Stormwater Management with Pervious Concrete Pavement

CA Dept. Water Resources

January 2010

What is Pervious Concrete?

- 15-25% Void Space
- Also Called No-fines Concrete

Pervious Concrete

Pavement Passes:

- 3 -10 gallons per minute per sq. ft.

= 6,000 to 20,000 inches per day!!!

Basic Ingredients

- Cement
- Coarse Aggregate
- Water
- No Sand
- Admixtures

Texture Comparison

Pervious Concrete is Not New!

In use as pavement in the US for over 30 years!

- Initial US applications were in Florida
- FL/GA/WA/OR initial applications were for flood control
- 1987 Clean Water Act and NPDES brought pervious concrete into use for control of urban runoff
- Several large applications in California that are over 6 years old and performing well
- Large number of parking areas in Florida which are 20-30 years old

Why use Pervious Concrete?

stormwater plume
Point Loma

Run-off Issues

Jay Manning, Dir. Washington, Dept. of Ecology

"Based on actual sampling in the Puget Sound basin, we have estimated that the volume of oil that is carried into Puget Sound by stormwater run off is equal to the oil spill in Prince William Sound that the Exxon Valdez spilled.

Every two years, the stormwater in Puget Sound carries that volume of oil into Puget Sound."

EPA Stormwater Regulations

- EPA Stormwater Phase II Regulations
- Cities greater than 50,000 must manage stormwater
- Limit amount of stormwater that can leave a building site
- Pervious pavement is a Best Management Practice (BMP)

Energy Independence and Security Act of 2007

Signed into Federal Law 12-19-07

SEC. 438. STORM WATER RUNOFF REQUIREMENTS FOR FEDERAL DEVELOPMENT PROJECTS:

"The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore to the maximum extent technically feasible, the **predevelopment hydrology** of the property with regard to the temperature, rate, volume, and duration of flow."

Stormwater may be Polluted

- Oils and Grease
- Metals
- Sediments
- Fertilizers

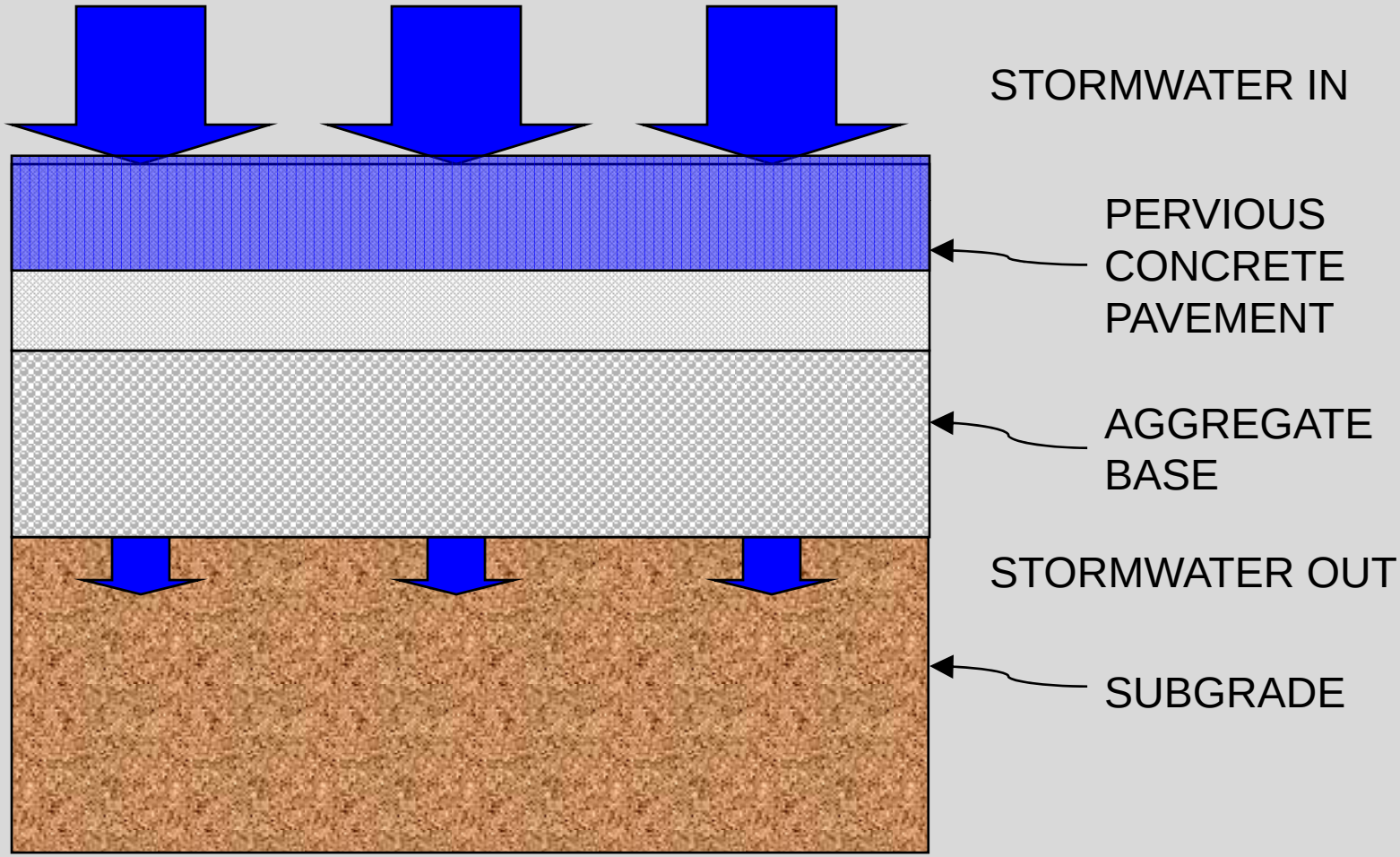
Pollution Treatment

- About 90% of the surface pollutants are carried off by the first ½-inch to 1-inch of rainfall (first flush)
- First flush passes through pavement into soil
- Soil filters and treats rainfall
- Rainfall is spread over entire parking area (instead of detention pond)

Hydrocarbons are treated by filtration and microbial conversion

Detention Pond is under the pavement

Solution to Stormwater Management



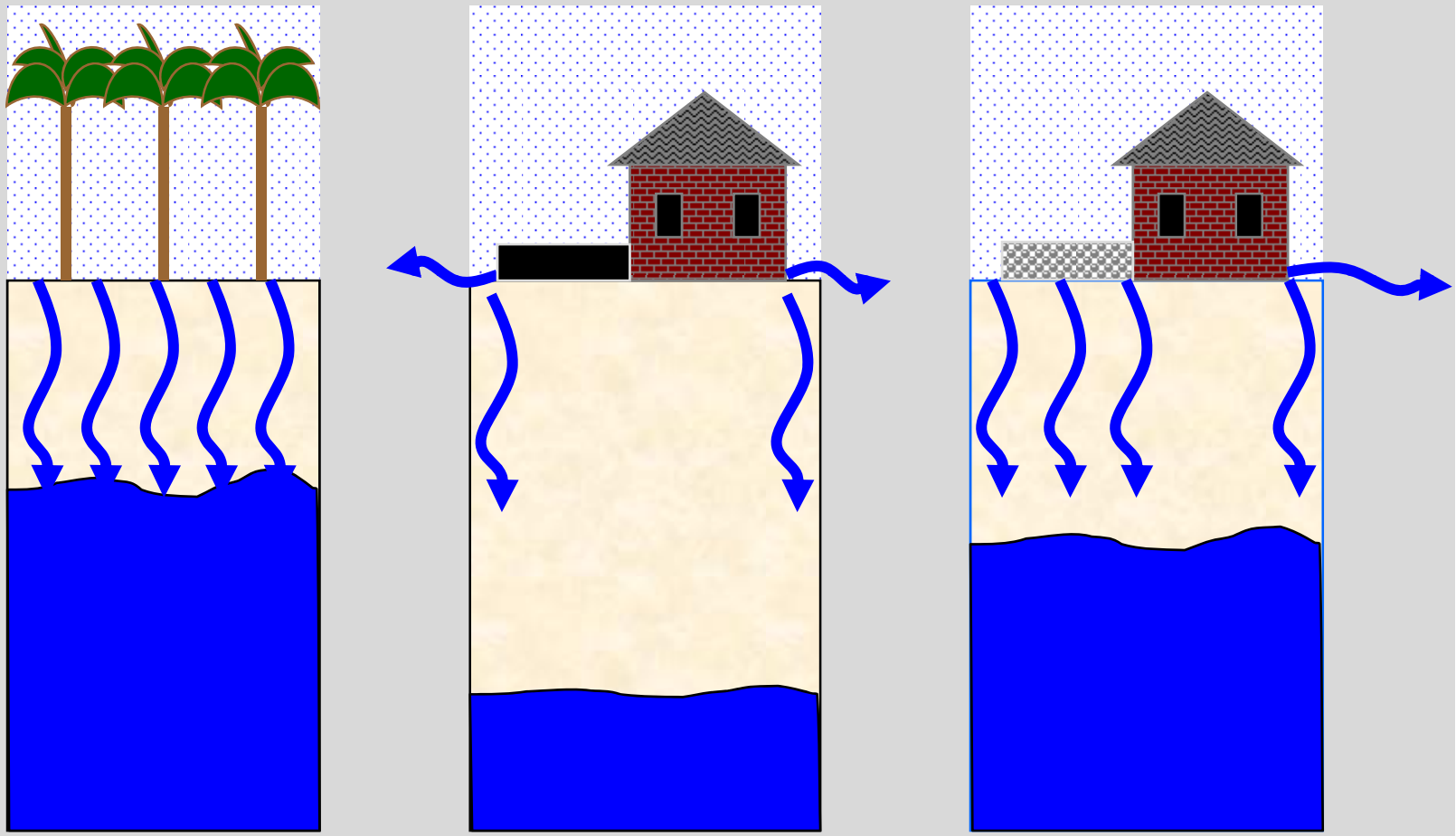
Capture the water…

- To save energy
- Keep it where it falls (rain or snow)
- Allow Infill development (SB 375)
- Financial benefits:
  - Incentives and rebates by water agencies
  - SB 790 incentives

Why?.....Sustainability

- Low-Impact Development
- Pollution Treatment
- Recharging Groundwater
- Tree Protection
- LEED Requirements
- Cool Communities

Low Impact Development

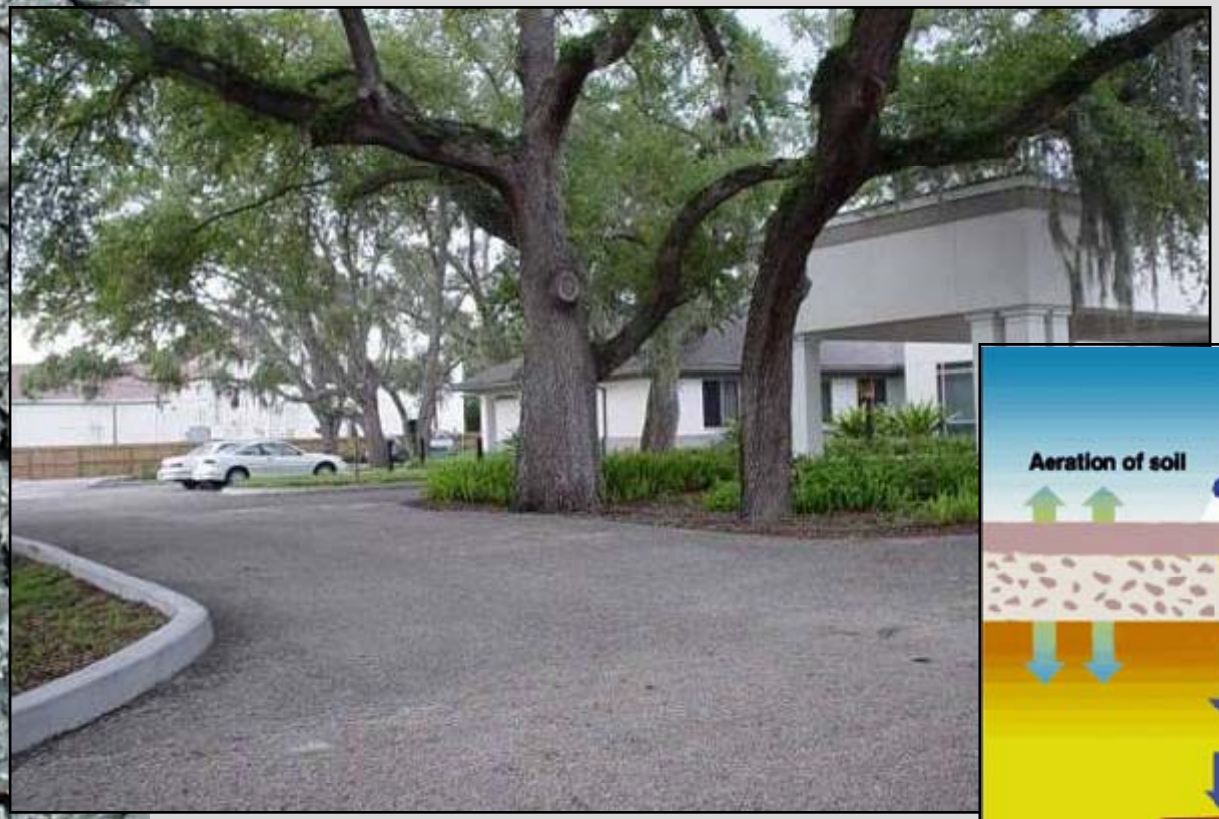


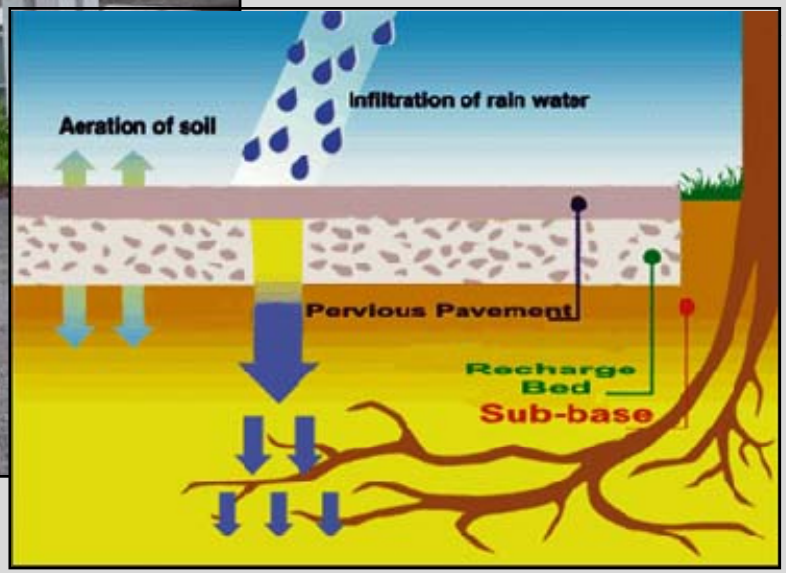
Pre-Development

Post-Development

Low-Impact Development

Protects Trees



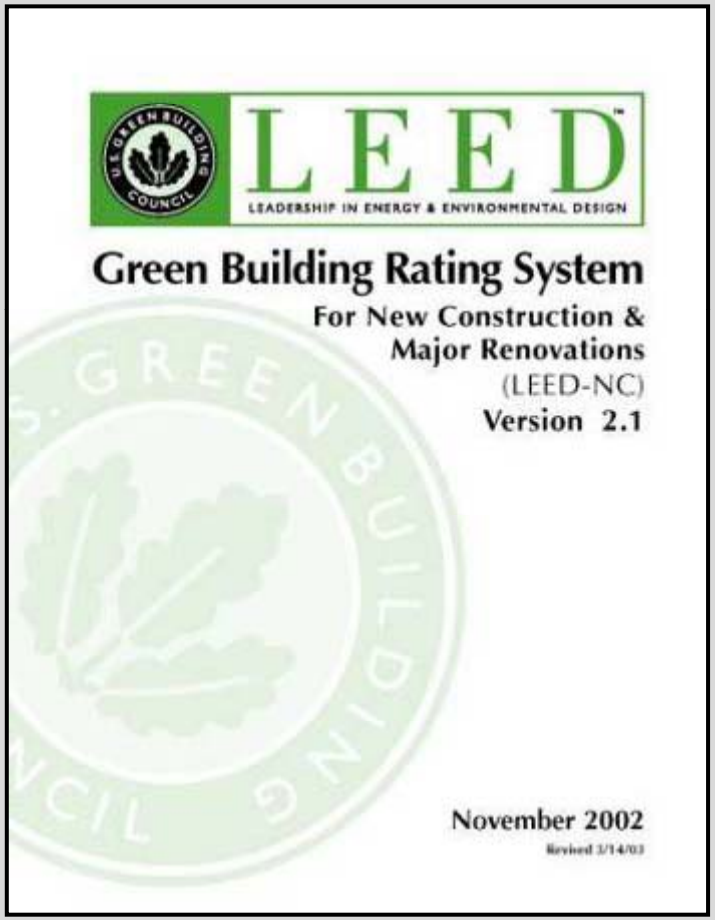


Can pave within the drip line
Water and air filters to roots

Tree protection

Meets LEED Requirements

- Reduce stormwater runoff
- Use Recycled Materials
- Use Regional Materials
- Reduce urban heat islands


LEED
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

Green Building Rating System
For New Construction & Major Renovations
(LEED-NC)
Version 2.1

November 2002
Revised 3/14/03

Design Considerations

Pavement Thickness

- Suggested Minimums
  - 6” Parking lots
  - 6” Residential Driveways
  - 8” Streets
  - 8” Commercial Driveways

Heavy truck traffic

- 10”in lifts

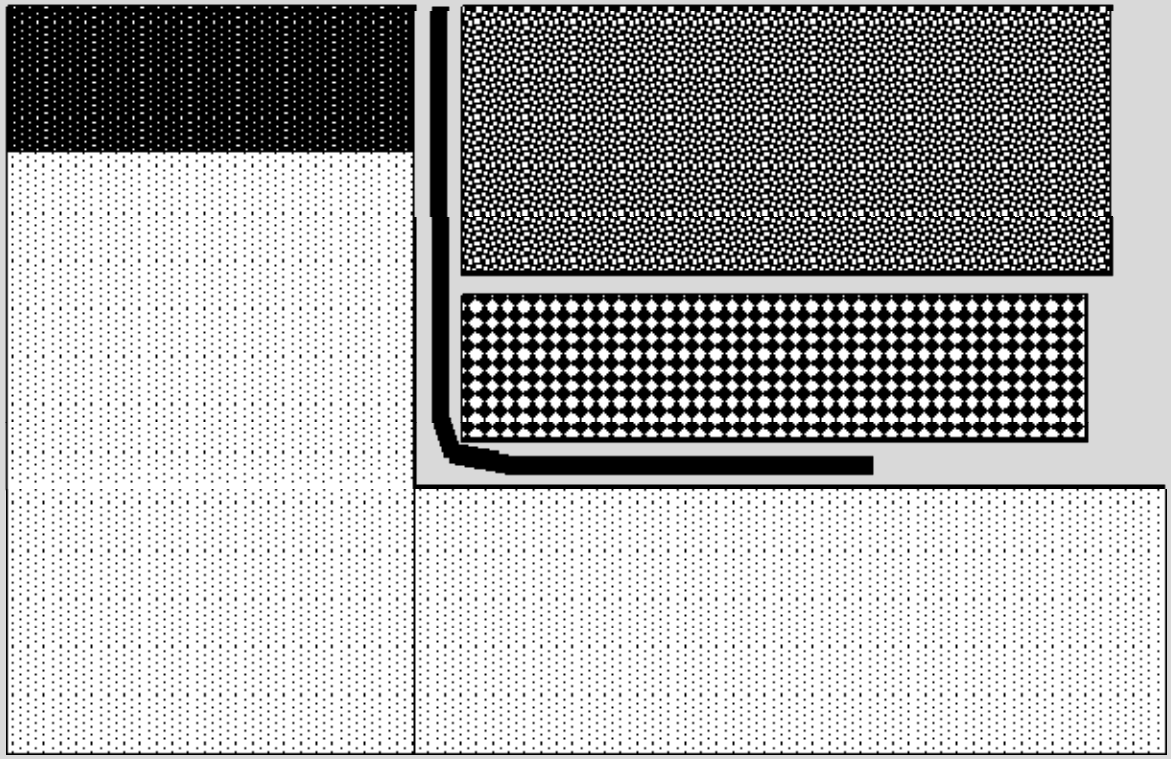
High volume traffic

-consider conventional concrete or a hybrid

Pavement Thickness is Volume Based

	Pathways & Sidewalks	0-20 ADTT	20-100 ADTT	100+ ADTT
Sandy	4" on native	6" on native	8" on native	10" on native
Silty w/ low clay	4" on 3-6" drain rock with filter fabric	6" on 3-6" drain rock with filter fabric	8" on 3-6" drain rock with filter fabric	10" on 3-6" drain rock with filter fabric
Moderate clay	4" on 6-12" drain rock with filter fabric	6" on 6-12" drain rock with filter fabric	8" on 6-12" drain rock with filter fabric	10" on 6-12" drain rock with filter fabric
Heavy clay	4" on 12" drain rock with filter fabric	6" on 12" drain rock with filter fabric and (optional) Darcy Columns	8" on 12" drain rock with filter fabric and (optional) Darcy Columns	10" on 12" drain rock with filter fabric and (optional) Darcy Columns

When Pervious Concrete Abuts Existing Pavement



Existing Asphalt or Concrete

3/4" or 1" drain rock at 6" thick

Subgrade

Pervious Concrete at 6" thick

Water barrier of 24" wide thick visqueen run down the 12" deep excavation and 12" under the drain rock

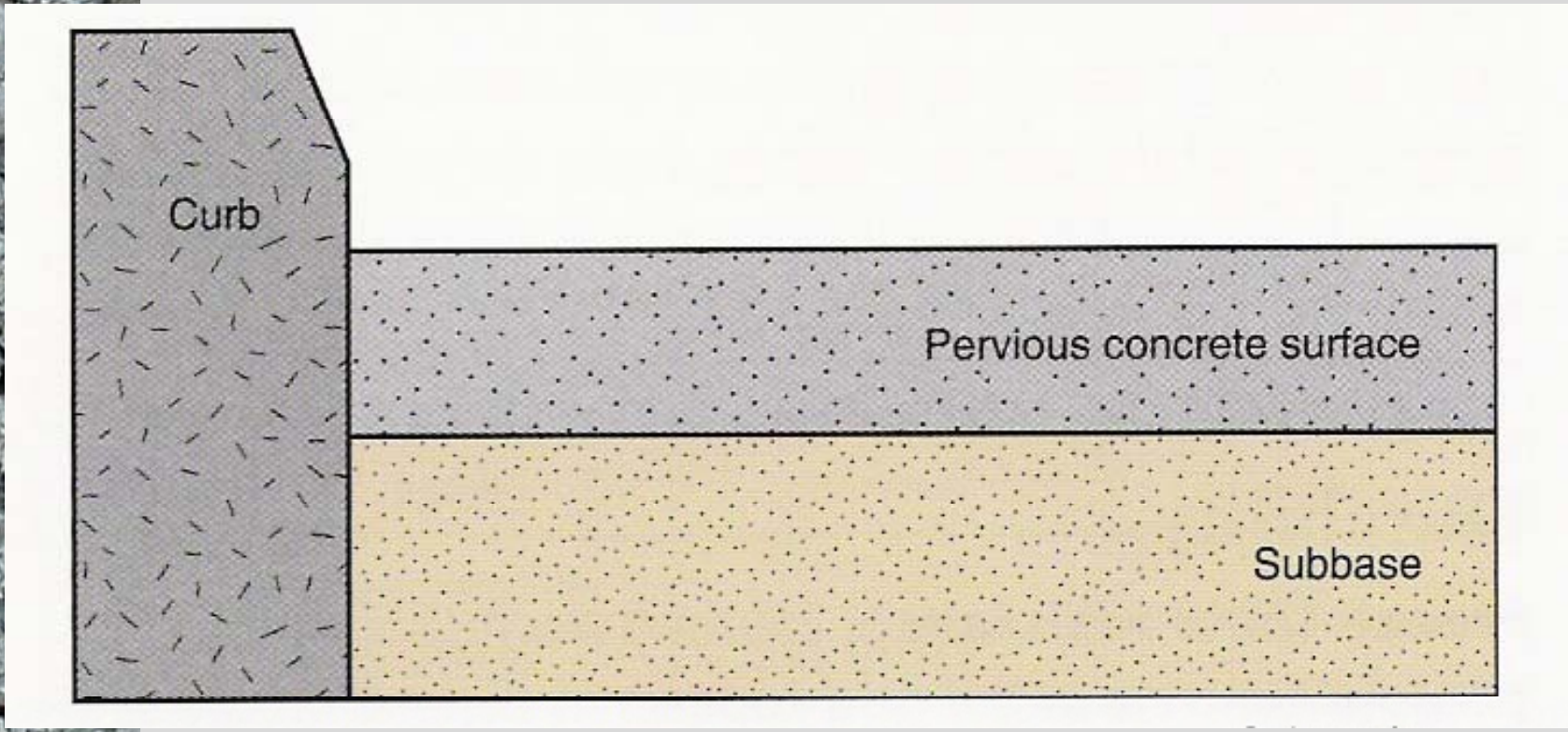
Freeze Thaw

Pervious concrete has been used in freeze thaw environments in the US for over 15 years

- Air entrain the cement paste
- Ideally use larger aggregate (1/2” x3/8” minimum)
- Place on 6-12 inches of drain rock (3/4” or larger clean crushed rock)
- Surface compaction critical to obtain snow-plow durability
- Nearly 100 installations in the Lake Tahoe basin
- Safeway parking area in Denver
- Approved by TRPA (Tahoe Regional Planning Agency) as an infiltration BMP

Limit Potential for Total Saturation of Slab

Freeze-Thaw Durability



What A Difference!

The Next Morning After a Twelve Inch Snowstorm

Pervious concrete in Denver at the Safeway Shopping Center

The conventional asphalt parking lot across the street

Conventional Asphalt Pavement
(Across The Street – NOT Part of the Project)

Elev. 6500 Ft.

ARD Building

Northern Arizona Univ.

Flagstaff, Ariz.

11-30-06

Pervious Concrete Pavement

(Contributing as part of the Project Certification)

Elev. 6500 Ft.

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LEED

LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

Platinum

Chicago’s Green Alleys

This LID uses high albedo concrete which is safer and not slippery

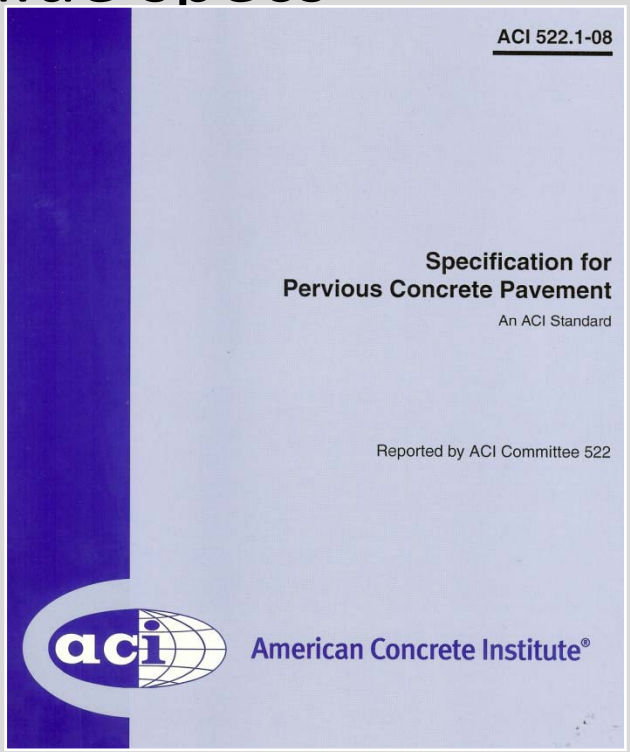
Getting it right..

Understand Total Site Layout

- Where is the pervious proposed?
- Capture impervious surfaces?
- Landscaping or building runoff ?
- Drainage Release?

Specifications

- Utilize locally available guide specs
  - PSCA
  - NRMCA
  - ACI 522



- Insist on the following…

Qualified Contractor

- NRMCA Certification required
- Previous successful installations
- Test panels on job site
- Mix design submittals

Text reference for

Pervious Concrete Contractor Certification

NRMCA Publication #2PPCRT

Where to use Pervious Concrete

SIDEWALKS AND PATHWAYS

Seattle, WA

Olympia, WA

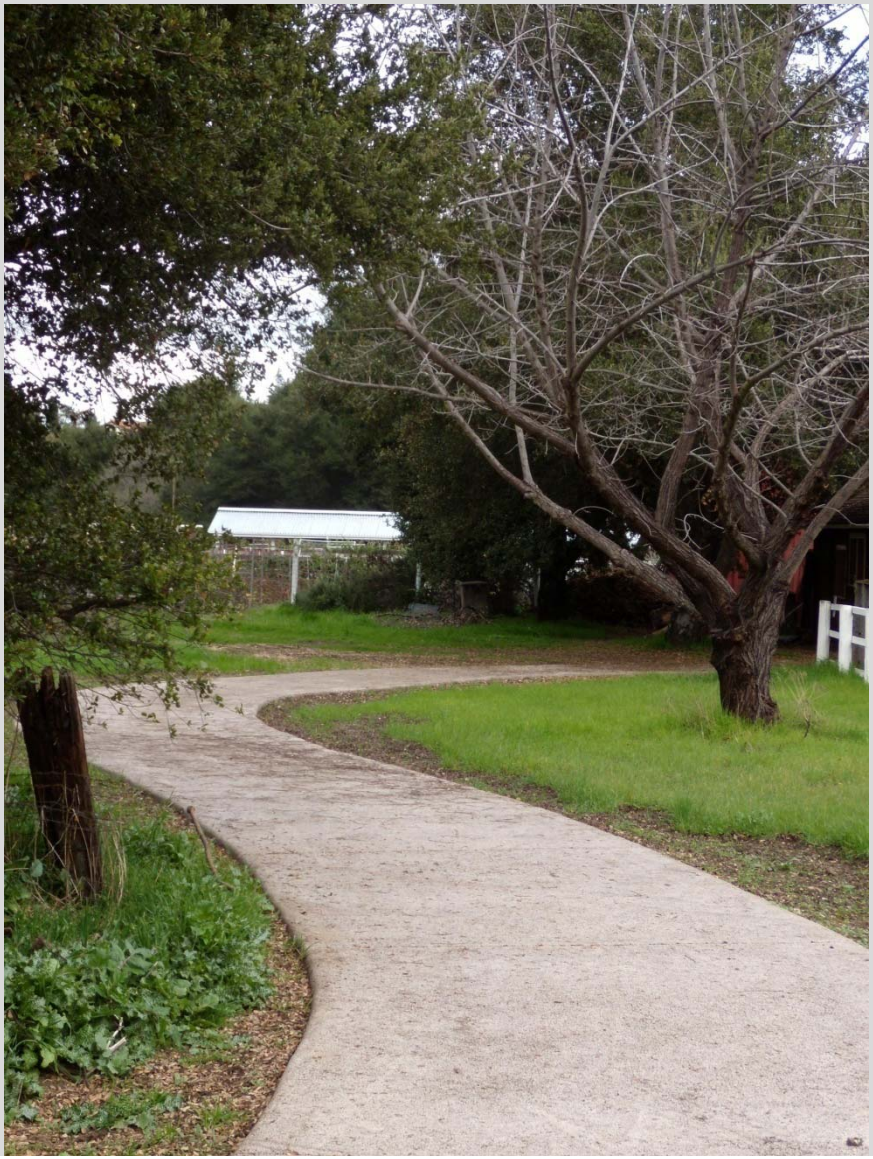
Sacramento, CA

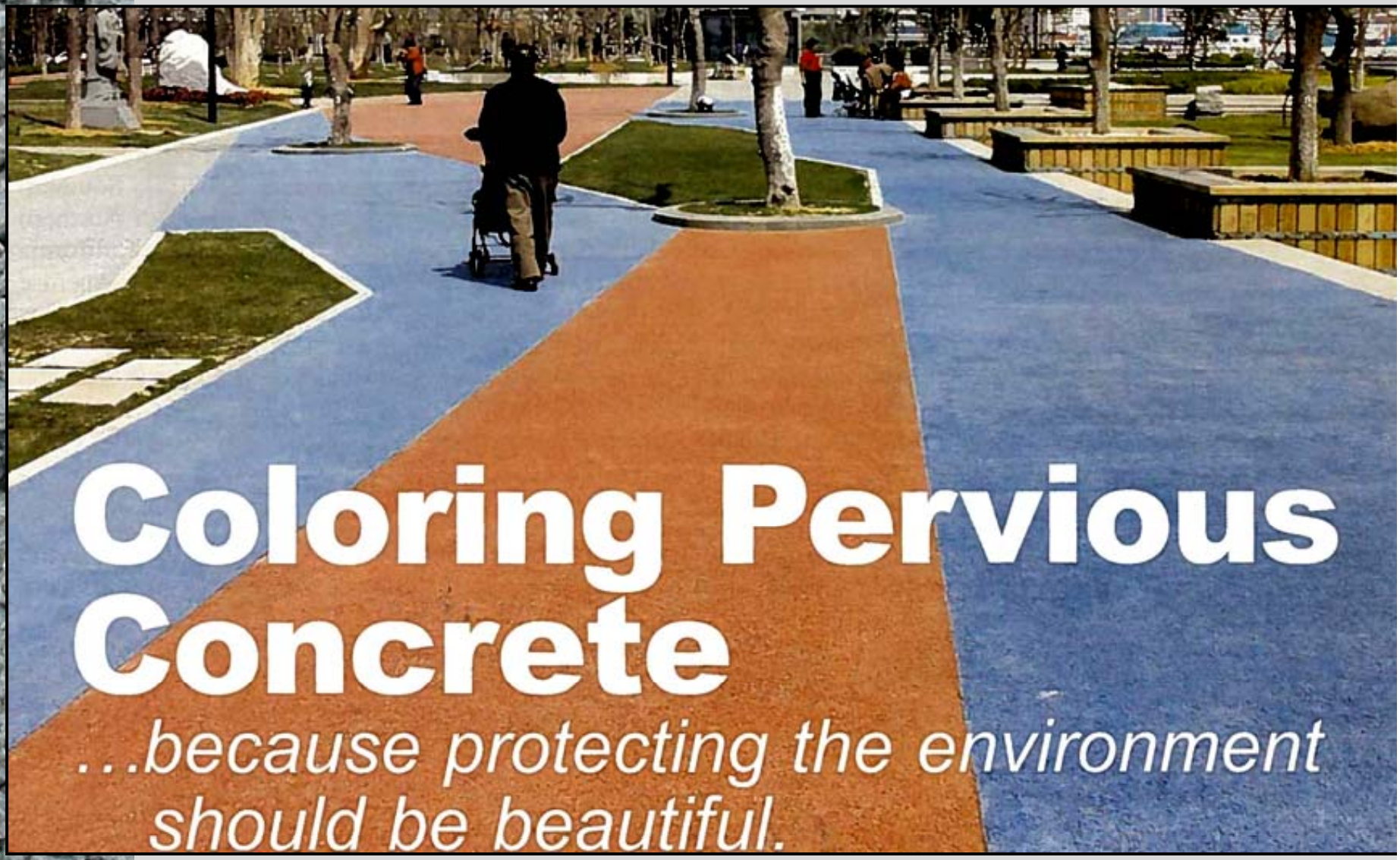
Fair Oaks, CA

San Francisco

Monterey Country Club

Stevens Creek Trail





Coloring Pervious Concrete

...because protecting the environment should be beautiful.

Colored pervious concrete

Architectural Pervious Concrete

Univ. of Calif. - Berkeley

Large Pedestrian Area

Figure 3. A porous concrete infiltration facility was constructed over one of Villanova University's high-pedestrian-traffic areas.

Along Mississippi River – Minneapolis Metro

PARKING LOTS

Kings Beach Placer County, CA

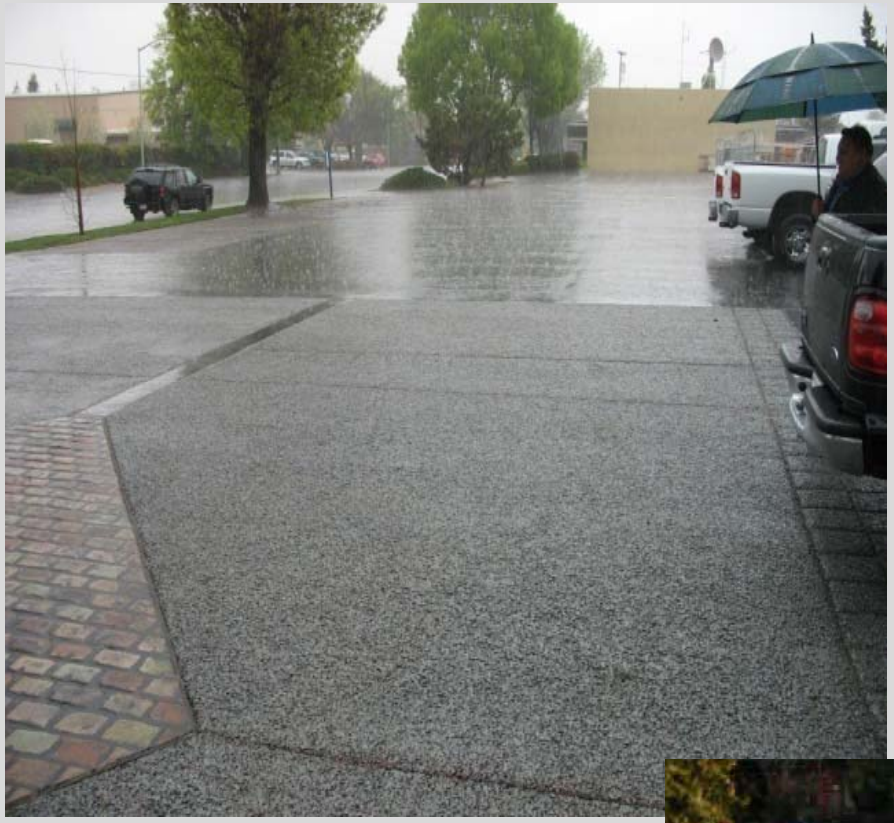
Cerritos, CA

Menlo Park, CA

Petaluma, CA

Conventional vs Pervious

TRPA Parking lot



Fresno – stamped pervious concrete mixed with stamped decorative conventional concrete.

Ocean Honda, Soquel

Park & Ride Parking Lot (4 acres)

Serving Site of 2008 Super Bowl – Glendale, Ariz.

Pervious Concrete Shopping Center Entrance/Service Road

"Canyon Crossing" – Puyallup (Seattle), WA

Prime Outlets – Williamsburg, VA

Re-Const. & Expansion

Major Factory Outlet Mall - 120 stores

(Completed Apr, 2008)

- 7.6 acres - Pervious Concrete
- 3.5 acres - Conventional Concrete

Prime Outlets – Williamsburg, VA

<u>Water Harvesting</u>

Infiltration system design included underground stormwater chambers for nearby irrigation

Pervious Concrete Parking Stalls
Conventional Concrete Drive Lanes

20 year old retention pond behind the mall

Former Detention Pond

Filled with Porous Load-Bearing Crates

Former Detention Pond

Granular Base Over Load-Bearing Crates

Pervious Concrete Over Former Detention Pond

How many cars/trucks can you park on <u>YOUR</u> Detention Pond ?

On This Project - <u>419</u>

STREETS

Sacramento, CA

Oakland, CA

Sultan, WA

Portland, OR

Residential City Streets

Composite Design – Portland, Oregon

Pervious Concrete – Portland, Oregon

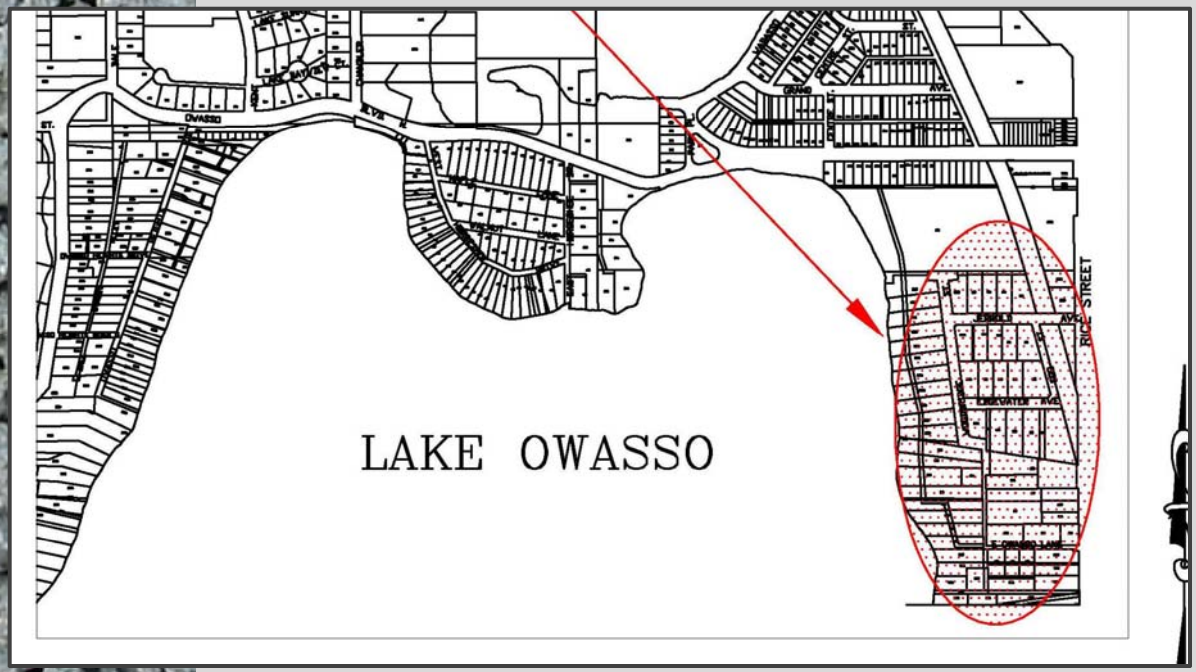
City of Shoreview, MN
2009 Street Reconstruction Project
Woodbridge Neighborhood

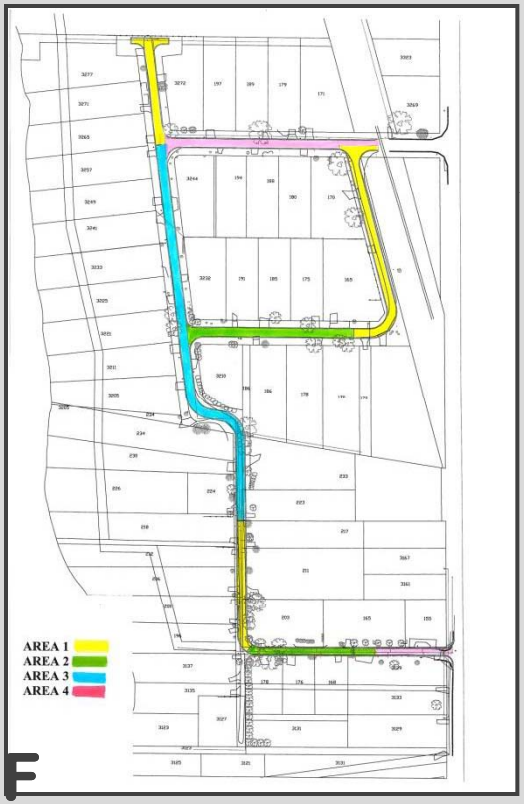
Purposes

1. Low Volume Traffic
2. "Replacement" of Traditional Storm Sewer System
3. Control stormwater runoff & recharge groundwater
4. Stormwater Filtration (first flush pollutants)

20'

City of Shoreview, MN
2009 Street Reconstruction Project
Woodbridge Neighborhood

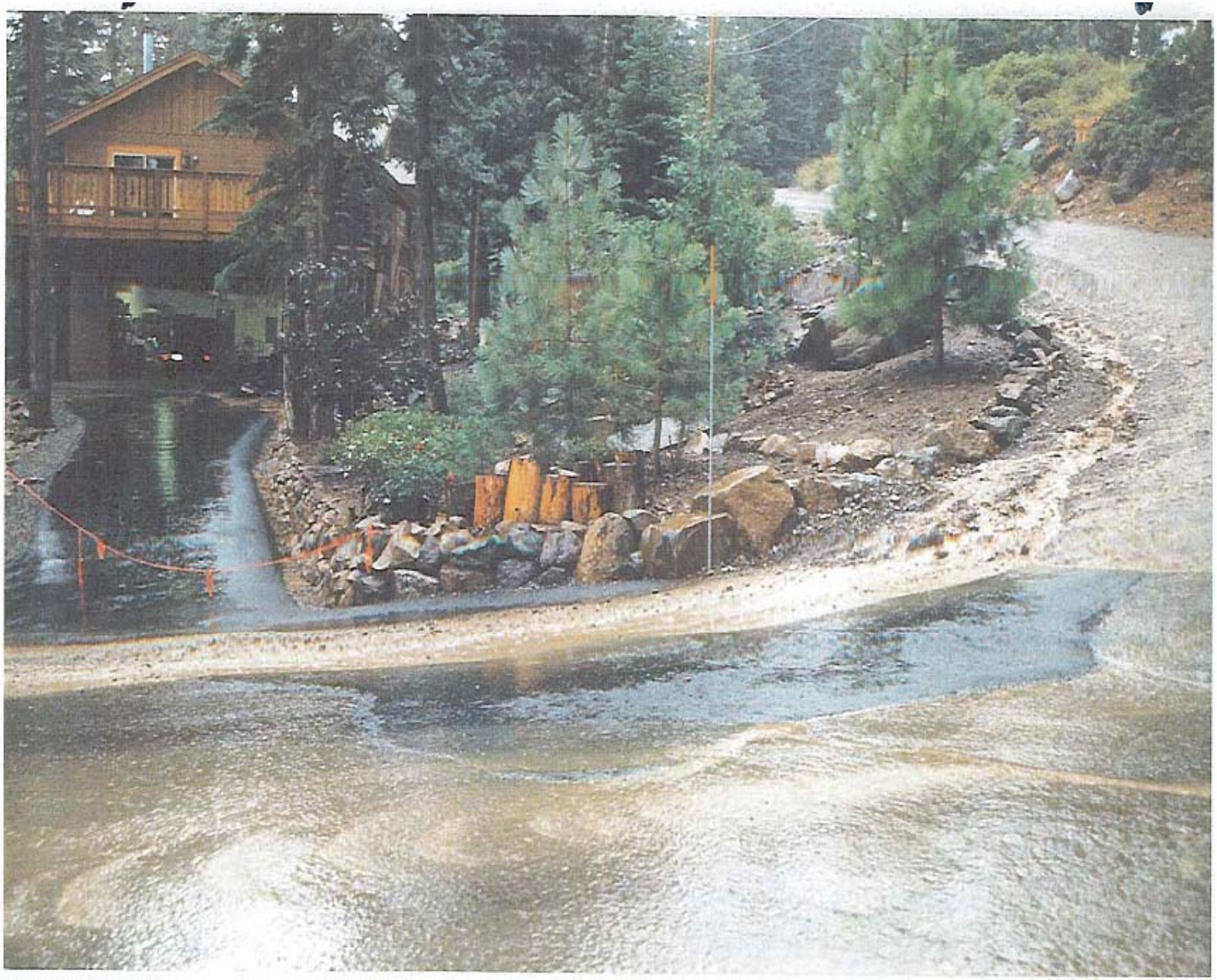




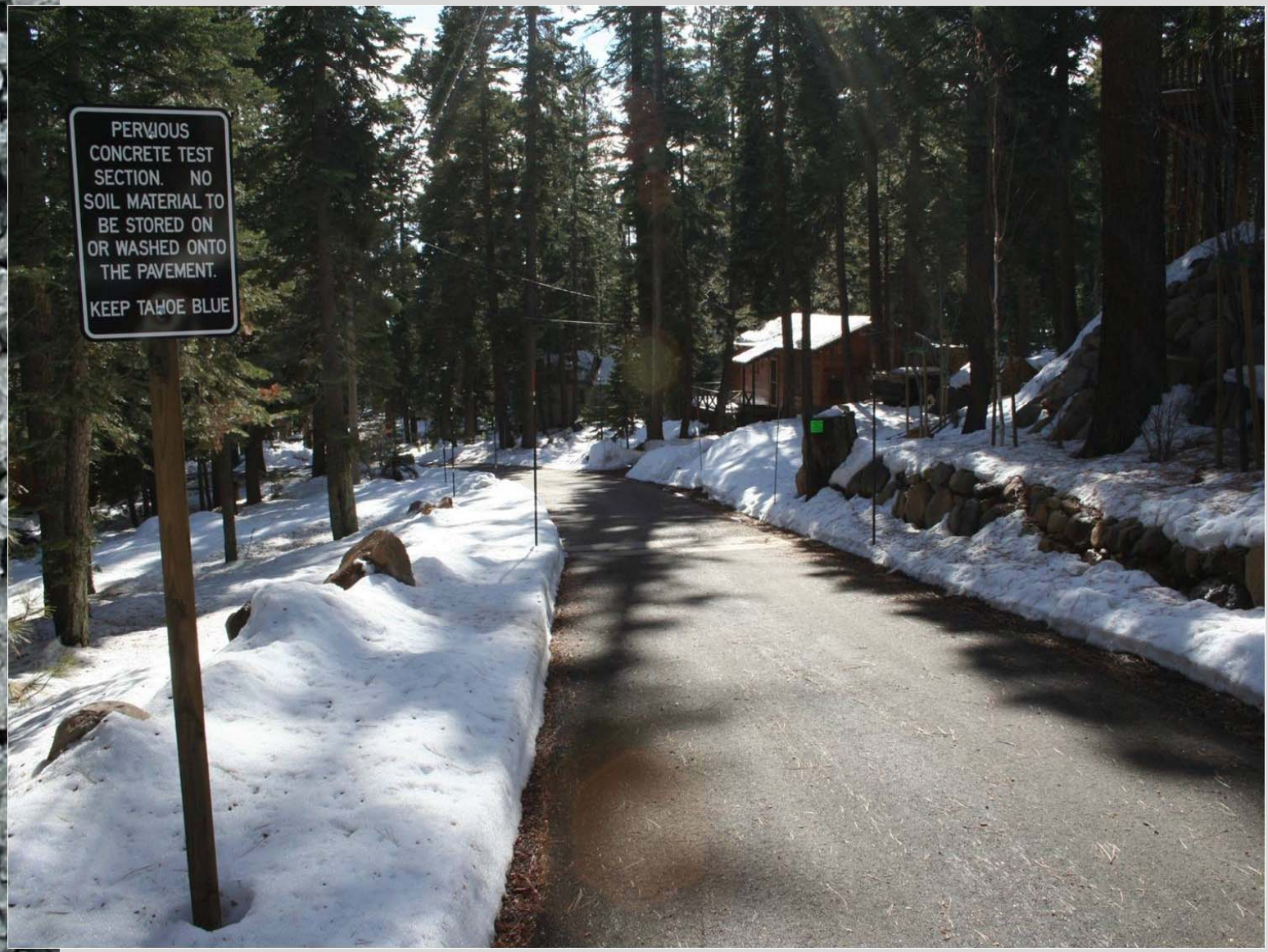
Pavement approx. 1 mile long / 79,000 SF

CMI Homes in Sultan, WA

Extra lots and savings in stormwater management provided savings of $250,000 to CMI



Wildrose Ave. and Laurel Dr.


PERVIOUS
CONCRETE TEST
SECTION. NO
SOIL MATERIAL TO
BE STORED ON
OR WASHED ONTO
THE PAVEMENT.
KEEP TAHOE BLUE

Marine Mammal Center, Marin Headlands

Pervious Concrete

Filters Water in Excess of 270 Inches per Hr.

Why Pervious Concrete?

- Saves Money for Agencies:
  - Eliminate upgrading of overburdened storm sewer systems
  - Reduce stormwater runoff monitoring requirements
  - Recharge groundwater to extend the lifetime of aquifer water sources

The Goal

Pervious Concrete:

- The right choice for today and tomorrow!

- **Paulette Salisbury, FCSI, CDT**
- Technical Specialist
- California Nevada Cement Association
- 925-918-0982
- Paulette.salisbury@cncement.org

600 ml
PYREX