# *A Changing Climate: Some Implications for Stormwater Systems*

**Michael Simpson, Chair**
Environmental Studies Dept.
Antioch University New England

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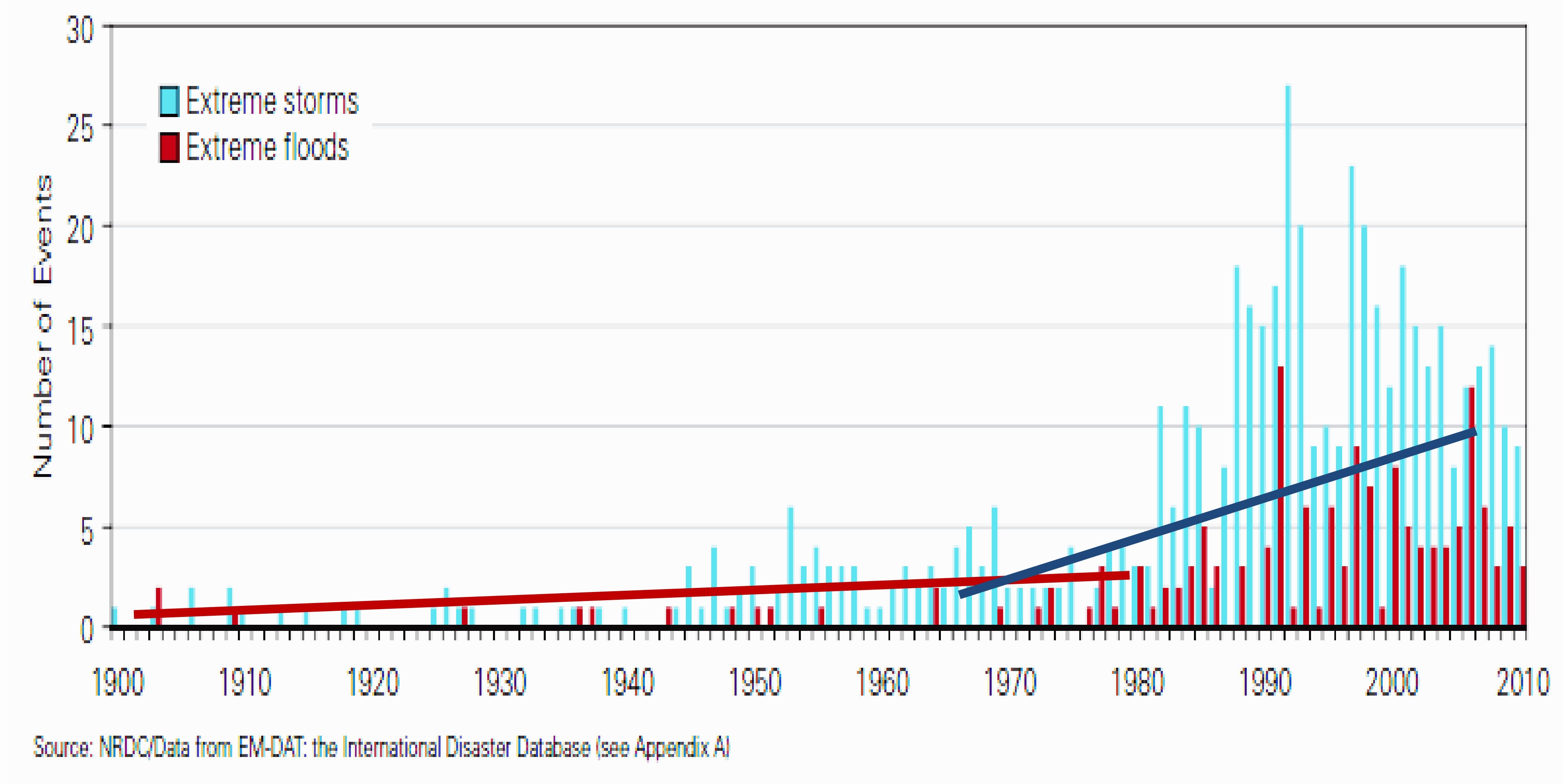
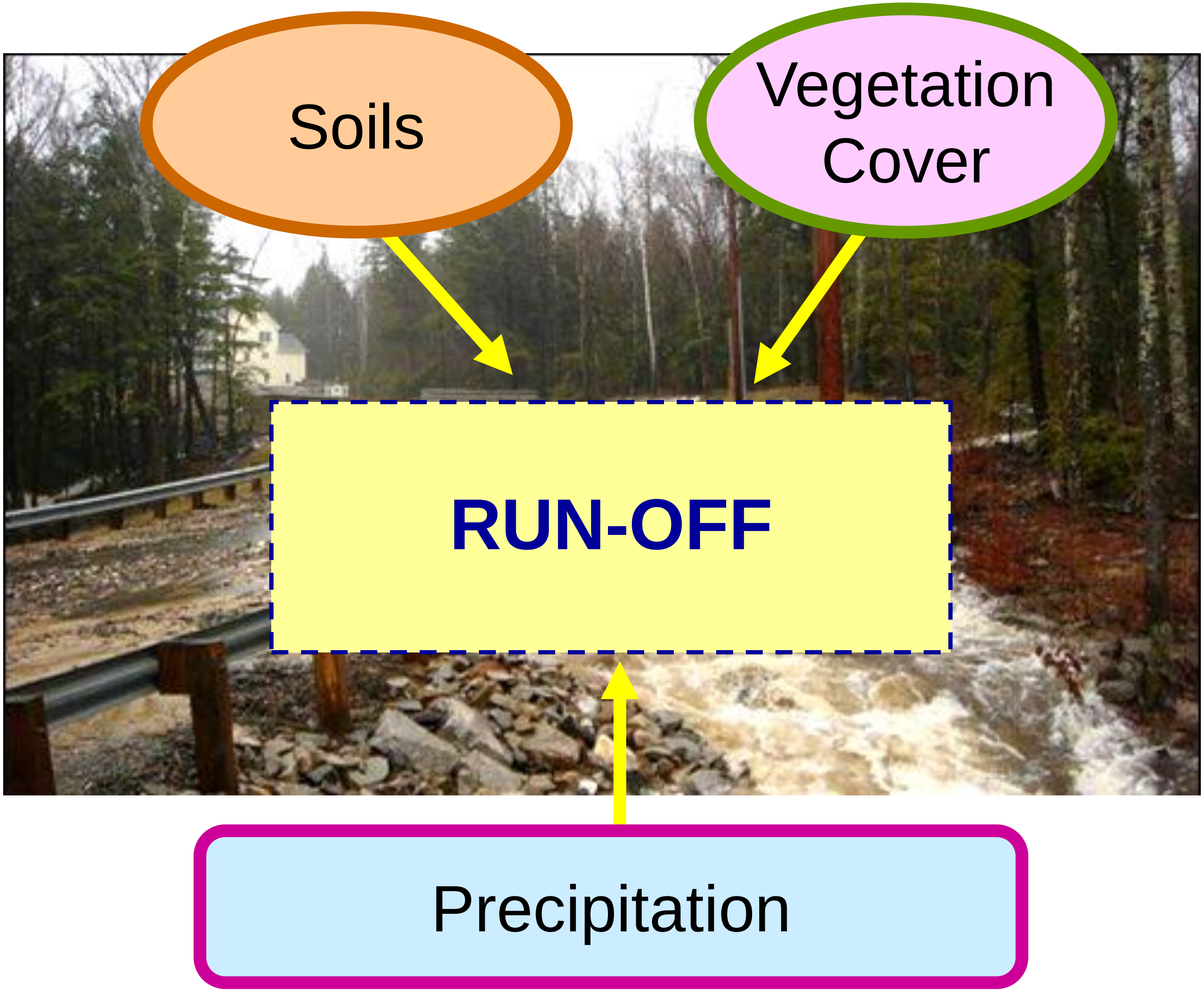
# Reaching Critical Thresholds

## Number of Extreme Storms in US
1900-2010



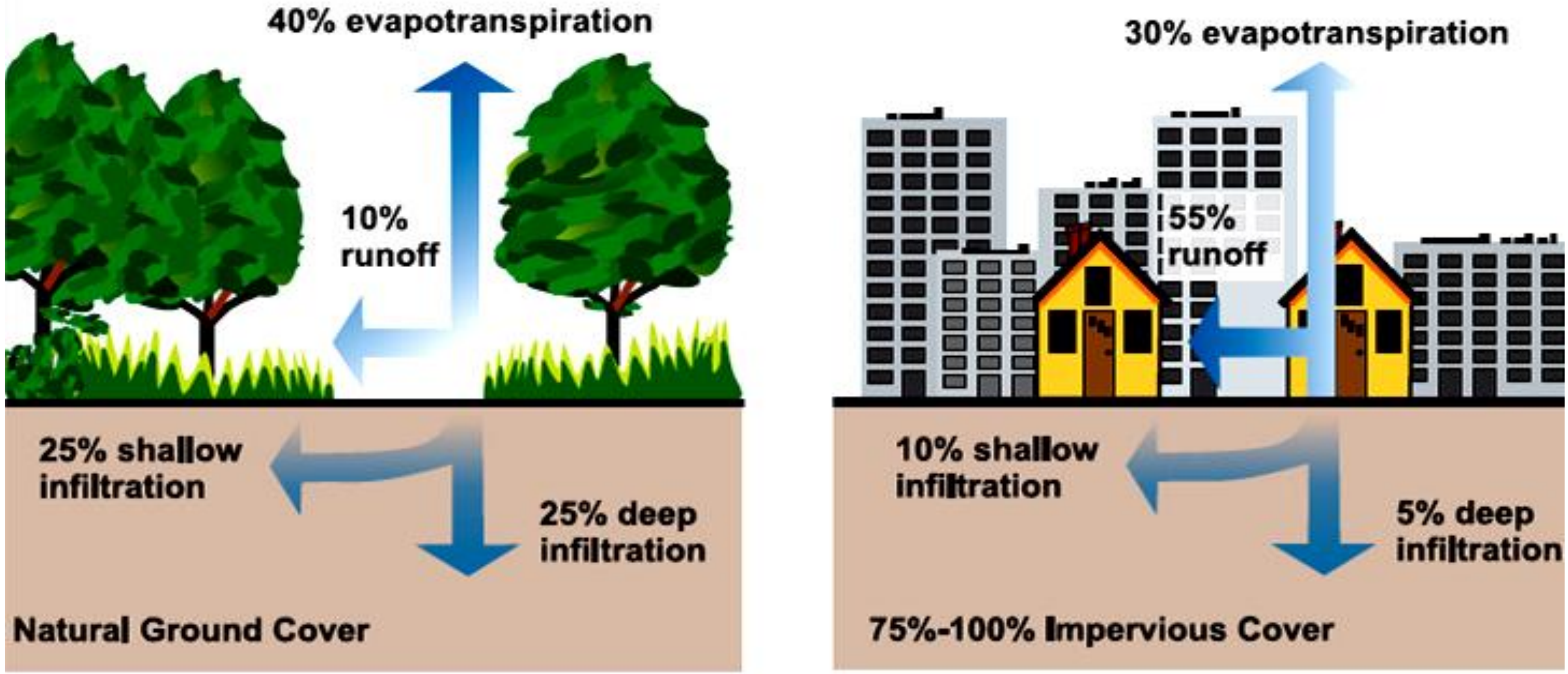

Symposium

MAPLE
IN
Historical De
MAPLE
OUT
Meets Today's Run-off

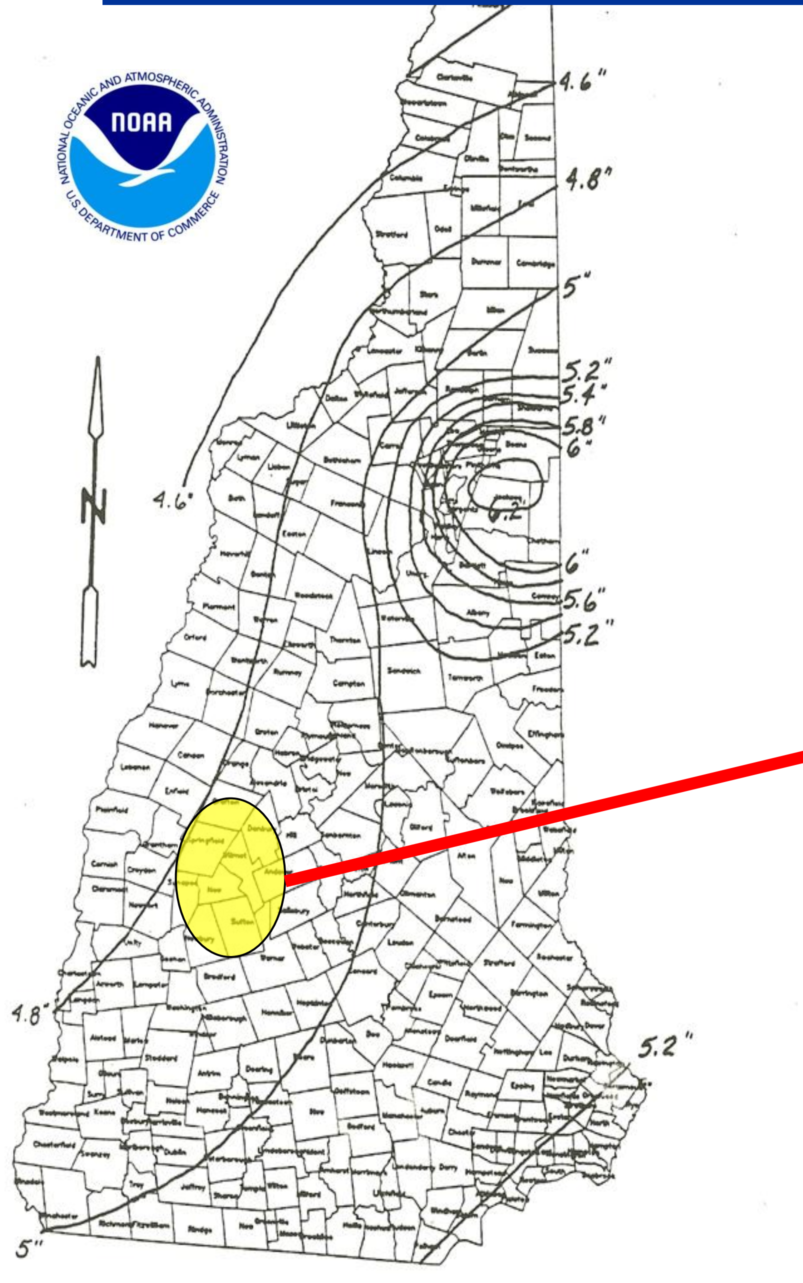

Soils
Vegetation Cover
RUN-OFF
Precipitation

# A Changing Landscape

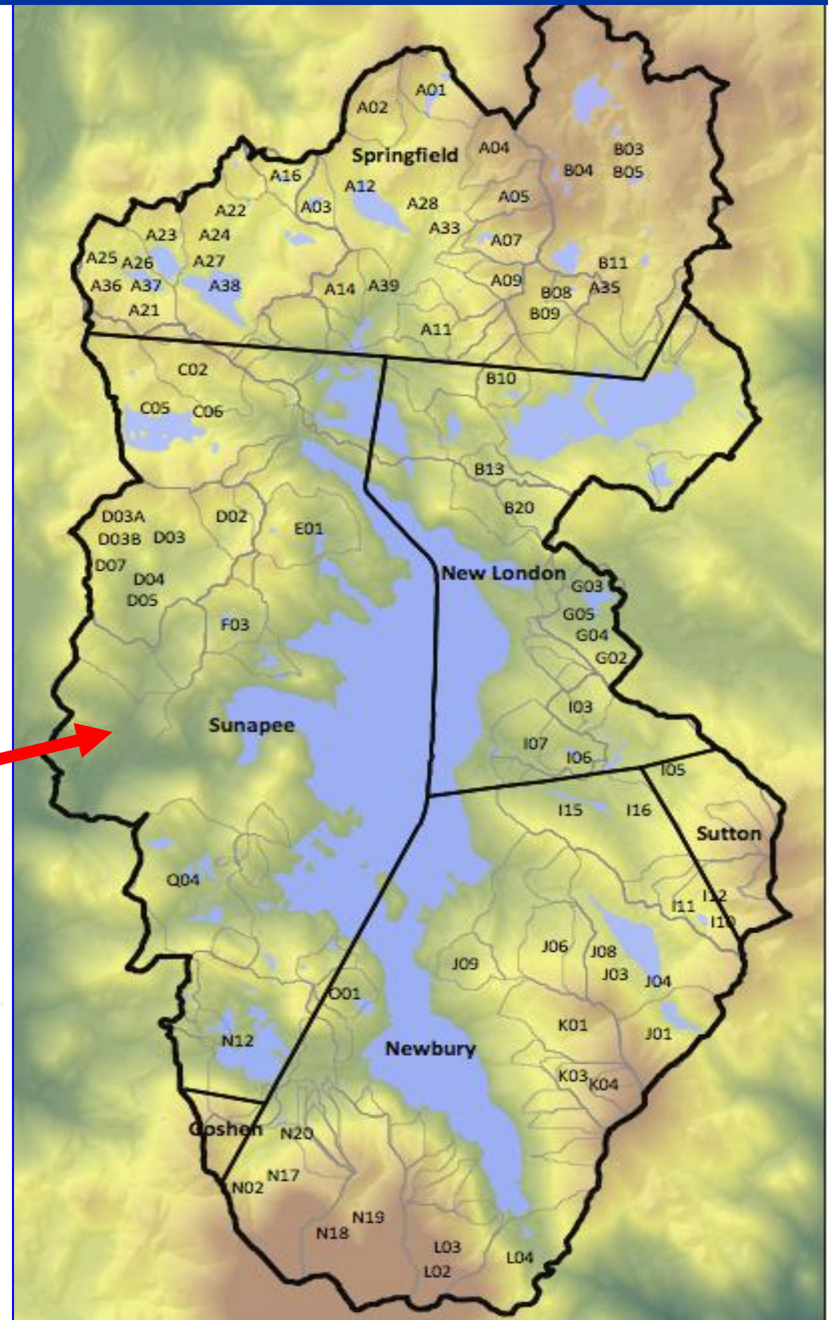
Courtesy of UCONN Cooperative Extension


40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover
30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Cover

# Lake Sunapee watershed: Delineated catchments

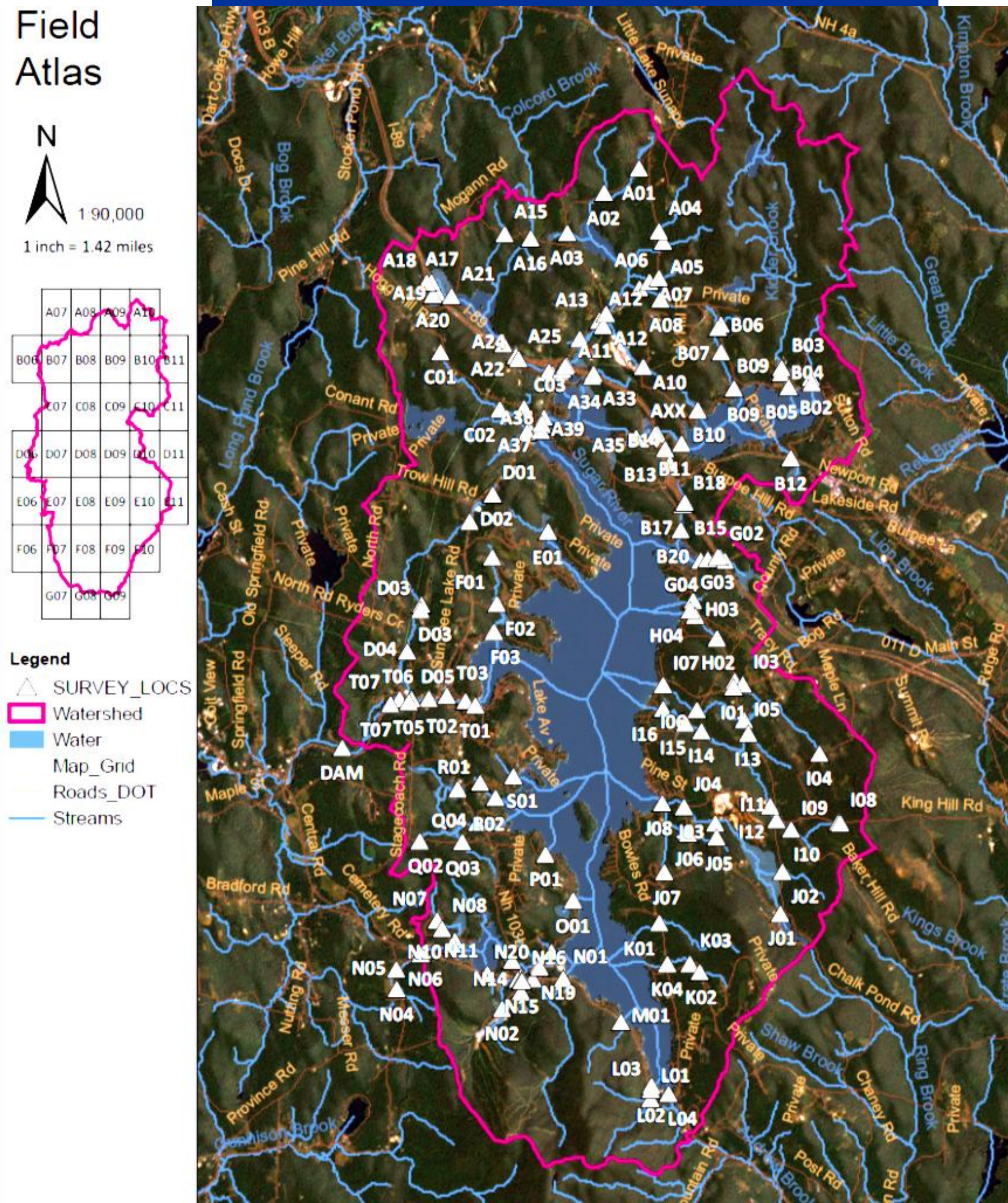



6-9 -- 25-YEAR FREQUENCY 24-HOUR DURATION RAINFALL



# Field Data Collection

## 210 road crossings



# Relating storm events (amount of precipitation) to probability

| Return period of a specific precipitation amount for a storm | Annual Probability of exceeding the amount **(1 / return period x 100)** |
|---|---|
| 1- year storm | 100% |
| 2-year storm | 50% |
| 5-year storm | 20% |
| 10-year storm | 10% |
| **25-year storm** | 4% |
| 50-year storm | 2% |
| 100-year storm | 1% |

## DATA Input

**Historical Climatic Data**
Precipitation
Evapotranspiration

**Precipitation Scenarios**
Global Circulation Models
Down-Scaling

**Current Land Characteristics**
Soils,
Water Bodies
Parks /Protected Land

**Projected Land Characteristics**
Impervious Surfaces
Green Infrastructure

**Existing Culvert Sizing**
**For Peak Flow**

## Modeling

**Run-off / Peak Flow Calculations**

**NRCS Run-off**
**&**
**EPA-SWMM**

**w/ Calibration**

## Outputs

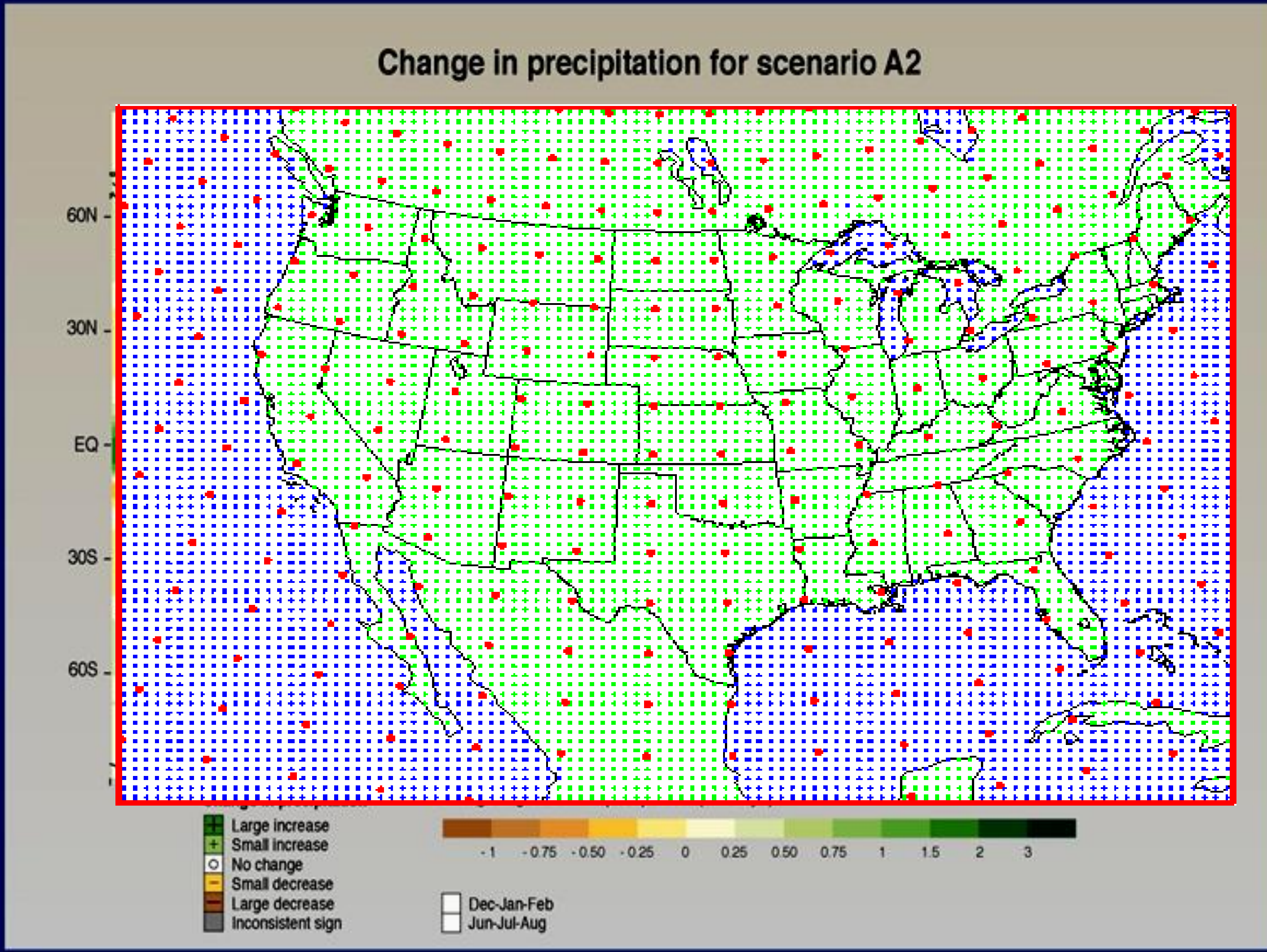
**Projected Precipitation Amounts**
Optimistic - Pessimistic

**System Components Adequacy**
Current
Projected

**Projected Pipe Sizing**

**Impact of Green Infrastructure**
Extent of Mitigation

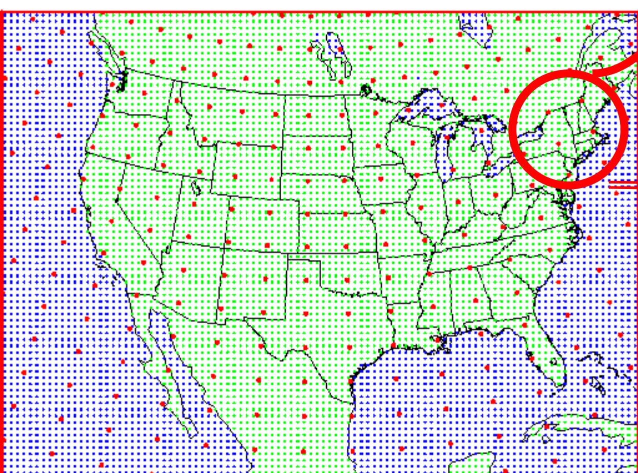
**Projected Cost Impacts**

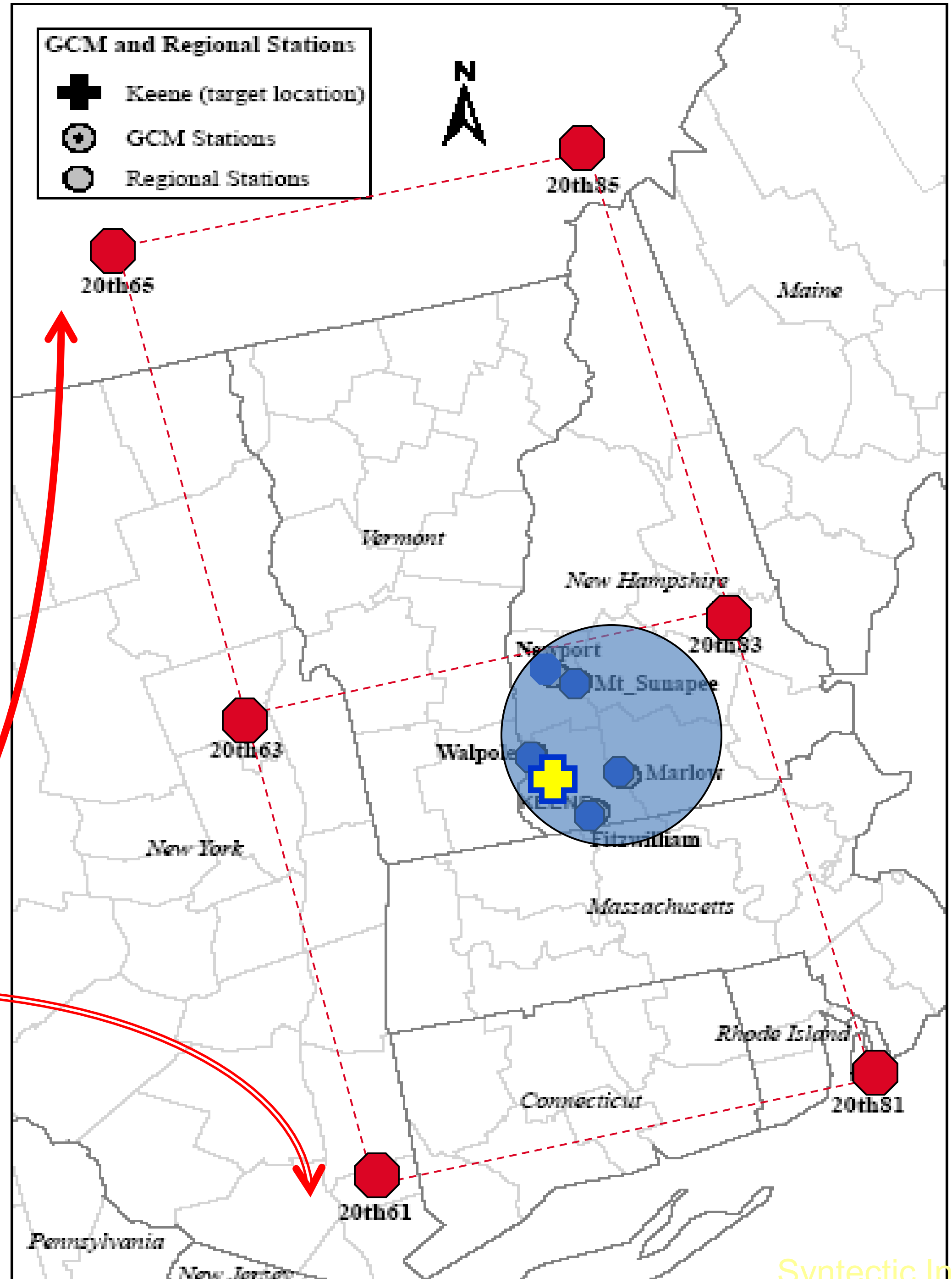



SYR - FIGURE 3-3 a)

A Changing Climate

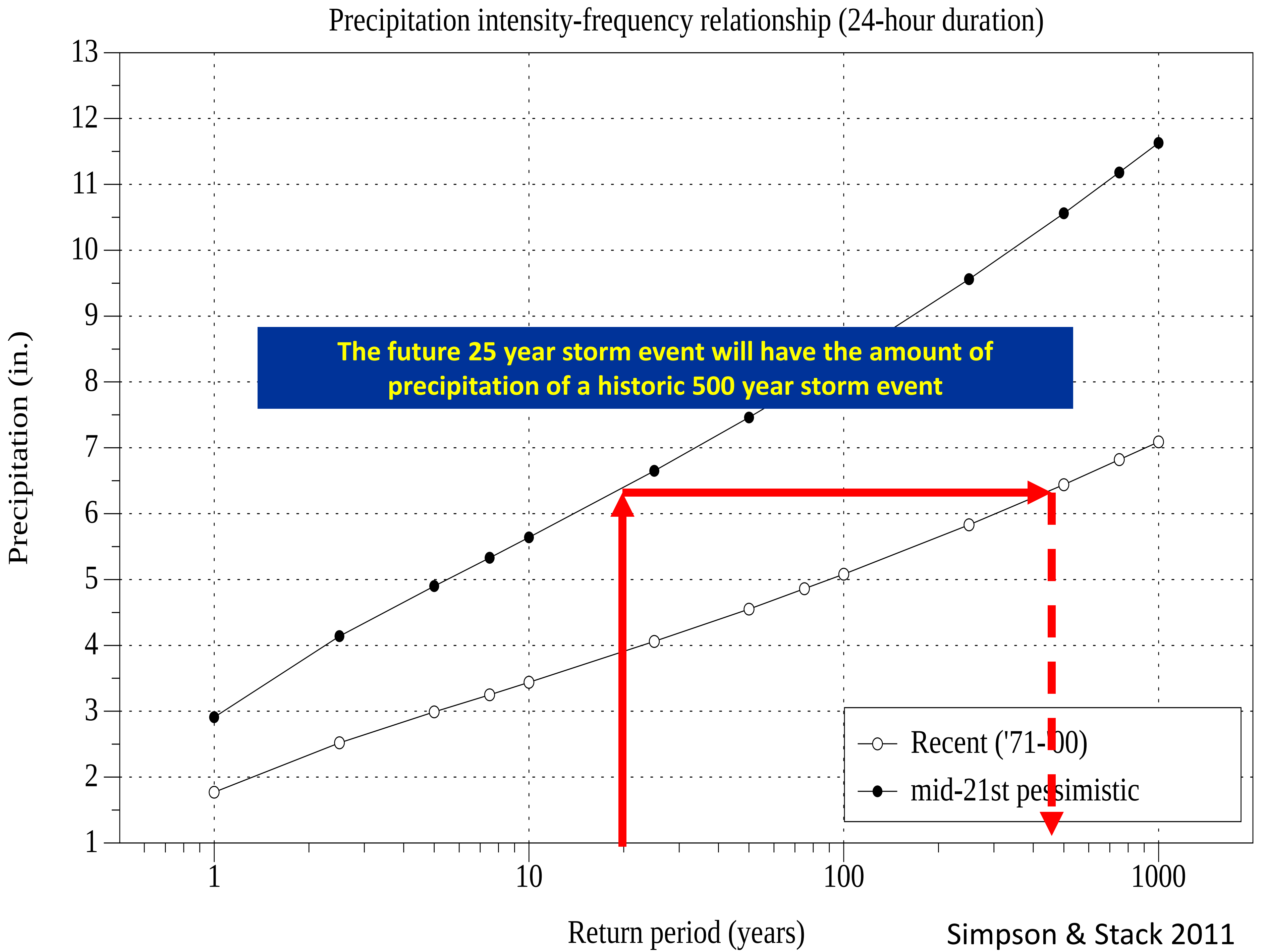
# Six gridpoints proximate to study areas in NH were used to transfer the expected change in precipitation from the GCM to Keene and regional stations

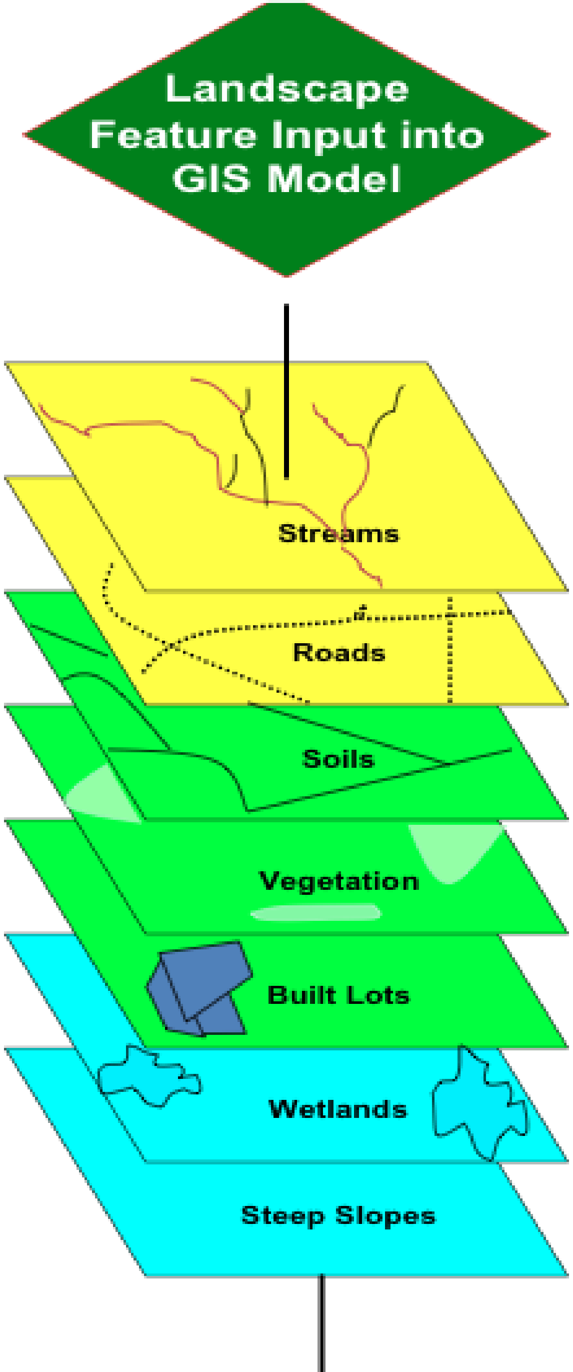




# Return Period : Current and Future

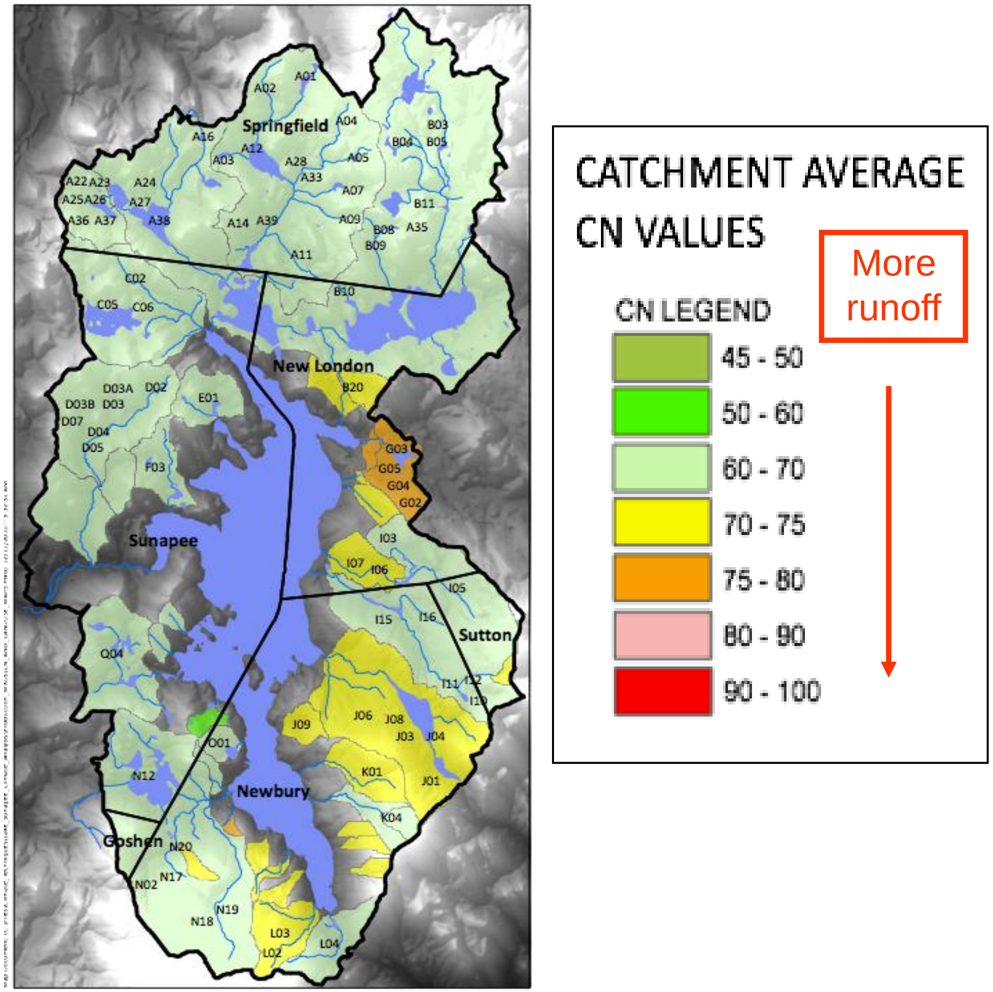
| Return period (years) | Recent climate | mid-21st cent. Optimistic | | mid-21st cent. Moderate | | mid-21st cent. Pessimistic | |
|---|---|---|---|---|---|---|---|
| 2.5 | 2.5 | 2.84 | | 3.3 | | 6.86 | |
| 5 | 3.17 | 3.47 | | 4.11 | | 8.4 | |
| 7.5 | 3.57 | 3.88 | | 4.66 | | 9.39 | |
| 10 | 3.86 | 4.19 | | 5.1 | | 10.13 | |
| 25 | 4.84 | 5.28 | 9% | 6.74 | 32% | 12.75 | 163% |
| 50 | 5.67 | 6.22 | | 8.31 | | 15.03 | |
| 75 | 6.2 | 6.82 | | 9.39 | | 16.5 | |
| 100 | 6.59 | 7.27 | | 10.23 | | 17.59 | |


Precipitation intensity-frequency relationship (24-hour duration)
Precipitation (in.)
13
12
11
10
9
8
7
6
5
4
3
2
1
1
10
100
1000
The future 25 year storm event will have the amount of precipitation of a historic 500 year storm event
Recent ('71-'00)
mid-21st pessimistic
Return period (years)
Simpson & Stack 2011

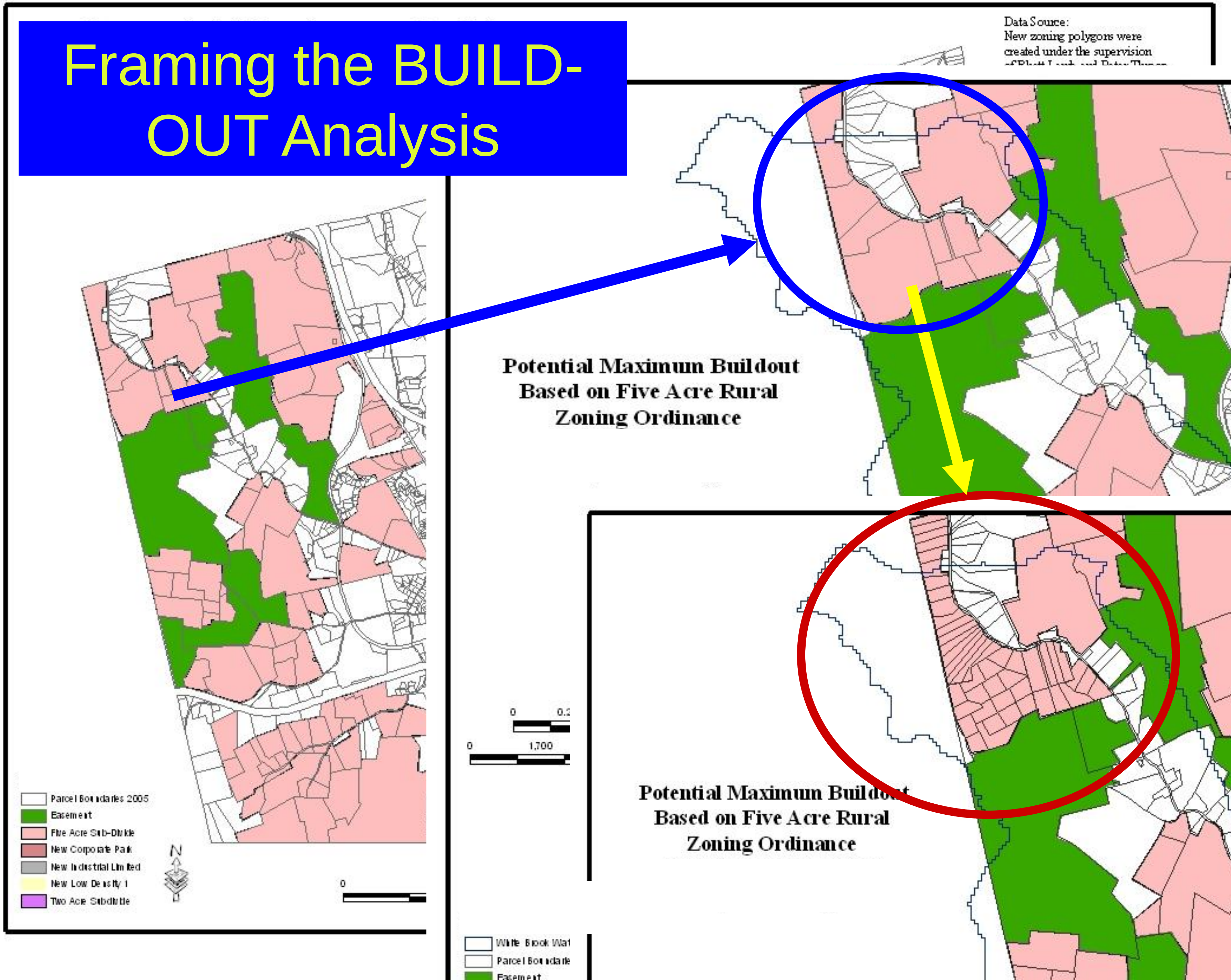


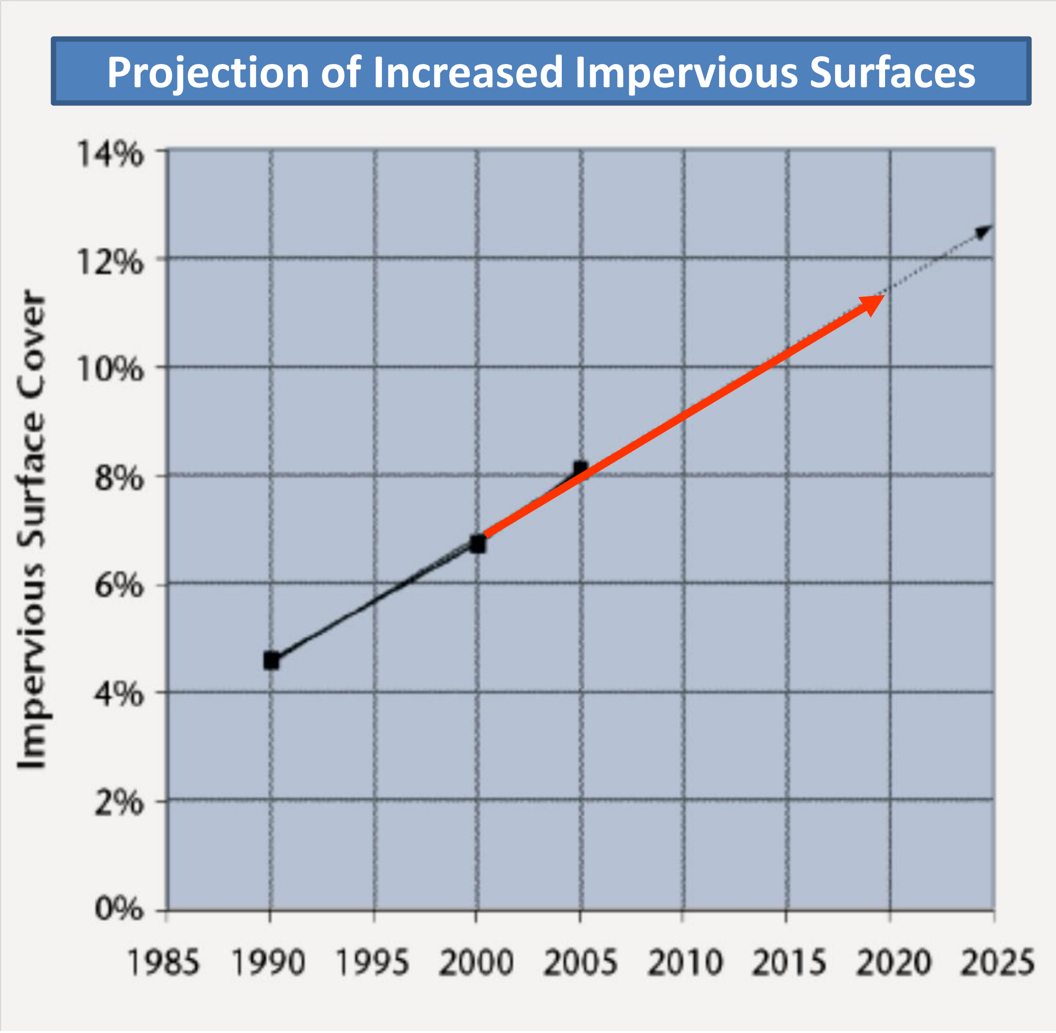

## Runoff potential (CN value)

### Current (5% build-out)



# Framing the BUILD-OUT Analysis

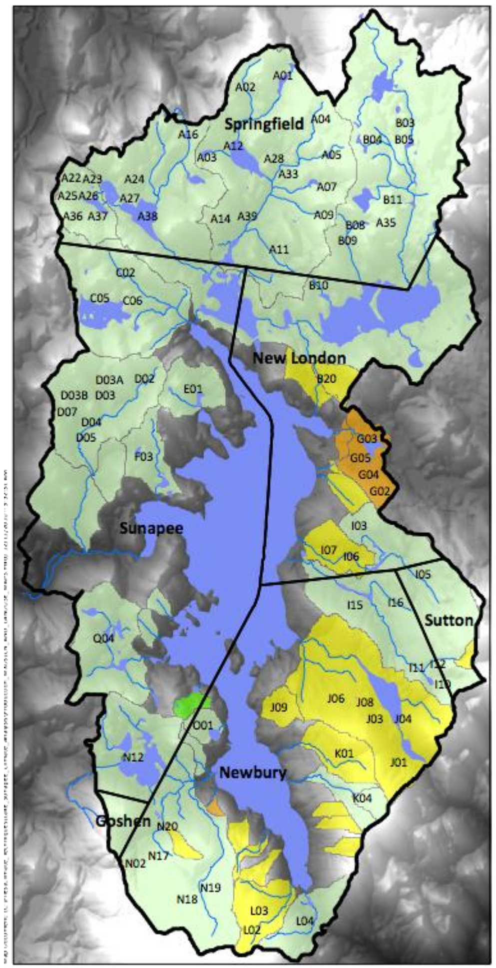


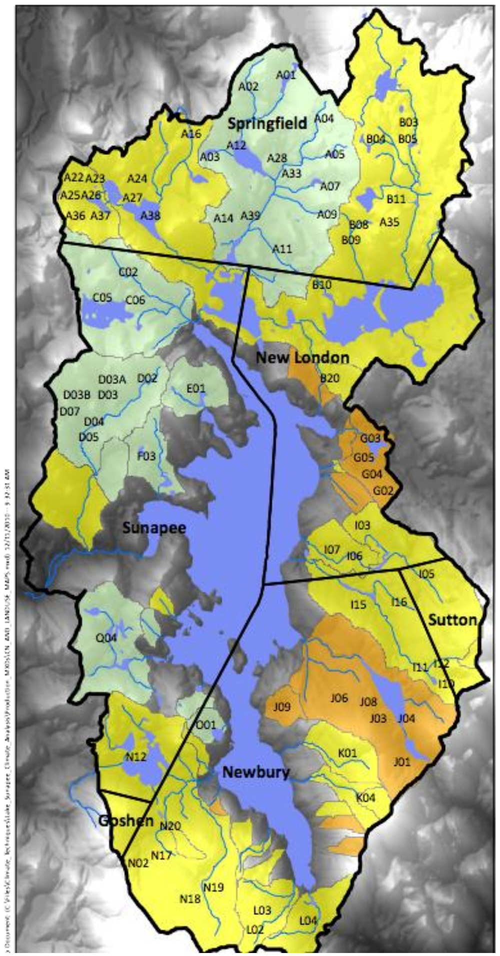

Projection of Increased Impervious Surfaces
Impervious Surface Cover
14%
12%
10%
8%
6%
4%
2%
0%
1985
1990
1995
2000
2005
2010
2015
2020
2025

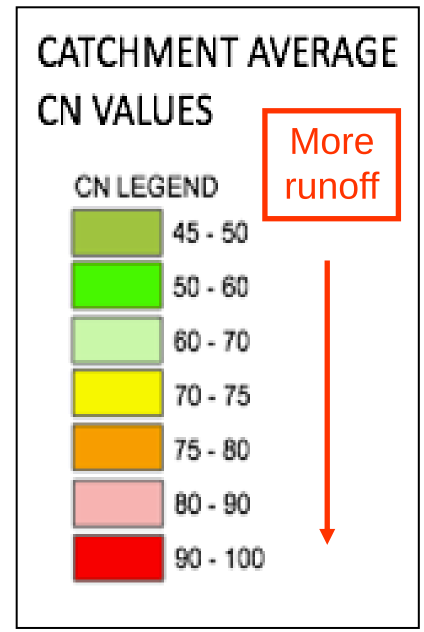
# Runoff Coefficient (*curve number*)

## As the result of land-use change

Current | Buildout

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# COMPARISON OF LANDUSE RESULTS

LU: CUR/BLDASS/LIDASS

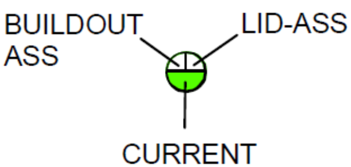
PRECIP: BASELINE ML

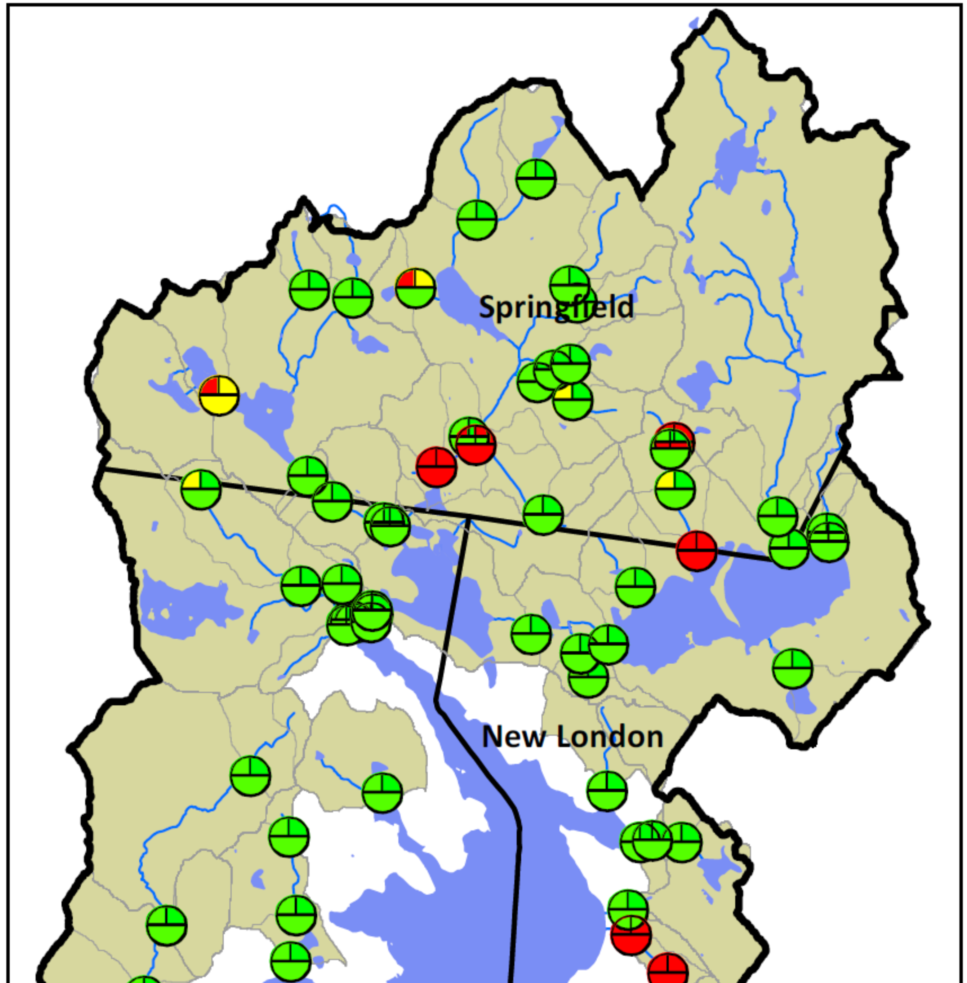
AMC: TYPE II

REPLACE (YES, TRANS, or NO)

- YES
- TRANS
- NO

**Result Position**

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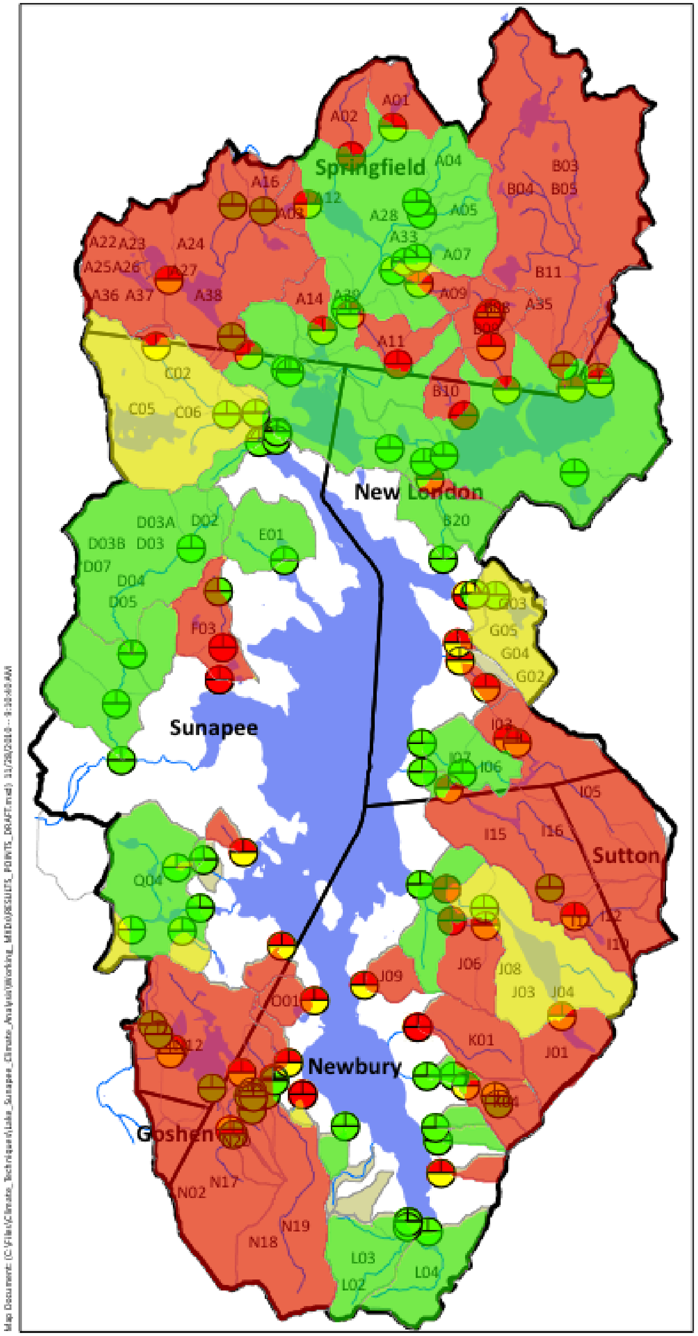
Climate Techniques

# <u>Lake Sunapee watershed</u>:

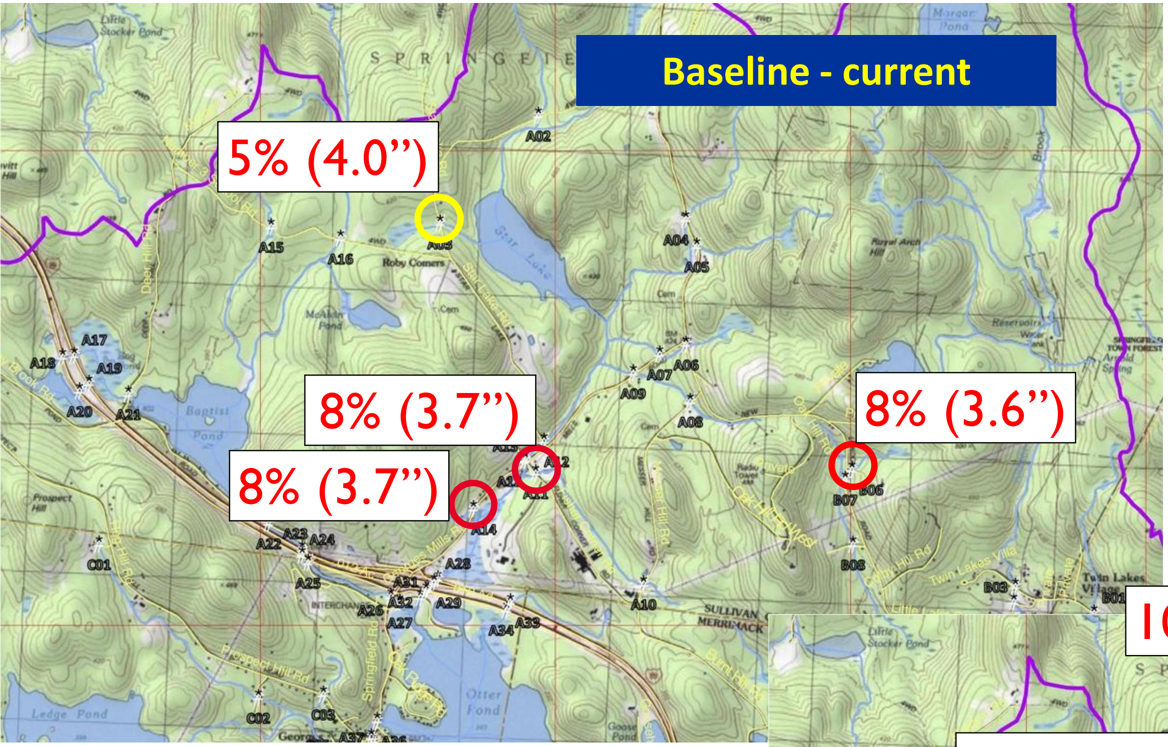
## Spatial impact of undersized culverts

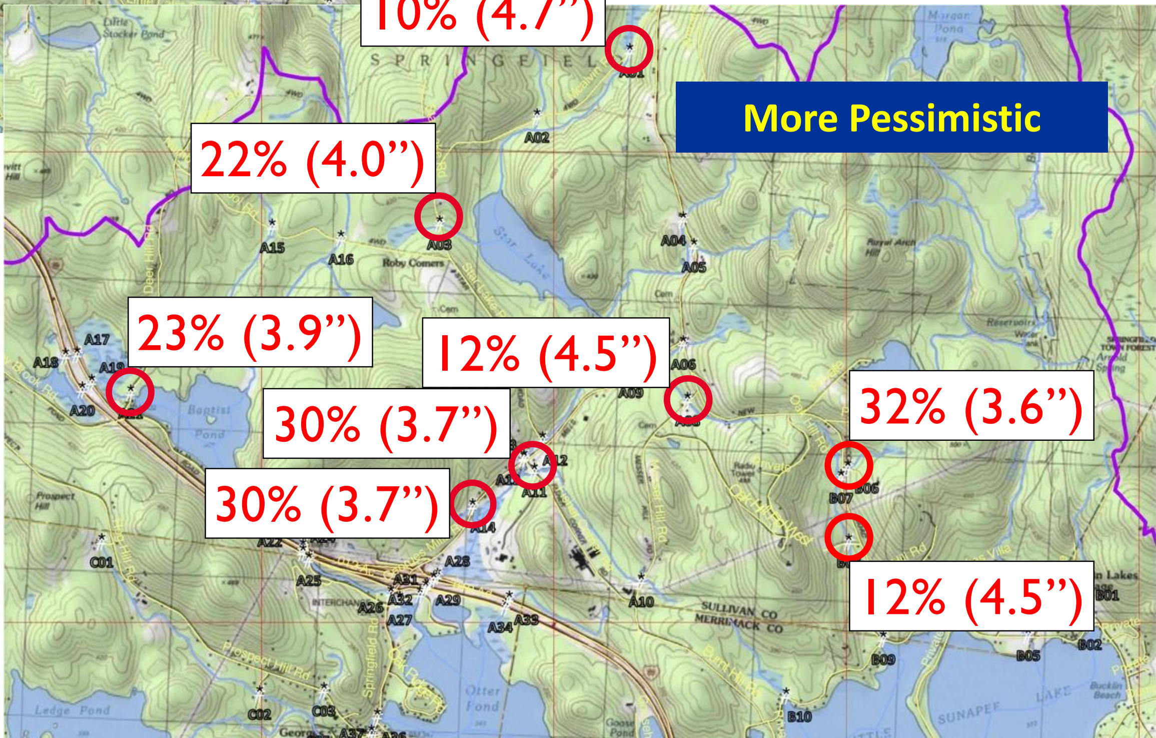



**What are the areas potentially vulnerable**

REPLACE (YES, TRANS, or NO)
- YES
- TRANS
- NO

# Drainage system vulnerability

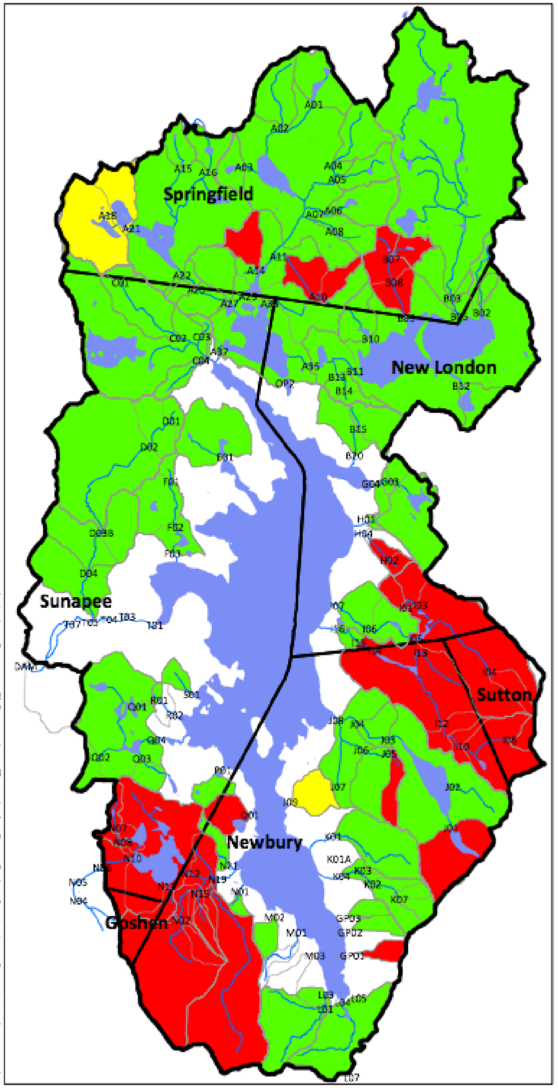



Sunapee Study 2012

# Drainage system adequacy

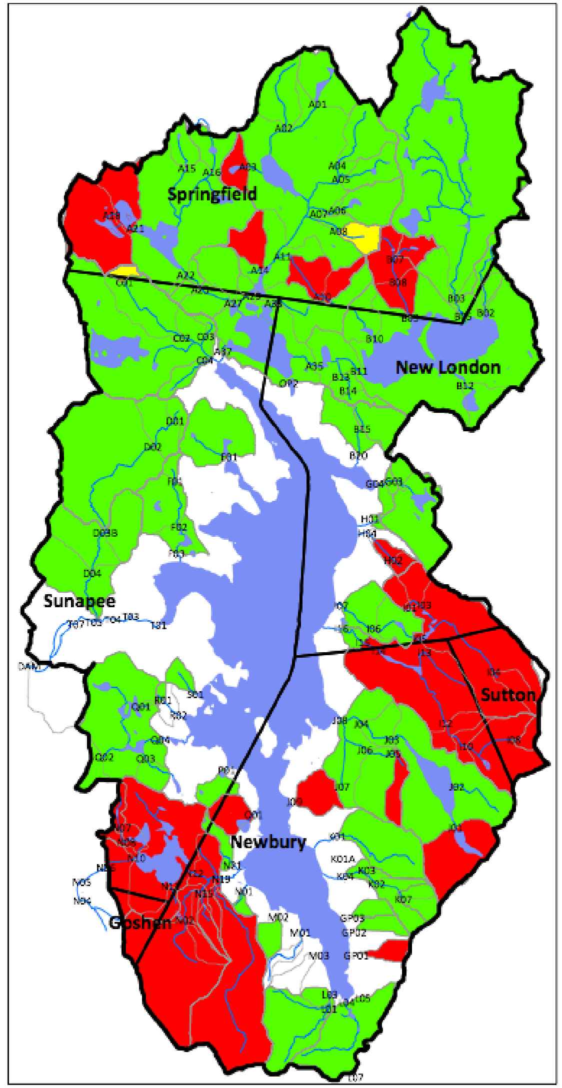
## Recent conditions



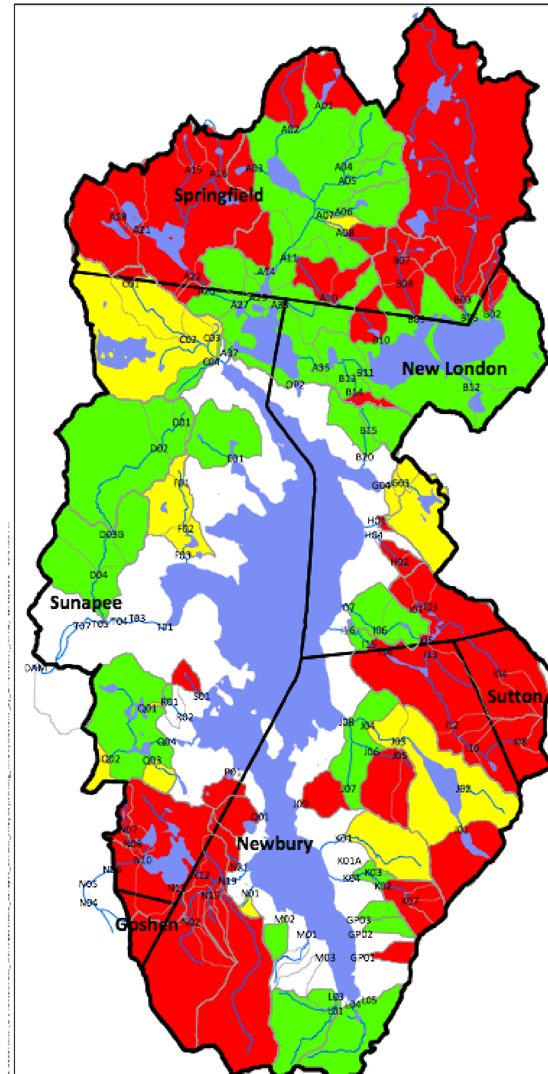

REPLACE (YES, TRANS, or NO)
- YES
- TRANS
- NO

Trans = transitional

## *With* population growth




## *And* more extreme rainfall

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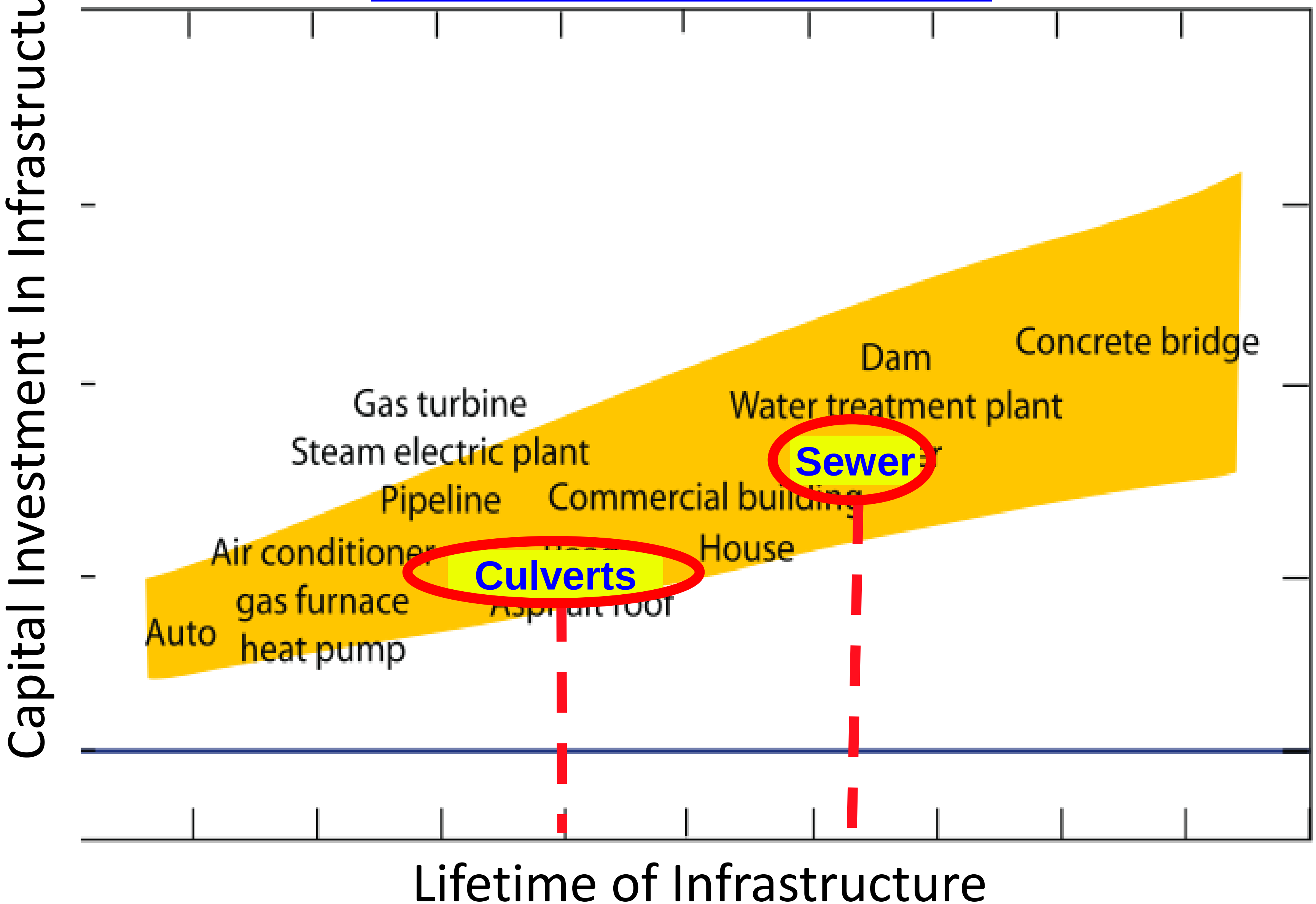
Climate Techniques

# Vulnerability is Contextual

| Percentage of stormwater culverts **already undersized** for 24hr, 25year rainfall amount | | | |
|---|---|---|---|
| Newbury, NH | **14 %** | Lake Sunapee Basin Study | **Simpson et al, 2012** |
| New London, NH | **23%** | Lake Sunapee Basin Study | **Simpson et al, 2012** |
| Springfield, NH | **14%** | Lake Sunapee Basin Study | **Simpson et al, 2012** |
| Sunapee, NH | **0%** | Lake Sunapee Basin Study | **Simpson et al, 2012** |
| Stratham, NH | **46%** | Winnicut River Basin Study | **Lawson & Simpson 2011** |
| Durham, NH | **9%** | Oyster River Basin Study | **Simpson & Stack, 2010** |
| Keene, NH | **26%** | White Brook Watershed Study | **Simpson et al, 2006** |
| Ottawa, Canada | **21%** | Ottawa 2001 Study | **Waters et al, 2003** |

# Historical Designs



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EPA United States Environmental Protection Agency


# LOCAL SOLUTIONS: Northeast Climate Change Preparedness Conference

May 19, 20 and 21st 2014
The Center of New Hampshire, Manchester, NH

Antioch University is hosting a regional conference for local planners, decision-makers and educators to understand how to create healthy resilient communities that are better prepared to handle severe weather and climate impacts.