Land Use and Infrastructure Planning in a Changing Climate: Integrating Regional Climate Information with Local Policies

The Climate IMPACTs Decision Support Tool
CIMPACT-DST™

Spencer Reeder – Cascadia Consulting Group

SE Florida Regional Compact Climate Leadership Summit
December 2012
We’re seeing a one-hundred year storm every two years.

- NY Governor Mario Cuomo
Key Challenge

What Most Decision Makers Want:

Impact A

- Upper Extreme
- Best Estimate
- Lower Extreme

Year X, Y, Z
What Science Often Produces:

Model Analysis 1

Impact A

Upper

Best

Lower

Model Analysis 4

Impact A

Upper

Best

Lower

Empirical Analysis 7
Projected Increases in Annual Temperature

Compared with 1970-1999 average

- **2020s**: +2.0°F (1.1-3.4°F)
- **2040s**: +3.2°F (1.6-5.2°F)
- **2080s**: +5.3°F (2.8-9.7°F)

Choice of emissions scenario matters more after 2040s.
Cities can be HOT

NASA infrared  Sacramento (1998)

Image: NASA/Marshall Space Flight Center
Projection: 13” Increase in Sea Level
Integrating Key Factors in the CIMPACT-DST

- Climate Information: Current & Future
  (as available, at relevant scales)

- Good Adaptation Practices
  (Regional, International)

- Regulations and Policies
  (Local, State/Provincial, National)

- Location (Spatial) Information
  of natural/climate hazards
  (leveraging existing maps & GIS)
How the Tool fits in the overall process

Climate Information
VA
Information Generation & Assessment
Tool
CIMPACT-DST
Response Strategies
Planning & Design Guidelines
Policy Development & Implementation

Planning & Design
Guidelines
Tool Overview

INPUTS

Local climate hazards & sector-specific policy info

Regional Climate Projections

OUTPUTS

1. Brief summary of latest climate information (temperature, precip, sea level rise)

2. Brief summary of local impacts for specific sectors (forestry, roads, buildings)

3. Sector-specific guidelines & recommendations (areas not to build, materials to use)
The State of Washington, USA
Impacts on Washington’s natural and human environments
Primary Impacts translating to Downstream Impacts

Sea Level Rise

Ecosystems & Species
- Marine & coastal ecosystems
- Salmon and other species
- Aquaculture

Human Health
- Injury/safety
- Coastal drinking water supply

Communities
- Transportation infrastructure
- Coastal infrastructure (e.g., bulkheads)
- Recreation & tourism
- Ports, harbors & shipping
- Homes & building
- Communications infrastructure
- Urban flooding/stormwater
Using the Tool: Overview

1. Select Project/Sector Type
2. Enter Basic Information (Address, Project Name, Department)
3. Select Lifespan
4. Determine Hazard Exposure (Spatial Info – GIS)
5. Tool Produces Output
Hazard Locations identified with City’s mapping resources (e.g., GIS)

Flood prone areas
## Climate impacts table (Seattle, USA)

<table>
<thead>
<tr>
<th>Project Lifespan</th>
<th>Temperature Increase</th>
<th>Sea Level Rise</th>
<th>Changes in Precipitation &amp; Streamflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 2030</td>
<td>+1.1°F to +3.3°F annual average temperature increase during the 2020s.</td>
<td>+2 to +13 inches by 2030. Extreme tides and storm events can add an additional 1 to 3+ feet to marine water levels.</td>
<td>-9% to +12% change in annual precipitation during the 2020s.</td>
</tr>
<tr>
<td>up to 2050</td>
<td>+1.5°F to +5.2°F annual average temperature increase during the 2040s.</td>
<td>+3 to +22 inches by 2050. Extreme tides and storm events can add an additional 1 to 3+ feet to marine water levels.</td>
<td>-11% to +12% change in annual precipitation during the 2040s.</td>
</tr>
<tr>
<td>up to 2090</td>
<td>+2.8°F to +9.7°F annual average temperature increase during the 2080s.</td>
<td>+6 to +46 inches by 2090. Extreme tides and storm events can add an additional 1 to 3+ feet to marine water levels.</td>
<td>-10% to +20% change in annual precipitation during the 2080s.</td>
</tr>
</tbody>
</table>
Functional Overview

Project Factors

Type
✧ Bridge
✧ Building (new/remodel)
✧ Drainage System
✧ Electricity Distribution
✧ Park/Open Space
✧ Right-of-Way

Lifespan
✧ Up to 2030
✧ Up to 2050
✧ Up to 2090
✧ Beyond 2090

Hazard Zone
✧ Flood Zone
✧ Landslide
✧ Sea Level Rise

Climate Factors

Primary Impacts
✧ Temperature
✧ Sea Level Rise
✧ Precipitation

Secondary Impacts
✧ Thermal Loads/Stress
✧ Erosion/Landslides
✧ Flooding
✧ Etc. ....

Outputs

Overview
Impact Range
Guidance

CIMPACT-DST
Huế Climate Impacts Planning Tool

Impacts to the city’s physical environment resulting from a changing climate will pose challenges for capital projects. The Climate Impacts Planning Tool will assist you in identifying key factors to be considered in the design and implementation of a project. It will also provide information and guidance on assessing risk and possible adaptation strategies.

**System Requirements:** Windows Excel 2007/2010, macro-enabled.

Note: For projects whose overall budget exceeds $5 million, a more detailed business case analysis should be used.

Enter information about your project and select from the drop-down menus. The climate impact buttons and map below show where in the city significant impacts are expected. Please allow 10-20 minutes to complete the Climate Impacts Planning Tool. Click the 🔄 icons for help.

**Project name:**
(enter project name)

**Site street address:**
(enter site address, if known)

**City department:**
(select City department)

**Project type:**
(select project type)

**Climate Impacts**

- Higher Temperatures
- Sea Level Rise
- Precipitation & Streamflow

**Climate Impact Overview:**
For an overview of each of the three climate impact categories (Temperature, Sea Level Rise, or Precipitation & Streamflow), click on the corresponding button above.
This information generated collaboratively with local partners.
Primary Objective -> User-friendly, rapid assessment; provide information & guidance

Phases of Seattle Project:
1. Departmental Interviews
2. Synthesize local knowledge
3. Vulnerability assessment
4. Craft candidate adaptation strategies
5. Evaluation of adaptation strategies
6. Integrate above
7. Internal outreach

Departmental Interviews
- City Light (Electricity Provider)
- Dept. of Planning & Development
- Dept. of Transportation
- Fleets & Facilities Dept.
- Parks & Recreation
- Seattle Center (Public Events Assets)
- Seattle Public Utilities

- Solicited representative project types
- Gathered climate impact concerns
- Captured existing planning processes & tools
Seattle Project Status

- Deploying the tool as part of an effort to integrate climate change adaptation into city planning & project design
- Influenced bridge design on drawbridge project

- **Achievements:**
  - Building internal **awareness** with City staff
  - **Increasing the resilience** of a variety of projects (e.g., bridge design, City facility site selection)
  - Integrating tool into current City project design processes
City of Olympia - Extreme High Tide + 22” Increase
• Raise floor elevations of new buildings
• Consolidate stormwater outfalls; reduce avenues for marine water to flow into downtown
• Prepare for tidal gate and pump installations
• Heighten shorelines
• Monitor hot spots and tides
Project Type: Electricity distribution/transmission

Enter information about your project. Use the map link below on the right to obtain the necessary location information about the project's proximity to climate impact hazard zones. This information is needed for three of the dropdown menus on the left side of the page.

Expected lifespan of project:
- (select lifespan)
  - up to 2030
  - up to 2050
  - up to 2090
  - beyond 2090

Drainage Zone
- (select zone)

Vulnerable Population Zone:
- (select zone)

Use the link on the left to view the critical areas maps. These maps will help you identify whether your project is in a climate impact hazard zone.
Using the Tool: Basic Steps

1. Select Project or Sector
   - Bridge
   - **Building** (new/remodel)
   - Water System Component
   - Electricity System
   - Park/Green Space
   - Roads (new/repair)

2. Enter Basic Information: Project Title, Address, Your Department
Using the Tool: Basic Steps

3. Select Project Lifespan
   - 2030
   - 2050
   - 2100
   - Beyond 2100

4. Determine Individual Hazard Zones:
   Using the address, determine if your project is in the floodplain, or landslide area, or very low near the ocean coast?

View Maps or GIS system
Using the Tool: Basic Steps

5. Tool Provides Outputs
   ✷ Impact Overview
   ✷ Sector Specific Impact Information
   ✷ Guidelines/Recommendations
Temperature Impacts

Projected Impacts & Exposure

Projected Range of Impact
+1.1°C to +1.5 °C annual average temperature increase from 2031 to 2050.

Potential Exposure - Temperature
MODERATE potential for significant increased thermal stress for this project. Extended summer heat waves are more likely.

Project Sensitivity: Temperature

The overall sensitivity of your project to temperature will be influenced by a number of factors. Key factors are outlined below. The tally provided at the bottom of this section will assist you in selecting an overall project sensitivity.

Factors to consider in determining overall sensitivity:

When determining the overall sensitivity of your project to temperature, consider the direct effects of higher temperature (and how the current design may or may not mitigate these) on the project or asset's function, its safety, and lifespan.

Function: Low
Safety: High
Lifespan: Moderate

It is important to consider other related factors as well. Three of these are listed below to assist you in determining your project's overall sensitivity to temperature. Feel free to consider other factors not listed here in your determination to overall sensitivity.

Financial/Cost:
How much more expensive would future maintenance and/or retrofit actions be to improve temperature resilience compared to design modifications or changes made now? 

Environmental:
To what extent might nearby ecosystems be adversely affected by a project design that does not account for higher temperatures?

Human Health and Social Justice:
If the project does not adequately address the effects of higher temperatures, how severely might this affect under-served communities or at-risk segments of the populations, like the very young or elderly?
Discussion / Q&A
Thank You!

• Acknowledgements
  – **SEATTLE:** City of Seattle staff – Tracy Morgenstern, Hillary Papendick; Adaptation International – Sascha Peterson; Cascadia Staff - Shannon Donegan, Christy Shelton, Andrea Martin. Climate Impacts Group at The University of Washington.
  – **VIETNAM:** ISET staff - Ken MacClune, Dr. Phong Tran, Sarah Reed, Dr. Nguyen Ngoc Huy; Cascadia Staff – Christine Grant, Shannon Donegan, Christy Shelton, Pat Keys.

Contact info: [spencer@cascadiaconsulting.com](mailto:spencer@cascadiaconsulting.com)