Foundational Elements of Community Disaster Resilience Pre- and Post-Disaster

NIST Community Disaster Resilience Workshop
February 18, 2015
Grand Forks, North Dakota

- 3rd largest city in state (~55,000 pop. / 20,000 households)
- Area: 20 square miles
- University of North Dakota
- Grand Forks Air Force Base

Prior to 1997:
- History of flooding; flood stage reached at 28 feet
- Mostly earthen levees could sustain flood heights of 49 feet plus 3 feet of “free board”
- USACE design study underway

- Red River of the North travels 550 miles northward
- Extremely flat terrain, 830-832 ft. above sea level
1997 Record Snowfall
54.11’

(J.W. Green, March 1997)

(Staff Sgt. Charles Morris, US Air Force, April 17, 1997)

(FEMA, 1997)

(Steven Norbeck, USGS, 1997)
Grand Forks Flood and Fire
The Aftermath

- Nearly 80% of city inundated
- 90% residents displaced for weeks
- Water began receding after 3 days but took nearly 5 weeks
- 9,000 homes damaged; 700 severely damaged or destroyed
- 11 downtown buildings and 60 apartments burned
- 750 commercial units damaged; all 385 businesses in downtown were impacted
- Electricity, water and sewer services shut down citywide
- City Hall, County Courthouse and other government buildings damaged
Key Ingredients of Grand Forks’ Recovery

- Local leadership with political will and buy-in for hazard mitigation
- Strong State and Federal partnerships—both before and after flood
- Swift and adequate post-disaster funding, cooperatively managed
- Resilience in both interim and long-term recovery goals and specific programs:
  - Voluntary acquisition and relocation
  - Enhanced flood protection (levee and floodwall) system
  - Permanent river greenway construction
  - Downtown revitalization

(Images of a map of Grand Forks and flood protection systems)
River crested at 49.5 feet on April 1, 2009

(Greg Abner, City of Grand Forks, March 29, 2009)
Grand Forks’ Resilience “Costs”

- Losses of $1 to $2 billion, and comparable recovery costs much of which funded by federal, state, and local government
- Social and business displacement, some long-term; cultural and historical losses as well
- Mitigation strategies took nearly a decade to achieve, even with swift, well-funded, and well-coordinated start to recovery
- Negative effects on elected officials, staff and population, especially in recovery years 2 and 3

(geosynthetics, 2009)
“Resilience means the ability to prepare and adapt to changing conditions and withstand and recovery rapidly from disruptions”

- Reduce the impact of hazard events
- Return to social functioning more quickly
- Reduce the time and cost of recovery
- Break the cycle of destruction and recovery
A. Maslow’s Hierarchy of Needs: 5-Stage Model

- Biological and Physiological Needs
- Safety Needs
- Belongingness and Love Needs
- Esteem Needs
- Self-actualization
Community Resilience "Holistic" Model

- **People, Livelihoods**
- **Governance and Community Institutions**
- **Economy, Networks and Supply Chains**
- **Structures, Infrastructure, and Built Environment**
- **Environmental, Ecology, and Physical Environment**

(Source: Laurie Johnson 2011)
“Building Local Capacity and Accelerating Progress: Resilience from the Bottom Up”
*Disaster Resilience: A National Imperative, National Academies 2012*

- Organizing communities, neighborhood, and families to prepare for disasters
- Communicating risks, connecting community networks, and promoting a culture of resilience
- Engaging the whole community in disaster policy making and planning
- Linking public and private infrastructure performance and interests to resilience goals
- Improving public and private infrastructure and essential services (such as health and education)
- Adopting and enforcing building codes and standards appropriate to existing hazards
- Adopting sound land-use planning practices
Foundational Element 1: Enable “locally meaningful” characterizations of hazards and risks.

(Town of Portola Valley, CA, Ground Movement Potential Map)
California Statewide Mandates for Seismic, Wildfire, and Flood Hazard Identification

(My Hazard, California Office of Emergency Services)
Considerable Variability in Hazard Mapping/Assessment Across the U.S.

- Hazard knowledge and ability to “map it” varies by peril: earthquake (faulting, liquefaction, landslide, strong shaking), flooding (riverine, dam/levee failure, storm surge, sea level rise), wildfire, landslides/debris flows, hurricane-force winds, tornadoes, hail, ice, subsidence, man-made, etc.
- Variations in mapping approach and accounting of uncertainty (inventory/identification, hazard/susceptibility, probabilistic, risk)
- Variations in mapping scales (regional to site-specific)
- Variations in legislative/policy controls: national, state, and local mandates requiring specific action versus informational or advisory only
Foundational Element 2: Ensure robust and effective integration of hazard information in public policy
Foundational Policy Pathways for Hazard Information

Planning Policies
- Comprehensive Plan (Land Use and Hazards/Safety Elements)
- Specific/Area Plans
- Hazard Mitigation Plan
- Emergency/Evacuation Plans

Development Regulations
- Zoning and zoning overlay districts
- Subdivision regulations
- Geologic/hazard site investigations
- Hazard-specific setbacks and regulations
- Environmental Review
- Grading ordinances and site development controls

Land and Property Acquisition
- Acquisition of undeveloped land
- Acquisition or transfer of development rights
- Acquisition of damaged properties
- Relocation of buildings

Building Standards
- Building codes
- Hazard-specific provisions
- Retrofit requirements

Critical Infrastructure and Public Facilities Policies
- Design and construction standards
- Locational restrictions
- Capital improvement programs

Taxation and Fiscal Policies
- Impact fees
- Assessment districts
- Tax breaks/incentives

Information Dissemination
- Real estate disclosures
- Professional education/certification
- Public information/warnings

States requiring local comprehensive plans (2009)


States requiring local comprehensive plans to address hazards (2009)
Coastal State Building Code Effectiveness Rating

(Insurance Institute for Business & Home Safety (IBHS), August 2013)
Are There Opportunities to Expand the Hazard/Risk Discussion as part of (Re)development?

- Where (more precisely) to build?
- What to build?
- How to build?
- Also, address:
  - Who pays for detailed investigations and hazard mitigation?
  - Who ultimately owns the (retained) risk and how to ensure their awareness and preparedness?
Town of Portola Valley, CA

Windy Hill Open Space Preserve
**Delta Stewardship Council/ Delta Plan**

**Central Valley, CA**

- 2009 Delta Reform Act and allocation of $700 million annually
- Delta Stewardship Council created in legislation to achieve the state mandated coequal goals for the Delta: “providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem”
- Delta Plan, adopted in 2013, comprehensive, long-term management plan that included a multi-hazard analysis
- Delta Science program and board – provide information for water and environmental decision-making in the Bay-Delta system
- California Water Bond $7.5 billion approved in November 2014

Source: Delta Plan 2013
Post-Disaster Resilience Building Experiences

Time compression means that normal city building processes, in all their complexity, now must happen much more quickly (100 years \(\rightarrow\) 10 years).

( Olshansky, Hopkins, & Johnson, Natural Hazards Review, August 2012)
Tohoku Region, Japan
2011 Earthquake and Tsunami
Rebuilding

(Reconstruction Design Council in Response to the Great East Japan Earthquake, June 2011; translation by K. Iuchi)
Rikuzen Takada City, Japan

Raised land for commercial/industrial use → Hillside residential relocation areas

Source: http://www.japan-guide.com/g9/5038_03.jpg, April 2014
Tohoku Region, Japan
2011 Earthquake and Tsunami Rebuilding

http://www.reconstruction.go.jp/english/130528_CurrentStatus_PathToward_FINAL.pdf

Collective household relocation

Land readjustment

Public housing development

[ Soma City, Fukushima Prefecture ]
Structure: Wooden flat compound for 12 houses

Unprecedented scale of devastation results in a massive amount of projects

Great Hanshin-Awaji Earthquake (project term: 2 years)

Great East Japan Earthquake (project term: 8 years)

Great Hanshin-Awaji Earthquake (project term: 6 years)

Great East Japan Earthquake

24 municipalities
245 districts

3 municipalities
3 districts

Chuetsu Earthquake

Great East Japan Earthquake

20 municipalities
58 districts

5 municipalities
20 districts

Great Hanshin-Awaji Earthquake (average project term: 8 years)

26,000 houses

Over 20,000 houses
Canterbury Region, New Zealand
2010-2011 Earthquakes

Dust cloud rising as building collapse in downtown Christchurch NZ on 2/22/11
Source: Gilly Needham
M7.1 (9/4/10); M6.2 (2/22/11); M6/M5.6 (6/13/11); M5.9/M5.8 (12/23/11)
National Government-led “Red Zone” Buyout of >7,000 Homes and Significant Upgrades to Building Standards

http://cera.govt.nz/maps/technical-categories
Bring New Orleans Back Commission’s Proposed Recovery Plan
January 2006

US$8.7 billion program
>128,000 participants (2011)

(Data from 123,917 closings as of July 2009):
>92% repairs, but 9,822 opted to sell home
(20% of which left state)

In New Orleans, 4,683 homes sold increasing the pre-storm blight challenges of many neighborhoods

Sold Homes as a % of Owner-Occupied Households
(Green and Olsansky, 2012)
New York State
Post-Sandy Community Reconstruction Planning

Table 2
Effect of Landscape Attributes on the Exposure of Assets

<table>
<thead>
<tr>
<th>Landscape Attribute</th>
<th>Least Exposed</th>
<th>Most Exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion Rate</td>
<td>Shoreline is accreting or minor erosion</td>
<td>Average annual shoreline erosion is 1 foot per year or more</td>
</tr>
<tr>
<td>Beach Width</td>
<td>The waterline is not in contact with shore defenses or upland vegetation or only in contact temporarily during storms</td>
<td>The waterline is in frequent or daily contact with shore defenses or upland vegetation</td>
</tr>
<tr>
<td>Shore Defenses</td>
<td>Constructed to anticipated conditions including storms and sea level rise and well maintained</td>
<td>Not constructed to anticipated conditions including storms and sea level rise or poorly maintained</td>
</tr>
<tr>
<td>Protective Vegetation</td>
<td>Healthy, dense upland or wetland vegetation, near the asset</td>
<td>Vegetation is sparse or distant from the asset</td>
</tr>
<tr>
<td>Dunes or Bluffs</td>
<td>Dunes are broad, above Base Flood Elevation, vegetated and have space to retreat. Bluff slope is stable and vegetated</td>
<td>Dunes are narrow and unvegetated, eroded (scarped), discontinuous, below Base Flood Elevation, or constrained by adjacent structures. Bluff slope is unstable and partially vegetated</td>
</tr>
<tr>
<td>Soils</td>
<td>Soils are stable and/or rocky</td>
<td>Sites of former wetlands that have been filled, or unconsolidated sand and fine sediment, or sandy coastal barriers</td>
</tr>
</tbody>
</table>
(Source: Haas, Kates, and Bowden, 1977, Reconstruction Following Disaster)

Governance is “an intended activity undertaken by one or more actors seeking to shape, regulate or attempt to control human behavior in order to achieve a desired collective end.”

(Joerg van der Heijden, Governance for Urban Sustainability and Resilience: Responding to Climate Change and the Relevance of the Built Environment, 2014)
Three Key Governance Problems for Urban Sustainability/Resilience

(Joerg van der Heijden, Governance for Urban Sustainability and Resilience: Responding to Climate Change and the Relevance of the Built Environment, 2014)

● Governments are slow to react to existing problems. It often takes a long time to develop and implement legislation and regulation and even longer for these to take effect.

● Introducing new legislation and regulation is often inconsequential. Cities (re)develop too slowly for most legislation and regulation to be meaningful.

● A “wicked set of market barriers” stand in the way of capitalizing the economic benefits that resilience can bring.
Getting Governance Right

(Joerg van der Heijden, Governance for Urban Sustainability and Resilience: Responding to Climate Change and the Relevance of the Built Environment, 2014)

- Traditional governance – Direct regulatory interventions (regulation, subsidies, and taxes)
- Collaborative governance (networks, partnerships, and agreements and covenants)
- Voluntary programs and market-driven governance (best-of-class benchmarking and certification, tripartite financing, green leasing, contests and challenges, sustainable procurement)
# Traditional vs. Collaborative Governance

*(Innes and Booher, *Planning with Complexity, 2010)*

<table>
<thead>
<tr>
<th>Traditional Governance</th>
<th>Collaborative/Network Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• More directive leadership model</td>
<td>• More generative leadership model, creating conditions to bring teams together and help build collective capacity to learn about problems and find solutions together</td>
</tr>
<tr>
<td>• Manager is organizer/controller.</td>
<td>• Manager is a mediator and process manager</td>
</tr>
<tr>
<td>• Goals are clear, and success is attainment of the goals.</td>
<td>• Goals are sometimes in conflict or likely to change as part of deliberation. Success is realization of collective action and capacity to adapt to change.</td>
</tr>
<tr>
<td>• Linear/rational approach to planning</td>
<td>• Non-linear approach to planning where goals may be revisited as part of analysis, policy development or implementation</td>
</tr>
<tr>
<td>• Public participation – Complies with legal requirements, educate the public, and obtain public support for proposals.</td>
<td>• Public participation – Engage in joint learning and deliberation; build public capacity for problem-solving and adaptation</td>
</tr>
</tbody>
</table>
Value of the NIST Disaster Resilience Framework

- Framework is a policy tool for defining and implementing a robust and defensible approach to resilience building at the community-level
- Opportunity to improve community-level hazard and risk characterization
- Opportunity to improve land use, building and infrastructure standards and practices, adoption and implementation
- Leverages the “Whole Community” – Collaboration on a “Large-scale”: multi-disciplinary, multi-governmental, and non-governmental partnerships and alliances

Requires SUSTAINABILITY (political will, technical and financial resources, collaboration, metrics)
Resilience is formed through the interdependencies that evolve from established societal patterns and the work of building resilience both pre- and post-disaster.
>M6.7 Earthquake in California
>99% Chance in next 30 Years
5 Factors Influencing Post-Disaster Recovery Timeframes

1. Complexity of property ownership and parcel characteristics
2. Availability and types of financing, and funding requirements
3. Existence and effects of pre-existing plans and conditions
4. Institutional framework and level of stakeholder involvement
5. Level of government intervention and complexity of the regulatory framework

Building Resilience
(Disaster Resilience: A National Imperative, National Academies 2012)

- Assess vulnerabilities and risk
- Develop risk management/resilience actions and strategies (risk avoidance, reduction, transfer, and retention)
- Establish community resilience performance goals
- Develop financial and implementation plans (Assess costs/benefits of improving resilience, considering other community investment priorities. Who pays now? Who pays later?)
- Measure and monitor resilience building progress
The Process of Building Community Resilience
(Multinational Resilience Policy Group, 2013)

- It is a matter of democratic governance that involves partnering with communities, building mutual support within communities and across jurisdictional boundaries, and sustaining involvement.

- The work of building resilience, both pre- and post-disaster, demands cooperation, among citizens, between subnational and national levels of governments, and integration of both the public and private sectors.

- Resilience is formed through the interdependencies that evolve from established societal patterns and not as a replica of institutional, group or program arrangements.
## Community Types: Social Capital for Resilience

<table>
<thead>
<tr>
<th></th>
<th>Vertical</th>
<th>Strong</th>
<th>Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong</td>
<td></td>
<td>Type I</td>
<td>Type II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- high potential for collective action</td>
<td>- strong capability to define needs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- high potential for aid to meet needs</td>
<td>- lacks ties with external aid opportunities</td>
</tr>
<tr>
<td>Weak</td>
<td></td>
<td>Type III</td>
<td>Type IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- powerlessness, dependent</td>
<td>- isolated and powerless</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- knowledge of aid, but weak ability for aid to meet needs</td>
<td>- limited access to external aid</td>
</tr>
</tbody>
</table>

(Adapted from Berke, Kartez, and Wenger 1993; in National Research Council, *Facing Hazards and Disasters*, 2006, 234)