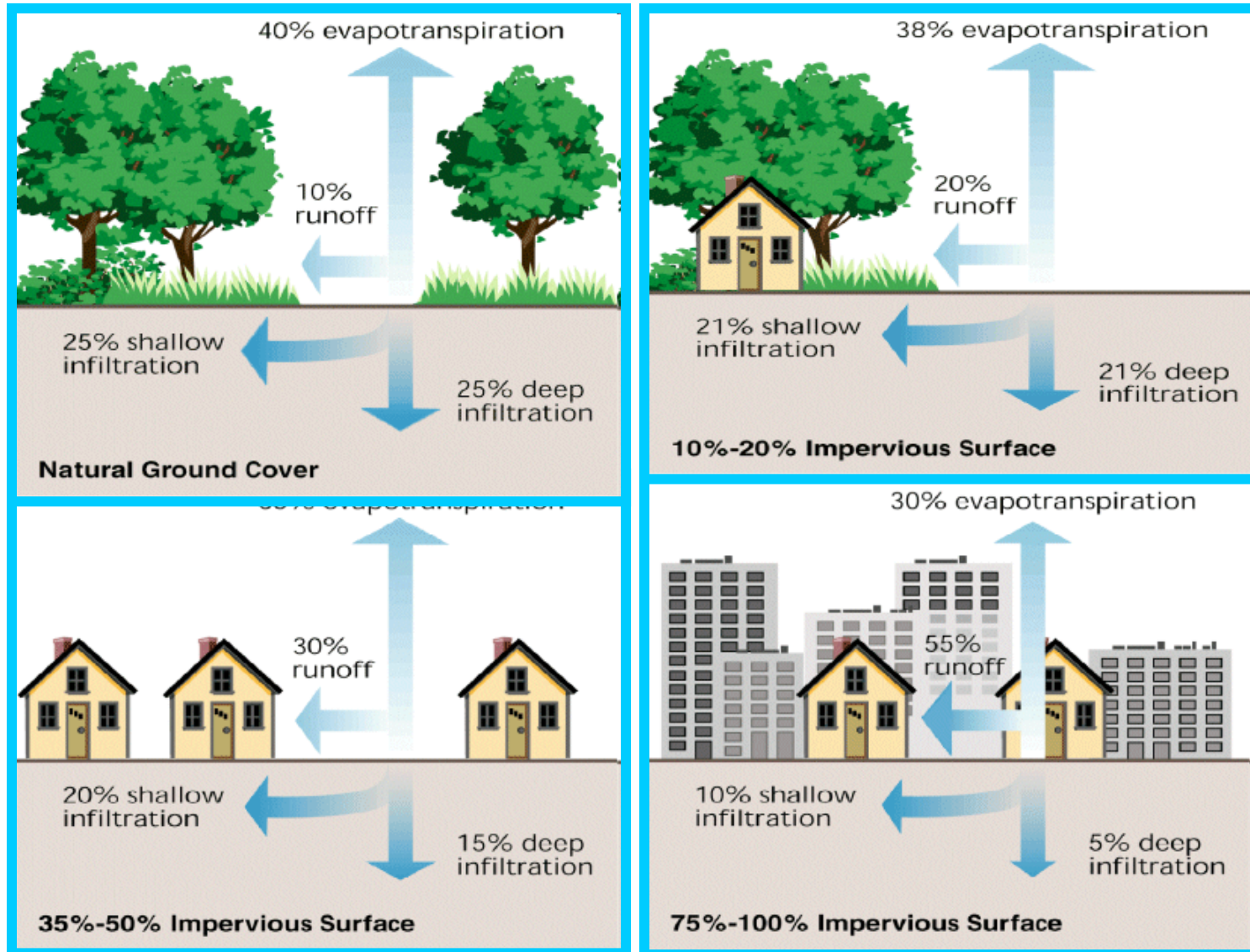


State of the Science using Trees for Stormwater Management

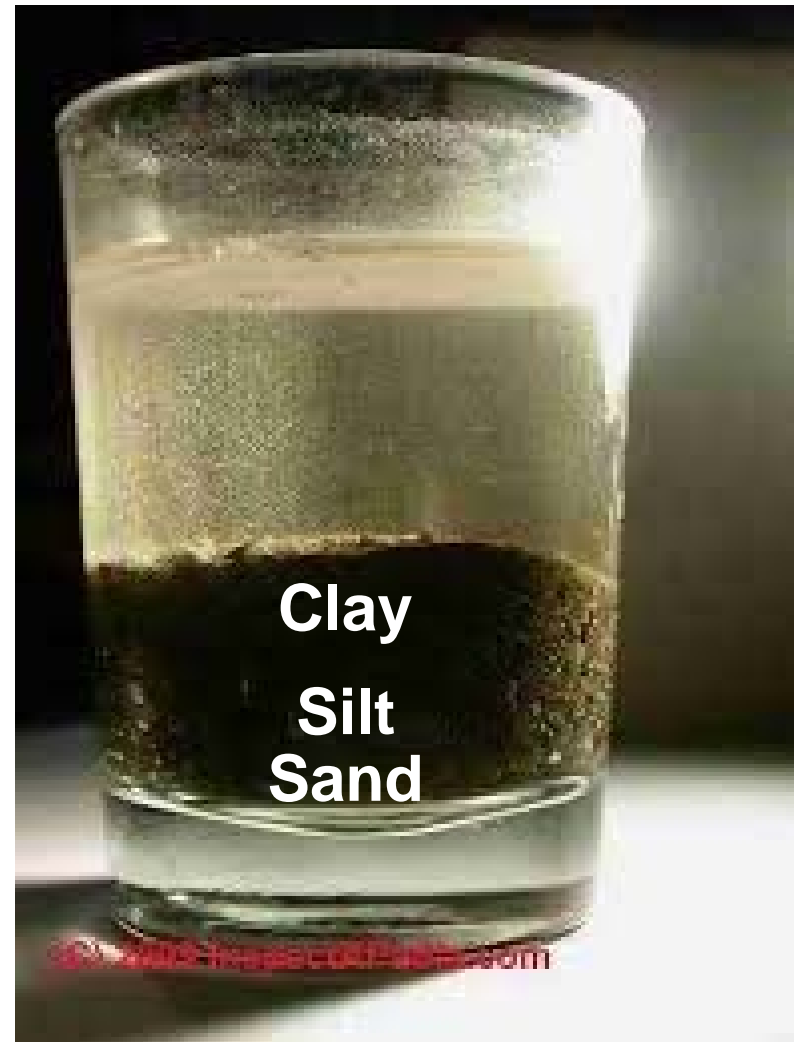
BIG TREES for Cleaner Rivers, Lakes, Bays

PRESENTED BY: Nicole Peterson, ASLA
Landscape Designer
Kestrel Design Group

An Upside Down World



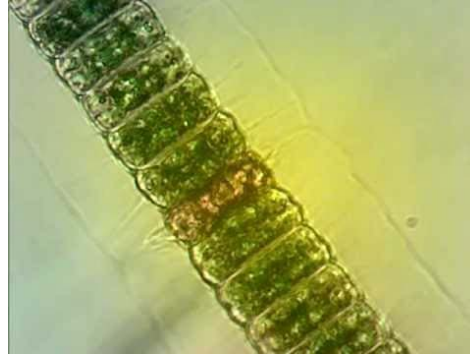
TSS (Total Suspended Solids): Sand, Silt, Clay, Organics



NITROGEN & PHOSPHOROUS IN WATER...



+



+



Nitrogen

Phosphorous



Big Trees For Stormwater Management? YES

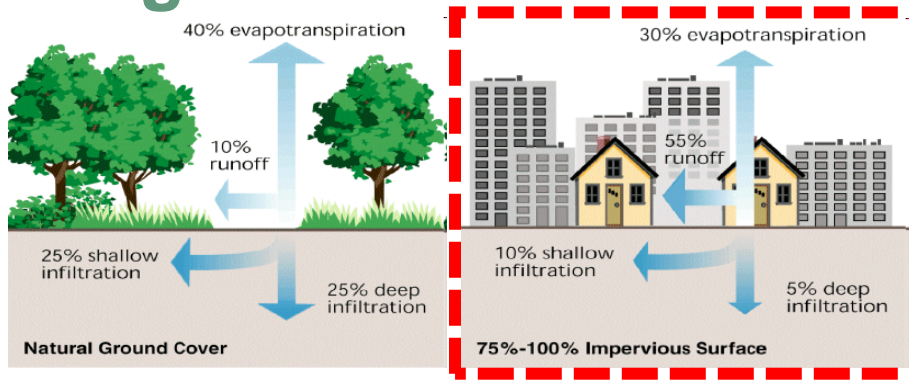


Image from Fairfax County
Park Authority, Fairfax VA

“Nearly all of the associated problems result from one underlying cause: loss of the water-retaining and evapotranspiring functions of the soil and vegetation in the urban landscape.”

EPA - 2008

OLD PARADIGM

Huge
Pipe



Localized Flood
Control

EMERGING PARADIGM

Medium
Pipe



Flood Control
Volume
Rate
Water Quality

WHAT DOES A SUCCESSFUL STORMWATER URBAN FOREST LOOK LIKE?

It's Trees:

- 1) *Have Large Volumes of Air Filled Soils...***
- 2) *Species Diversity***
- 3) *Irrigated by Small Storms from Hard Surfaces...***
- 4) *Store Roots & Stormwater under Pavement...***
- 5) *Plant Trees Small & Maintain Correctly...***
- 6) *Grow Canopy & Trunk Rapidly***
- 7) *Grow Dark Green Opaque Canopy***
- 8) *Live to Maturity...***
- 9) *Cover Hard Ground Surfaces with Canopy...***
- 10) *Rigorously Sweep, Compost, Reuse Leaves***

References:

Trees: Urban; Ball; McPherson; Xiaou; Watson; Green; Gilman; Bassuk; Grabowski; Smiley; Shigo.
Stormwater: Hunt; Weinstein, Schueller; Bannerman; Kim; Graham; Davis; Hsieh; Hong; Ermillio.

KEY #9: Cover Hard Ground Surfaces with Canopy

What's So Great About Big Trees? Interception

Stormwater Interception Hackberry vs Age of Tree

150 Gal.
Year 5



5000 Gal.
Year 40



Images from http://www.tankwatersolutions.com.au/rainwater_tanks.php

KEY #9: Cover Hard Ground Surfaces with Canopy

Minneapolis Chain of Lakes Correlative Study



53 Miles²



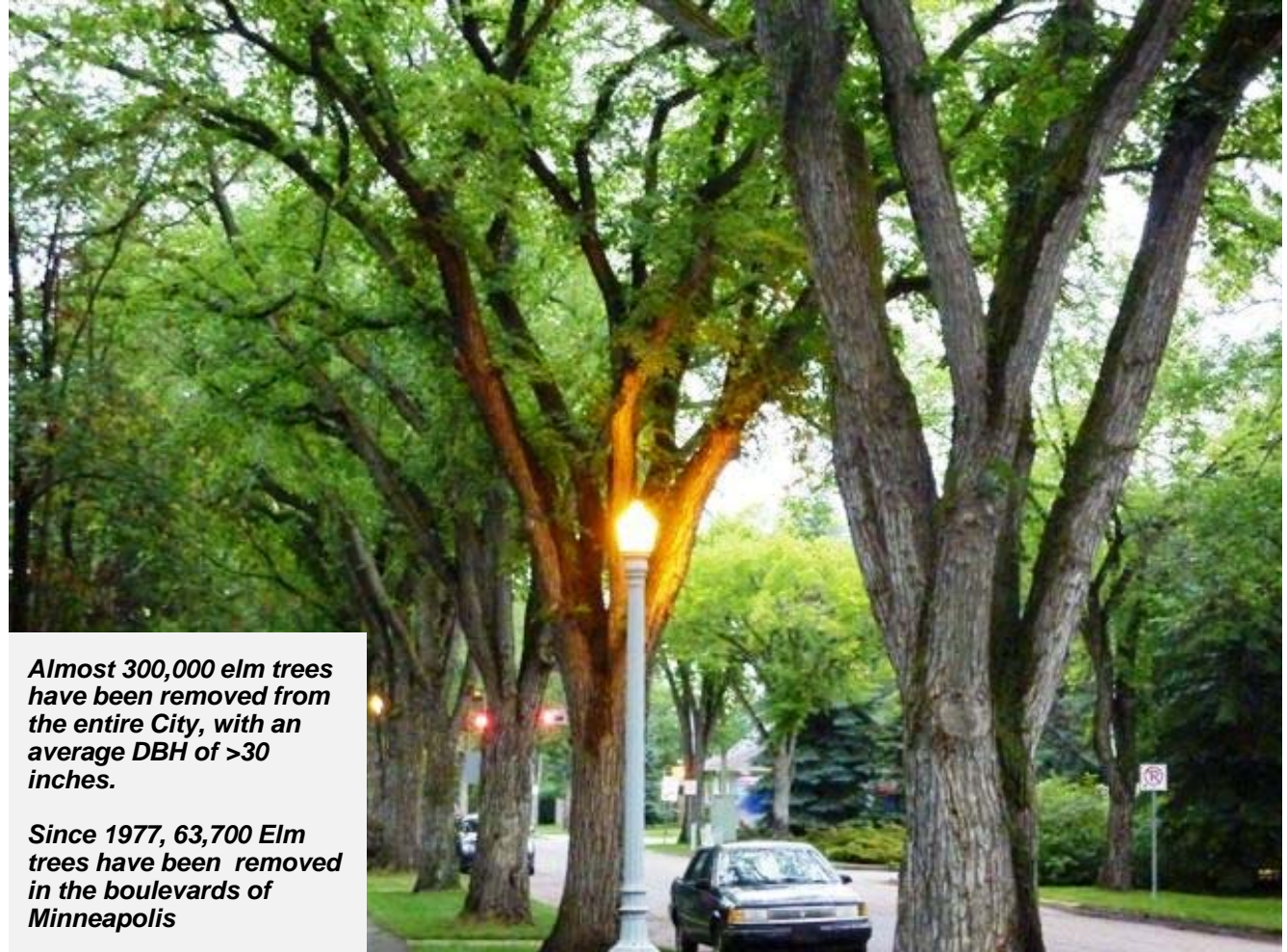
KEY #9: Cover Hard Ground Surfaces with Canopy

American Elm Tragedy: Minneapolis

**In the Late 1800s,
American Elm (*Ulmus
americana*) made up 90%
of the boulevard trees in
Minneapolis**

**USDA Zone 4.....30.5" Annual
Precipitation.....Type II Storms**

- 1963: First Dutch Elm Disease Detected in Trees
- 1972: Elms Dying in the Thousands
- 1977: 31,000 Elm Trees Removed
- 1978: 20,000 Elm Trees Removed
- 2004: 10,000 Elm Trees Removed
- 2005-2015: 2,700 Elm Trees Removed Annually



*Almost 300,000 elm trees
have been removed from
the entire City, with an
average DBH of >30
inches.*

*Since 1977, 63,700 Elm
trees have been removed
in the boulevards of
Minneapolis*



KEY #9: Cover Hard Ground Surfaces with Canopy

Modelled Stormwater Value to Minneapolis

Benefits of Large Street Trees



American Elms

Tree size		Stormwater Interception		
DBH (cm)	DBH (inches)	cubic meters/ tree/yr	Gal/tree/ yr	cf/tree/yr
38	15	5.4	1,427	191
114	45	63	16,640	2,225

Total street tree population 120,676

-American Elms: 9.9% of total street trees
-30.75% of total street tree stormwater
benefits (total tree stormwater benefits) =

3,400,000 cf

= 78 acre feet

= Candlestick Park: 78 feet Deep Water

-3142 total elms >36" DBH = 2.6% of total
street tree population = 1,163,000 cf
= 27 acre feet

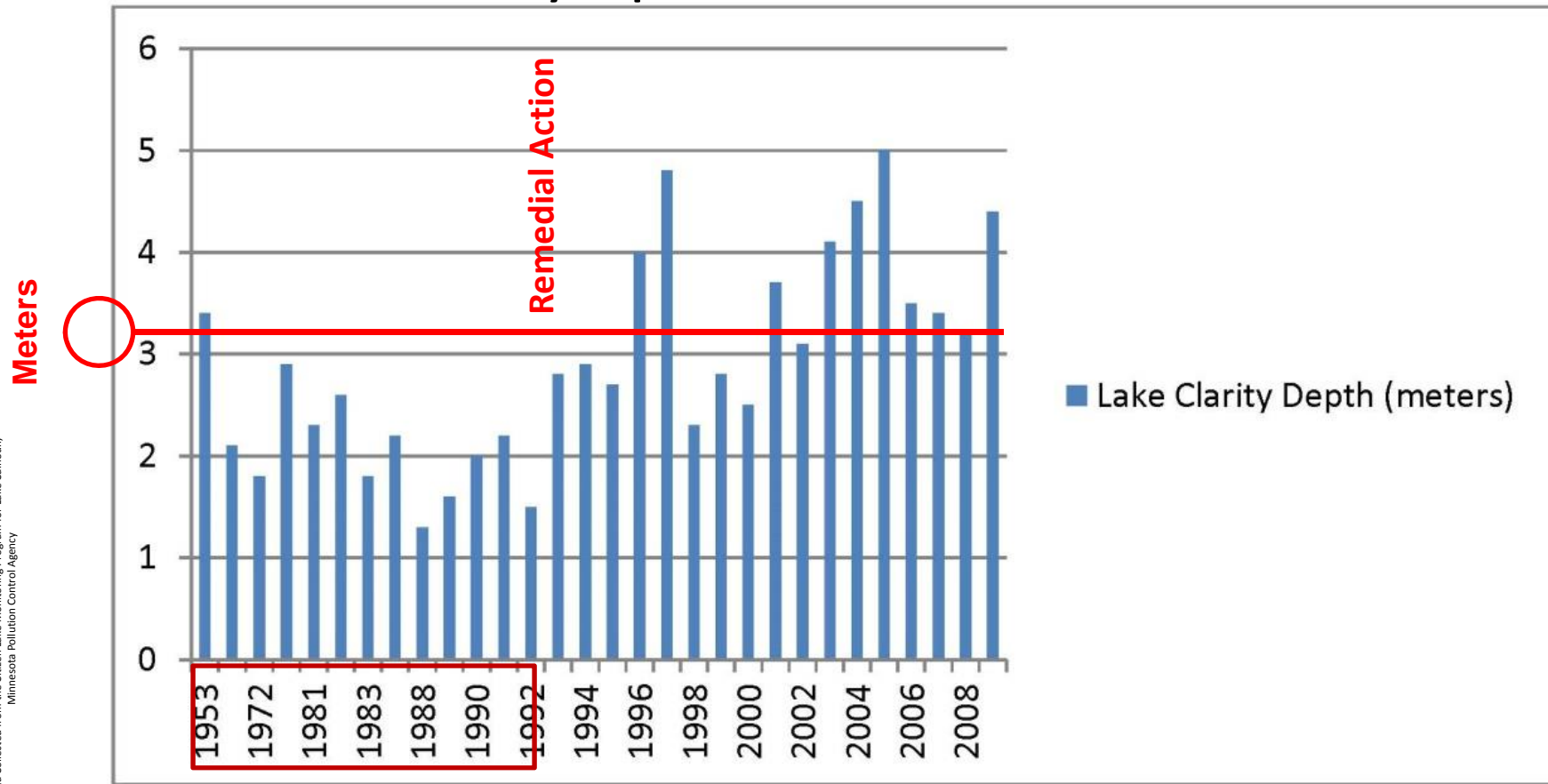


Source: Minneapolis Municipal Tree Resource Analysis,
McPherson et al, 2005, and personal communication

KEY #9: Cover Hard Ground Surfaces with Canopy

Relationship of Tree Species Diversity and Water Quality

Lake Calhoun Lake Clarity Depth Over Time in METERS

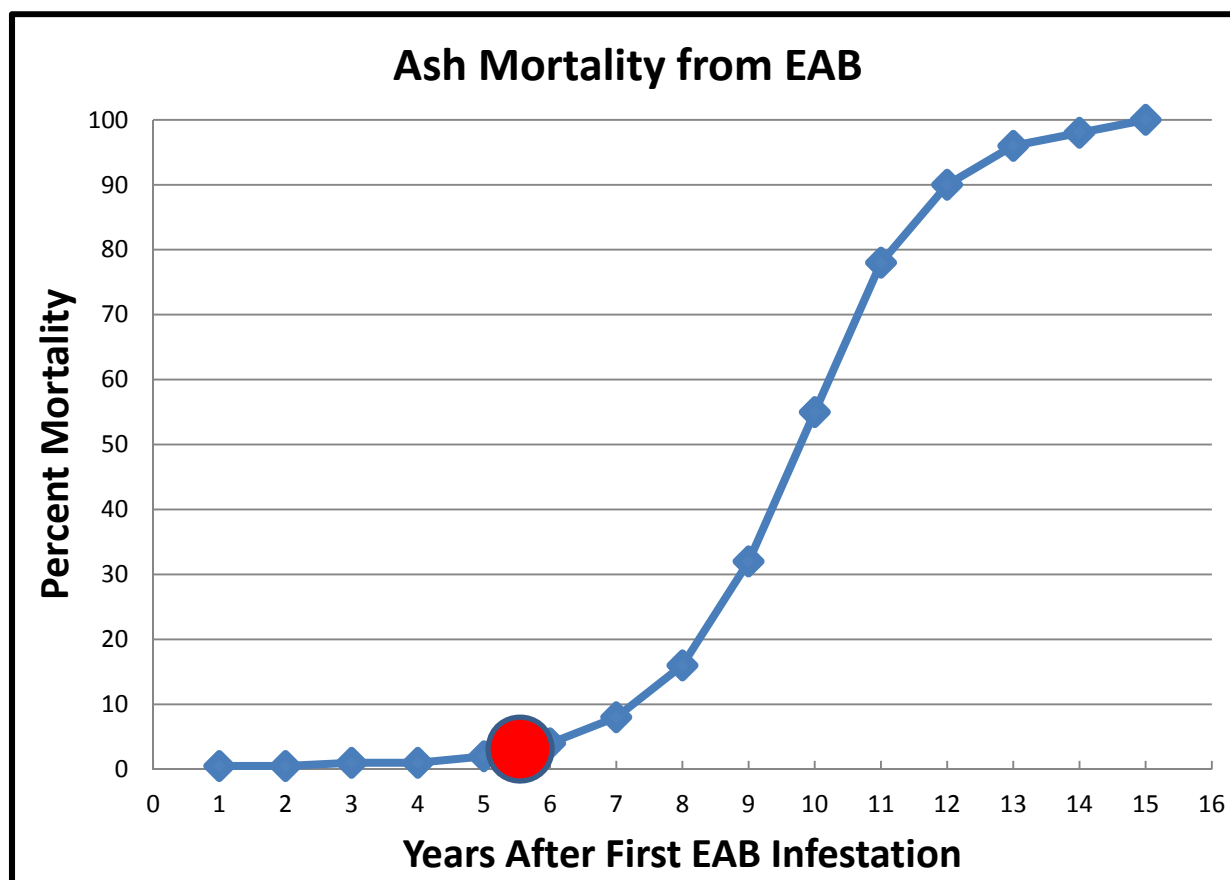


There is a correlation to loss of tree canopy and water clarity

Following the removal of Elm trees (during the late 1970s and early 1990s), there was a **marked decrease in water clarity depth in the Chain of Lakes**, yet building development stopped in 1953 throughout the contributing sub-watershed around Lake Calhoun.

KEY #9: Cover Hard Ground Surfaces with Canopy

EAB: A Predictable Pattern of Losses



Based on data from Dr. Dan Herms, The Ohio State University

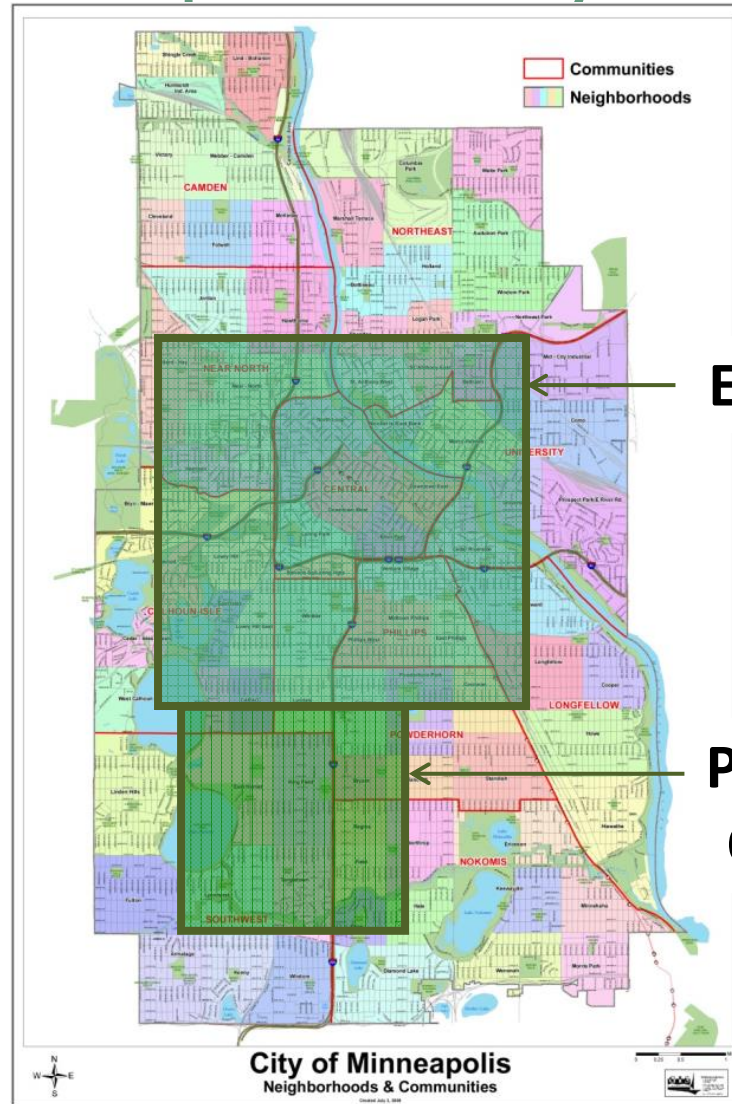


MPRB 5000 Ash Trees being Removed Annually; Average Ash >18" DBH

KEY #9: Cover Hard Ground Surfaces with Canopy

Relationship of Tree Species Diversity and Water Quality

**Dutch Elm Disease
& Emerald Ash
Borer**



KEY #9: Cover Hard Ground Surfaces with Canopy

A New Hope!

40% by '40...for Minneapolis
40% Urban Tree Canopy by 2040



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