Creating Resiliency in Streams

Restoration and Floodplain Reconnection

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June 23, 2016
“...the United States will experience more frequent and more severe flood events in coming years.”

From: Addressing Affordability and Long-term Resiliency through the National Flood Insurance Program
“The next century will, I believe, be the era of restoration”

-E.O. Wilson
Our Disaster Recovery Plan Goes Something Like This...
Overview

- Risk vs. Uncertainty
- What is resilience and how do we measure it?
- Challenges
- Opportunities
- Take Home Messages
Risk vs. Uncertainty

Human created encroachments = risks

Natural variability = uncertainty
## What is the Likelihood of Flooding?

<table>
<thead>
<tr>
<th>Years in floodplain</th>
<th>Chance of at least one 10-year flood</th>
<th>Chance of at least one 50-year flood</th>
<th>Chance of at least one 100-year flood</th>
<th>Chance of at least one 500-year flood</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10%</td>
<td>2%</td>
<td>1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>2</td>
<td>19%</td>
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<tr>
<td>3</td>
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<td>18%</td>
<td>4%</td>
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<td>93%</td>
<td>40%</td>
<td>22%</td>
<td>5%</td>
</tr>
<tr>
<td>30</td>
<td>96%</td>
<td>45%</td>
<td>26%**</td>
<td>6%</td>
</tr>
</tbody>
</table>

**The longer you occupy the floodplain, the greater your chance of being flooded.**

FEMA has not identified all areas that may be at risk of flooding. Between 20%–25% of flood insurance claims are from areas OUTSIDE the FEMA Special Flood Hazard Area in supposedly “low risk” areas.

**Over a 30 year mortgage, there is a 25% chance of a 100-year flood.**

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**Risk Level:**

- **High Risk**
  - In FEMA 100-year floodplain
  - Also in 10, 50 and 500 year floodplain.
- **High Risk**
  - In FEMA 100-year floodplain
  - Also in 50 and 500 year floodplain.
- **High Risk**
  - In FEMA 100-year floodplain
  - Also in 500 year floodplain.
- **Medium Risk**
  - In 500-year floodplain
- **Low Risk**
  - Above 500-year floodplain

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**FEMA Special Flood Hazard Area**

- One-percent or greater chance of flooding in any year. (FEMA Flood zones A, AE, A1–A30, AO, AH)
From: Anthropogenic Transformations in the Terrestrial Biosphere (Ellis 2011)
Resilience

The power or ability to return to the original form after being stretched.

Toughness.

Anticipating/preparing for disturbance.
Resiliency

Pivoting from trying to prevent natural disturbances to naturally managing disturbances

Considering both flood risk and erosion risk

Floodplain reconnection
"Natural" or "green" infrastructure tends to be more resilient to water stress than human-engineered infrastructure because it bends, rather than breaks.
Resiliency Metrics

Percent reduction of land area in the 100-year floodplain

Number of insurable structures left in the floodplain & number of structures removed from the floodplain
Resiliency Metrics

Reconnection of the channel to an active floodplain bench

Increased room for the river channel – will the alternative better allow the river to “be a river”
Challenges

Considering Human Factors such as Private property and Redevelopment
Challenges

Communicating benefits associated w/ floodplain reconnection
Where I See Opportunities

Riparian Corridor Management
“Freedom Space”
- Flood protection
- Urbanization Buffers
- Infrastructure Protection
- Aquatic Habitat
- Water Quality
“Activate” floodplain for larger flows

- Natural process
- Biological lifeline

Where I See Opportunities

Capital and maintenance costs

Ecosystem services
Where I See Opportunities
Where I See Opportunities
Where I See
Opportunities
Where I See Opportunities

Figure 2.18. Three components of environmental (watershed) management to control pollution. (From Novotny, 2000.)

Floodplain Management
Include natural variability within studies and designs to address risk AND uncertainty

Take Home Message
THANK YOU!
Resiliency Metrics

1. Percent reduction of land area in the 500-year floodplain
2. Increased hydraulic capacity of the bridge crossing
3. Flow rate that causes overtopping of structure
4. Depth of overtopping of a structure during a 100-year event (the lower the depth, the greater the level of safety)
5. Number and value of properties that should be purchased by community to remove structures from the floodplain (assuming willing sellers)
6. Flow velocity through the bridge (lower velocity means reduced scour and damage potential during flood events)
7. Increased land area available for ecological restoration and improvements
8. Percent increase in available open space/natural land area
9. Opportunity for outdoor/natural areas recreation (i.e., soft path trails, environmental education, access to river, bird watching, fishing, etc.)
10. Benefits to pedestrian and bicycle safety
11. Reduced flooding frequency and damages to the pedestrian trail underpass
12. Number of properties with improved redevelopment potential
13. Ability of the proposed improvements to be resistant and adaptable to future disruptions
14. Reduced maintenance effort and costs
15. Anticipated cost of damages from a flood event