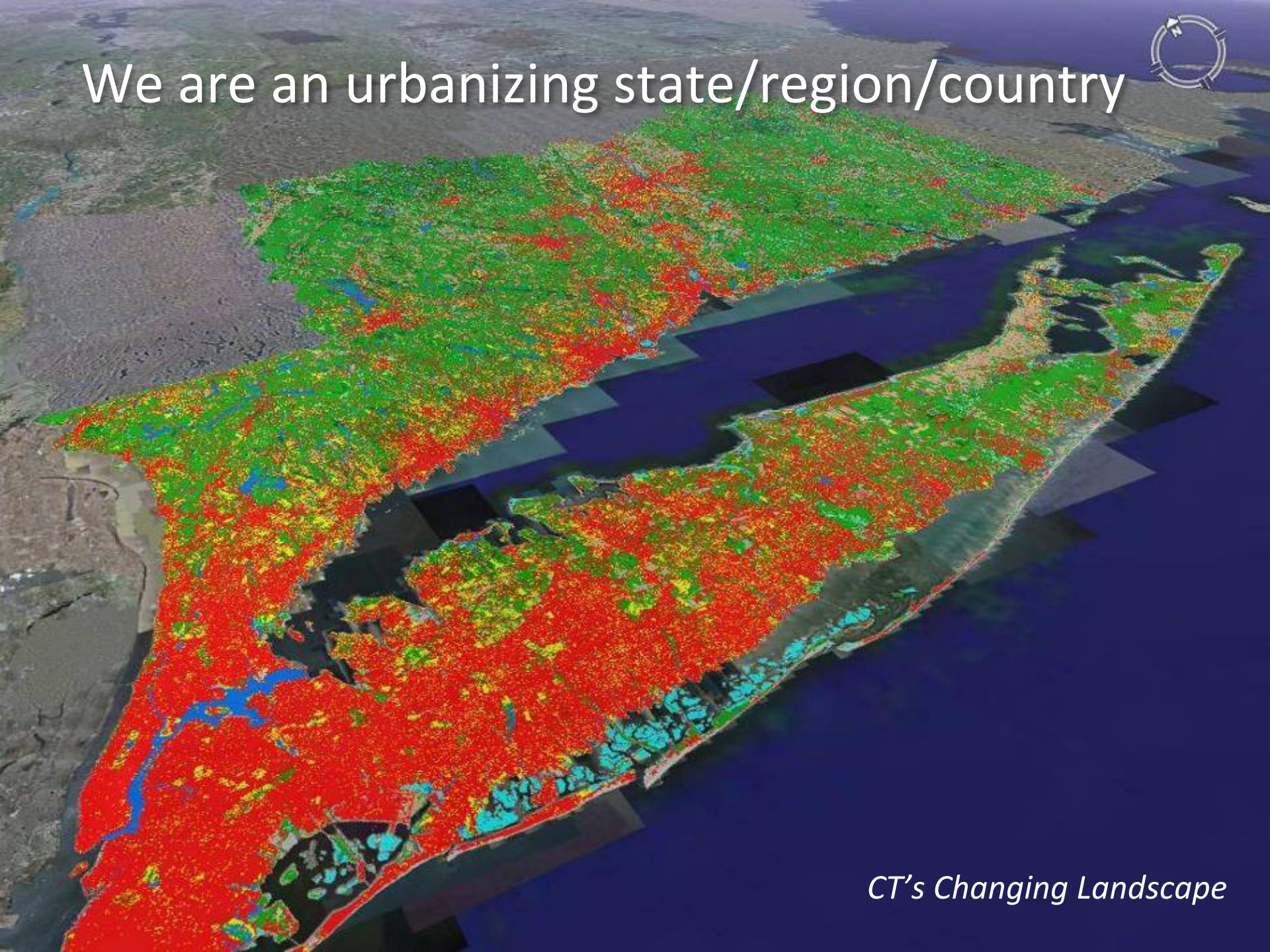
Stormwater & Flooding



The view from Chez Arnold…



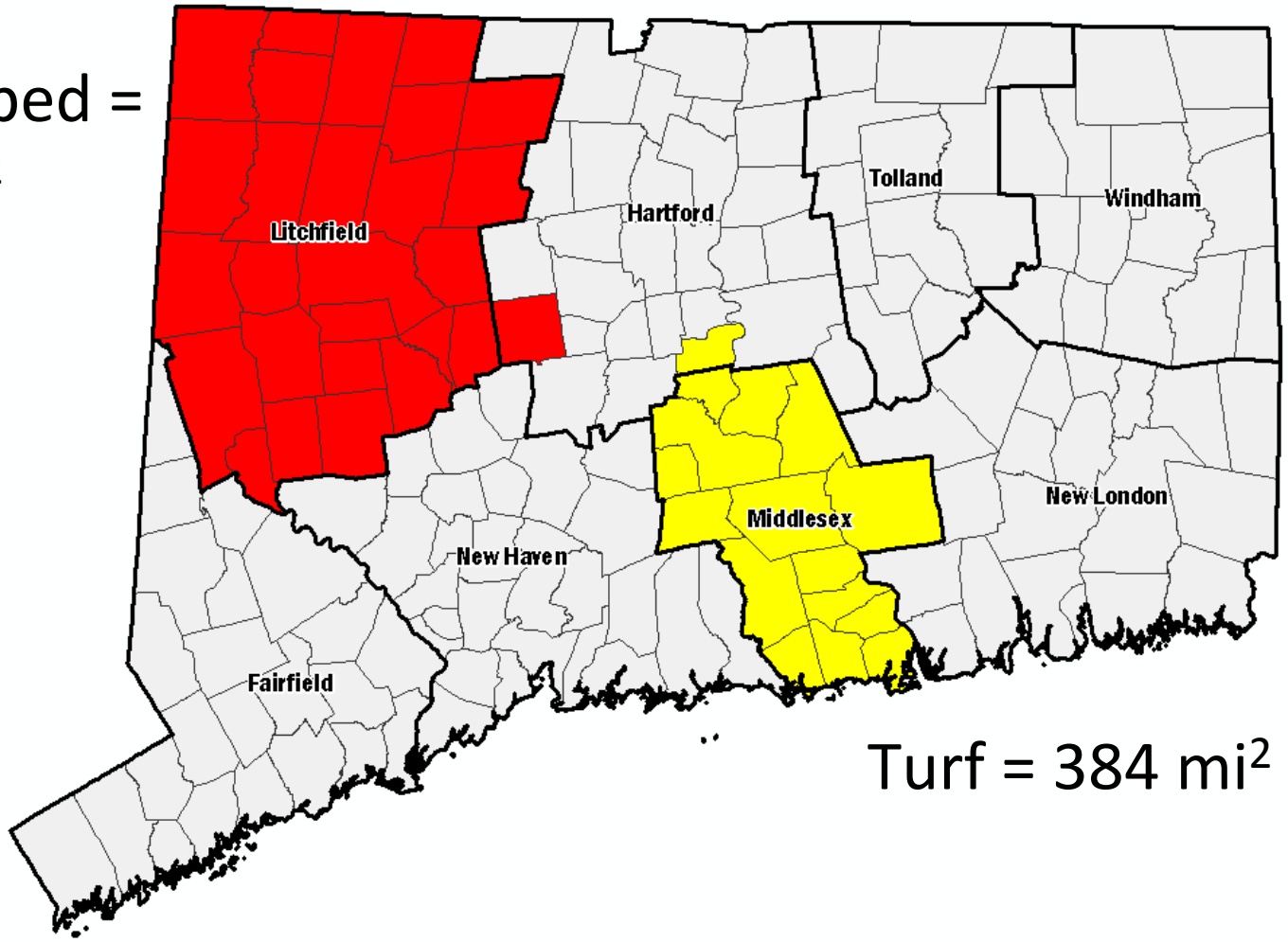
We are an urbanizing state/region/country



CT's Changing Landscape

The “development footprint”…

Developed = 946 mi^2

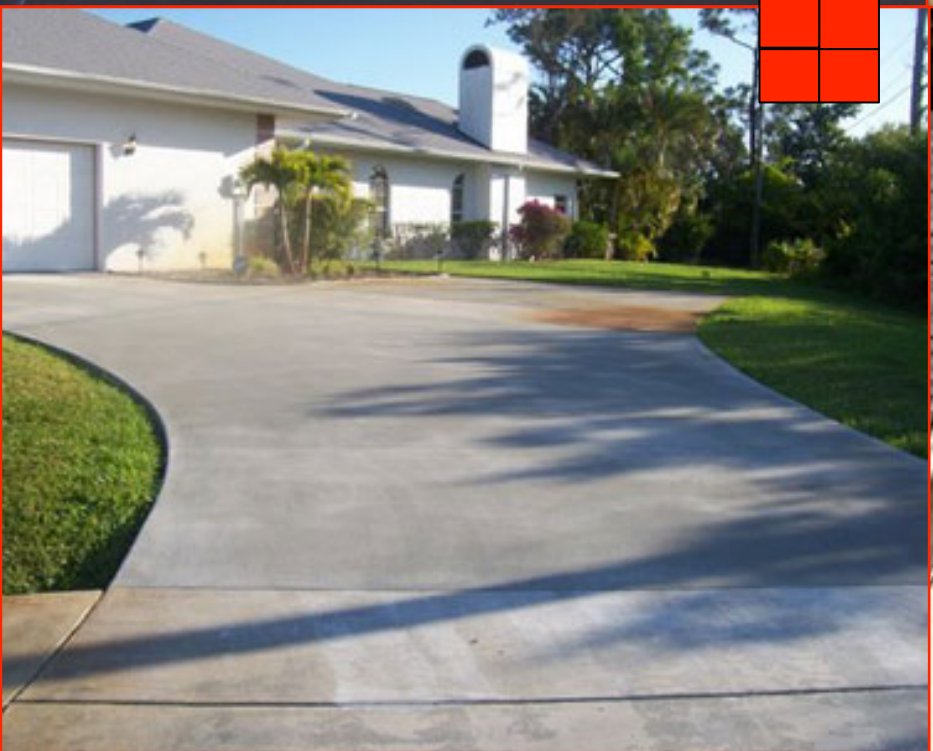


Turf = 384 mi^2

Impervious Surfaces

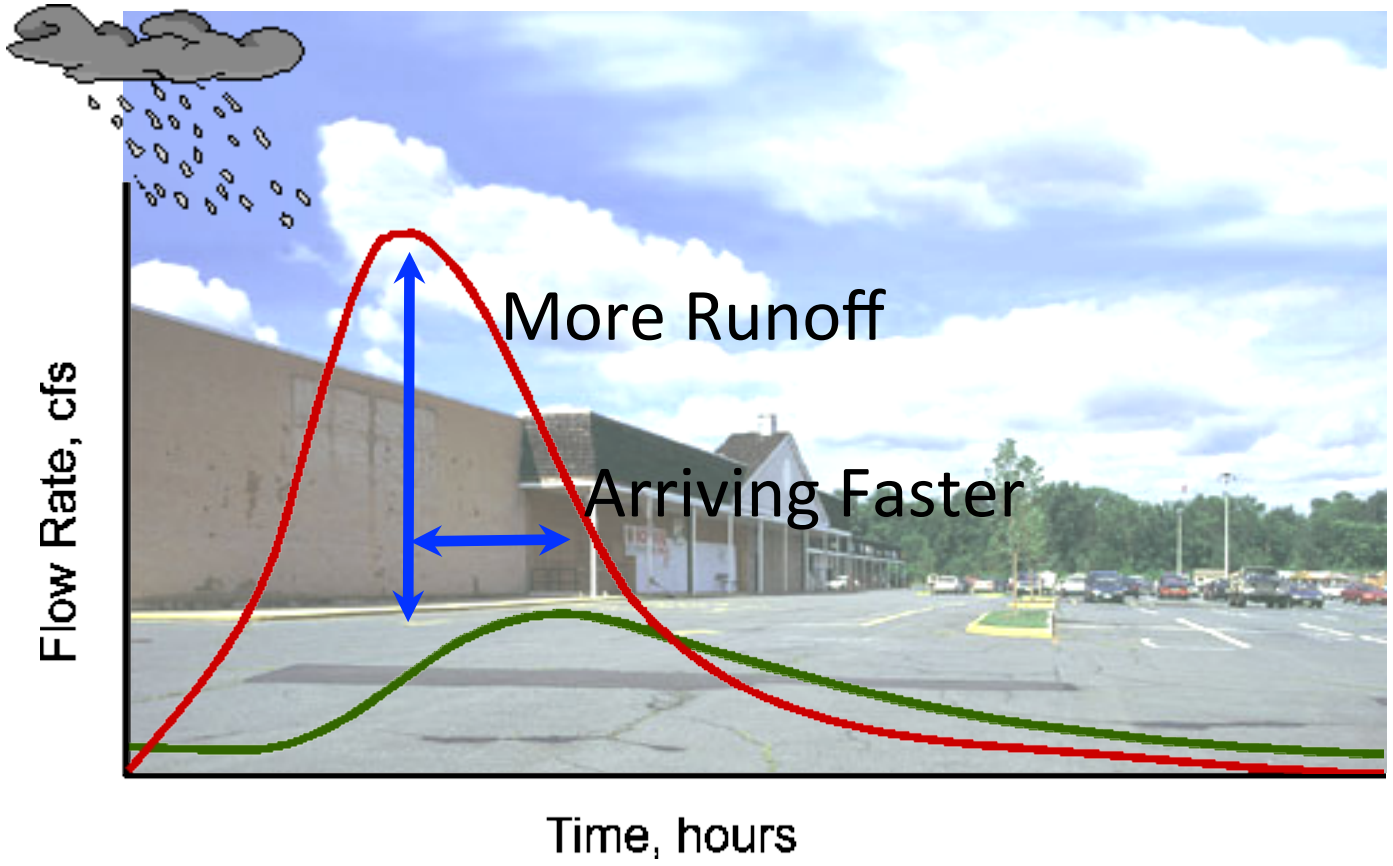








Hydrologic Impacts of Development



The Effects of Urbanization



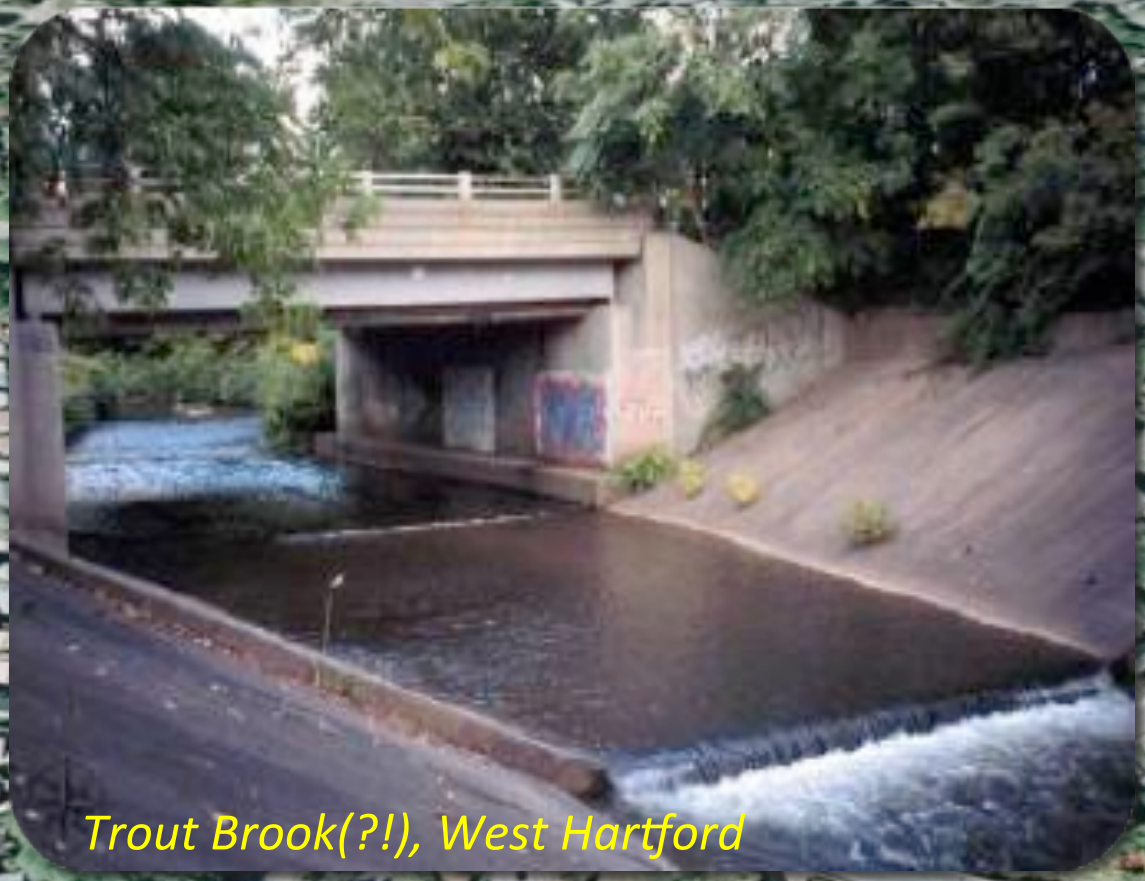
Falls River, Essex

The Effects of Urbanization



Goodwives River, Darien

The Effects of Urbanization

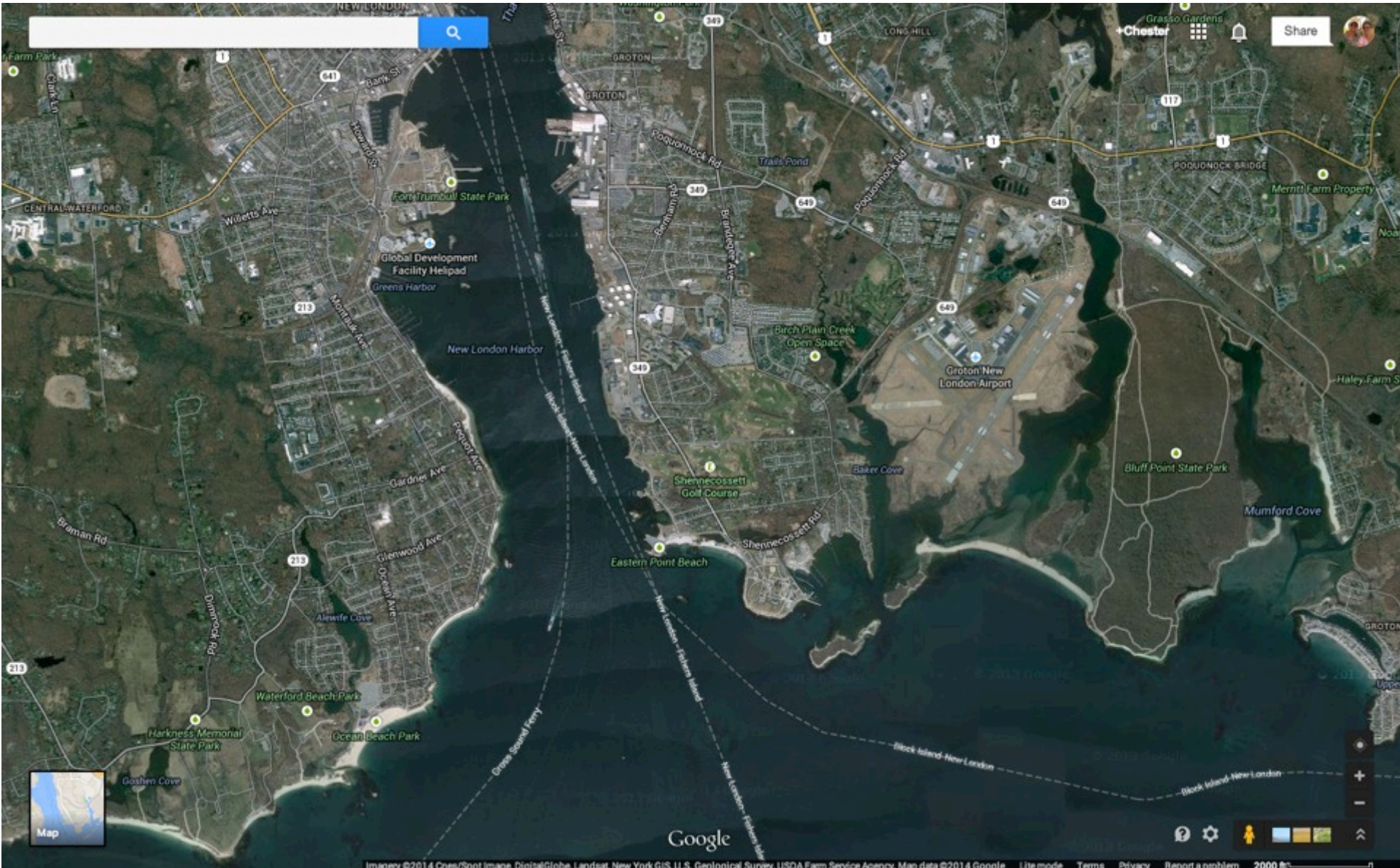


Trout Brook(?!), West Hartford

The Effects of Urbanization: Park River, CT



Yeah, but is it really that big of a deal?



Our beloved venue



Our beloved venue



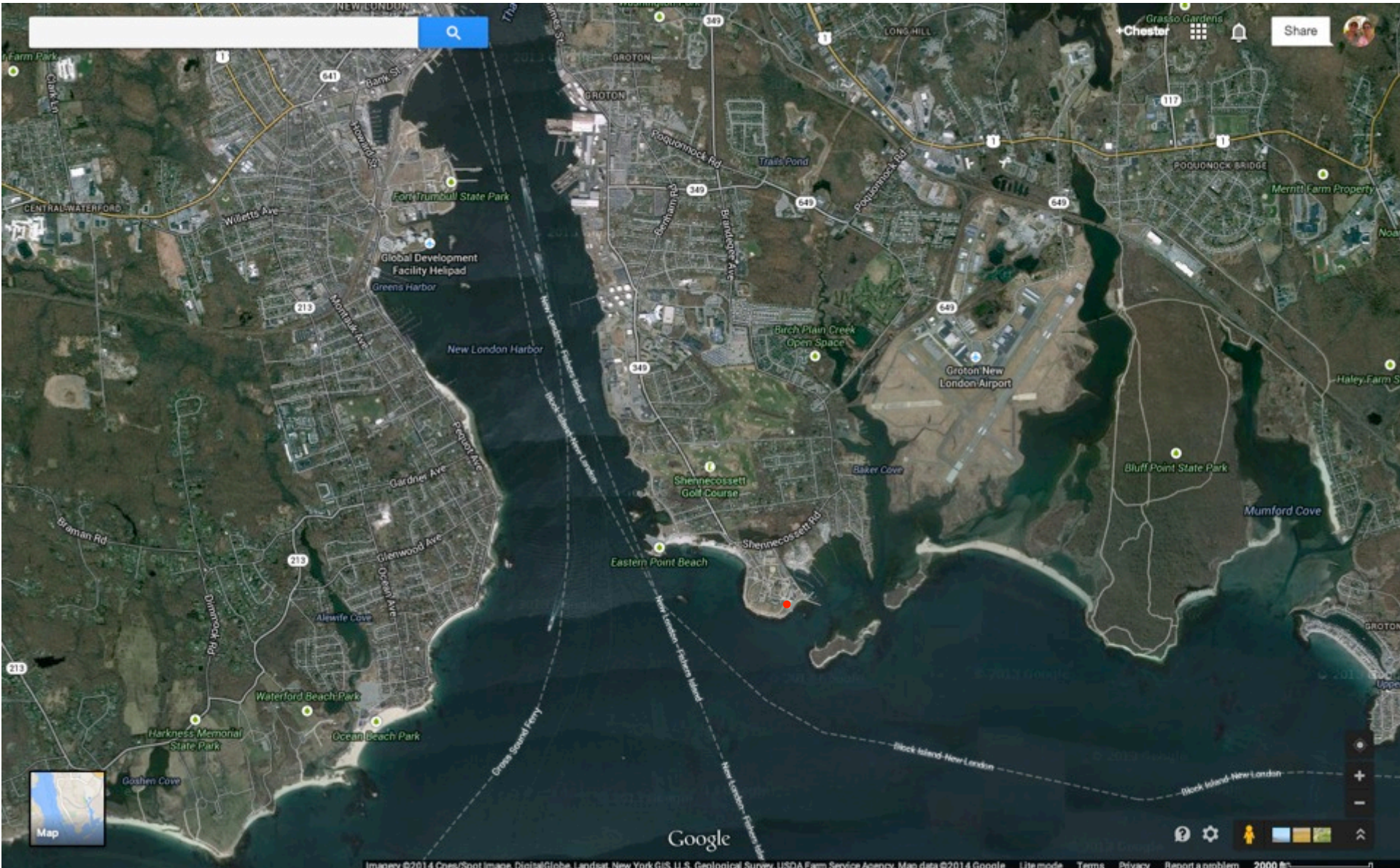
57,000 ft^2 of impervious area

1 inch of rain = 35,530 gallons

Annual (48”) = 1,705,544 gallons

= 2.6 Olympic pools!

Yeah, but is it really that big of a deal?



Water Pollution



Stormwater is the #1 source of water pollution in the U.S. (US EPA)

Sewage Spill In Stamford Closes Beaches, Cancels Regatta

Email | Facebook 20 | Twitter 21 | g+1 1

By KELLY GLISTA, Kglista@courant.com
5:55 pm, May 1, 2014

STAMFORD — Heavy rains overnight caused about 25 million gallons of partially-treated sewage to spill into the Stamford Harbor from the wastewater treatment plant, officials said Thursday.

The city has closed the beaches and shellfish beds, and canceled a regatta that was scheduled for this weekend as a precaution, city Director of Administration Mike Handler said. Increased beach patrols are planned as well.

The spill began at about 10:30 p.m. Wednesday, Handler said, when the water flow exceeded what the wastewater treatment plant was designed to handle. Early Thursday morning the plant experienced the highest level of water flow ever recorded there, he said.

The water flow level decreased throughout the day Thursday and is expected to return to normal levels Thursday night, Handler said.

A state Department of Energy and Environmental Protection spokesperson said that they've been in touch with Stamford officials since early Thursday morning. The city Health Department will be taking samples of the water to measure bacteria levels, which are expected to be very high.



Heavy Rain Caused Sewage Spills In State Waterways



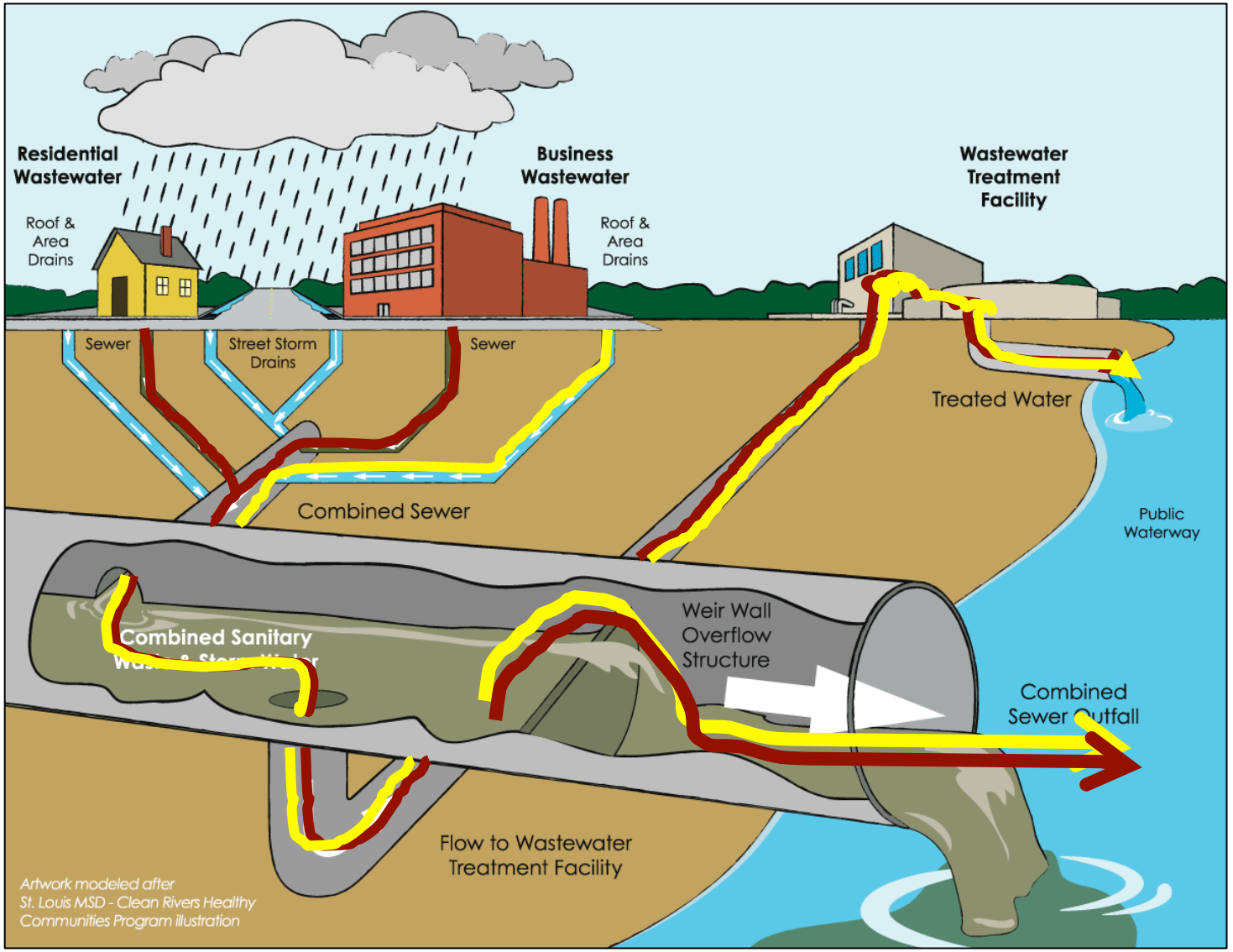
ADVERTISEMENT

Flooding = erosion

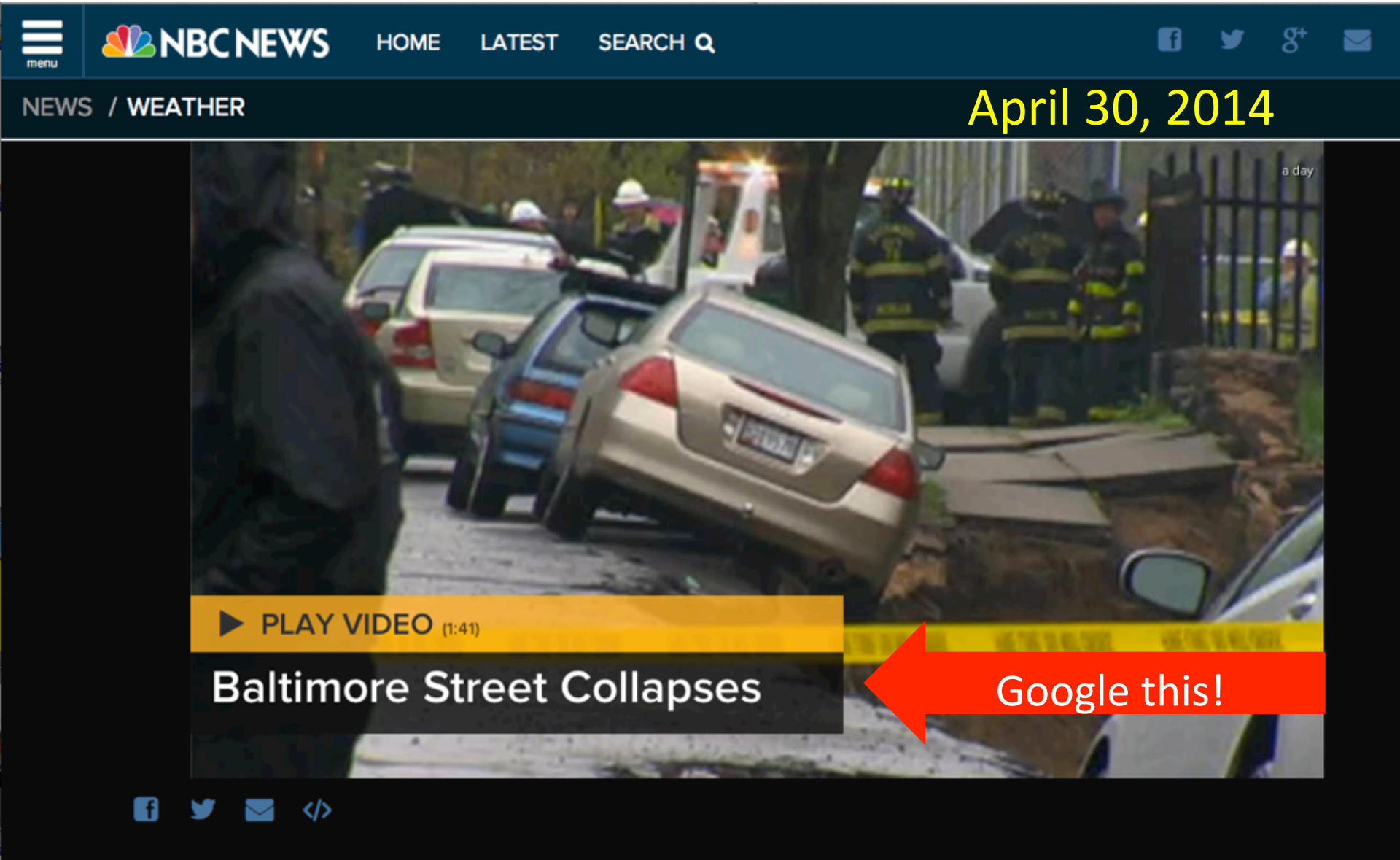


CT River after Irene

Combined Sewer Overflows



Infrastructure Meltdown



http://www.youtube.com/watch?v=zglXPDQHIHY

Liability

Homeowner with a FROG phobia is awarded $1.6M after runoff flood water inundates his property with the slimy creatures

By HELEN POW

PUBLISHED: 17:18 EST, 8 April 2013 | **UPDATED:** 17:26 EST, 8 April 2013

Comments (19) | Share +1 0 Tweet 36

A frog-fearing New York state man has won a $1.6 million payout after a developer drained so much storm water onto his property it turned into a wetland inundated with the slimy amphibians.

Paul Marinaccio Sr. described himself as 'a prisoner in my own home' after the Town of Clarence, a suburb in Buffalo, gave Kieffer Enterprises the go-ahead to divert water onto his 40-acre property, making it the ideal habitat for frogs.

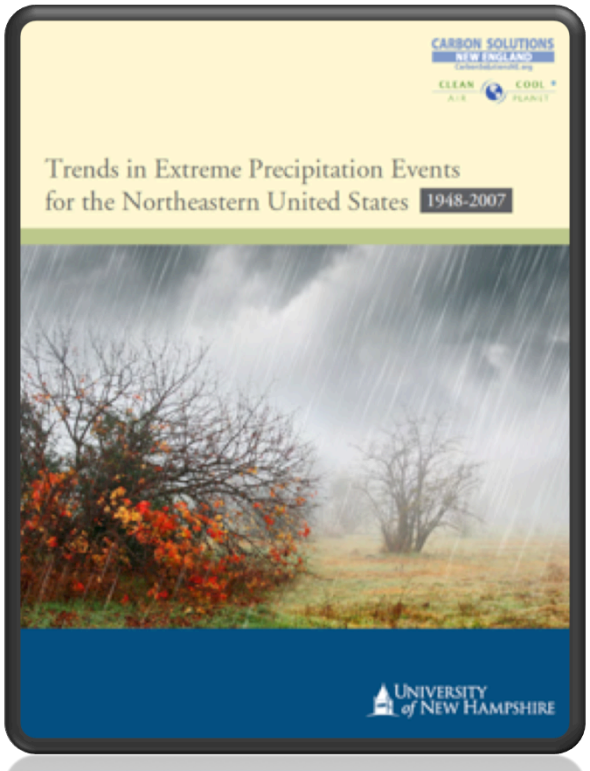
While the state's highest court ruled a couple of weeks ago that he wasn't entitled to an additional $250,000 in punitive damages, he's still come out a winner, and the town has also agreed to dig a drainage channel to dry up his land and, hopefully, the frogs.



Winner: Paul Marinaccio, pictured on April 6, has been awarded $1.6 million in damages

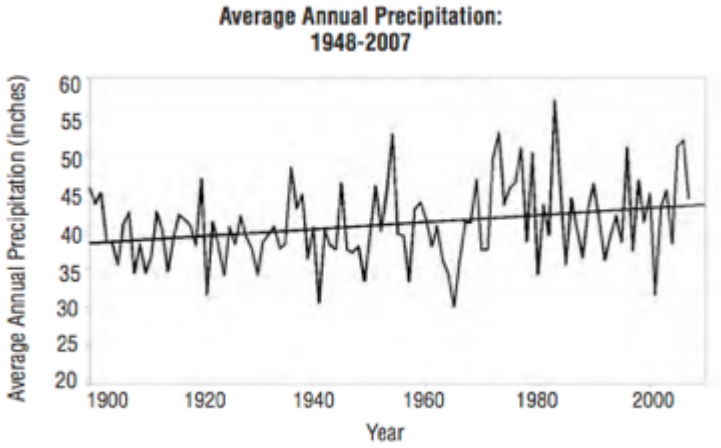
And *NOW*…

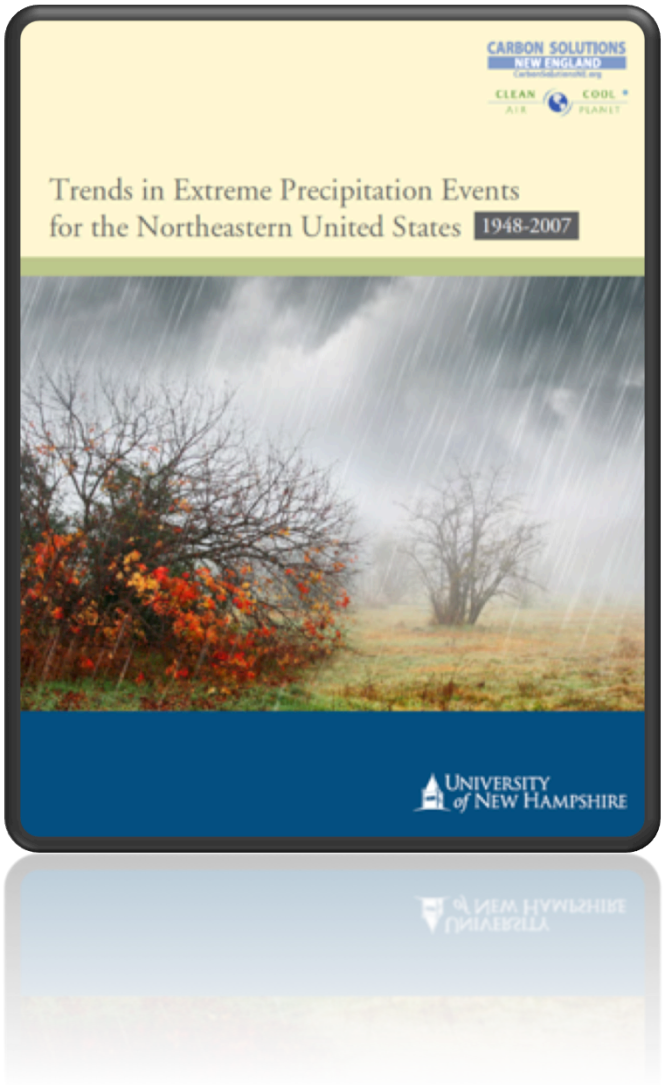
All studies indicate more rainfall, and more intense rainstorms, in the Northeastern US



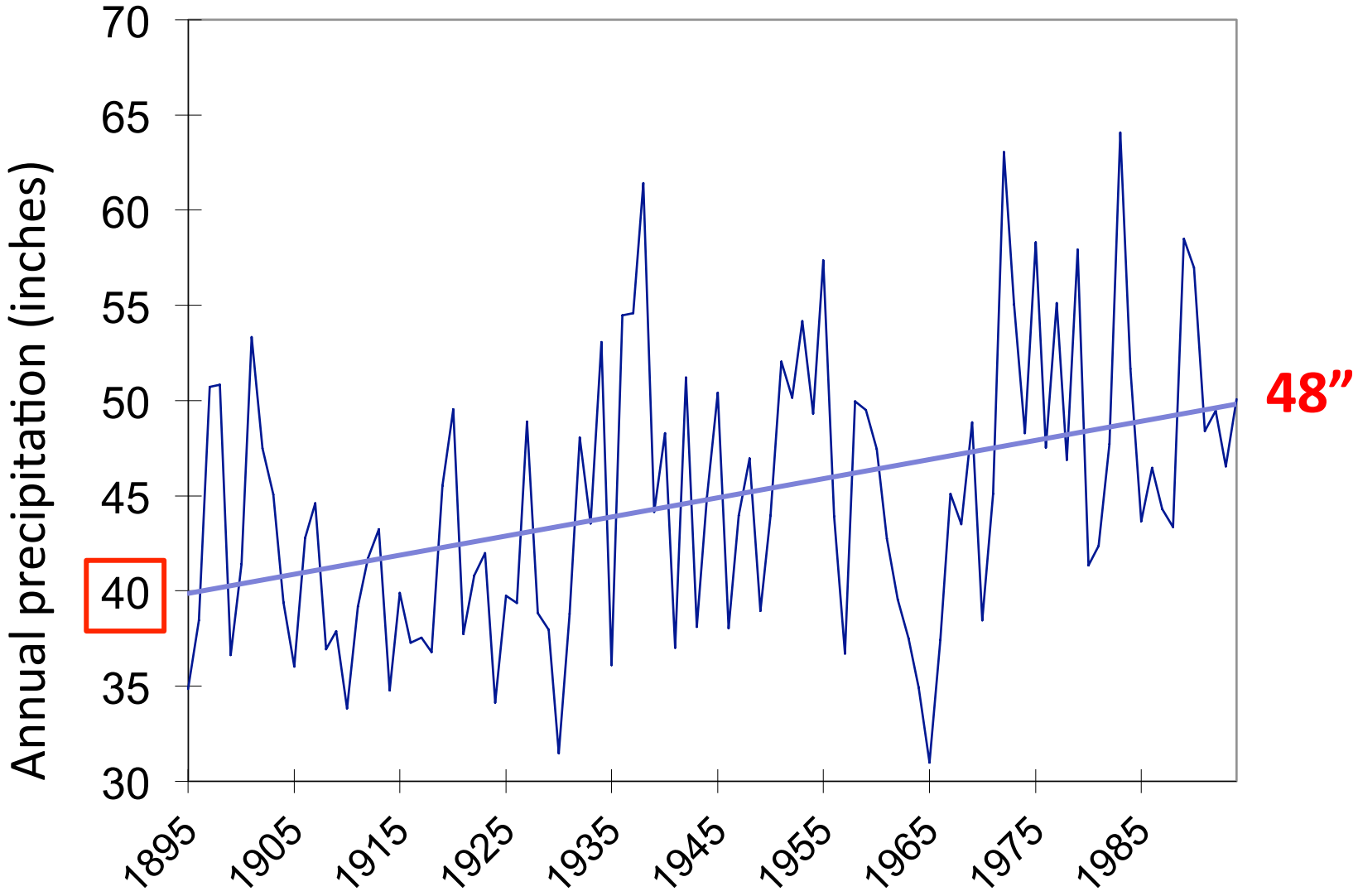
Our Soggy Prospects

In this study, a range of definitions for extreme precipitation was examined to provide a robust indicator of climate change in the Northeastern United States. All of the definitions…indicate that the occurrences of extreme precipitation events, and the intensity of rainfall, are increasing.





100 Years of Precipitation Data for CT



Source: Miller, et al. 2003. Precipitation in Connecticut. Report No. 38. Institute of Water Resources, University of Connecticut.

Probability and Return Period

Recurrence interval (years)	Probability of occurrence in any given year	Percent chance of occurrence in any given year
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

"100-yr storm" is the new 50

Probability model for New London, CT, updated with recent rainfall data

RI	TP-40 (in)	Updated values (in)
1	2.5	2.80
5	4.0	4.14
10	4.5	4.85
25	5.5	5.99
50	6.0	7.02
100	7.0	8.25









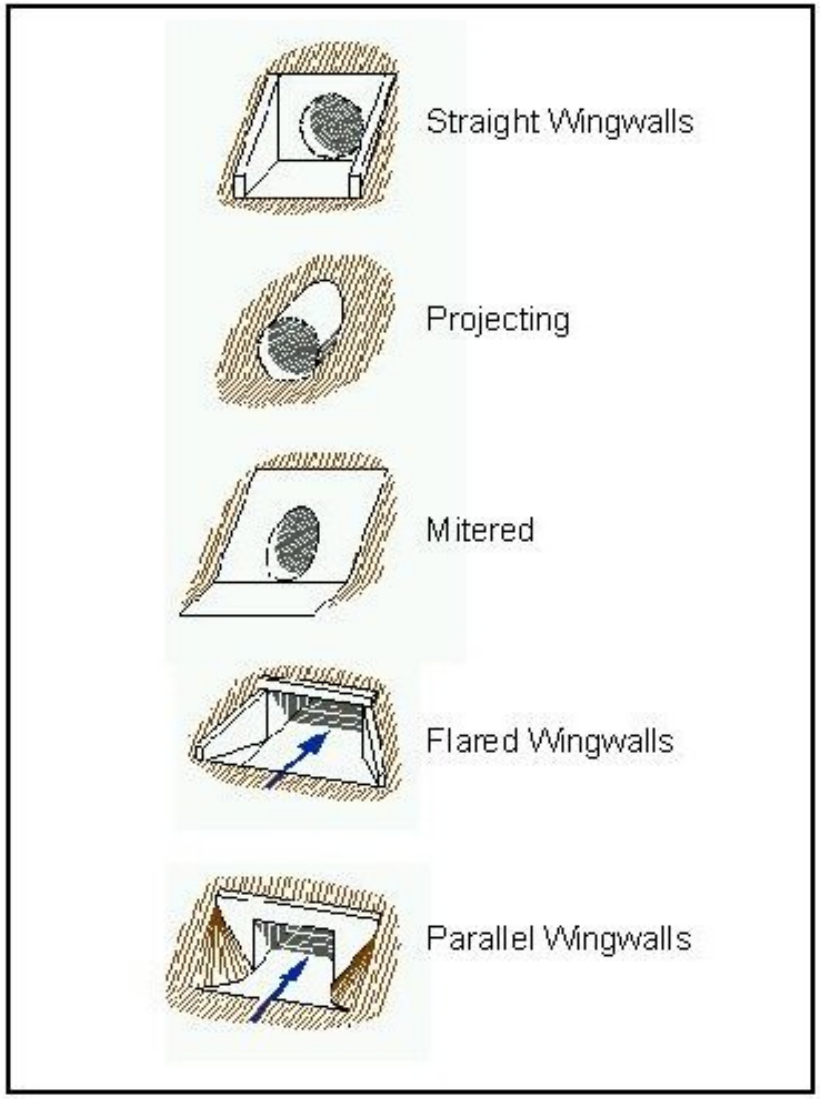
Strategies

They're mostly about

infrastructure

Resizing conventional Infrastructure

- identify priority flood-prone areas
- Revise drain and culvert standards based on the new precipitation regime
- Build this into the capital expenditures plan



Green Infrastructure




Riparian Corridors

Urban trees as stormwater devices



"UTC" Goals

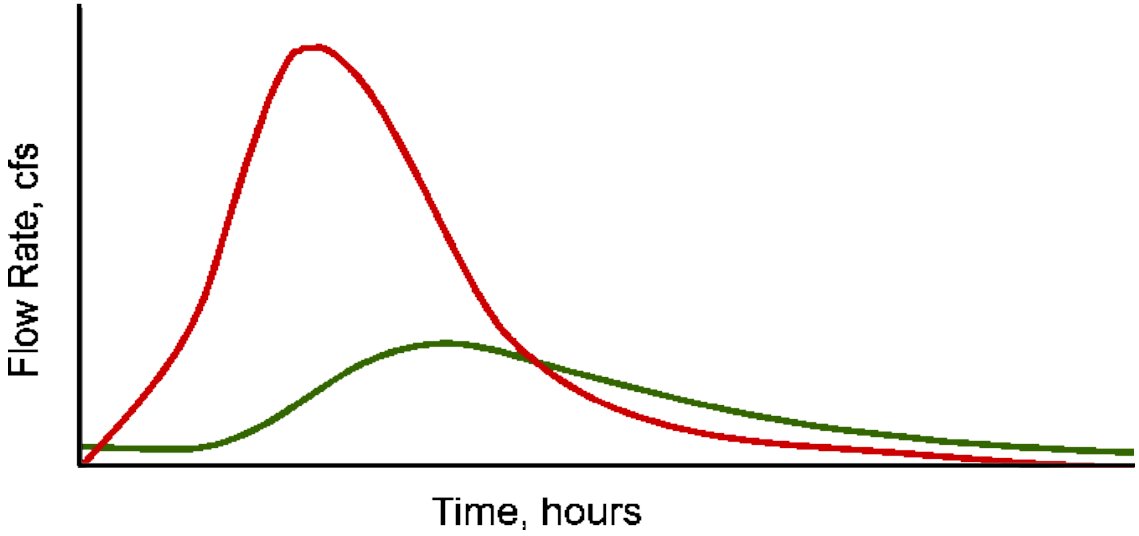


Low Impact Development



Low Impact Development

A site design strategy intended to maintain or replicate a site's ***natural hydrology*** *systems through the use of* ***small-scale*** *controls integrated throughout the site to manage runoff* ***as close to its source as possible***







2

T



2011
Laurel Hall








2012
Oak Hall



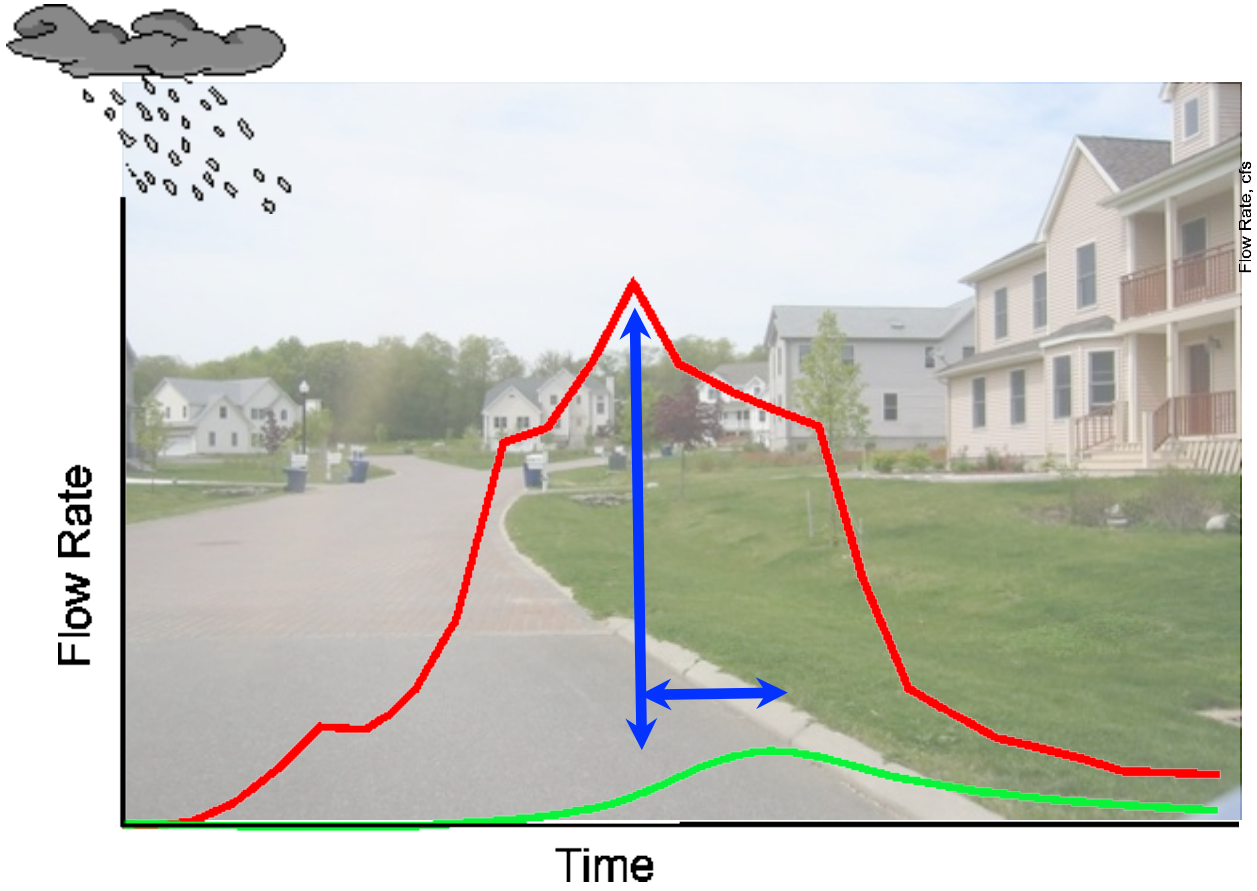
2013

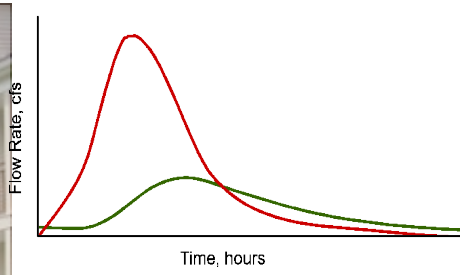
Rain Gardens & pervious asphalt parking stalls near Whetten Center.

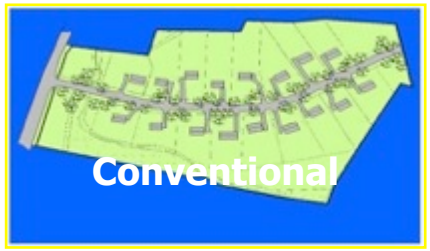
But does it work?

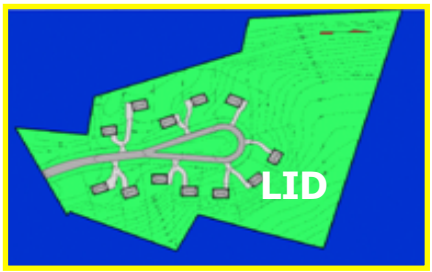


Jack Clausen's $ 1M graph…

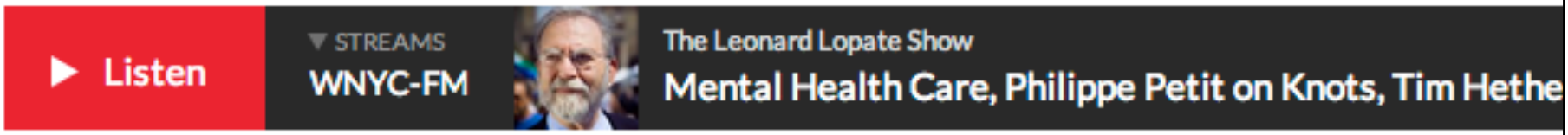








First: Awareness



RT @PBSDS: It's time for a new Blank on Blank!! A lost 1996 @WNYC interview with David Foster Wallace on "A

WNYC

Causes of Sandy Flooding Rooted in Over Development

WNYC

Tuesday, February 12, 2013

By Bob Hennelly

THANKS!


NBC NEWS
HOME
LATEST
SEARCH
NEWS / OTHER
Sewer turns into geyser after flooding in Colorado



Teaching: Communities



Today's Offering

- urbanization & your waterways
- Climate change implications for flooding
- Things to think about

Rain Garden

A depression that collects rainwater from a roof, driveway or yard and allows it to infiltrate into the ground.



Rain Garden Smartphone App



Cumulative volume of stormwater reduction by campus LID practices…….

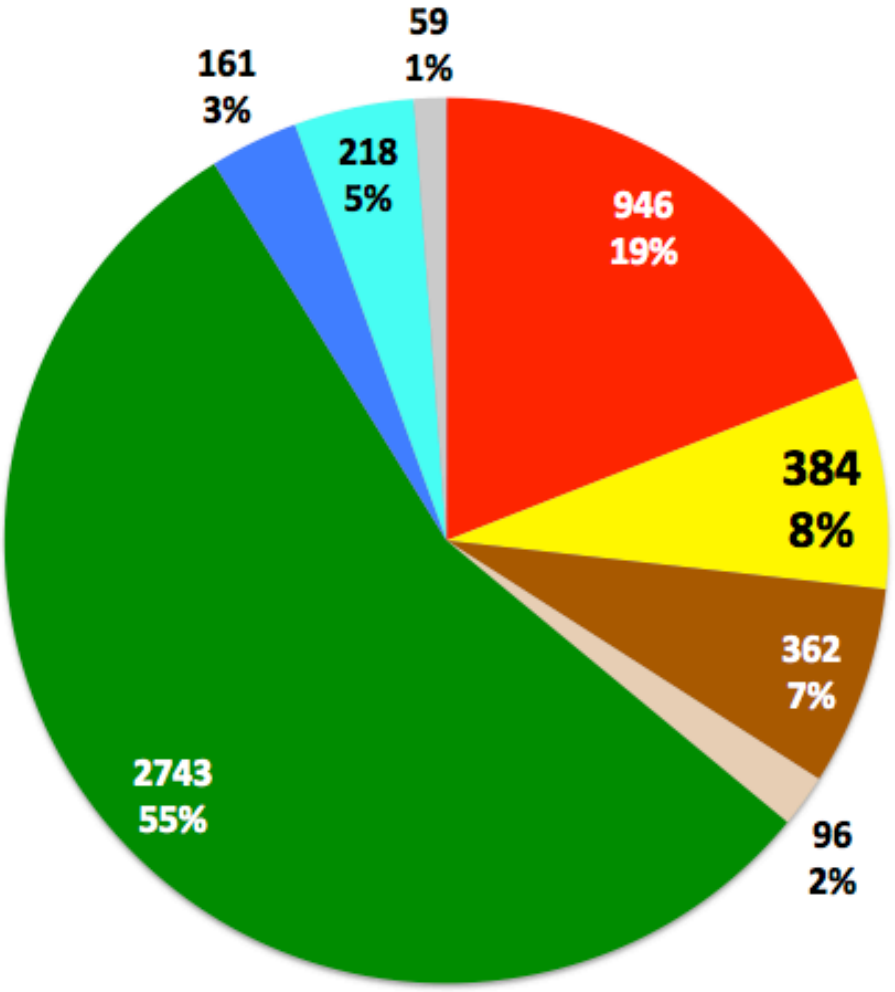


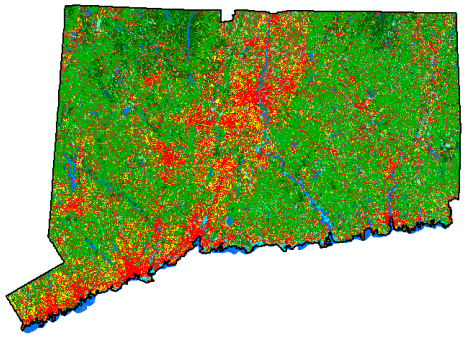
Total area of IC disconnected by campus LID practices……



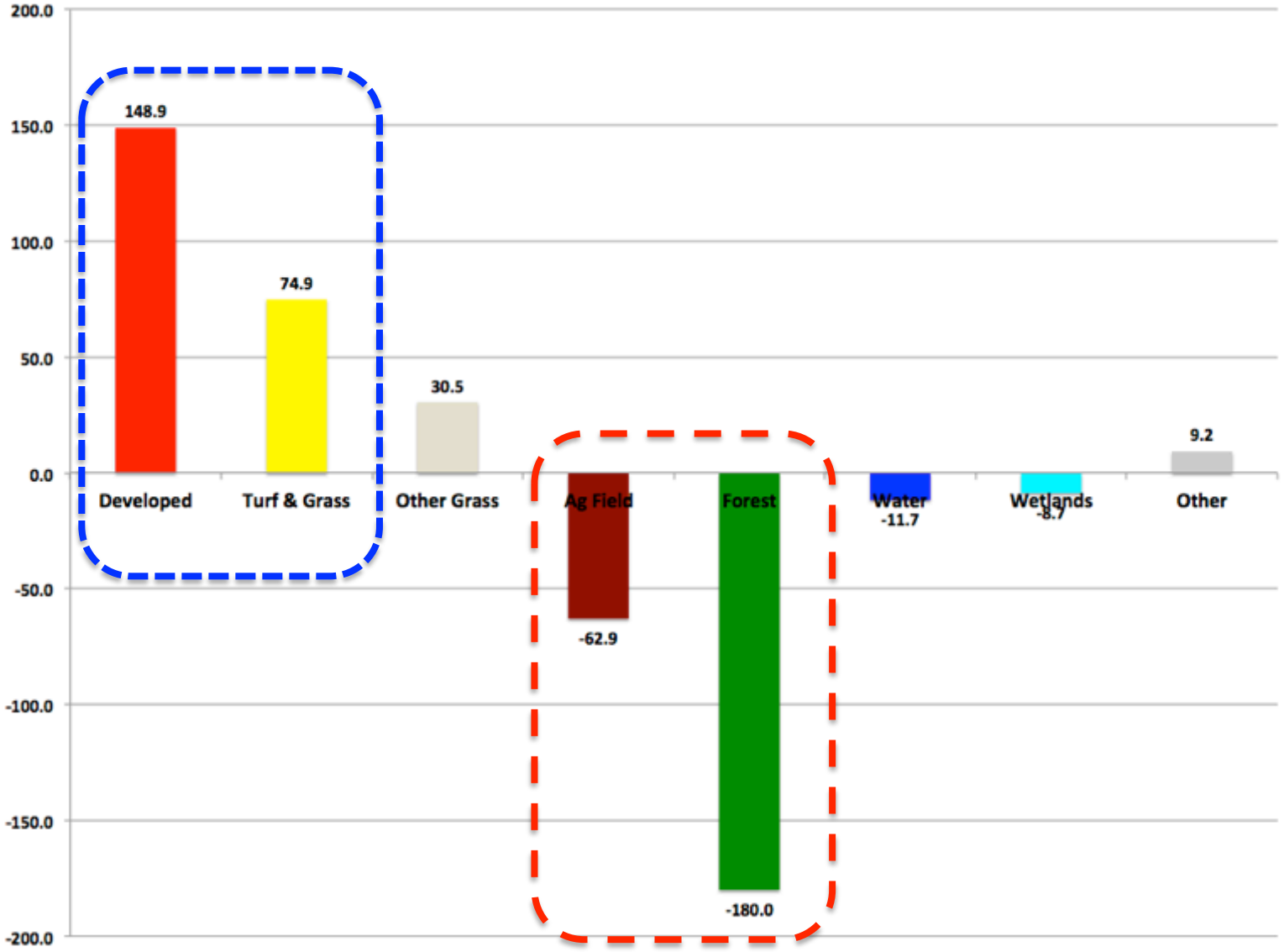

"LID Cluster" subdivision
Low- mow areas
cluster layout
Bioretention cul-de-sac
Rain gardens
pervious & shared driveways
grassed swales
pervious & narrow road
- 12 lots clustered on 6.9 acres
- Designed to minimize site runoff

Land Cover 2010: Status





CT land cover change: 1985 - 2010



Storm Frequency Analysis

- Calculated from past data for a measurement location
- Sort and rank precipitation data, highest to lowest
- Return period (T) =

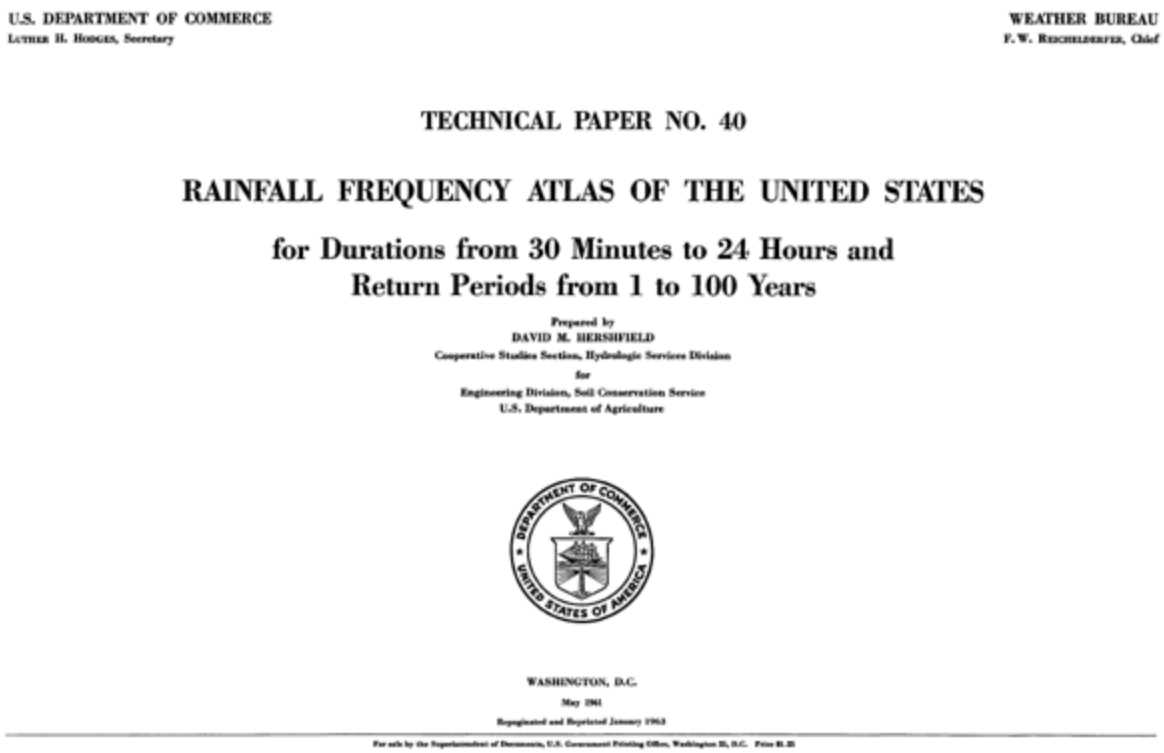
Where n=the total number
m=rank of that value

http://bcove.me/2lspa5ig

Buffers help, but can't do the whole job alone...



Uses of storm frequency values



U.S. DEPARTMENT OF COMMERCE
LUTHER H. HODGES, Secretary

WEATHER BUREAU
F. W. REICHELDERFER, Chief

TECHNICAL PAPER NO. 40

RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and
Return Periods from 1 to 100 Years

Prepared by
DAVID M. HERSHFIELD
Cooperative Studies Section, Hydrologic Services Division
for
Engineering Division, Soil Conservation Service
U.S. Department of Agriculture

WASHINGTON, D.C.
May 1961
Reprinted and Reprinted January 1963

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $1.25

Effects of Using Outdated TP-40 Values

http://precip.eas.cornell.edu/

Quiz Time!

Last year we had a 100-year storm (8 inches of rain in a 24 hour period). What are the chances that we will have another 100-year storm this year?

A. 0.1%

B. 1%

C. 10%

D. 50%

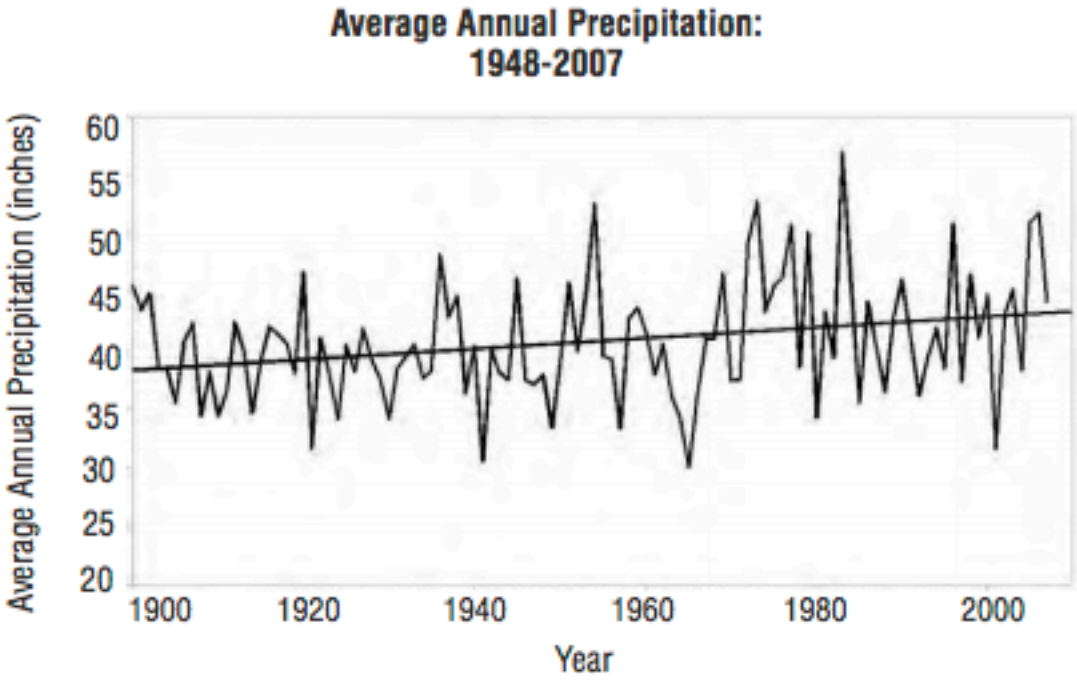


Figure 10: Graph showing the average annual precipitation from 1900-2007 for the eleven long-term stations in the Northeast. The trend line shows an increase in the average annual precipitation since 1900.