

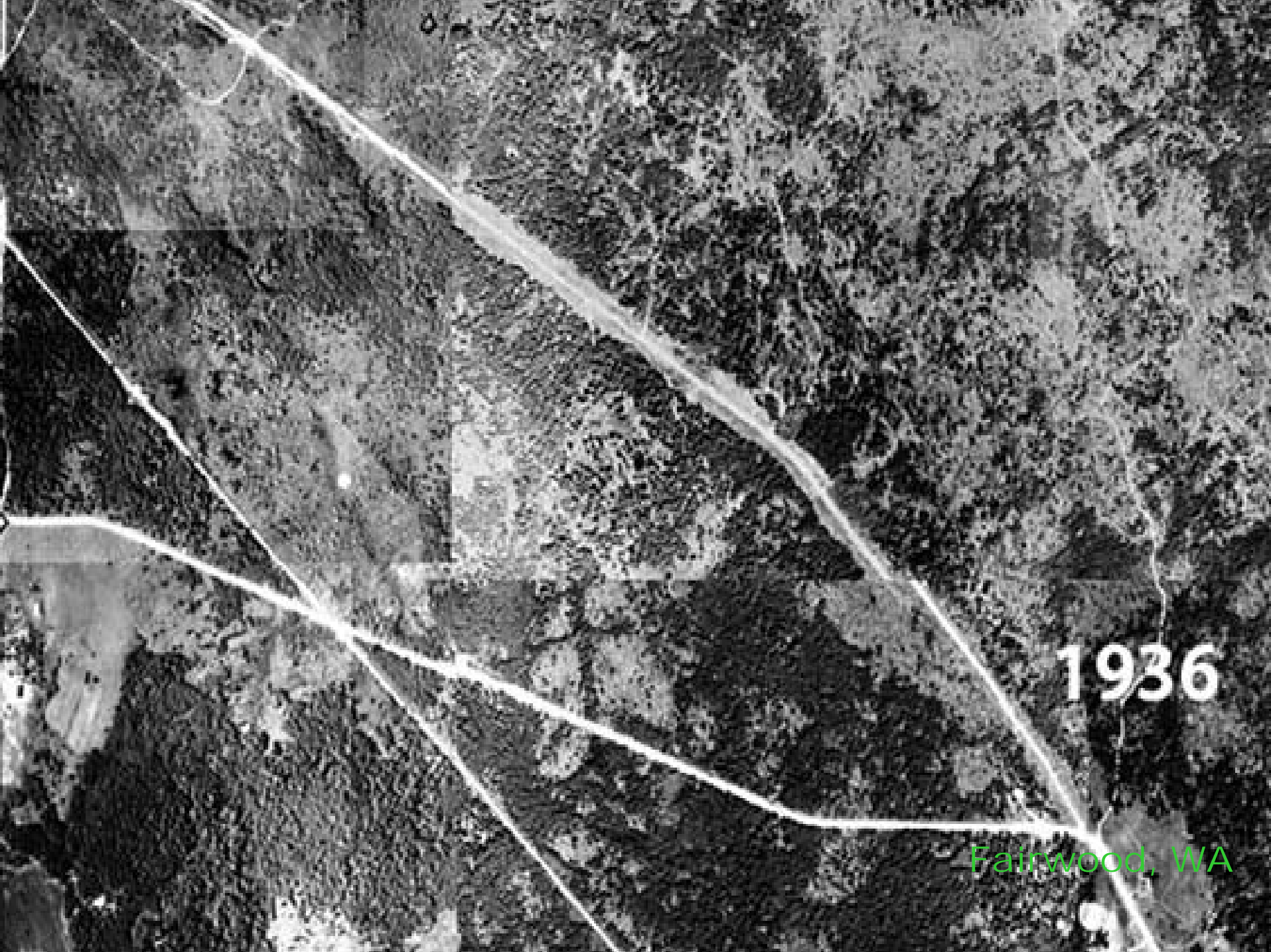
Just when we were getting it right:

**Stormwater management
for the 21st century in the
Pacific Northwest**

Derek B. Booth

**Stillwater Sciences, Inc.
University of Washington**

February 2007
Water Center—Annual Review



1936

Fairwood, WA



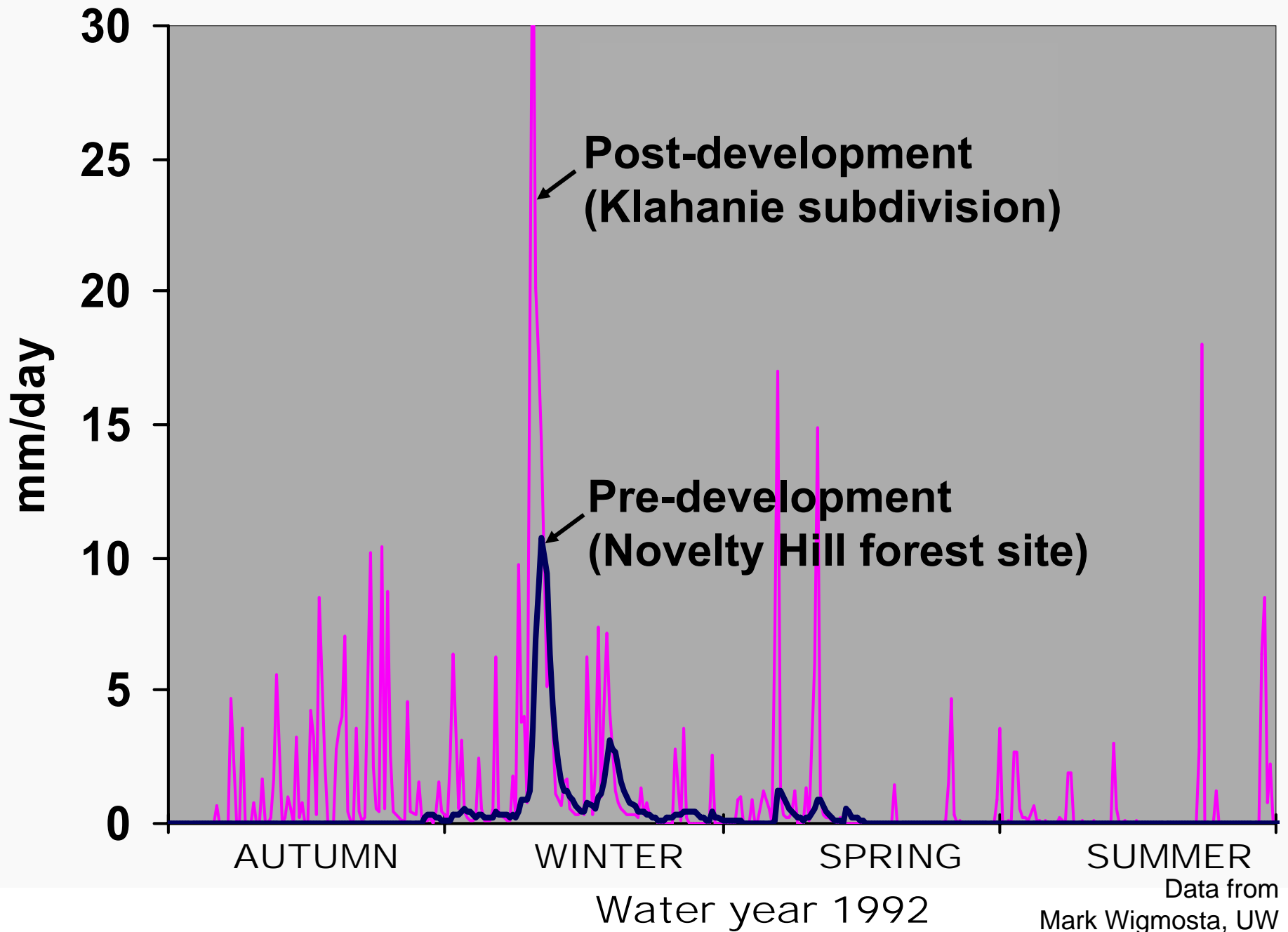
1970



1996



2010?





ca. 1 m

An aerial photograph of a suburban residential development. The image shows a dense cluster of houses with dark roofs, interspersed with green trees and grass. The roads are winding and light-colored, creating a complex network of streets. The overall scene is a typical example of a planned residential neighborhood.

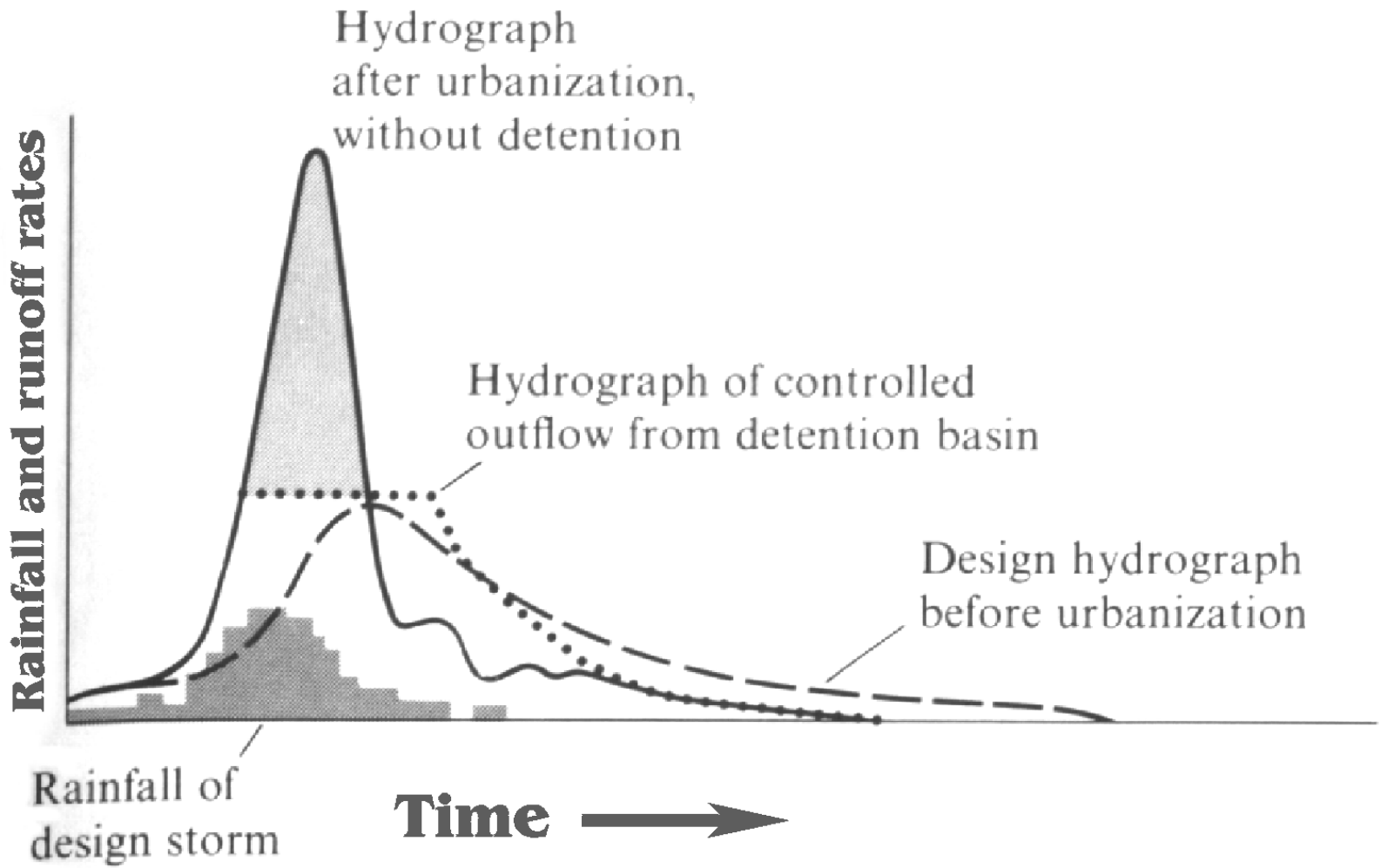
So, have *landscape-scale* changes
resulted in a landscape scale of
mitigation?

...well, not exactly.

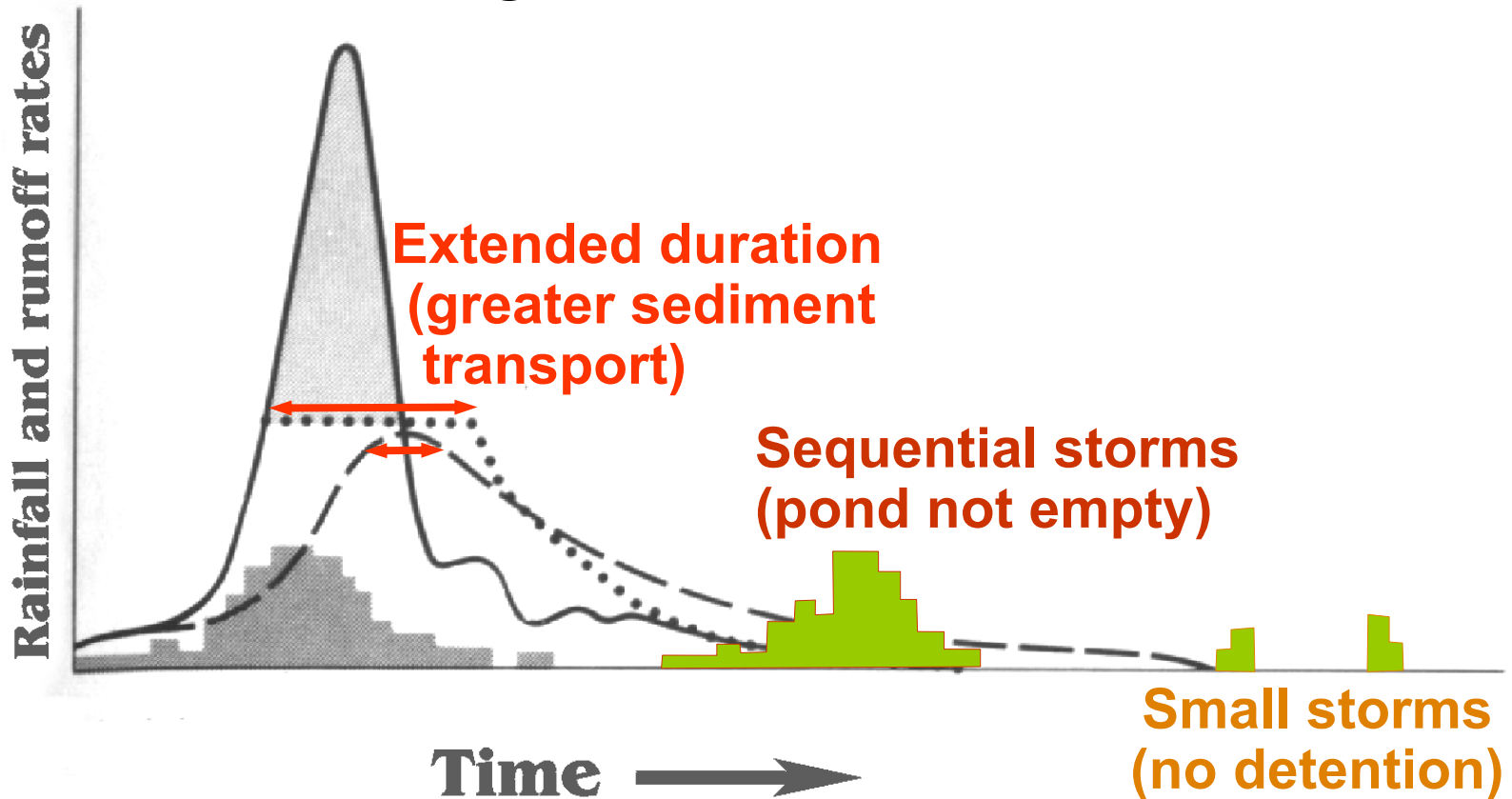
Klahanie near Issaquah, WA

Instead, we collect the runoff and deliver it to an end-of-pipe “treatment center”.





BUT: Even *with* detention, hydrograph changes (and their consequences) are still significant, as a result of...



WHY have end-of-pipe
“solutions” been so popular?

- Easy to implement
- Require little or no adjustment to business as usual
- Certified by state-of-the-practice engineering techniques to “work”



This also “works”...

...but so
does
this.



LOW IMPACT DEVELOPMENT

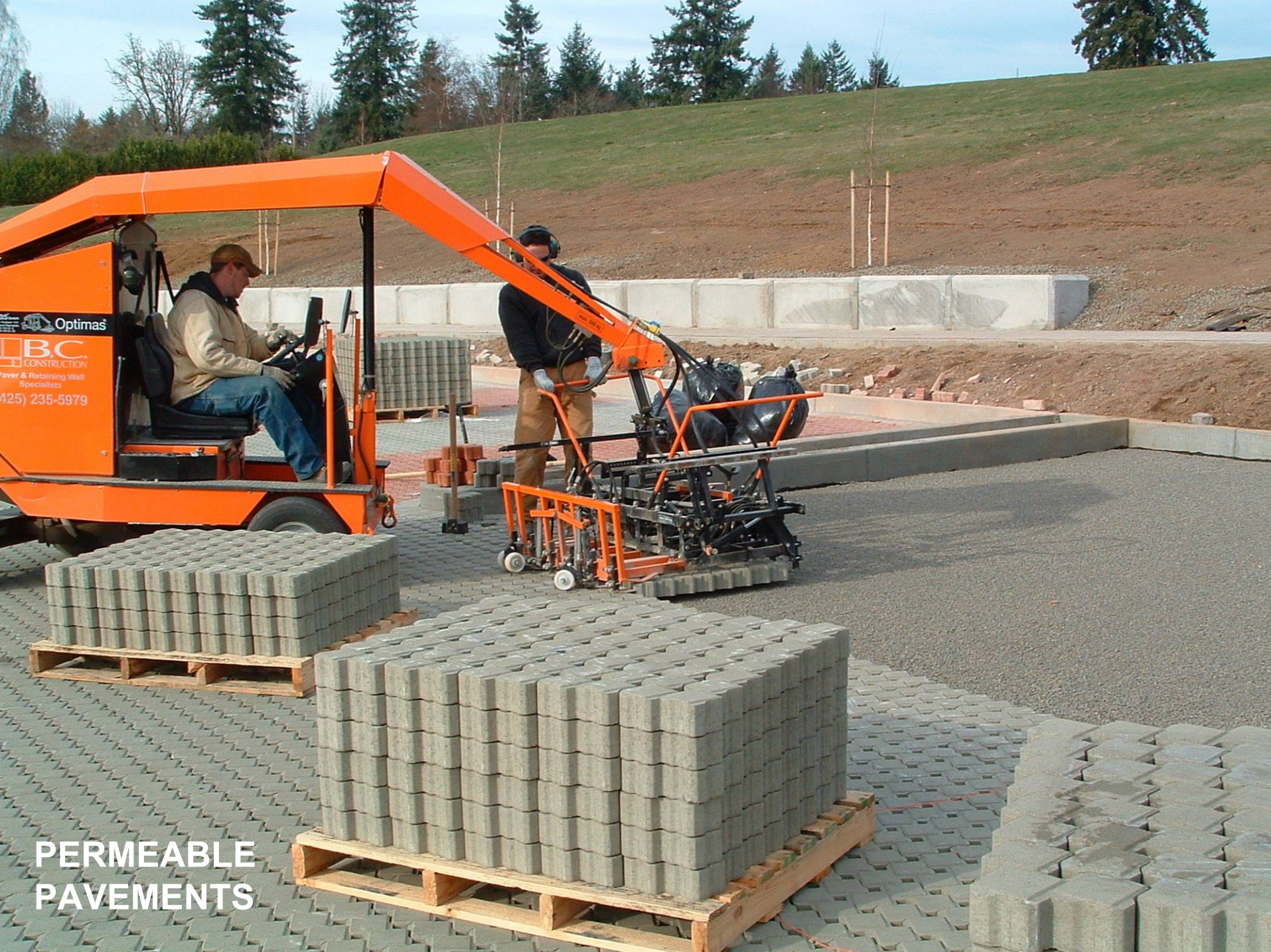
TECHNICAL GUIDANCE MANUAL FOR PUGET SOUND



JANUARY 2005

DOWNSPOUT DISCONNECTION





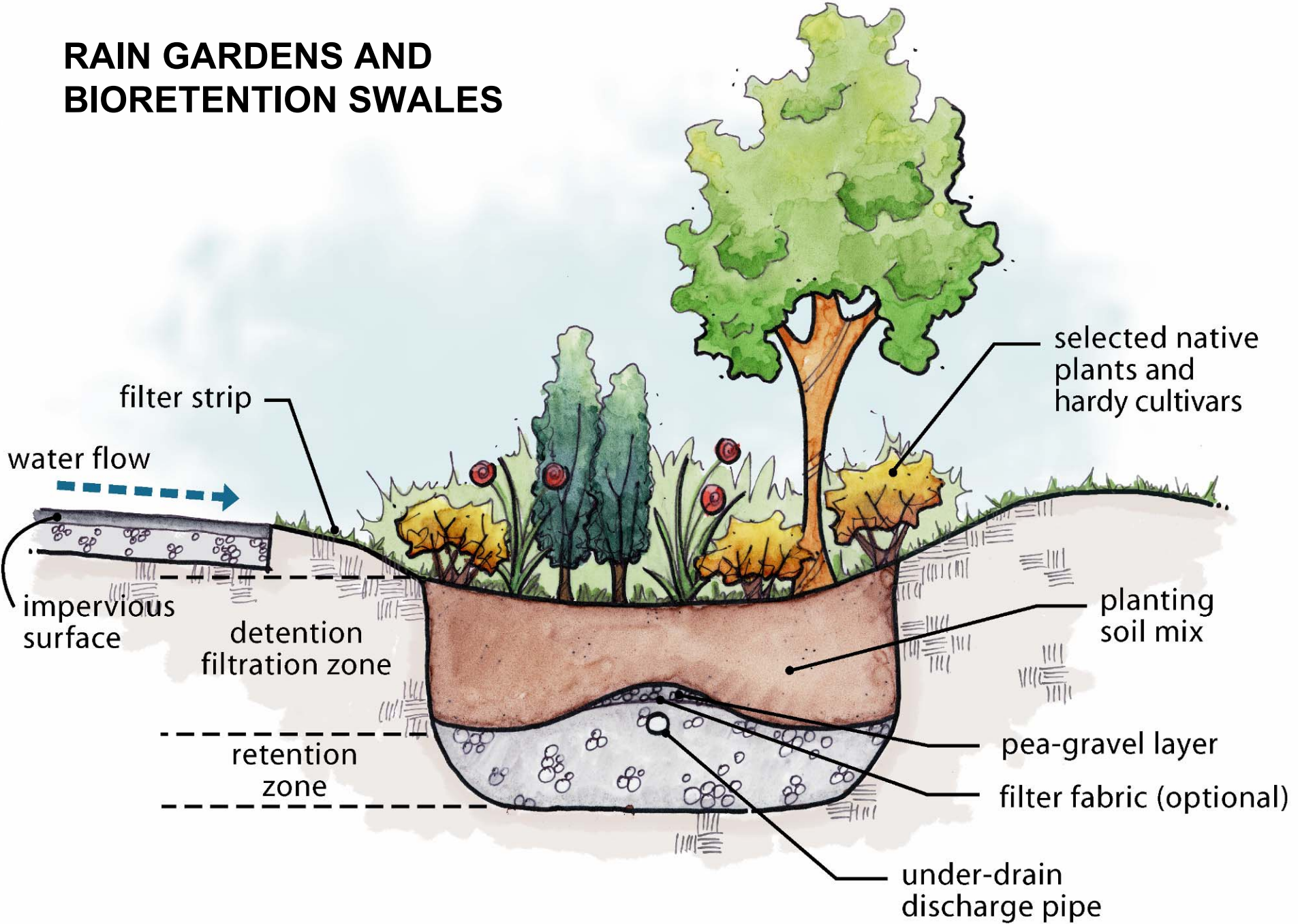
Optimas
IBC
CONSTRUCTION
Paver & Retaining Wall
Specialists
(425) 235-5979

**PERMEABLE
PAVEMENTS**

GREEN ROOFS



RAIN GARDENS AND BIORETENTION SWALES



SEA Streets,
City of Seattle



SEA Streets monitored catchment (2.3 acres)

Monitoring period	March -July 2000	March -July 2001
Rainfall (inches)	7.96	9.00
Runoff (CF)	4979	132
Runoff rate	625	15

SEA Streets monitored catchment (2.3 acres)

Monitoring period	March -July 2000	March -July 2001	
Rainfall (inches)	7.96	9.00	11% more rainfall
Runoff (CF)	4979	132	
Runoff rate	625	15	98% less runoff

IN SUMMARY:

The symptom: "too much runoff".

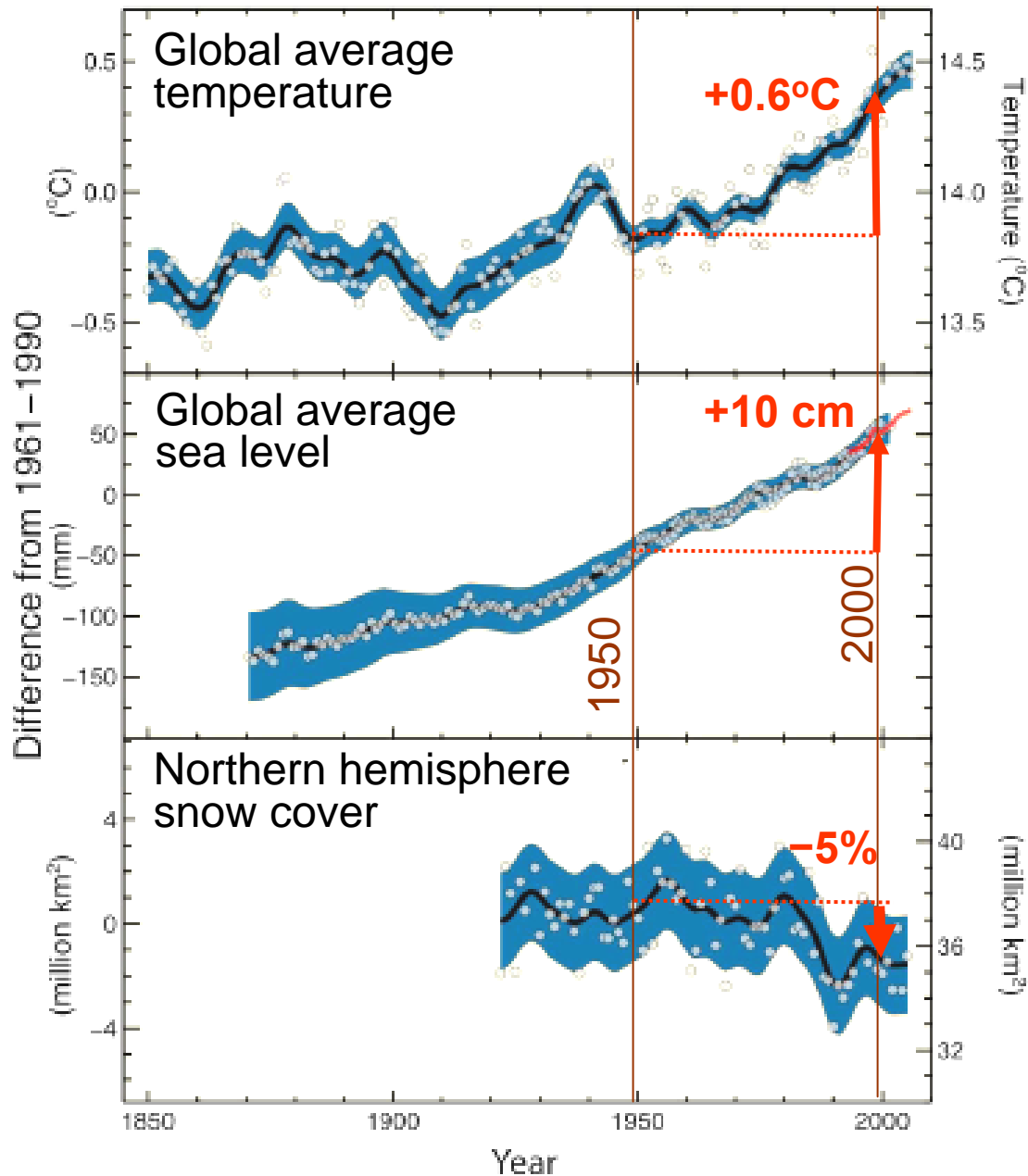
The cause: loss of soil-moisture storage, which redirects subsurface flow to surface runoff.

Strategy: apply mitigation at the source, and at the scale of the original disturbance.

Implementation: reintroduce surface runoff into the subsurface throughout the developed landscape.

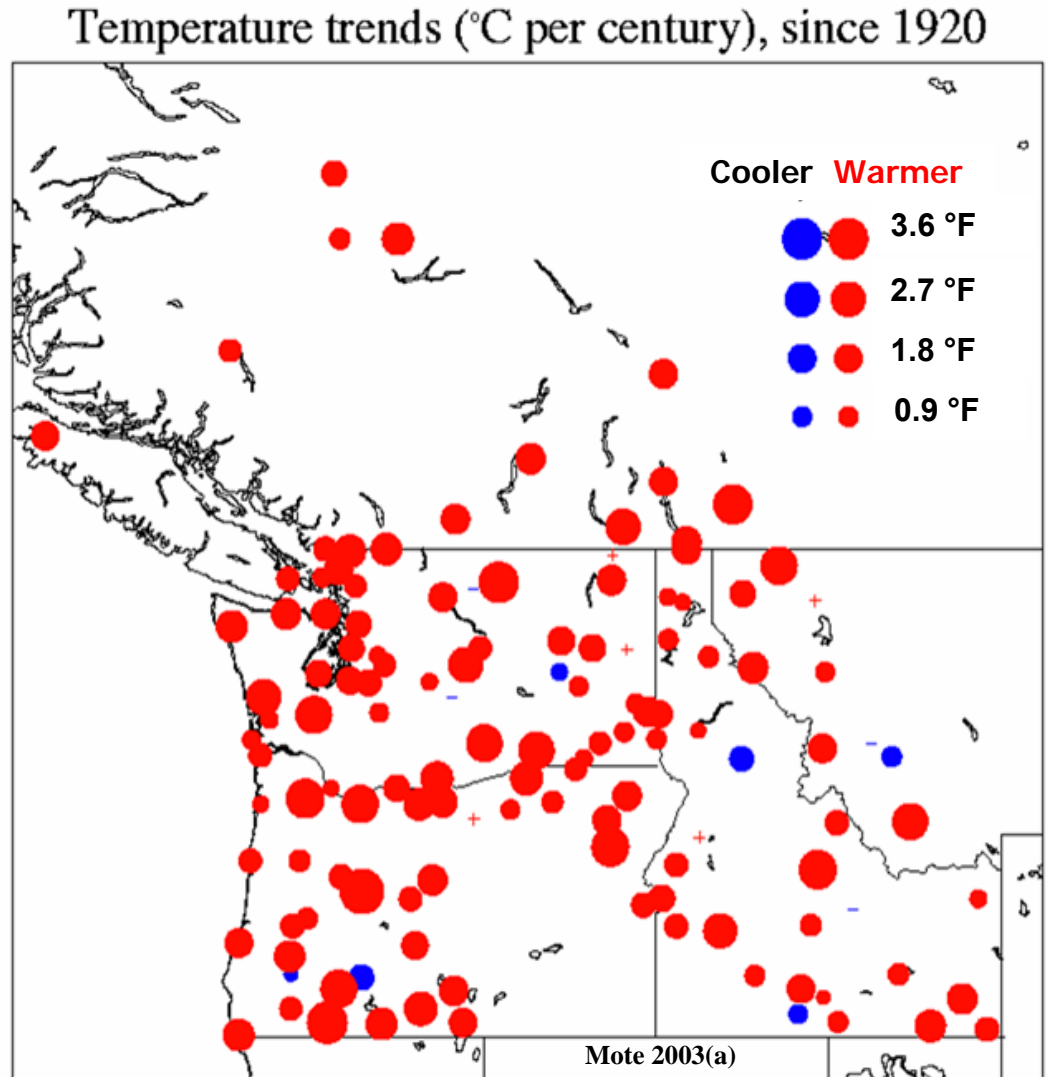
...so, what's the problem?

Changes in Temperature, Sea Level and Northern Hemisphere Snow Cover



PNW Temperature Trends by Station

- Average annual temperature **increased +1.5°F** in the PNW during the 20th century (+2.3°F across Puget Sound)
- Almost every station shows warming
- Extreme cold conditions have become rarer
- Low temperatures rose faster than high temperatures



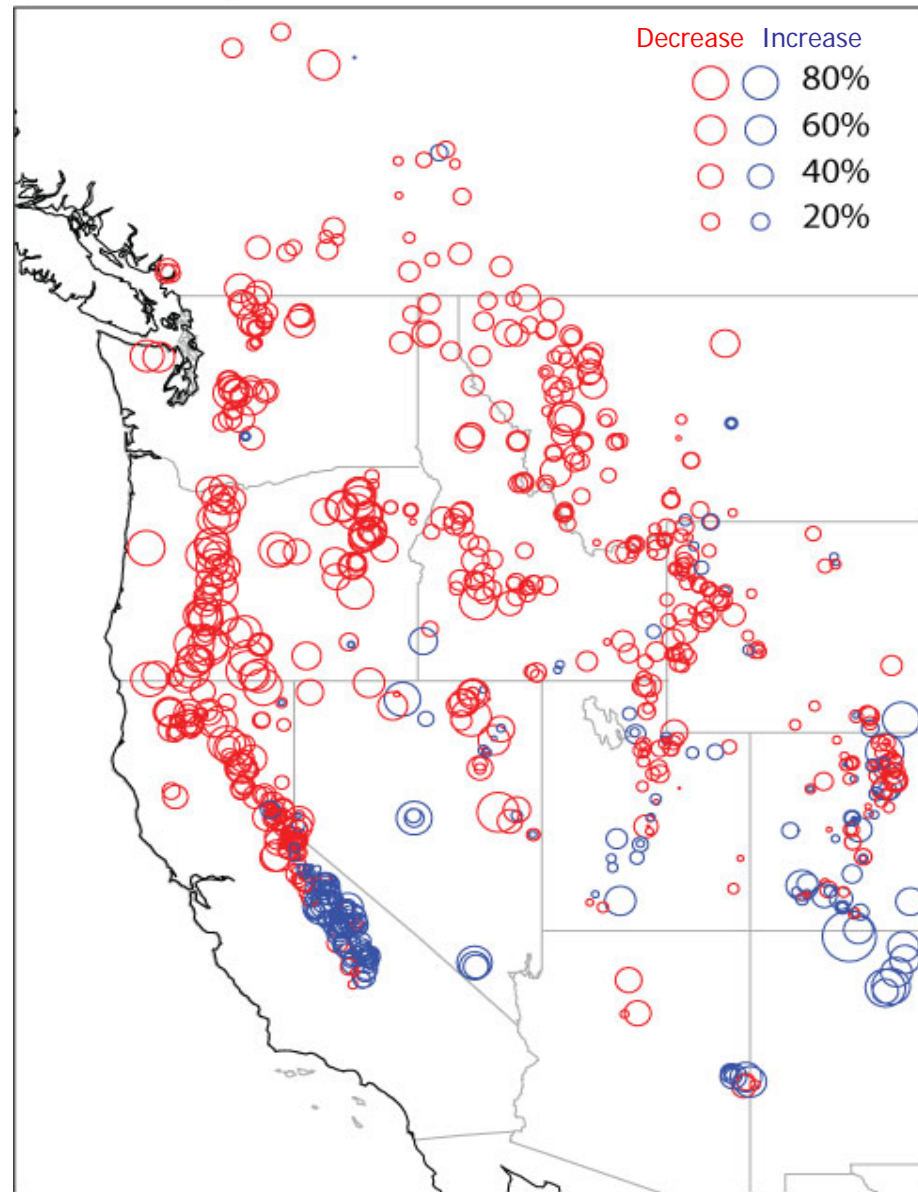
Snow-Water Equivalent Trends

a. April 1 SWE Observations 1950-1997

Most PNW stations showing a decline in snow-water equivalent

Numerous sites in the Cascades with 30% to 60% declines

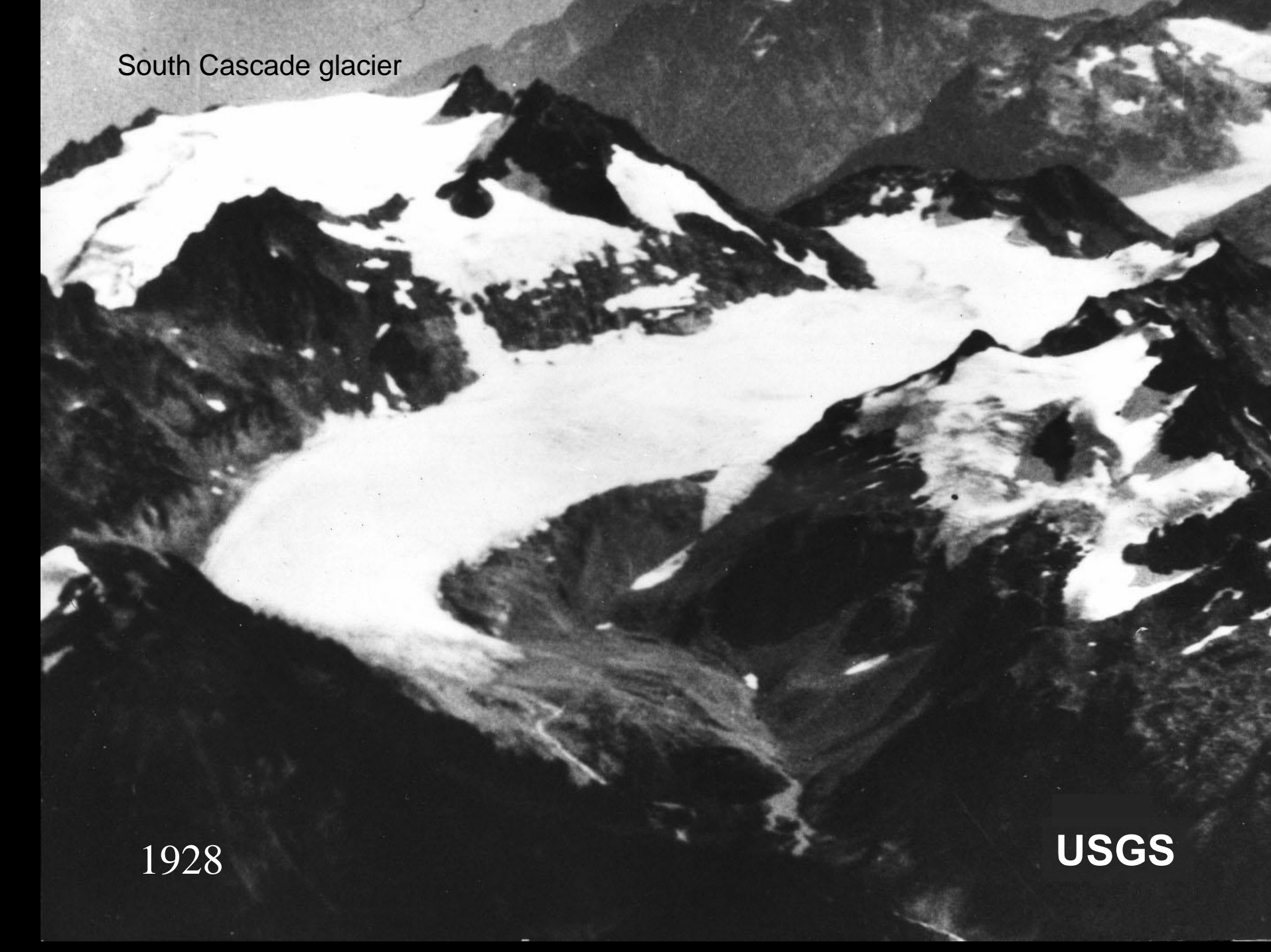
Similar trends seen throughout the western United States: 73% of stations show a decline in snow-water equivalent



South Cascade glacier

1928

USGS



South Cascade glacier

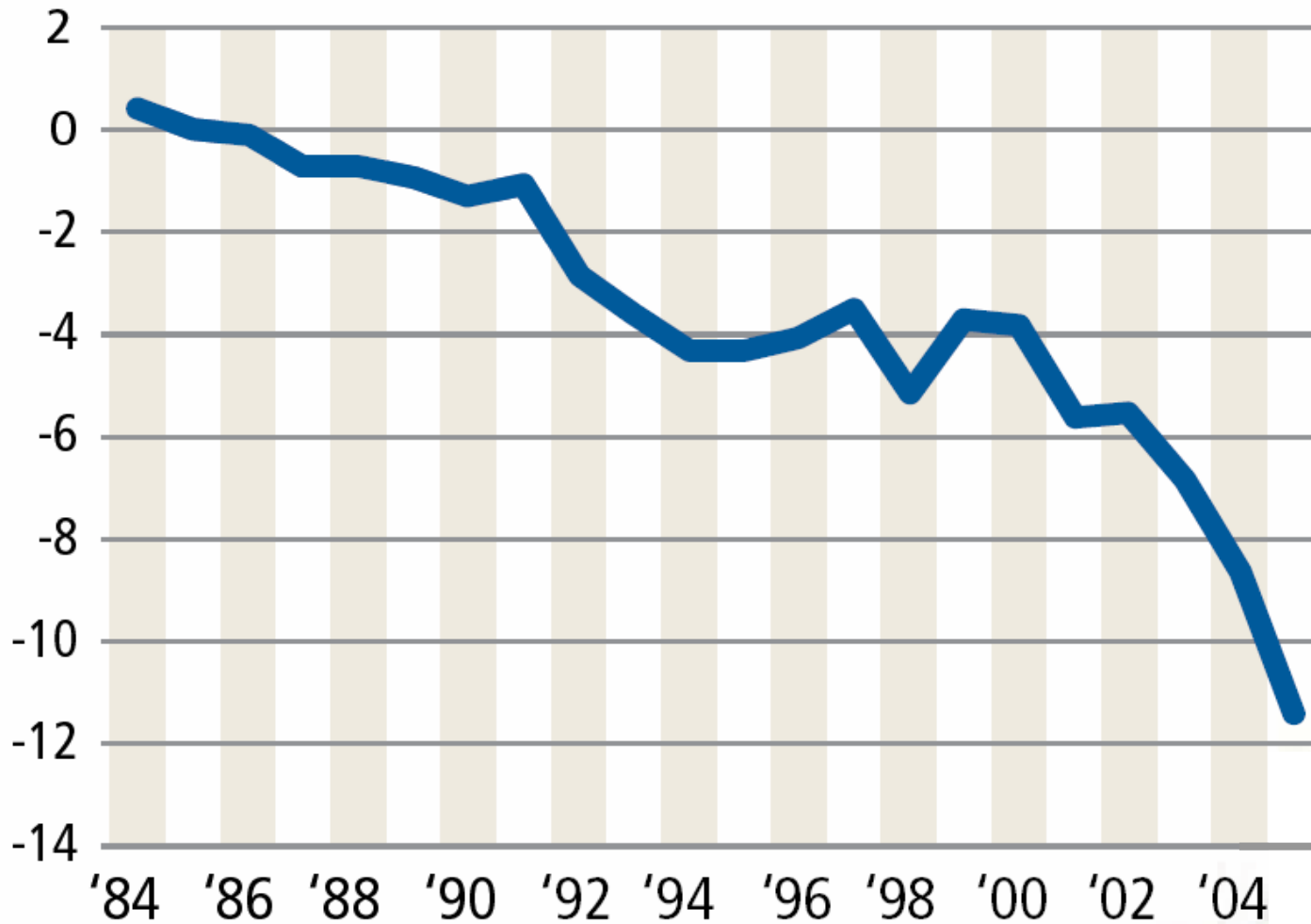


2000

USGS

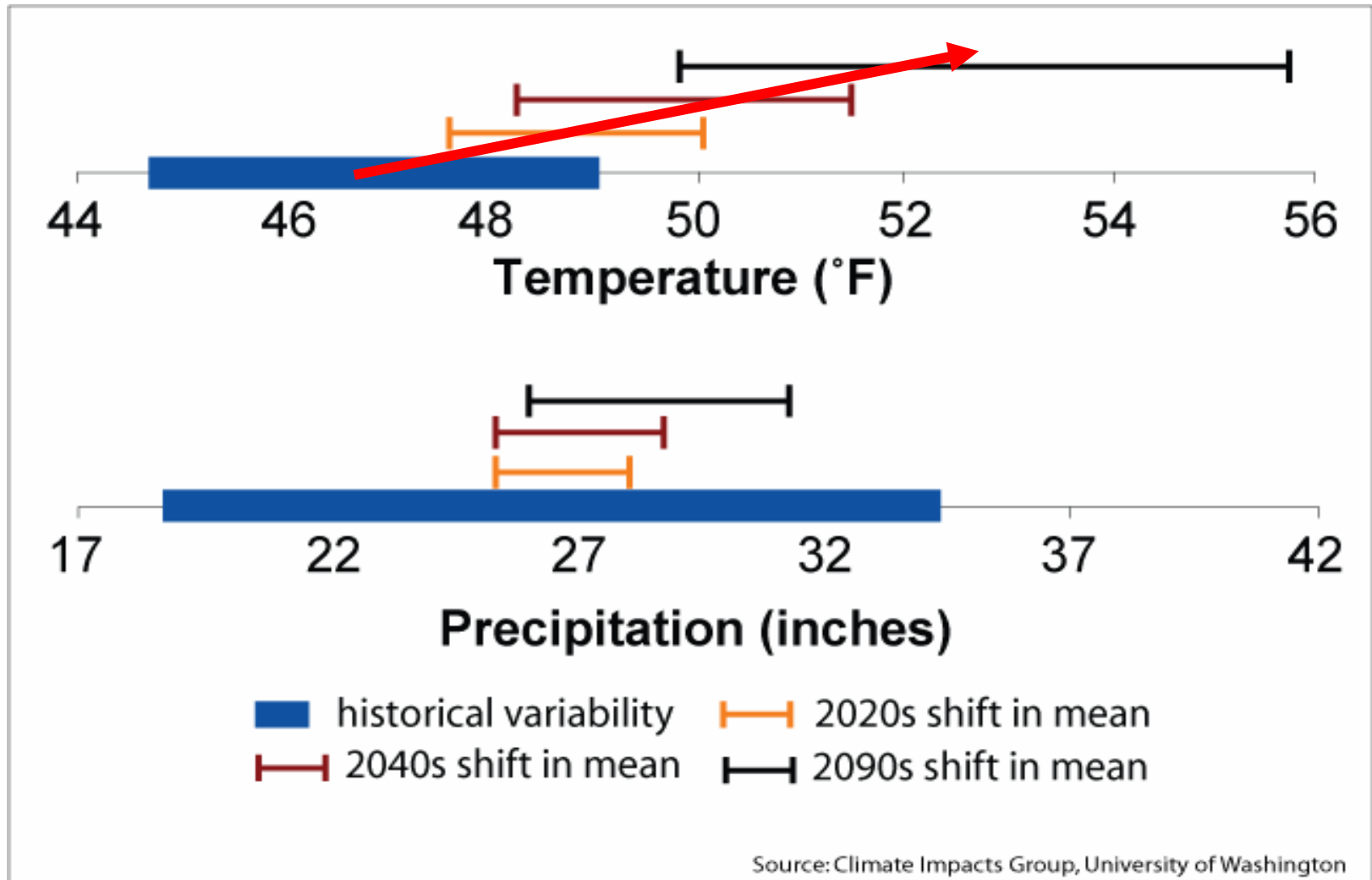
North Cascades glacier decline

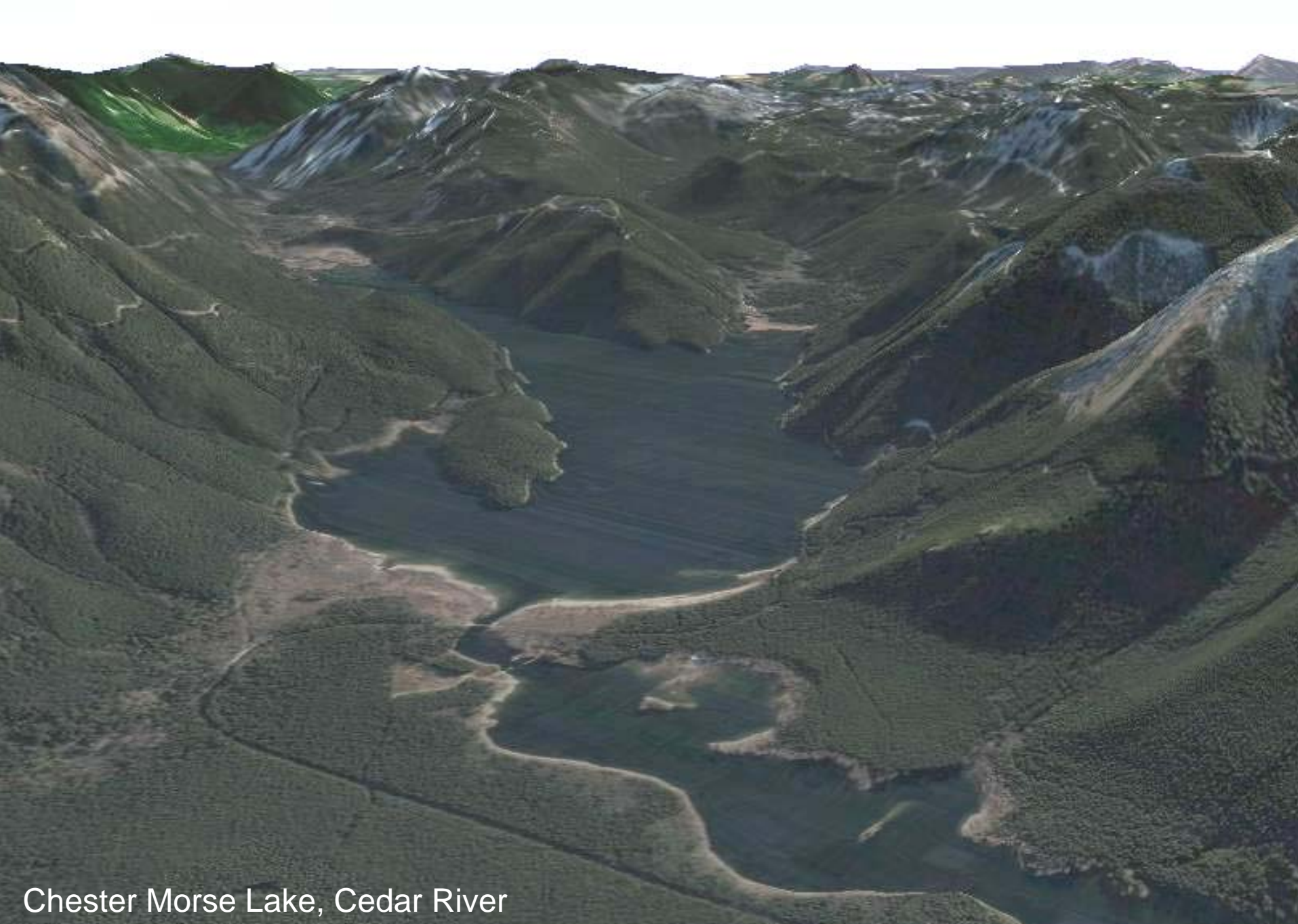
Annual average glacier depth converted from snow and ice into its equivalent in water, measured in meters



Data from North Cascades Glacier Project;
graphics courtesy of Seattle PI

Average temperature could increase beyond the year-to-year variability observed in the PNW during the 20th century as early as the 2020s

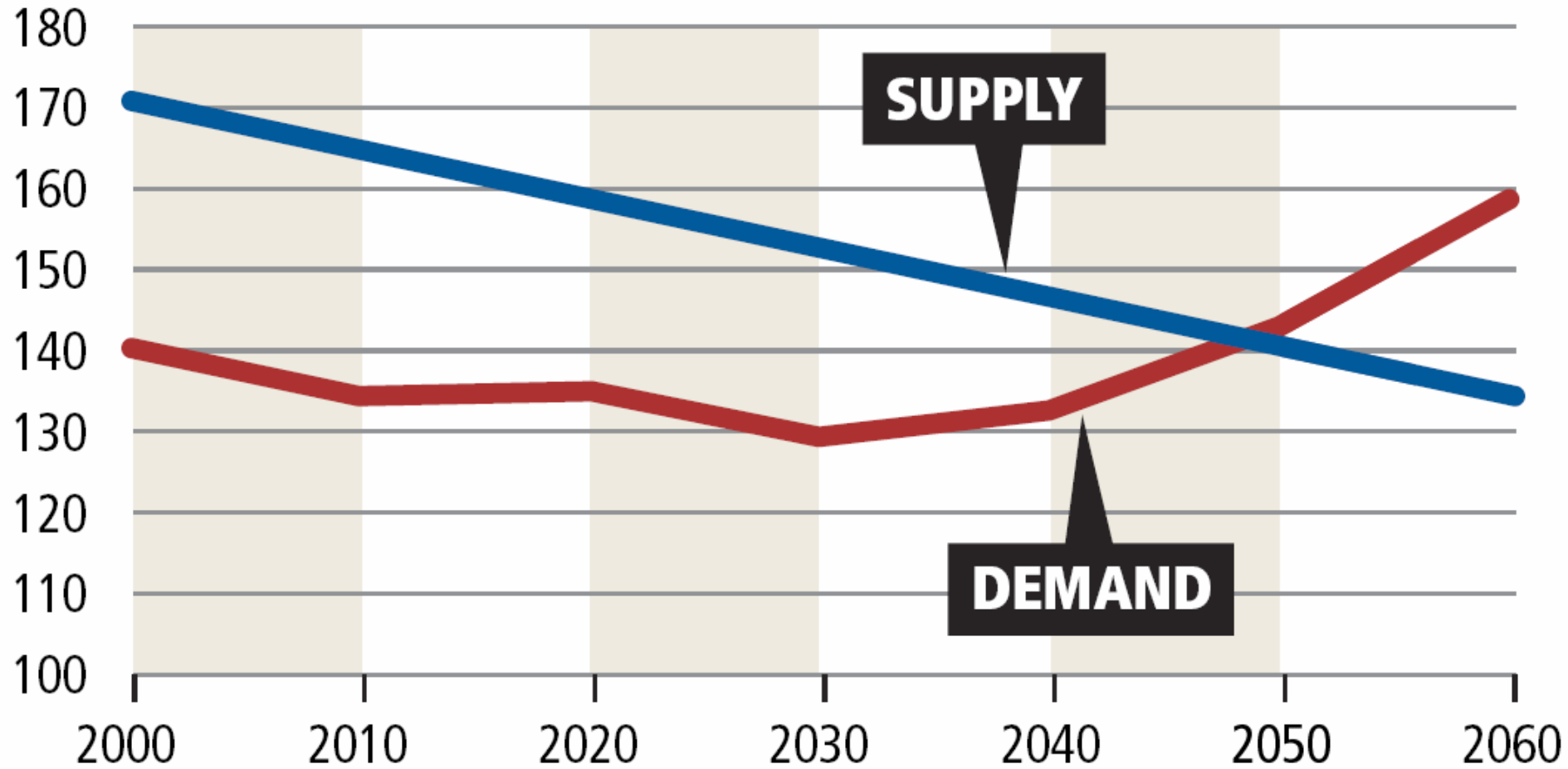




Chester Morse Lake, Cedar River

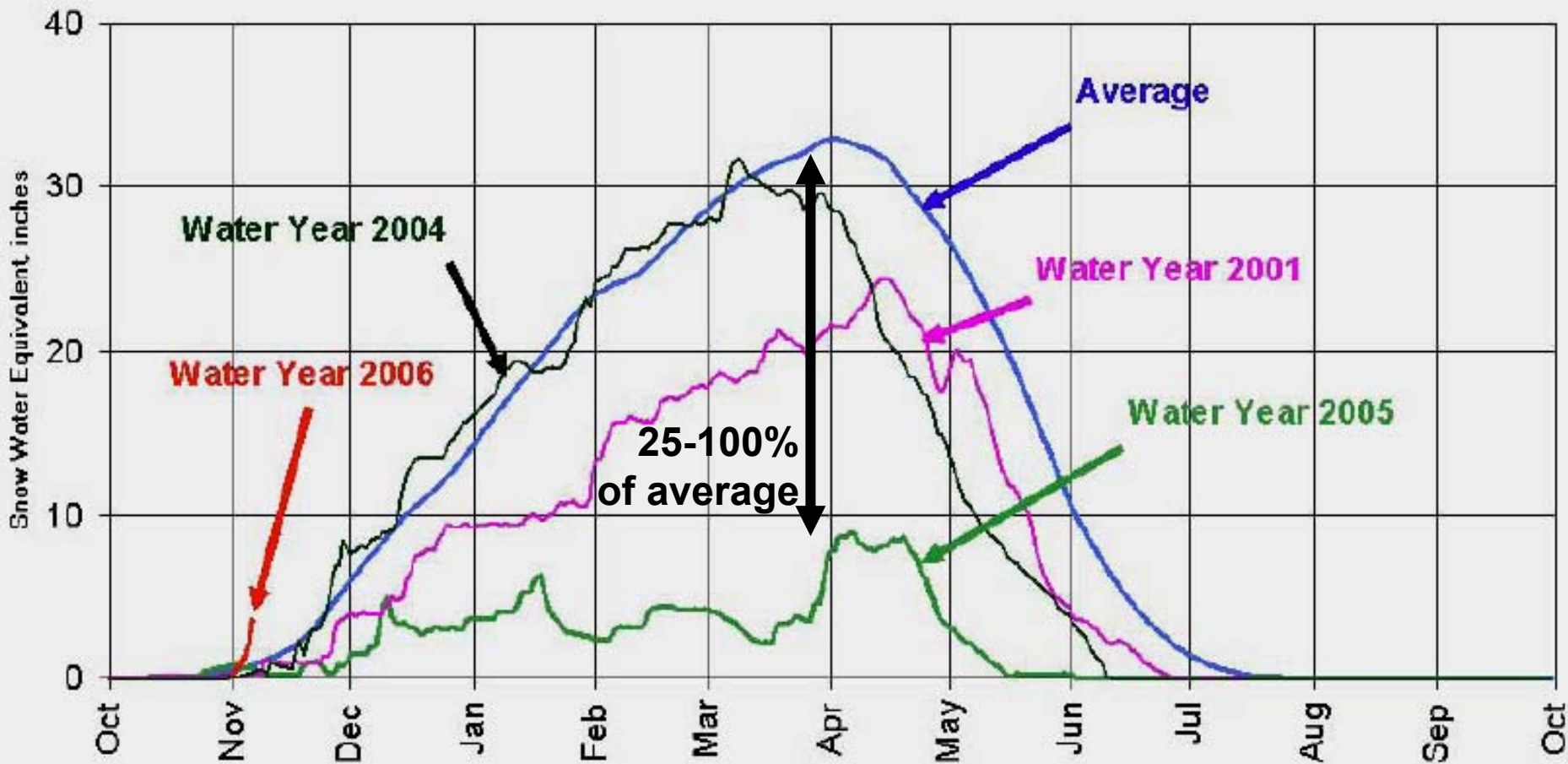
Seattle water supply and demand projections

In millions of gallons per day, assumes no change in water management



Data from SPU; graphics courtesy of Seattle PI

Cumulative Snowpack Snow Water Equivalent Weighted Average Cedar/Tolt



from Seattle Public Utilities

Water is becoming too scarce,
and too precious, to waste.

But "waste" can be defined in
many different ways...

Waste?



Wise use?



King Street Center

VIRTUAL TOUR

HOME

ABOUT US

THE PARTNERSHIP

RESOURCES

CONTACT US

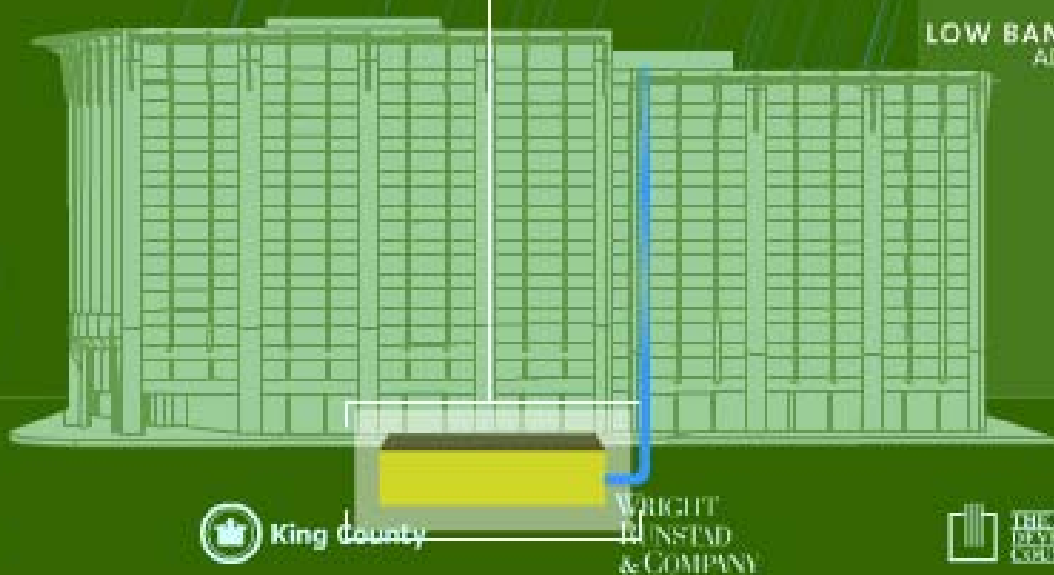
FEATURES

- WATER RECLAMATION
- LIGHTING
- ENVIRONMENTAL
- OUTDOOR PLAZA
- THE LOBBY
- THE OFFICE
- HVAC
- PAINT, TILES, CARPET
- FURNISHINGS/PARTITIONS
- WASTE PREVENTION
- GATES/ARTISTRY
- EXCAVATION & SOILS

LOW BANDWIDTH TOUR ▶
ADA compliant

WATER RECLAMATION

16,200 gallons storage
60% of annual building
water needs



Sponsored by:



WRIGHT
FUNSTAD
& COMPANY





CRISIS



CONFLICTS



SOLUTION



RURAL



URBAN



PEOPLE



POLICY

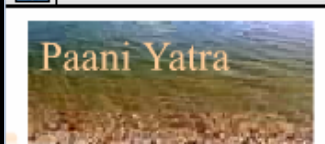
Google

go

WWW RWH Search

Search for Water Harvesting Systems

- Jal Swaraj
- Raincentre
- Newsletters
- Events
- Paani Yatra



- RESEARCH TOOLS**
- [RUNOFF CALCULATOR](#)
 - [FAQ ON RWH](#)
 - [TECHNICAL HELPLINE](#)
 - [GROUNDWATER MAP](#)
 - [WATER LINKS](#)
 - [DOSSIERS](#)
 - [LEGISLATION](#)
- HOW TO HARVEST**
- [INDIA'S WATER HARVESTING TRADITIONS](#)
 - [RURAL WATER HARVESTING CASE STUDIES](#)
 - [URBAN MODELS](#)

Huge water potential in Delhi

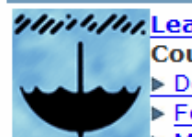
JAL SWARAJ CAMPAIGN



A campaign for participatory, equitable and decentralised paradigm for water management with the objective of making water everybody's business.

[more>>](#)

TRAINING PROGRAMME



[Learn to harvest the rain...](#)

Course dates

- ▶ [December 26-29, 2006](#)
- ▶ [February 12-15, 2007](#)
- ▶ [March 19-22, 2007](#)

JOIN THE NATIONWIDE RAINWATER HARVESTING DATABASE

Counting the raindrops

CSE needs your help to create a nation-wide database of Urban Rainwater Harvesting structures and practitioners, which can be accessed by all online.

[Please fill in this simple form to add your project to the database.](#)



BEST RAINWATER HARVESTER'S AWARD

DJB announces Best rainwater harvester's award

In a bid to encourage the rainwater harvesters and acknowledge the efforts of those contributing to it, Delhi government announced the Chief Minister's "Best Rain Harvester" award. The award carries Rs. 2 lakhs and a

TIGER TASK FORCE

Government appoints CSE director, Sunita Narain, chairperson of a five-member Task Force to review the management of Tiger Reserves in India

[Terms of Reference>>](#)



Stockholm Water Prize (2005)
Awarded to CSE

[Learn more>>](#)

DONATE

Support CSE's knowledge-based activism
100% exemption for donations made to CSE's Campaign on Rainwater Harvesting!

DOWN TO EARTH MAGAZINE



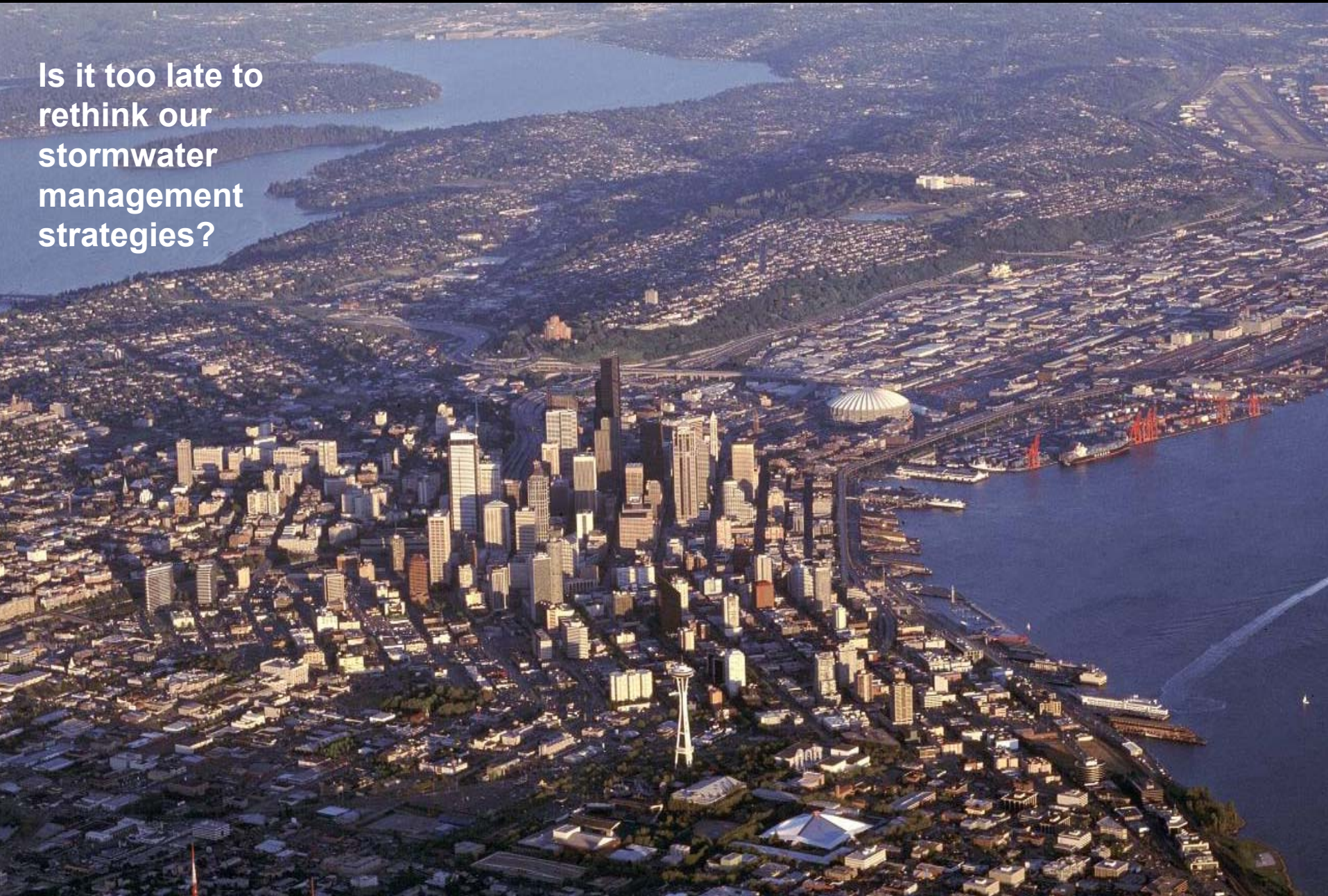
Clouded out

While climate change

Ideally—"stormwater" would go back to where it should (i.e. the ground), and we are developing the technology, the experience, and the regulations to encourage and/or require this...

...but water may soon become too valuable a commodity to allow this to occur.

Is it too late to
rethink our
stormwater
management
strategies?



Never!

