Green Pavements

Paving a Better Future for Tennessee

Alan Sparkman

Tennessee Concrete Association

Illiteracy – Yesterday and Today

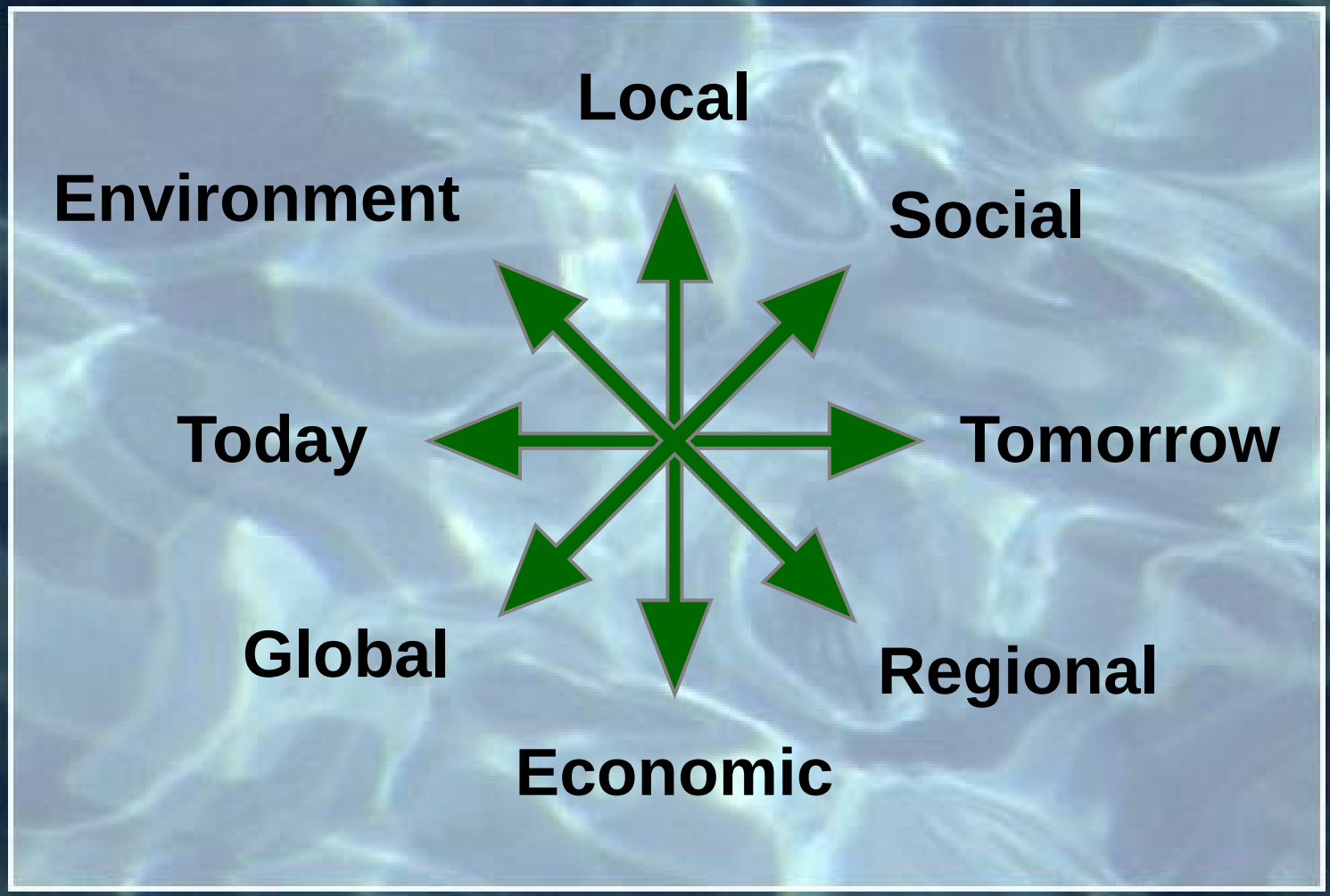
- The illiterate of the future are not those who cannot read or write
- They are those who cannot learn, unlearn, and relearn
  - Alvin Toffler
- Obsoledge – Obsolete Knowledge
  - Toffler in Revolutionary Wealth
  - The faster things change, the more obsoledge we carry

Sustainability

- Environmental issues
- Economic issues
- Social and safety issue
- Long term view

Does not create an “environmental debt” for future generations to pay

“Triple Bottom Line”

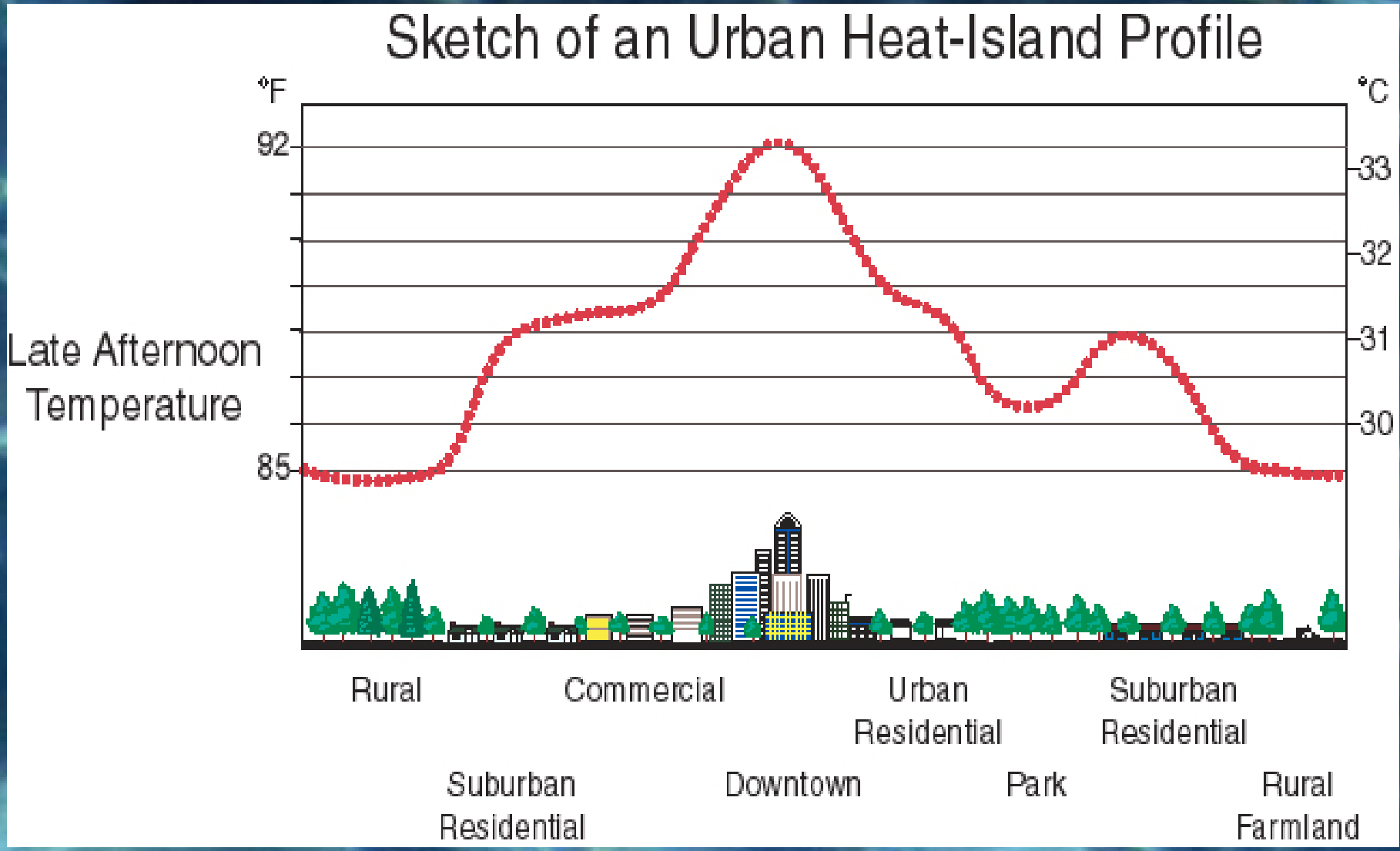


Green Dimensions

- Air
- Water
- Resource Use
- Community Benefits
- Life-Cycle Costs and Benefits ($$$$)

Air

What is an Urban Heat Island?



Atlanta
Central Business District
Night Data – May 1997

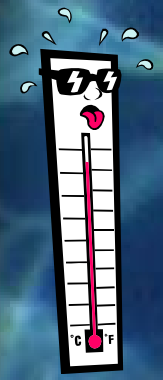
Urban Heat Island Characteristics

Compared to suburban neighbors:

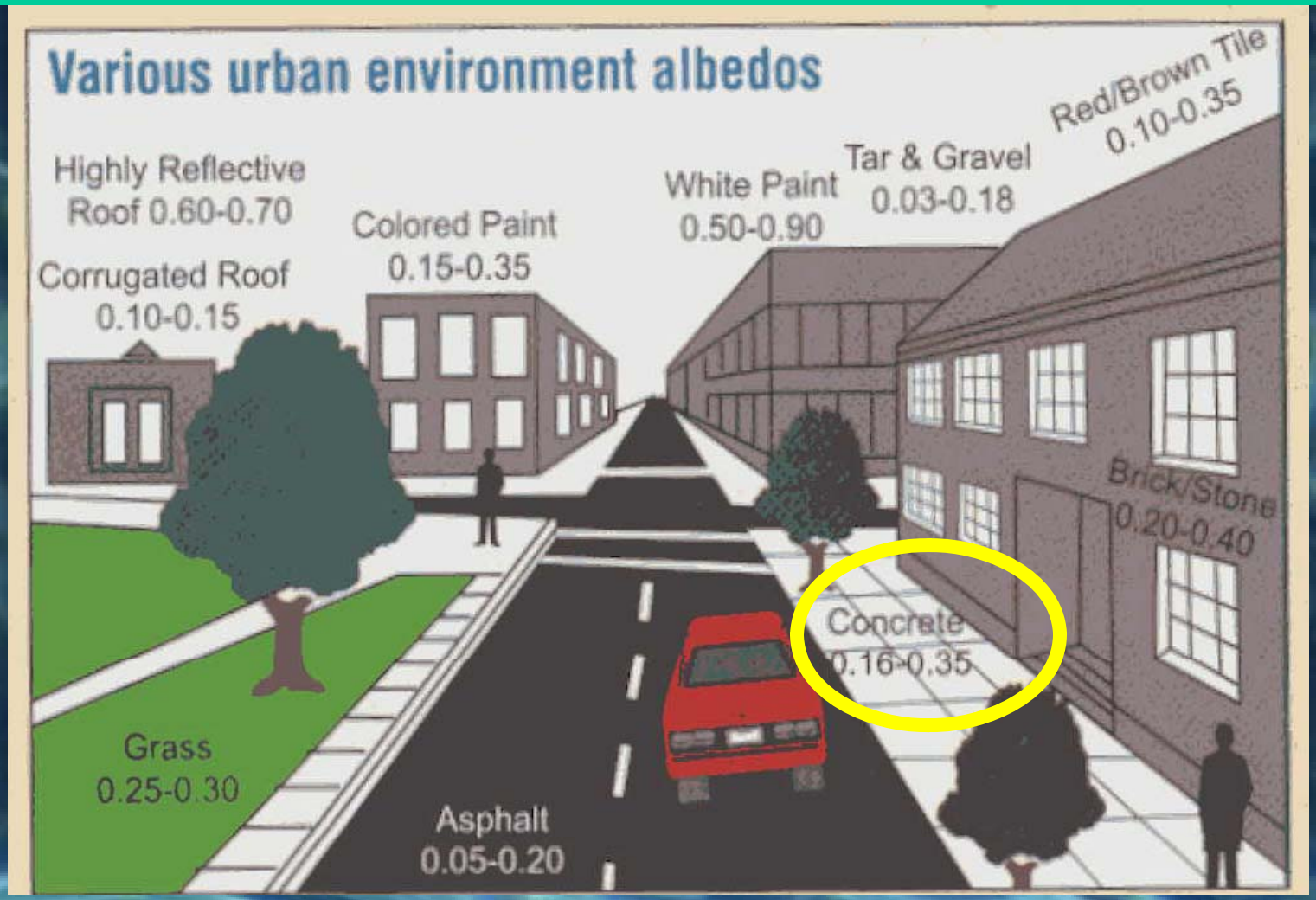
- Temperatures are 8-10 degrees higher
- Ozone levels are higher
- Smog is greater
- Higher incidence of heat and smog-related health problems

Higher Temps Increase Energy Use and Worsen Air Quality

- increased demand for cooling energy
  - higher monthly utility bills for consumers
  - increased levels of pollution
    - NOx, SOx, PM, VOC, smog
    - CO_2
- increased incidence of heat and smog related illness and even death
- overall reduction in comfort levels

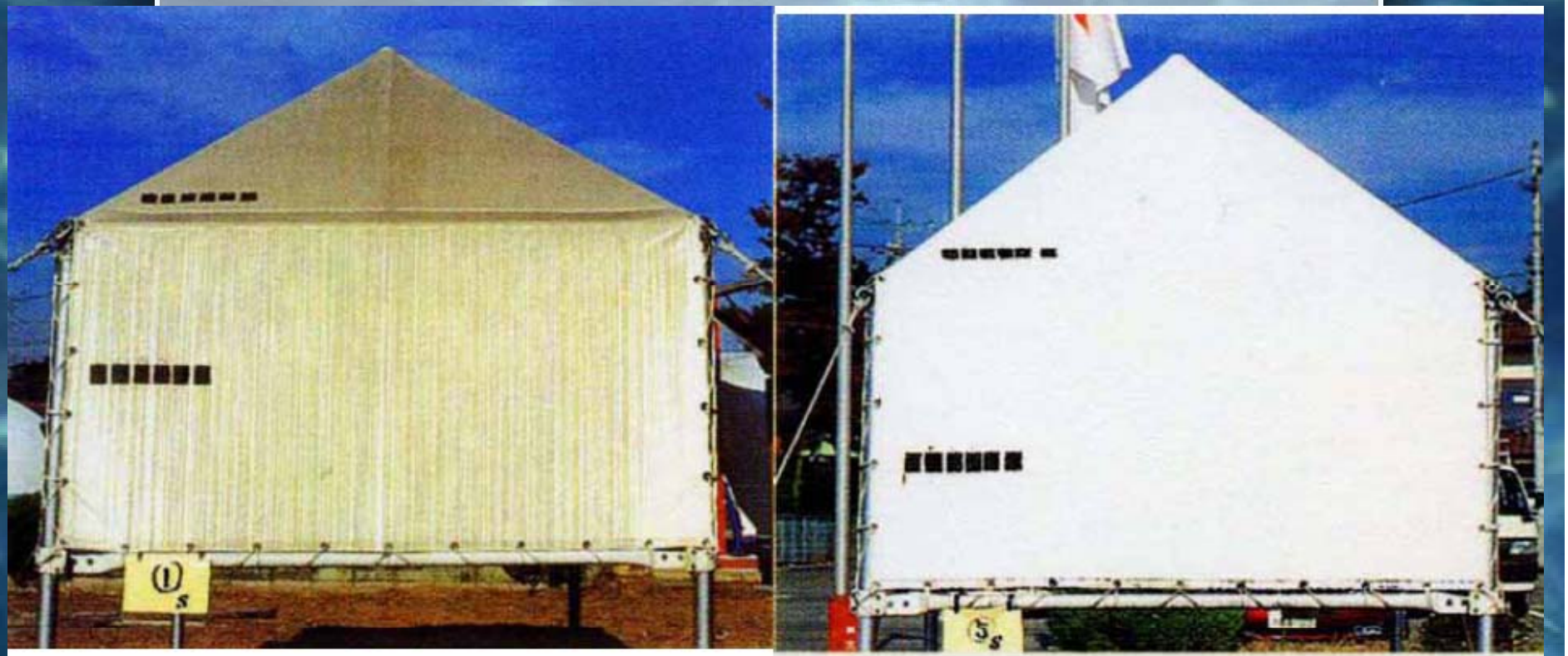


Albedos: The Amount of Light Reflected vs. Shone on an Object



0 = No light reflected / 1 = All light reflected

PVC fabric – 5 Months Exposure

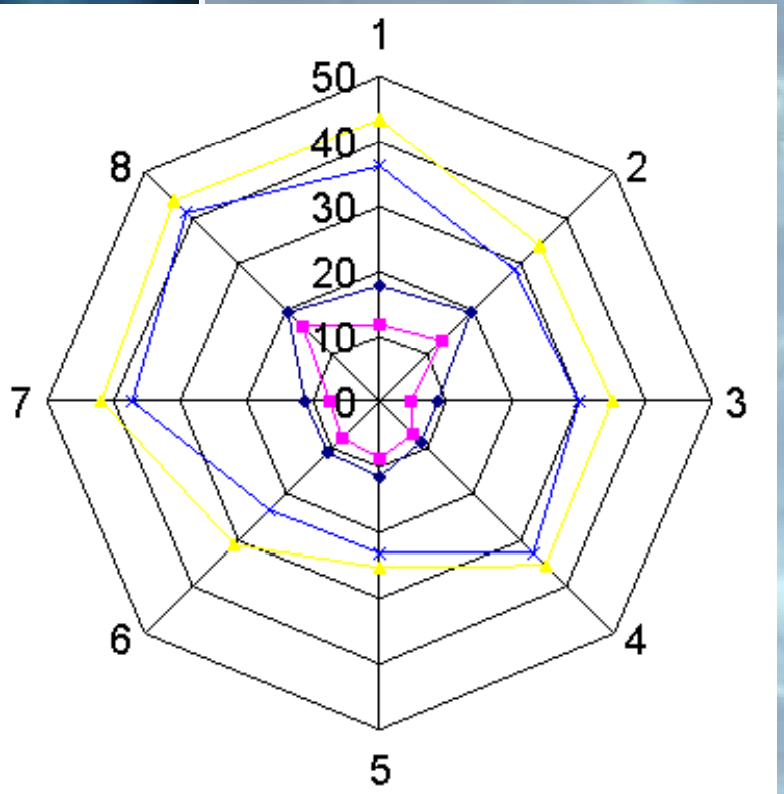


Untreated PVC fabric

Treated PVC fabric

Photo-Catalytic Cement

Experiment results vs. expected results (modeling)

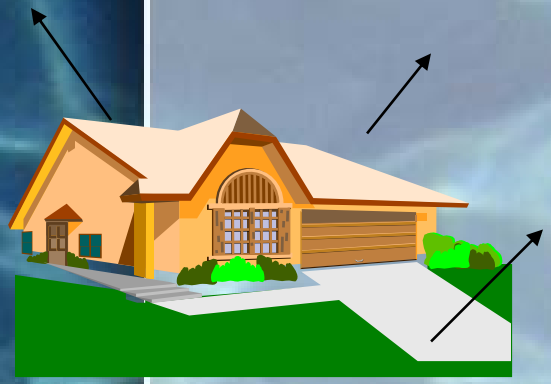


- **Using photocatalytic concrete, a 20% to 80 % reduction in NOx concentrations is typical.**
- **Several factors affect abatement rates including:**
  - **Solar irradiation**
  - **Pollutant concentration**
  - **Wind speed**
  - **Wind direction relative to the structure**
    - **Pollutant residence time**

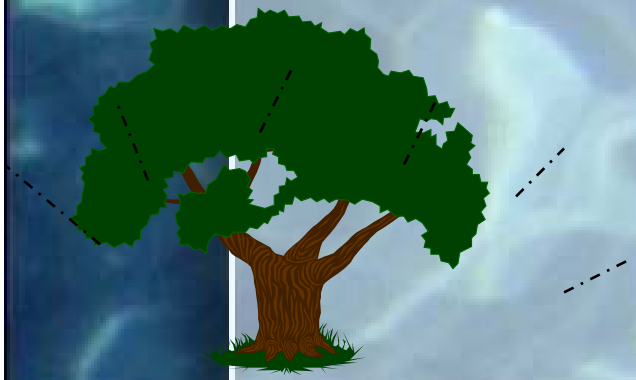
Real world evaluations proceeding – Segrate (Milan) 2002

- Heavily traveled two way road (1000 vehicles/hour).
- Thin layer of photocatalytic concrete applied to 230M long segment of bituminous road surface
- Reduction in Nox concentration in the photocatalytic treated area was measured between 50%-60%.

Key Measures Help Cities Keep Cool

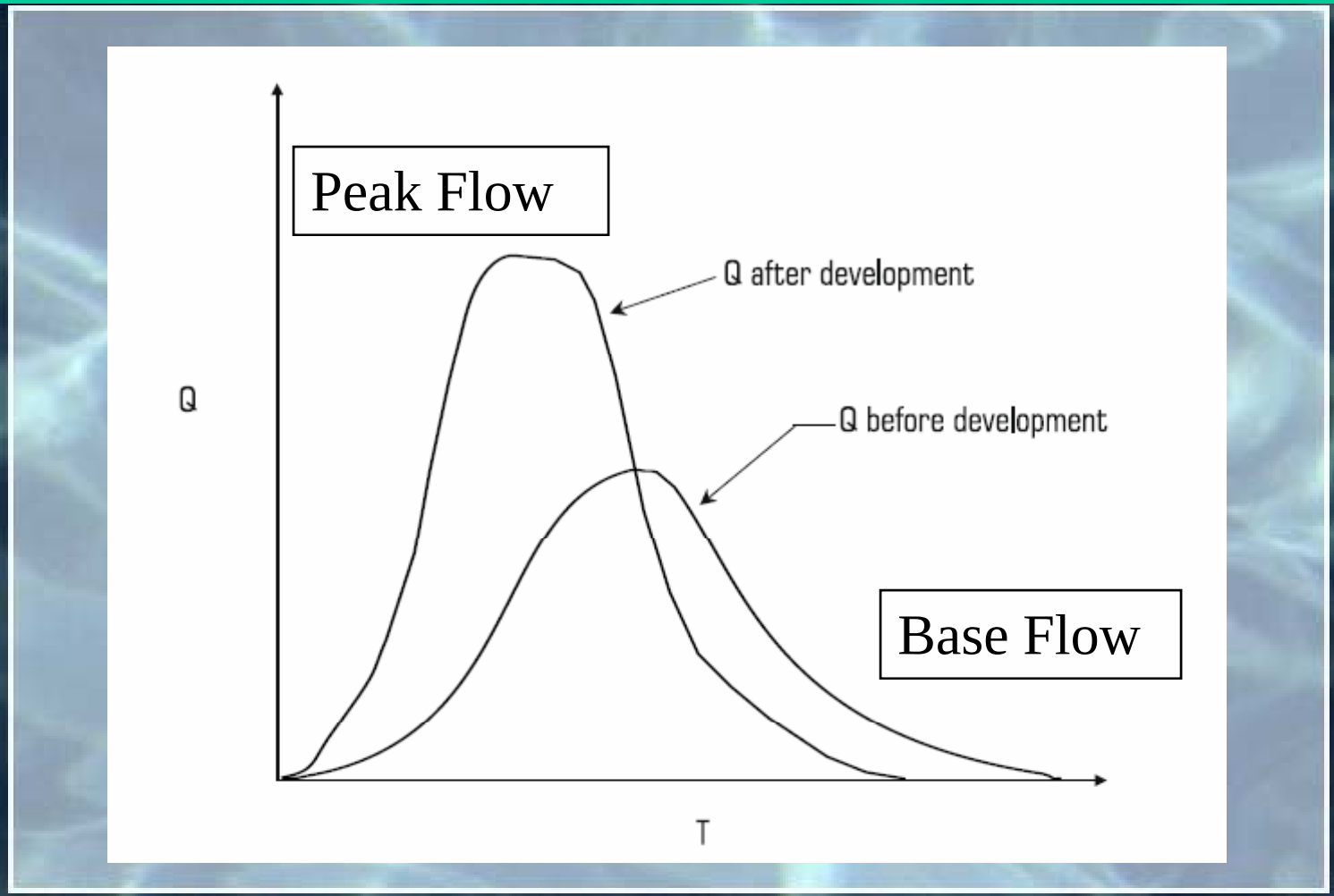


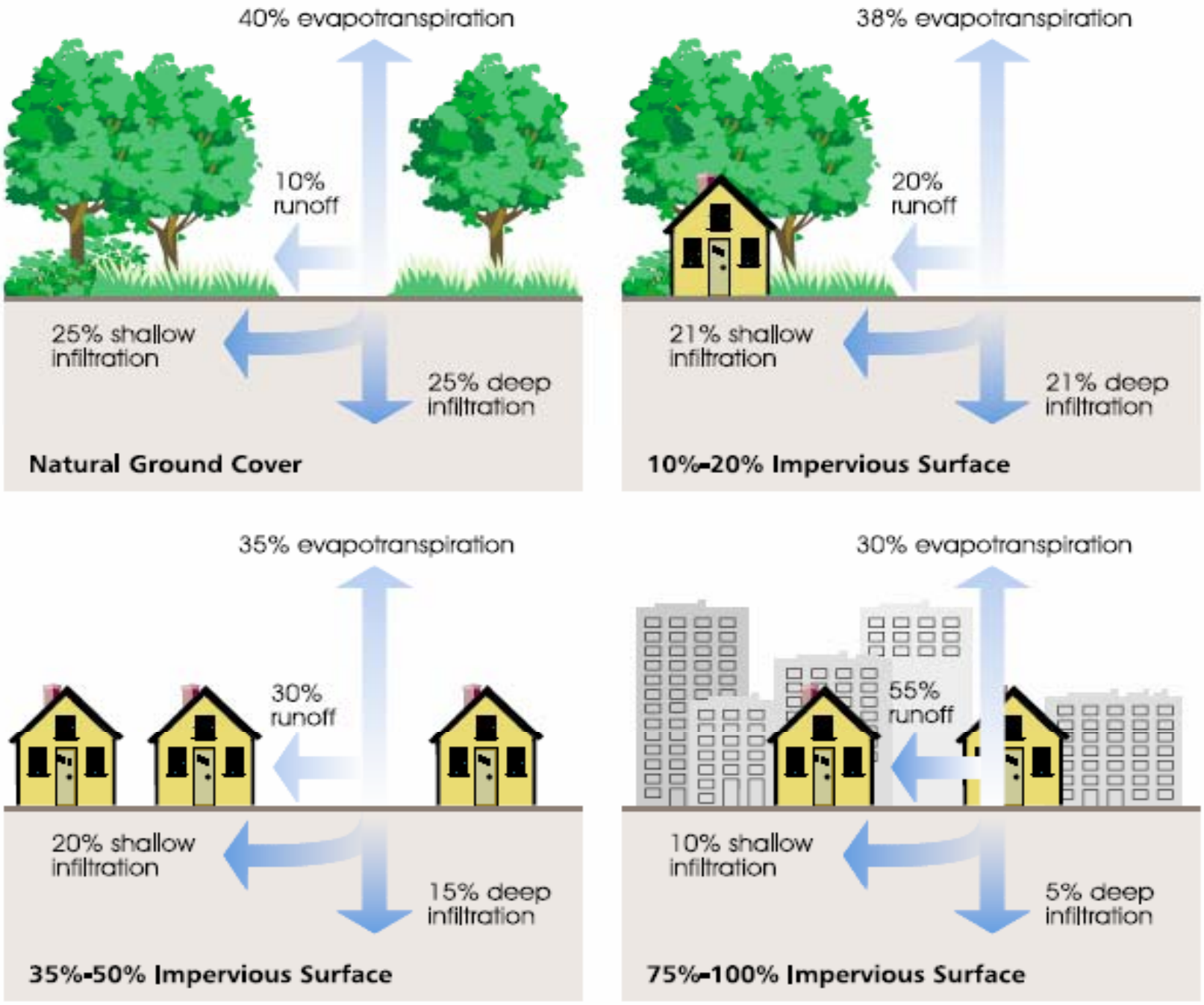
- highly reflective surfaces
  - roofs and *pavement*
  - reflect incoming solar radiation
- shade trees
  - block incoming radiation to keep buildings cooler
  - naturally cool the surrounding air through evapotranspiration



Water

Change in Runoff Volume




40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover
38% evapotranspiration
20% runoff
21% shallow infiltration
21% deep infiltration
10%-20% Impervious Surface
35% evapotranspiration
30% runoff
20% shallow infiltration
15% deep infiltration
35%-50% Impervious Surface
30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Surface

Question?

- What happens when **oil or grease** gets on conventional pavements?
  - Every time it rains some of it is emulsified into the rain water and washed into catch basins through storm water drains and then into streams, estuaries and finally into the Gulf or Ocean.

Health Concerns of Detention Ponds

Other Detention Pond Concerns

- Poor Land Use for Communities
  - – Can’t build in a detention pond
- Costly for Developers
- Increases Costs for Taxpayers
  - - Stormwater Utility Taxes
  - - Stormwater System Maintenance
- Poor Use of Our Water Resources
  - - Starves Urban Streams (base flow)

A Better Answer…

- **With pervious concrete**
  - It is contained by the concrete. Then the sun boils off some volatiles, and much of the remaining carbon is absorbed by soil and/or digested by plants, fungus or microbes.

Important Percolation Facts

- Over ½ of rain occurs in events of ½" or less
- Most soils have a 'perking cycle' of 5 days
- Pervious Concrete will absorb 3% of its total weight to go from a dry condition to surface saturation
  - Rain events of 1/8" to ¼" will merely saturate the pervious, producing little runoff or perking concerns
- Pervious Concrete does not lower the original perking capability of the area paved

Cumberland River Compact: Reduce Impervious Surfaces in the Cumberland River Watershed

- Parking lots constitute about 50% of the impervious surfaces in Nashville
- Parking requirements are based on national publications, rather than local information
- We can do more, with less pavement!

Parking Lots - Environmental Disasters Required By Code

- Minimum Number of Spaces
- Low Rate of Occupancy
- Impervious “Forever”

Parking Lots - Environmental Disasters

- Almost Total Runoff, No Percolation
- Public Water Needed for Vegetation
- Runoff Has Chemical Pollutants, Requiring Treatment
- Runoff is Hotter, Damaging Ecosystems
- Rapid, High Volume Runoff Requires Larger Public Drainage Facilities
- Hot Parking Lots Add to Urban Heat Island Effects and Ozone Creation

Morristown Hospital

Pervious Concrete Pavement Environmental Advantages

- Percolation Recharges Groundwater, Increases Base Flow
- Less Need for Irrigation
- Adjacent Trees and Vegetation Receive More Rainwater
- Runoff is Reduced - Cooler and Cleaner
- Cooler Surface Has Less Impact on Air Temperature – Reducing Urban Heat Island Effect
- More efficient land use – especially in urban areas
- Lower Costs to Owners and Reduced Maintenance
- Less stormwater infrastructure required
  - less capital outlay now
  - reduced maintenance forever

Pervious Concrete Pavements Are Cooler

- Absorbs and Stores Less Heat
- Lighter Color Reflects More Heat - Lower Surface Temperatures
- Open Void Structure Allows Cooler Earth Temperatures to affect the Pavement
- Cooler Air Temperatures - Less Urban Heat Island Effect
- Cooler Stormwater Runoff Temperatures

Pervious Concrete and Storm Water

- Runoff is Cooler
- Runoff is Cleaner
- Runoff is Reduced or Eliminated
- Runoff is Infiltrated (that's Good!)

Resource Use

See Natural Advantage Handout

Community Benefits

See Enlightened Handout

Life-Cycle Costs

What will maintenance cost 10 years from now?

Green Solutions

A Moderate Effort Can Yield Considerable Results:

- **Trees**
- **People Friendly “Sustainable” Development Practices**
- **Build today to reduce maintenance tomorrow**
- **Lighter Color Pavement (think CONCRETE!) and Roofing Materials**
- **Pervious Pavements for Temperature and Water Quality Benefits**
- **New Materials**
- **A New Way of Thinking!**

Questions?

Tennessee Concrete Association
www.tnconcrete.org
Alan Sparkman
asparkman@tnconcrete.org