Adapting to Changing-Stormwater Quantities through land-use Planning

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How can cities adapt to changing conditions? Learning from Montreal and New Orleans.

Isabelle Thomas, Associate Professor, University of Montreal
Isabelle.thomas.1@umontreal.ca
Introduction:

- Vulnerability of our communities: caused by climate change; land use planning patterns at different scales.

- Links between vulnerability, resilience, sustainable development and adaptation to climate change

- Needs to change our urban development choices and to choose long term adaptation strategies

- Sustainable environmental planning: reduce vulnerability while enhancing resiliency

- Needs for interdisciplinary as well as international collaboration.
I. How to locate the most vulnerable areas towards flooding in a climate change context?

Source: Y. Thibault, CSC, 2004
What changes to expect South of QC

**Spring**
- Comes earlier
- Less snow
- Quickly melts
- More rain

**Summer**
- Higher temperatures
- More storms and strong rain
- More drought in the south of Quebec

**Autumn**
- Later cold and snow arrival
- Longer drought
- Possibility of more rain

**Winter**
- Higher temperature
- More rain
- More cycles: frost/defrost / floating ice
- Less snow

Source: Ouranos, 2011
Main Goal:
Analysis of social and environmental vulnerability towards flooding so as to identify the main challenges and their vulnerability to river floods (Rivière des Prairies).

Changes – Research Questions –
Goal 1 – Goal 2 – Goal 3 – Goal 4 – Conclusion
Goal 1
Historical study of flooded areas

Urban development 1920-2009

Land use in study area

N. Bleau, 2010 (Adaptée de CSC, 2007)

Changes – Research design –

Goal 1 – Goal 2 – Goal 3 – Goal 4 – Conclusion
Deux modèles testés:

HEC-RAS ➔ 1D

Hydro-Sim ➔ 2D

What if scenarios
### Social Sensibility / Two Methods Tested

<table>
<thead>
<tr>
<th>INDICE DE SENSIBILITÉ SOCIALE (ISS)</th>
<th>INDICE DE SENSIBILITÉ SOCIALE PAR ADDED D’INDICATEURS PONDÉRÉS (ISSAIP)</th>
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</thead>
<tbody>
<tr>
<td>• Cutter et al. 2003.</td>
<td>• Fedeski et al., 2007; Ebert et al., 2009</td>
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<tr>
<td>• Quantitative methode…</td>
<td>• Quantitative and qualitative methode</td>
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<tr>
<td>• Complexe results</td>
<td>• Easier interpretation</td>
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### Preliminary Indicators

<table>
<thead>
<tr>
<th>Resident numbers</th>
<th>Unemployment rates</th>
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<tr>
<td>Population changes 2001-2006</td>
<td>Small income single parent families</td>
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<tr>
<td>% more than 65 years old</td>
<td>Small income families</td>
</tr>
<tr>
<td>% less than 14 years old</td>
<td>% new immigrants (2001-)</td>
</tr>
<tr>
<td>% families 3 children and more</td>
<td>% population understanding neither French nor English</td>
</tr>
<tr>
<td>% single parent families</td>
<td>% population age 25 without diplomas</td>
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</table>
Goal 3
Analyzing vulnerability

WORKSHOP

13 participants → 3 working groups

• Method presentations
• Discussions on methods and criteria
• Choices on criteria weight

EDUCATION
DISCUSSIONS
LOCAL PARTICIPATION

CHANGES – RESEARCH QUESTIONS –
GOAL 1 – GOAL 2 – GOAL 3 – GOAL 4 – CONCLUSION
**Goal 3**

**Analyzing vulnerability**

**TERRITORIAL SENSIBILITY**

Analysis steps

- Convertir des polygones en point
- Création d'une grille « Fishnet »
- Mise en relation des données et la grille « Spatial Join »
- Addition des sous-groupes
- Indice de la sensibilité territoriale

**Changes – Research Questions –**

**Goal 1 – Goal 2 – Goal 3 – Goal 4 – Conclusion**

Pamela Soto-Abasolo, 2012
Vulnerability ➔ IVu = (ISSAIP + IST) – Iadapt
Goal 4
Mapping vulnerability

Scenario 4: flood 2 years + 702 m³/s
Scenario 5: flood 100 years
Scenario 7: flood 100 years + 1000 m³/s
Scenario 9: flood 100 years + 2000 m³/s

Low vulnerability to high vulnerability

Pamela Soto-Abasolo, 2012
Adapting to changing conditions

Échelles
- Région/bassin
- Quartier
- Bâtiment

Ouvrages de protection

Détournement des flux d'inondation loin des zones affectées

Atténuation des crues et ouvrages de rétention d'eau, y compris l'utilisation d'espaces verts

Marges de recul et zones de non-construction plus grandes puis, en dernier recours, ouvrages de protection permanentes contre les inondations.

Élévation du niveau des planchers

Matériaux résistants aux inondations.

Pratiques de gestion optimale

Source: D. Dagenais


Changes – Research Questions –
Goal 1 – Goal 2 – Goal 3 – Goal 4 – Conclusion
II. What type of stormwater infrastructures can address issues of water conservation and sustainable use? Lessons from New Orleans

- Resilience: ‘as it suggests focusing on building something up rather than just reducing something, which is the case when talking about poverty or vulnerability reduction’.

  Andrew Collins (Director, Disaster and Development Centre, Northumbria University, UK)

- Disaster resilience activities can ‘lead to actions such as enhancing community coping capacity and livelihoods’, allowing communities to make appropriate choices within the context of their environments.’ Manyena (2006)
Challenge 1: Understanding vulnerability

Geographical location challenge?
Social equity and economical equilibrium?
Integrated governance?
Environmental protection?

« Wetland are not wasteland »

Population in New Orleans Metropolitan area in 2000
Hazard Knowledge?

**Hurricane protection system:** Data from New Orleans Regional Planning Commission (NORPC)

Urban development in flood prone areas

Croissance Urbaine dans l'Eastern New-Orleans entre 1982 et 2000
• Sunday August 28th 2005

Photos: CNN
Wetland loss

• > 100 square miles of wetlands destroyed after hurricane Katrina and Rita
“Hurricane sprawl”:

Source: Isabelle Thomas
Challenge 2: Resilient and sustainable adaptation and urban rebuilding

- Stable environment and Leadership
- Diversified economy
- Social equity
- Hazard mitigation planning
- Water and environmental protection
- Financial capacity
- Coordinated governance
Strategy 1: Short term environmental and urban viable and resilient rebuilding (0-3 years): Infrastructures;

- Drinking water, sewage, communication networks, electricity, waste management

- Road network

- Levee protection system enhanced

Source: Isabelle Thomas
Hazard reduction planning, adaptation

Federal level::
- «Safe development paradox» (Ray Burby)
- Flood Insurance adjustment / regulations

State level:
- Building regulations
- Urban Master plans with hazard mitigation regulations

Regional level: more collaboration
- Integrated environmental planning: Coastal Protection and Restoration Authority (CPRA): levees and coastal protection
- Long term wetland restoration
- New environmental mitigation and adaptation strategies
Lines of Defense (LOD) are definable geographic areas in which certain natural or manmade features or activities are promoted or implemented, resulting in the reduction of impacts by tropical weather systems in the Louisiana coast.

Adopted by:

- LA Department of Natural Resources
- US Army Corps of Engineers

Source: LPBF
Strategy 2: Mid term resilient and viable rebuilding (3-5 years): population return and economical growth.

-Metropolitan scale: from 7 levee boards to 2 levee boards

-City scale: urban rebuilding and citizen participation.

-Need for permits and hazards regulations / green buildings

-Neighborhood scales: resource centers / parks

-Viable and sustainable economical growth

-Stop urban sprawl: « hurricane sprawl »
• ULI Stratégie d’action
Neighborhood challenges: ex: Gentilly

Source: Isabelle Thomas
Strategy 3: (5-10 years) long term resilient and viable adaptation and planning

- Enhance social and environmental equity
- Enhance education and environmental awareness
- Rebuild viable and ecological neighborhoods and buildings
- Adapt urban redevelopment to flood hazards requirements

Source: Isabelle Thomas
Green rebuilding challenge in Ninth Ward

What link with the other plans?

@Thomas Isabelle
Innovative environmental planning practices?

- Adaptation and planning: Master Plan
- Urban Water plan: living with water: city as a sponge.
- Citizen participation and stakeholders education and awareness
- Mitigation and adaptation strategy coordination
Greater New Orleans Urban Water Plan, Waggonner & Ball Architects

-Issues: Flooding; Subsidence; Wasted Water Assets

-Principles: Live with water; Slow and Store; Circulate and Recharge; Work with nature; Design for adaptation
Uptown streets

Mirabeau Water garden
Vision, environmental adaptation

Cities have to develop innovative strategies to adapt to climate change and current urban patterns

- Hazards can’t be eliminated. Floods can be reduced by having knowledge on vulnerability (data; methods) and by developing resilient and viable urban planning practices.

- Enhance collaboration and coordinated strategies at different scales (geographies and governance)

- Develop and integrate innovative environmental adaptation practices in urban planning; cost benefit analysis towards implementation

- Create knowledge, education, networks and collaborations between academics and stakeholders as well as international cooperation.
Questions?

Isabelle.thomas.1@umontreal.ca