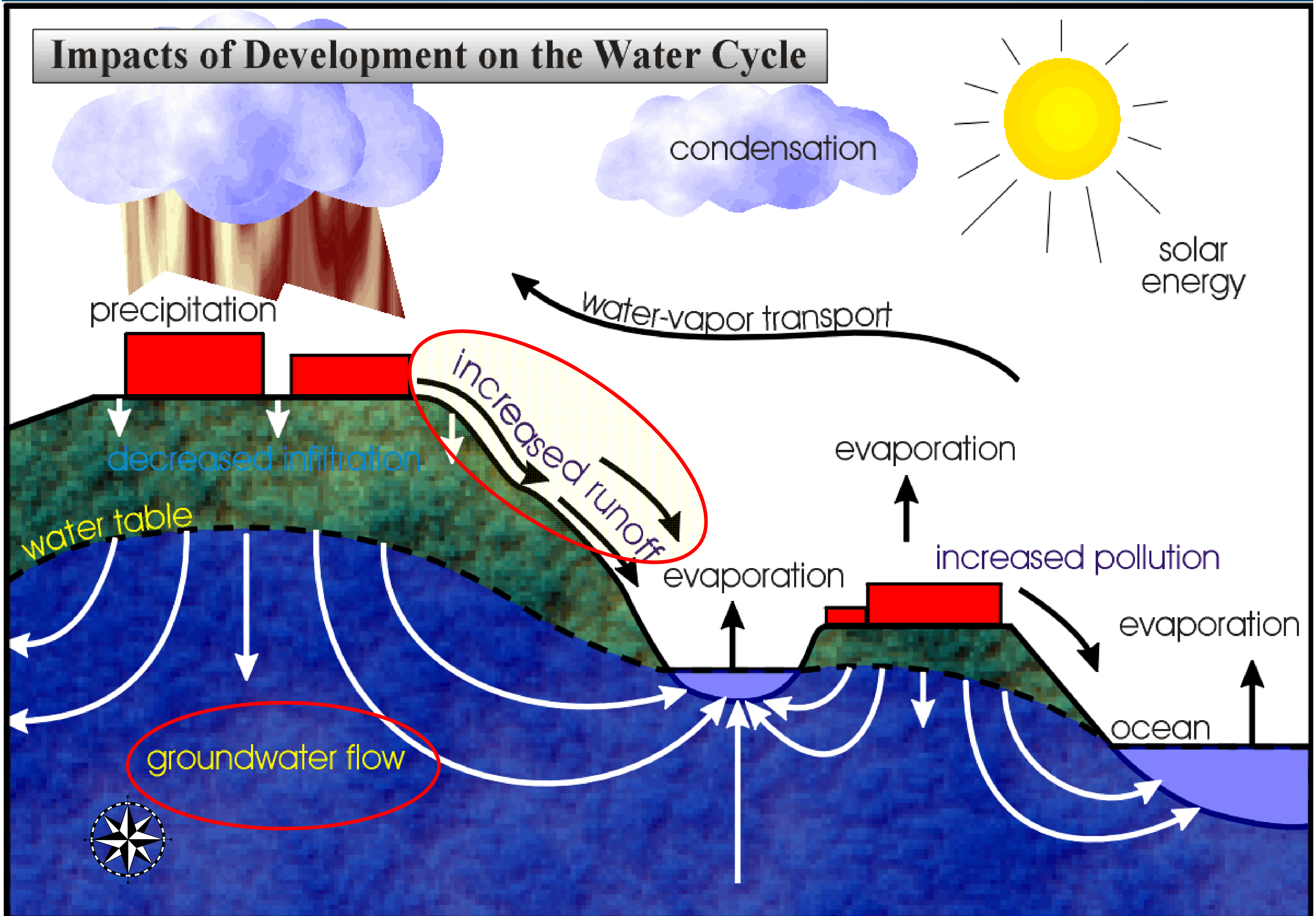
This publication was developed for waterfront property owners and local officials, and focuses on impacts to:

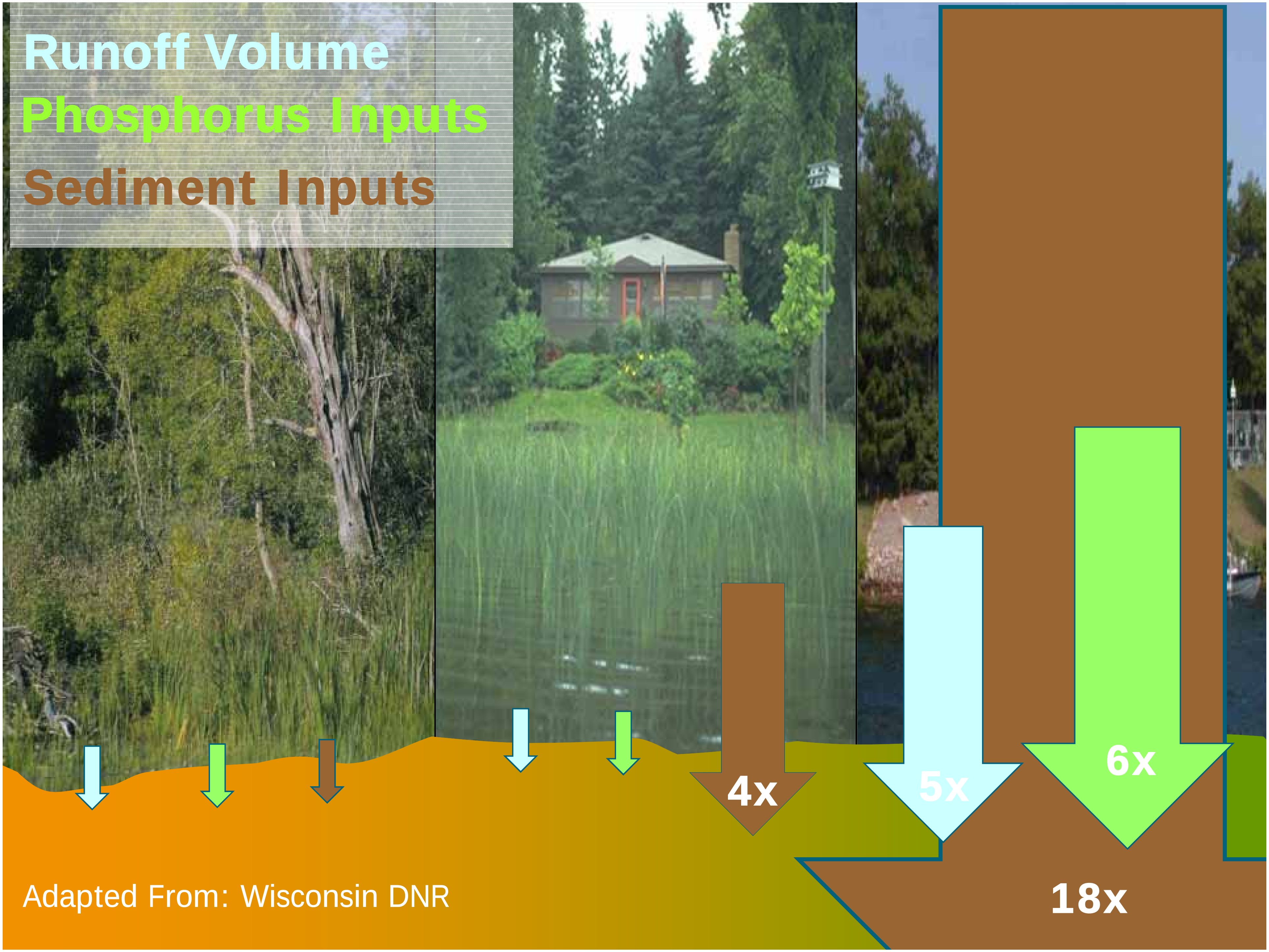
1. Fishing
2. Wildlife
3. Waterfront property values

Impervious surfaces


The Water Cycle
condensation
solar energy
precipitation
water-vapor transport
runoff
infiltration
water table
evapotranspiration
evaporation
evaporation
ocean
groundwater flow

Impacts of Development on the Water Cycle




Runoff Volume
Phosphorus Inputs
Sediment Inputs
4x
5x
6x
18x
Adapted From: Wisconsin DNR

Water quality & economics
Is there a connection?

"More polluted lakes have less valuable property than do cleaner lakes."

E.L. David, *Water Resources Research*, 1968

Water quality & economics

- A study of over 1200 waterfront properties in Minnesota found when water clarity changed by 3 feet changes in property prices for these lakes are tens of thousands to millions of dollars.

Krysel et al, 2003.

Healthy watersheds make healthy lakes & higher property values

- If water quality erodes, then the tax base around lakes erodes too
- *If waterfront property values and property taxes go down, whose taxes will go up to maintain county services?*

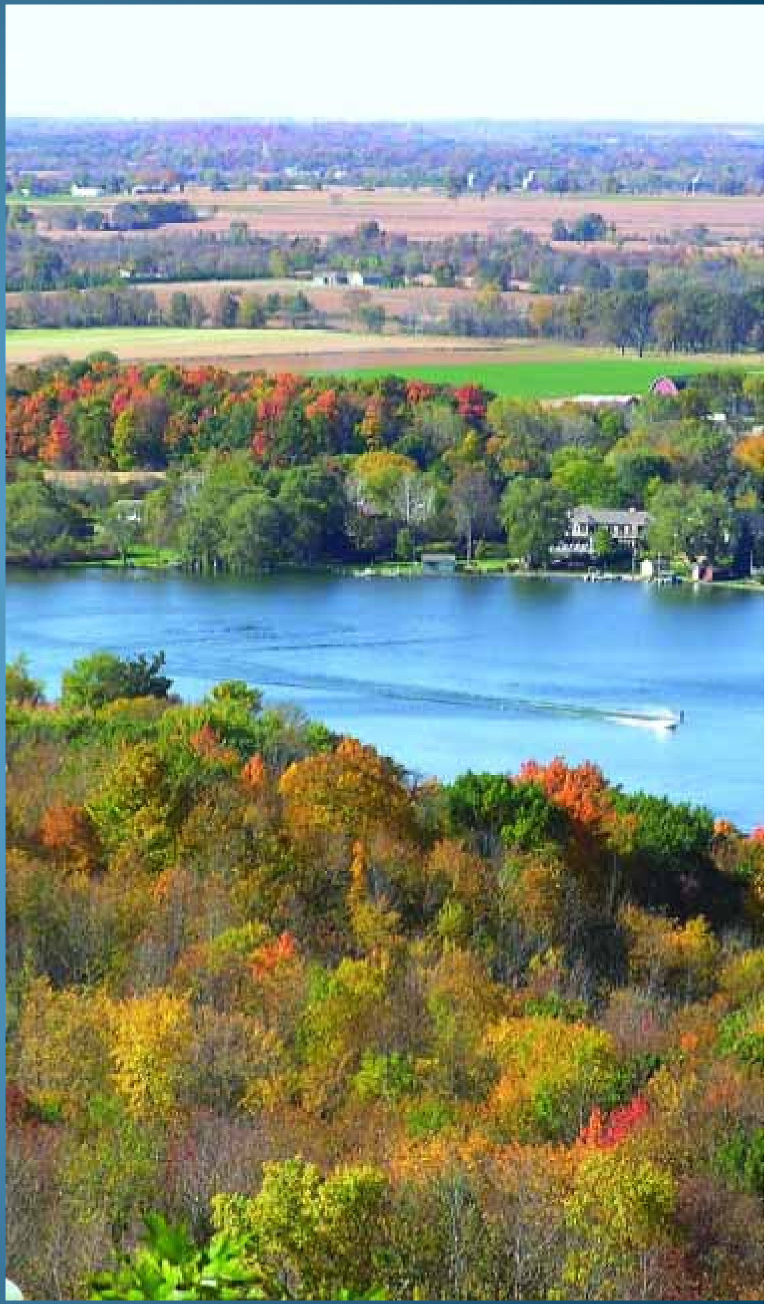


Figure 3

More Impervious Surfaces in Watershed →

Fish found in streams when impervious surface in the watershed was:

Less than 8%	8 - 12%	Greater than 12%
Iowa darter Black crappie Channel catfish Yellow perch Rock bass Horneyhead chub Sand shiner Southern redbelly dace		
Golden shiner Northern pike Largemouth bass Bluntnose minnow Johnny darter Common shiner	Golden shiner Northern pike Largemouth bass Bluntnose minnow Johnny darter Common shiner	
Creek chub Fathead minnow Green sunfish White sucker Brook stickleback	Creek chub Fathead minnow Green sunfish White sucker Brook stickleback	Creek chub Fathead minnow Green sunfish White sucker Brook stickleback

2008 study of 164 WI lakes found the same trend

Fewer species of fish →

Figure 3: The number of different stream fish species found in streams declines as the effects of impervious surfaces kill off more sensitive species.[9]

More impervious surfaces reduce fish because:

- **More runoff = less base flow and increased temps**
- **More nutrients** result in less oxygen in the water, which fish need to survive
- **More sediments** and algae growth make it difficult for some predator species that hunt by sight to find their food
- **More sediments** cover spawning beds of fish such as smallmouth bass and walleye, depriving eggs of oxygen

Brook Trout and Brown Trout

- Require cold, clean, high-oxygen water to survive
- Sensitive to pollution and low oxygen conditions
- Part of their diet consists of aquatic insects and small fish, whose populations decrease with increased runoff and sedimentation
- A study conducted on 33 cold water streams in Wisconsin and Minnesota found that when impervious surfaces covered more than 11% of a watershed, trout were eliminated from streams

Walleye

- Walleye typically spawn between mid-April and early May in WI when spring runoff is highest. Rock- and gravel-covered bottoms are their preferred spawning grounds.
- Impervious surfaces can cause soil erosion which leads to sedimentation. When the spaces between the rocks and gravel become blanketed with silt, walleye eggs can die quickly due to lack of oxygen.
- Adult walleyes are often able to cope under these conditions, but harming the success of eggs puts the survival of a healthy walleye population at risk.

- Impervious surfaces can be thought of as biological deserts where animals cannot find food or shelter, making them easy prey.

- Disturbed open spaces increase wildlife mortality rates and decrease their chances of successfully raising young.

Wisconsin Loons More Likely Found on Lakes with Good Water Clarity

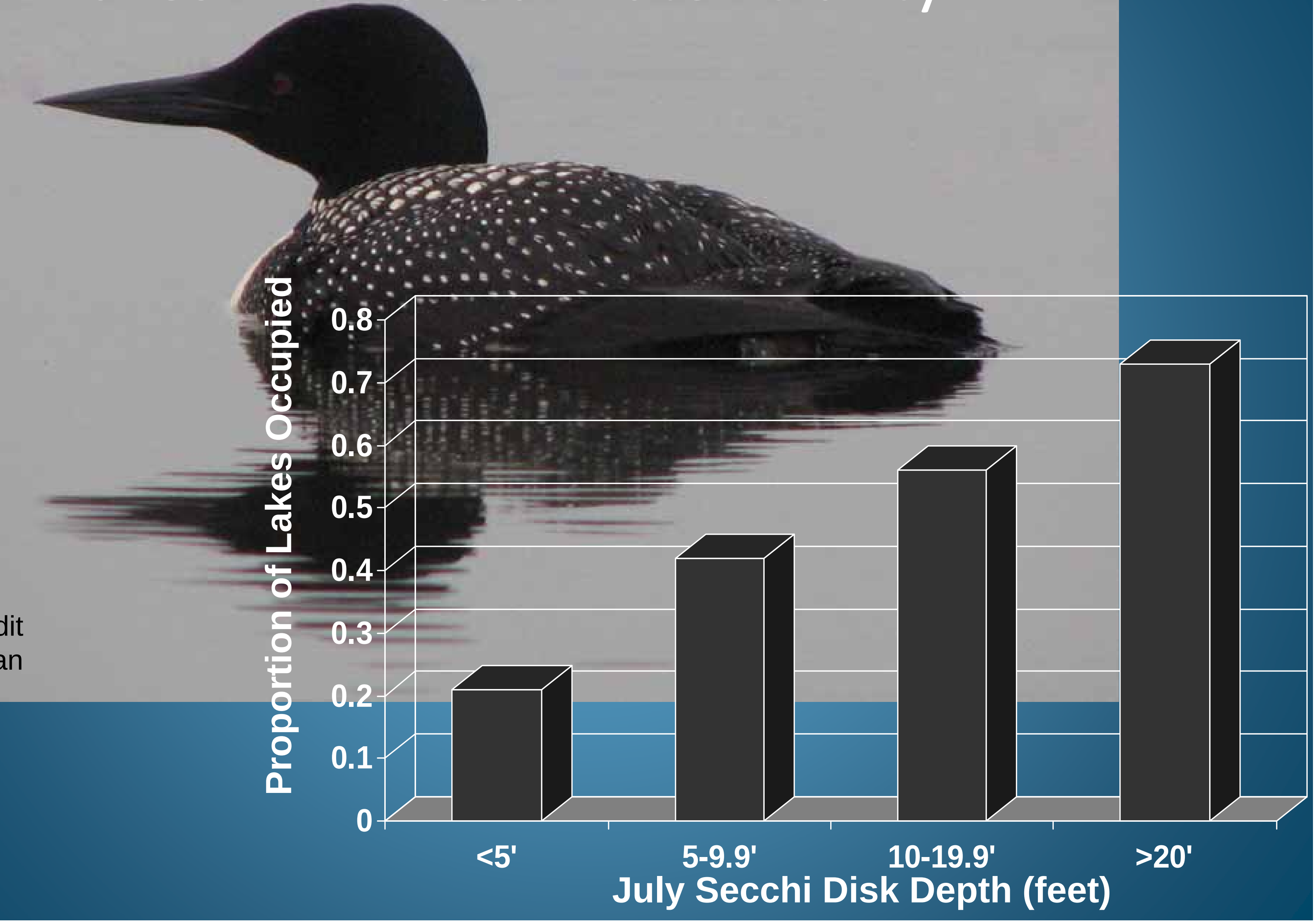


Photo credit
Doug Killian

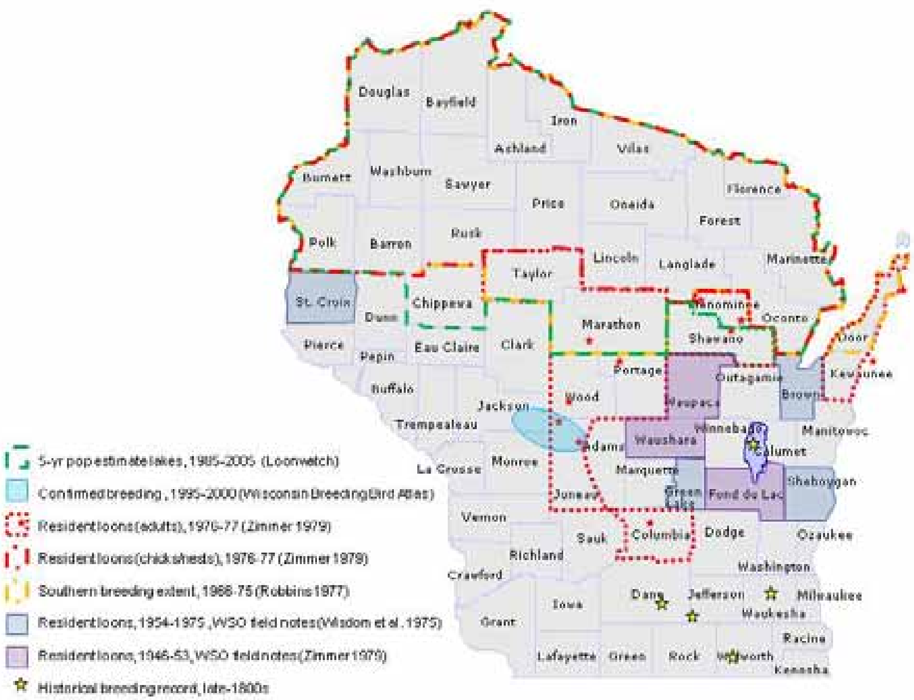
Common Loon

- Loons have been pushed northward, in part due to the effects of shoreland development.

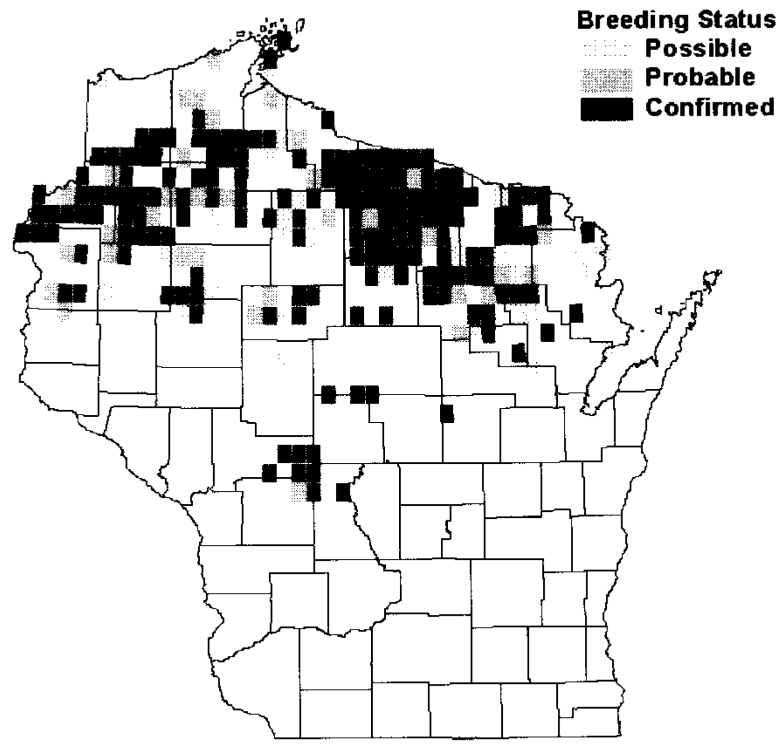
- Loons nest at the water's edge where they share incubation duties for 30 days. The presence of a safe, secure, undisturbed location to nest along the lake shoreline or on an island is a critical requirement for breeding loons in Wisconsin.

Historical accounts and current Wisconsin Breeding Bird Atlas show WI common loon breeding distribution has shifted north

Historic Distribution of Nesting Common Loons



Current Distribution of Nesting Loons



Max Breeding Status	# Quads	# Priority Blocks	# Total Blocks
Confirmed	162	99	228
Probable	34	40	59
Possible	30	26	93
Species Total	**226**	**165**	**380**
Total in Atlas	1132	1041	3853
Species Percentage	**19.96**	**15.85**	**9.86**

Species Total is the sum of all quads/priority blocks/total blocks the species was recorded in with at least a Possible breeding status. Total in Atlas is the number of quads/priority blocks/total blocks in the atlas with data (regardless of species). Species Percentage is the Species Total quads/priority blocks/total blocks divided by the Total in Atlas quads/priority blocks/total blocks.

Table 4–2. Historic (late-1800s) and recent (2007-2011) total phosphorus concentrations, Secchi readings, and trophic states of southern Wisconsin lakes that historically supported breeding common loons based on paleolimnological assessment estimates and recently measured values.

Lake	Core collected	Total phosphorus (µg L^{-1}) Historic level	Recent level[b]	Secchi reading (m) Recent level[b]	Trophic State Index (TSI_{TP})[c] Historic	Recent	Trophic class shift Historic → Recent
Delavan	no	15-20[a]	25-30	1.9-2.9	43-47	51-53	mesotrophic → eutrophic
Island	yes	na	na	na	-		-
Five	no	na	14-31	2.5-4.0	-	42-54	-
Koshkonong	no	na	104-492	0.3-0.5	-	71-94	-
Mendota	yes	15-20[a]	22-75	1.2-2.8[d]	43-47	49-65	mesotrophic → eutrophic
Monona	no	15-20[a]	30-94	1.2-1.8	43-47	53-70	mesotrophic → eutrophic
Winnebago	yes	40-50[a]	93-213	0.5-1.2	57-61	70-81	eutrophic→ hypereutrophic
Pewaukee	yes	20	14-22	0.5-1.1	47	42-49	mesotrophic→ mesotrophic

[a]Garrison et al. 2008.
[b]Source: Wisconsin DNR Surface Water Integrated Monitoring System average annual summertime records for 2007-2011.
[c]Calson Trophic State Index (Carlson 1977) based on total phosphorus concentration.
[d]Source: North Temperate Lakes Long Term Ecological Research program (*http://lter.limnology.wisc.edu*), NSF, Center for Limnology, University of Wisconsin-Madison.

Table 4–3. Change in land use from the time of the original Wisconsin land use survey (ca 1830) to current (2006) land cover within drainage areas of lakes that historically supported breeding common loons.

Lake	Drainage area (km^2)	Open water 1830	2006	Δ	Wetland 1830	2006	Δ	Forest 1830	2006	Δ	Herbaceous 1830	2006	Δ	Cultivated 1830	2006	Δ	Developed 1830	2006	Δ
Delavan	81,080	9.2	8.9	-0.3	2.0	1.4	-0.6	46.6	8.0	-38.6	42.2	1.1	-41.1	0	62.0	+62.0	0	18.6	+18.6
Island	75,558	0.2	1.4	+1.2	7.9	3.9	-4.0	73.9	8.1	-65.8	17.9	0.6	-17.3	0	70.4	+70.4	0	14.8	+14.8
Five	108,179	3.6	4.4	+0.8	10.3	10.3	0	42.5	15.9	-26.6	43.6	0.4	-43.2	0	33.2	+33.2	0	33.8	+33.8
Koshkonong	143,923	28.0	29.3	+1.3	7.7	9.7	+2.0	14.6	10.5	-4.1	49.7	0.6	-49.1	0	43.6	+43.6	0	5.3	+5.3
Mendota	82,276	41.6	44.4	+2.8	4.4	2.1	-2.3	51.8	6.7	-45.1	2.1	<0.1	-2.1	0	7.4	+7.4	0	39.2	+39.2
Monona	110,332	13.2	13.6	+0.4	19.2	6.9	-12.3	62.6	7.1	-55.5	5.0	<0.1	-5.0	0	14.0	+14.0	0	58.3	+58.3
Winnebago	478,384	97.8	99.8	+2.0	0.4	<0.1	-0.4	1.5	<0.1	-1.5	0.3	<0.1	-0.3	0	<0.1	0	0	<0.1	0
Pewaukee	89,242	9.8	10.1	+0.3	16.7	3.7	-13.0	18.6	13.8	-4.8	54.8	0.3	-54.5	0	27.6	+27.6	0	44.3	+44.3

Table 4–4. Lakeshore house density (2006) within 100 m buffer of southern Wisconsin lakes that historically supported breeding common loons.

Lake	Number of houses	Perimeter (km)	House density/ km shoreline
Delavan	492	26.1	18.8
Island	4	4.2	1.0
Five	45	3.3	13.5
Koshkonong	410	48.4	8.5
Mendota	699	38.4	18.2
Monona	813	27.1	30.0
Winnebago	3,592	181.2	19.8

From Kenow et al. 2013
Chapter 4, Focus on Energy
08-06 Grant Report

Project Title: Potential effects of climate change on inland glacial lakes and implications for lake-dependent biota in Wisconsin

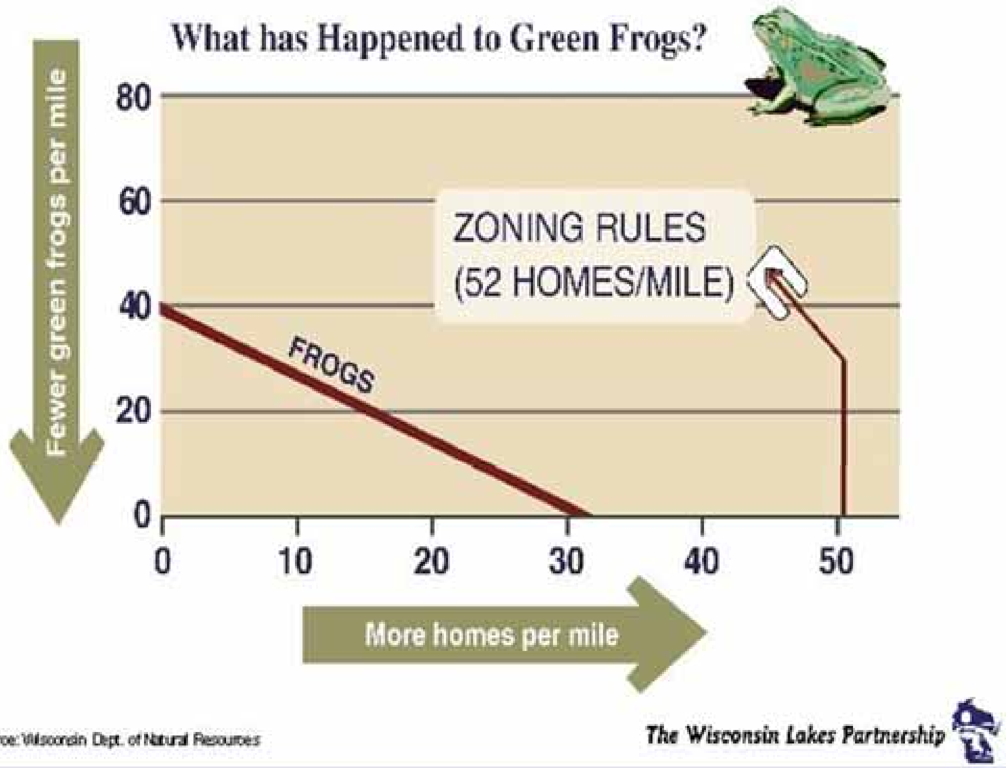
Green frog numbers are lower on developed lakes in northern Wisconsin

From: Woodford, JE and Meyer, MW (2002) Biological Conservation. 110(2):277-284.

Table 2
A comparison of lake attributes (physical characteristics), house and cottage density, green frog abundance, habitat fragmentation, and amphibian species richness among 12 developed and 12 undeveloped lakes in northern Wisconsin

	Developed lakes ($n = 12$)	Undeveloped lakes ($n = 12$)	Paired t-test ($t =$)	P-value
Lake area (ha)	46.7 (range = 11.2–160.0)	46.5 (range = 6.4–144.8)	0.09	NS
PH	6.8 (range = 5.3–7.8)	6.8 (range = 5.7–7.5)	0.21	NS
Alkalinity (ppm)	11.5 (range = 1.0–48.0)	13.1 (range = 1.0–57.0)	0.08	NS
Total shoreline perimeter sampled (km)	43.3	44.9	0.51	NS
House or cottage density (per 100 m of shoreline)	1.3 (0.48)	0.179(0.24)	8.56	<0.001
Green frog population (per 100 m of shoreline)	1.02 (1.66)	2.3 (2.06)	2.77	0.02
Suitable habitat (%)	0.66 (0.23)	0.82 (0.20)	2.83	<0.02
Green frog population (per 100 m of habitat)	1.49 (1.03)	2.60 (1.92)	2.24	<0.05
Habitat fragmentation D (ln$D$)	23.42 (1.77)	22.24 (2.66)	2.47	<0.05
Amphibian species richness	5.08 (1.44)	5.08 (1.16)	0.01	NS

NS = not significant.



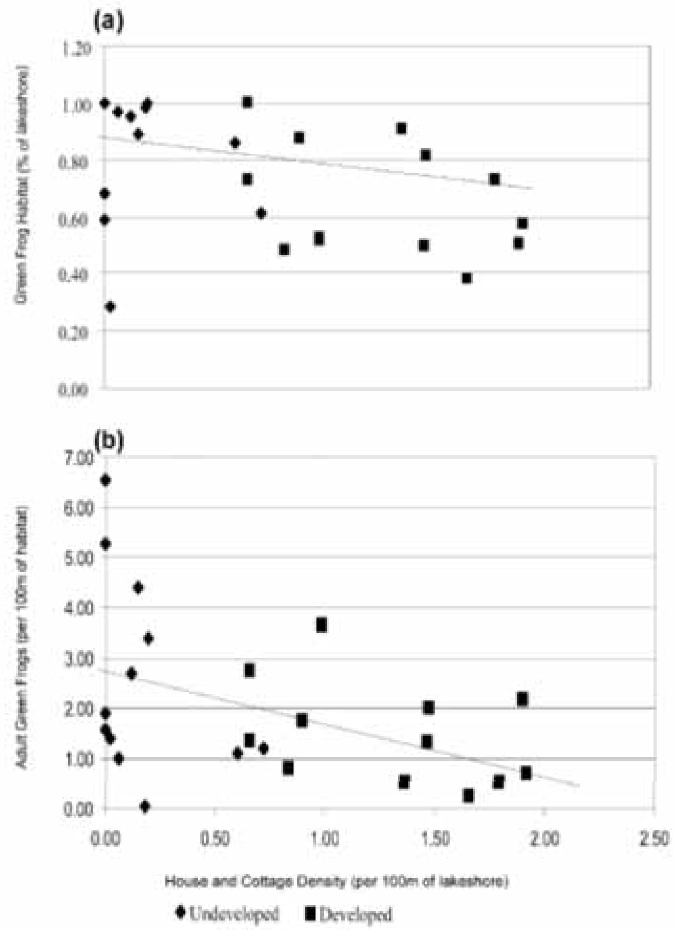


Fig. 3. "Best fit" models from linear regression for decreasing (a) green frog habitat ($y = -0.14x + 0.845$; $P < 0.05$) and (b) adult abundance ($y = -1.08x + 2.838$; $P < 0.05$) at developed and undeveloped lakes as shoreline house and cottage density increased.

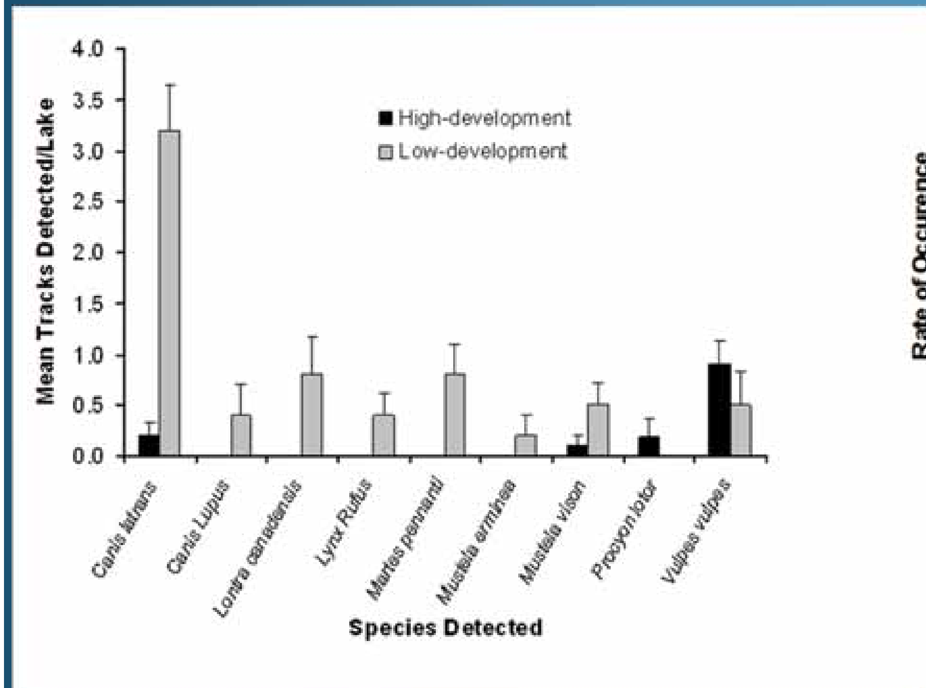
Carnivore diversity is lower on developed lakeshores in Vilas County, Wisconsin

From: Haskell, D.et al. (2012) American Midland Naturalist

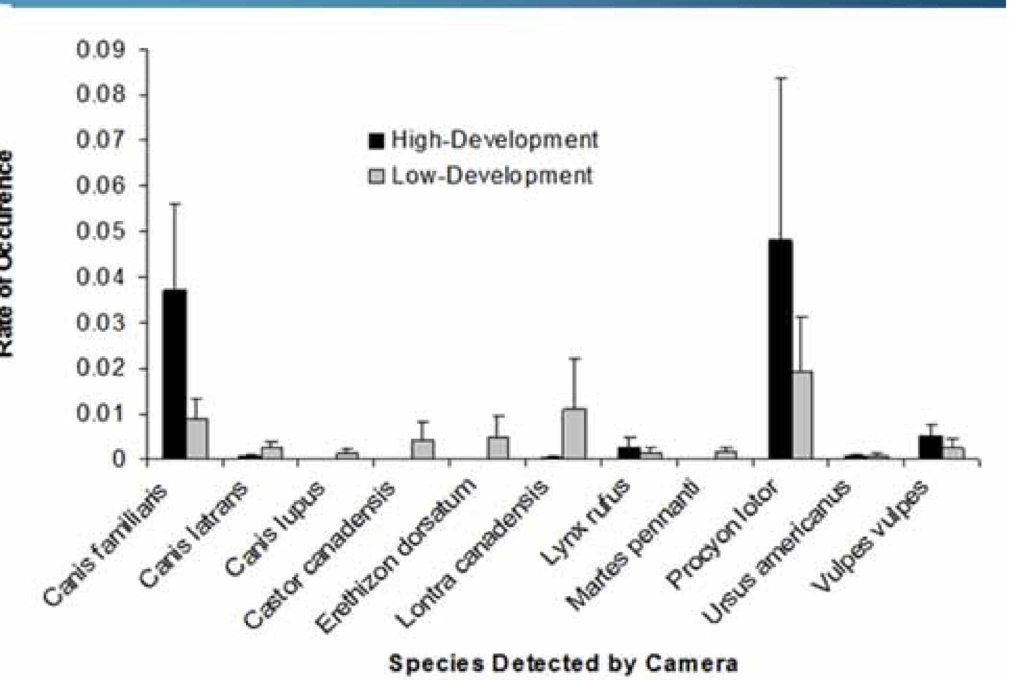
Relationship between Carnivore Distribution and Landscape Features in the Northern Highlands Ecological Landscape of Wisconsin.

From: Haskell et al. 2012. American Midland Naturalist.

Snow Tracks



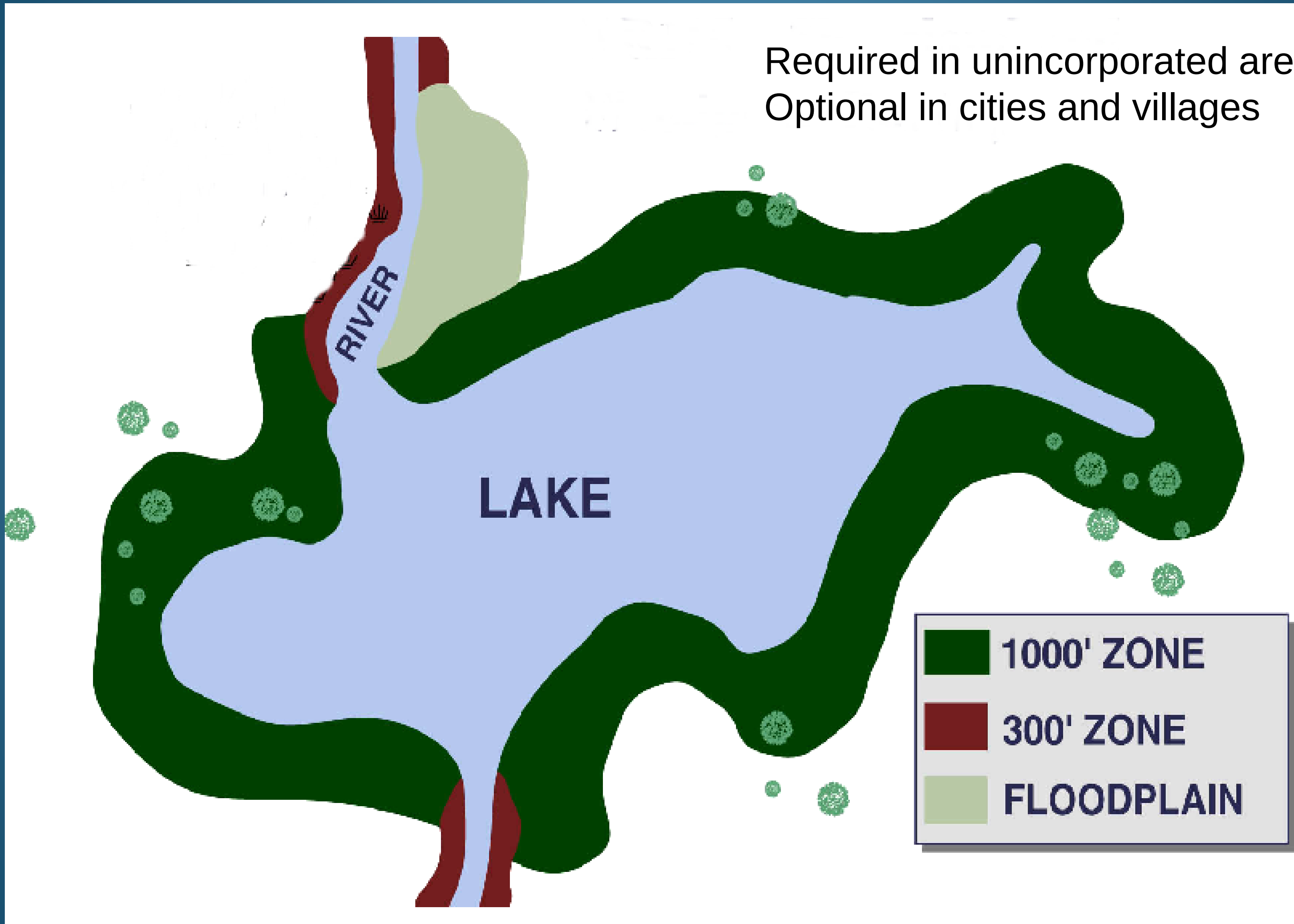
Camera



Our results suggest that a higher diversity of carnivores (P = 0.006) were present on low-development lakes. Coyotes (Canis latrans) were detected most frequently (n = 34) especially on low-development lakes. Fishers (Martes pennanti), wolves (Canis lupus), bobcats (Lynx rufus), and northern river otters (Lontra canadensis) were exclusively detected on low-development lakes by snow track surveys. Raccoons (Procyon lotor) and red fox (Vulpus vulpus) detection was greater on higher-development lakes than low-development lakes.

Shoreland zoning applies near lakes & rivers

Required in unincorporated areas
Optional in cities and villages



The Wisconsin Lakes Partnership

Purposes of shoreland zoning include…

- Prevent and control water pollution
- Protect spawning grounds, fish and aquatic life
- Reserve shore cover and natural beauty

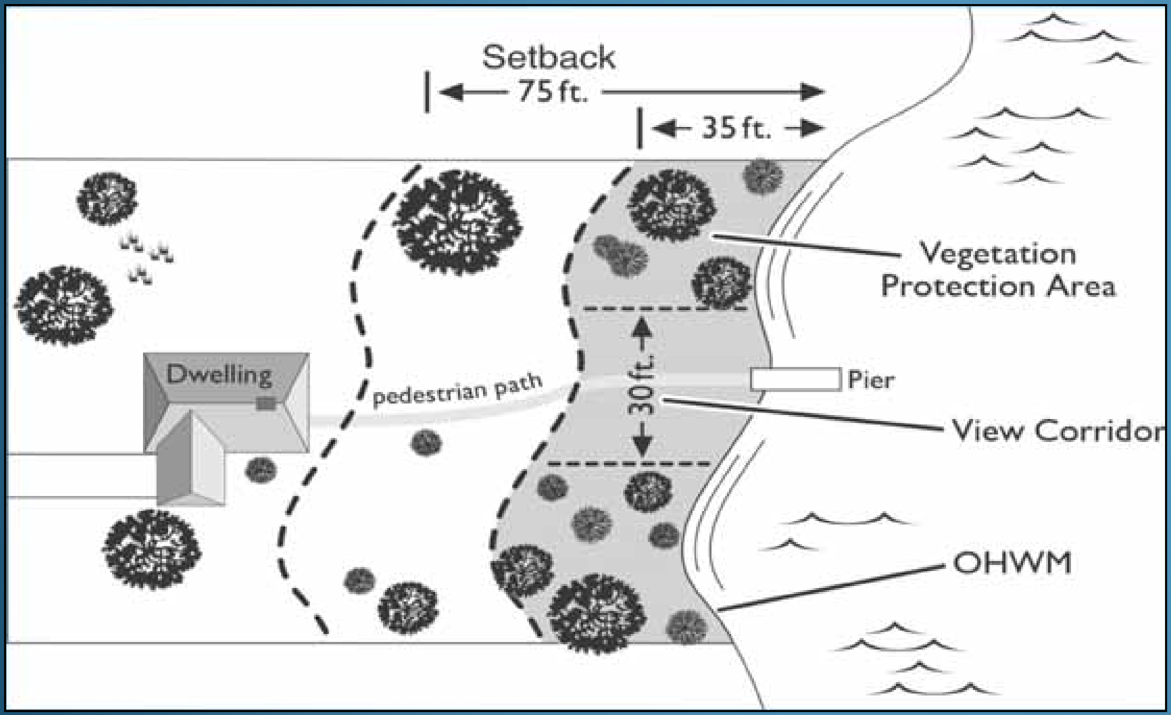
SHORELAND ZONING is in place to protect our lakes and rivers.

- Wisconsin Administrative Code NR 115 provides minimum standards for shoreland zoning.
- Many counties have chosen to adopt more protective standards.

With shoreland zoning

Without shoreland zoning

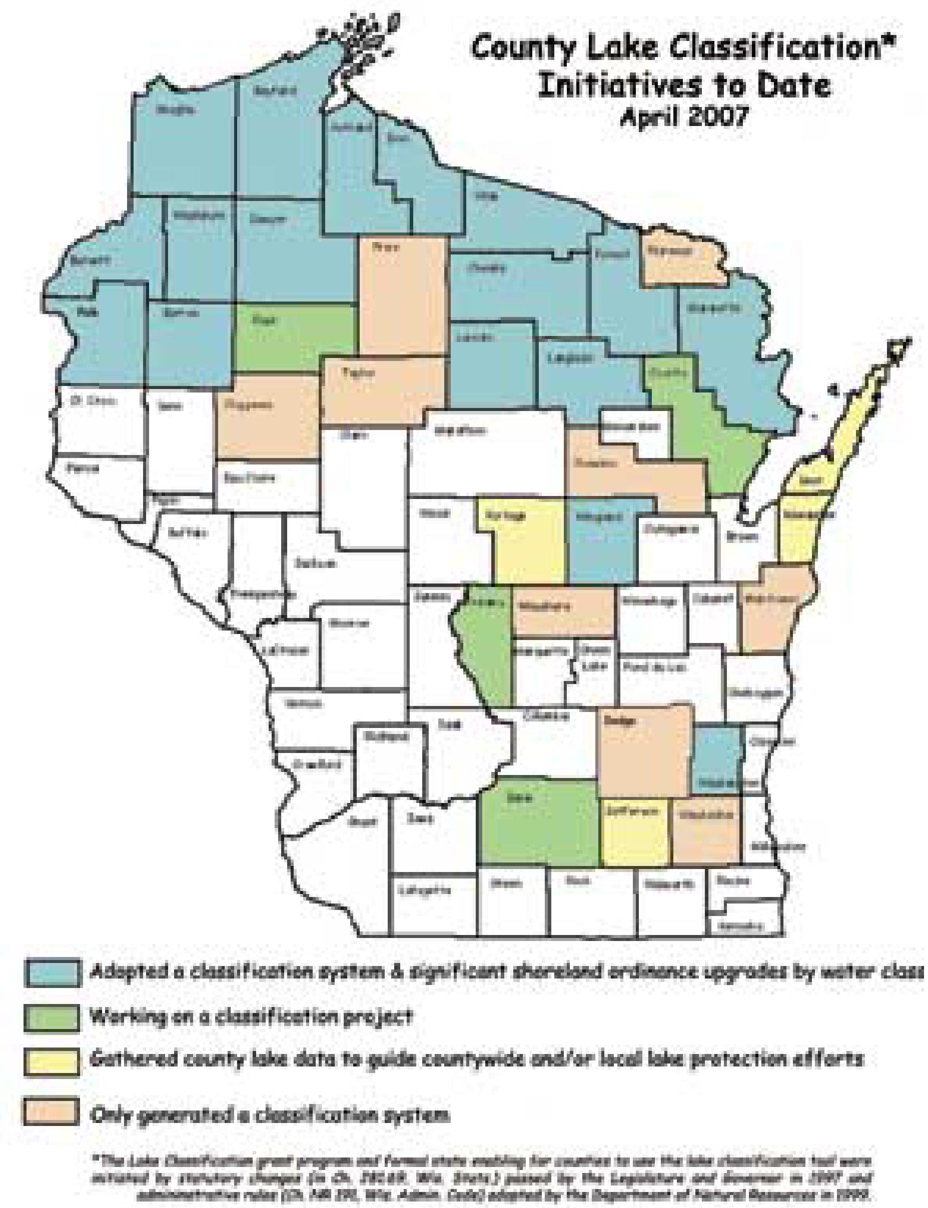
Minimum WI shoreland standards



- Adopted in 1966
- Lot size
- Vegetation protection area (buffer)
- Shoreline setback
- Impervious surface limit

Counties going beyond 1966 law

- Scientific studies continued
- Counties recognized inadequacies
- Adopted higher standards
  - 16 counties adopted impervious surface standards



Map by Wisconsin Lakes

State shoreland zoning rule - NR 115

- Fall 2009 – After an eight year public participation process to revise NR 115, consensus reached by the WI Realtors Assn, WI Builders Assn, WI Lakes and River Alliance. Approved by the WI Natural Resources Board.

- Feb. 1, 2010- Counties given two years to update shoreland zoning ordinances to meet new rule. Later, another 2 years given for counties to update – until Feb 1, 2014.

- 2012 – County zoning administrators meet with DNR staff to discuss changes to NR 115 to make it easier to administer. DNR is planning to take these ideas out to public hearings this summer.

Impervious surface standards (current)

- What is an impervious surface?
  - An area that releases all or a majority of the precipitation that falls on it
  - Includes rooftops, sidewalks, driveways, parking lots, etc.

- What are the geographical boundaries of this standard?
  - Applies to property within 300-feet of any waterway

- What is the standard?
  - Keep what you have
  - Up to 15% impervious no permit is needed
  - Between 15% - 30% ok with a permit and mitigation

For discussion at summer public hearings

- Impervious standards only apply to riparian lots or non-riparian lots that are entirely within 300’ of OHWM

- Impervious surfaces that do not drain to a lake or river are not counted

- Allow higher impervious percentages for already highly developed areas
  - Urbanized areas/clusters in 2010 US census
  - Zoned industrial or business

For discussion at summer public hearings

- For <u>highly developed areas</u>
  - No permit for
    - Up to 30% impervious in residential zoned areas
    - Up to 40% in industrial or business zoned areas
  - Permit with mitigation for
    - Up to 40% impervious in residential zoned areas
    - Up to 60% in industrial/business zoned areas

Figure 3

More Impervious Surfaces in Watershed

Fish found in streams when impervious surface in the watershed was:

Less than 8%	*8 - 12%*	*Greater than 12%*
Iowa darter Black crappie Channel catfish Yellow perch Rock bass Horneyhead chub Sand shiner Southern redbelly dace		
Golden shiner Northern pike Largemouth bass Bluntnose minnow Johnny darter Common shiner	Golden shiner Northern pike Largemouth bass Bluntnose minnow Johnny darter Common shiner	
Creek chub Fathead minnow Green sunfish White sucker Brook stickleback	Creek chub Fathead minnow Green sunfish White sucker Brook stickleback	Creek chub Fathead minnow Green sunfish White sucker Brook stickleback

Fewer species of fish

Trout are eliminated from WI streams at 11% impervious surface

Conclusion

When we leave shorelands in a more natural state with impervious surfaces below 8-10% we protect

- Healthy fisheries
- Shoreline wildlife
- Clean water for swimming and higher waterfront property values

Decisions about impervious standards are coming at the state and county levels


Mallard
They all depend on healthy shorelines
Common Loon