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USE SCENARIOS AND USER NARRATIVES: VIETNAM CLIMATE IMPACTS DECISION SUPPORT TOOL

AUGUST 2014
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Engility Corporation Contact:
Glen Anderson, Chief of Party, Glen.Anderson@EngilityCorp.com
Engility Corporation
1320 Braddock Place
Alexandria, VA 22314

Cover Photo: Michael E. Cote, Engility Corporation

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Global Climate Change Office, Climate Change Resilient Development Project
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Prepared by:
Andrea Martin, Program Manager
Cascadia Consulting Group
Seattle, WA

and

Engility Corporation
Washington, DC

Contact: Michael E. Cote, Engility Corporation, Michael.Cote@EngilityCorp.com

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ACRONYMS

CIMPACT-DST	Climate Impacts Decision Support Tool
DCEA	Danish Center for Environmental Assessment
IMHEN	Institute of Meteorology, Hydrology, and Environment
IRURE	Institute for Environmental Planning, Urban-Rural Infrastructure
KOICA	Korean International Cooperation Agency
MOC	Ministry of Construction
MONRE	Ministry of Natural Resources and Environment
SEA	Strategic Environmental Assessment
USAID	United States Agency for International Development
VIUP	Vietnam Institute for Urban-Rural Planning

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1. EXECUTIVE SUMMARY

This Use Scenarios and User Narratives document arrives at the following key project decisions and outcomes:

1. Use of the Tool would most likely occur under the following scenarios:
    - By all individuals and organizations who make urban planning decisions for Vietnam, including VIUP, IRURE, and foreign and domestic consultancies
    - While undergoing the Data Collection, Analysis, and Selection of Orientation stages of urban planning, in which environmental impacts such as climate change must be considered and integrated into the decision-making process
    - For developing regional provincial, general, zoning, detailed, or specialized technical infrastructure plans for provinces, cities, and towns of Vietnam

2. To employ the Tool, Users would ideally following the following steps:
    - Input of basic information on the project, such as the name and type of plan to which the Tool will apply (e.g., General Plan for Hai Phong)
    - Specification of the project's lifespan or planning horizon
    - Determination of the project's climate-related hazard exposure through consultation of spatial impacts visualizations
    - Consideration of anticipated climate impacts to the project and response strategies

3. To follow these steps, Users would progress through input tabs and output tabs of the Tool. Embedded information in the Tool, including regional climate projections; impacts, guidance, and policy information; and climate hazard maps, would then be refined and filtered based on User inputs to arrive at climate impacts and guidance output information that can inform urban planning decision-making.

4. The User experience would vary depending on the User's project planning type, sector, planning area, and planning horizon. Specifically, the project specification choices and maps presented to the User, as well as the output information, would vary by User and reflect the User's particular project characteristics.

5. Although general, detailed, and zoning planning includes specifications for all sectors (e.g., transportation, water supply), providing all sector impacts in a single space would be confusing and cumbersome. Therefore, the Tool would display climate impacts and guidance information for only one sector at a time. For general, zoning, and detailed planning, Tool Users would have to consult each sector individually to access all pertinent information.

2. OVERVIEW

Cascadia Consulting Group (Cascadia), on behalf of the U.S. Agency for International Development (USAID) and in collaboration with the Vietnam Institute for Environmental Planning, Urban-Rural Infrastructure (IRURE) and the Vietnam Institute for Urban-Rural Planning (VIUP), plans to configure, test, and deploy Cascadia's Climate Impacts Decision Support Tool (CIMPACT-DST, the "Tool") at the national level in support of integrating climate change considerations into planning activities in cities and provinces in Vietnam. The Tool facilitates such climate "mainstreaming" through consolidation and streamlining of vetted, best-available climate information and response strategies for Vietnam urban planning activities, transforming static extant information into actionable user-specific strategies.

This Use Scenarios and User Narratives document builds on the preceding Scope of Use, Needs Assessment, and Project Description documents with detail on the situations in which the Tool will be applied ("Use Scenarios") and the steps by which the Tool will specifically be employed by its users to fill gaps and answer key questions ("User Narratives").

The document begins with an overview of key points, decisions, and outcomes and then follows with detailed descriptions of:

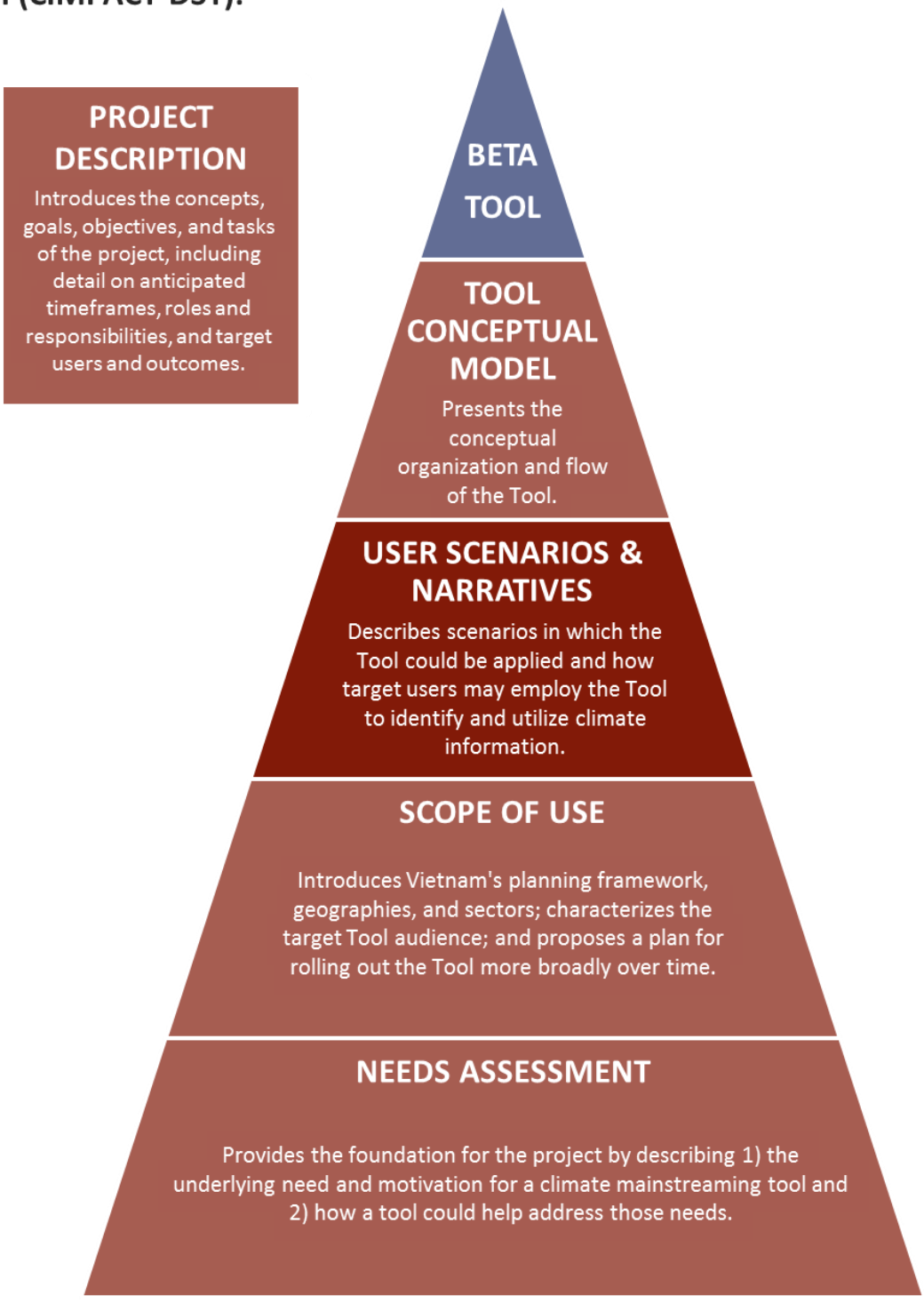
- Use Scenarios, including the specific questions, stages, and assessments informed by the Tool's outputs
- User Narratives, including key steps taken by the user to employ the Tool and integrate its outputs into planning Bullet 1

The document is supported by two auxiliary documents:

- An *Information Sources Plan* that details the information sources that will be consulted and integrated into the Tool's outputs
- A *Spatial Information Plan* that outlines the Tool's spatial information needs, how current availability aligns with those needs, and next steps for obtaining and compiling the Tool's spatial information.

PROJECT DOCUMENTS FOR NATIONAL VIETNAM CLIMATE PLANNING TOOL

This User Scenarios and Narratives is part of a series of documents being crafted to guide customization of the national Vietnam climate planning tool (CIMPACT-DST):



3. USE SCENARIOS

The situations under which planners, engineers, and managers would use the Tool are largely dictated by the stage of the planning process to which the Tool is most applicable. This section describes the planning stages most applicable to the Tool and implications for the specific scenarios under which the Tool would most likely be used.

3.1. PLANNING STAGES

As outlined in the project Needs Assessment, there are seven primary stages of the urban planning process, which range from initial data collection and analysis to plan establishment, assessment, approval, and implementation:

- **Planning requirements establishment.** Includes identifying a rationale for plan establishment, establishing objectives and bases, and overviewing location and positions of the planned region.
- **Data collection.**
- **Analysis.** Includes analysis and assessment of existing and natural conditions, relevant socio-economic elements, and the status of infrastructures.
- **Selection of orientations**. Includes identifying driving forces for development, population size and structure, scenarios for development, and land use planning orientations.
- **Establishment of construction plan**. Includes classifying zones (regional), establishing spatial arrangements, establishing orientations for technical infrastructure, and outlining requirements for urban planning management.
- **Assessment and approval.** Involves compilation, assessment, and approval of the final urban plan.
- **Plan implementation and management.** Cascadia Consulting Group (Cascadia), on behalf of the U.S. Agency for International Development (USAID) and in collaboration.

Across all planning types, use of the Tool would most likely occur at two points within these stages:

- **Between Stages 2 and 3:** At this point between Data Collection and Analysis, planners would use the Tool to guide plan development.
- **Between Stages 4 and 5:** At this point between Selection of Orientations and Construction Plan Establishment, the Tool would be used as part of the SEA to ensure that the plan appropriately considers climate change impacts in implementation and management. Cascadia Consulting Group (Cascadia), on behalf of the U.S. Agency for International Development (USAID) and in collaboration.

Table 3-1. Stages of Construction/Urban Planning, by Planning Type (Source: IRURE)

No.	Step	Regional construction planning	General Urban Planning	Detailed and Zoning Planning
1	**Planning requirements establishment**	**Planning requirements establishment** • Rationale for plan establishment. • Identify type of planning • Overview of location and position of planned region. • Identify major objectives of the regional construction planning. • Bases for the construction planning.	**Planning requirements establishment** • Rationale for plan establishment. • Overview of location and position of planned region. • Overview of urban development potential capacity and driving forces. • Identify major objectives of the general urban planning. • Identify different opinions of urban planning. • Bases for the urban planning.	**Planning requirements establishment** • Rationale for plan establishment. • Urban development objectives and requirements for planned area. • Bases for the urban planning.
2	**Data collection**	Data collection	Data collection	Data collection
3	**Analysis**	**Assessment of the current status and sources for regional development** • Location and borders of planning area. • Analysis and assessment of natural, environmental conditions. • Assessment of current status of social-economic development. • Development of urban areas and rural population quarters. • The current status of land use and social infrastructure, technical and environmental infrastructures. • Overall assessment of dynamics and priorities for development.	**Natural conditions and current status** • Analysis, assess the current status of land, population and employments. • Analysis of natural conditions and typical characters of the study area. • Identify and analysis vision points system. • Analysis of relevant social- cultural elements. • Analysis of the current status of technical infrastructure. • Comprehensive assessment.	**The current status of planning area** • Location, characters and status of natural conditions. • General assessment.

No.	Step	Regional construction planning	General Urban Planning	Detailed and Zoning Planning
4	**Selection of Orientations**	**Regional development axioms** • Objectives and opinions for regional development: -Identify vision; -Identify strategic objectives for regional development; -Opinion for regional development -Regional nature. • Development orientations: -inner and outer relationships; -regional driving forces. • Regional development scenarios: -Forecast of social-economic growth, population, labour/employment, land and economic structure transition, labour structure; -Forecast of urbanization process and ability; development forms according to urbanization.	**Urban development axioms** • Driving forces for urban development: -Relationship of inner and outer of the area; -Technical-economic bases for urban area; -The potentiality for urban development; • Urban characters and functions. • Population size, labor/employment in forecasted alternatives • Urban construction land size in selected alternative. • Assess and rank land area/plot, select land for urban development. • Set up scenarios, models and structure for urban development. • Orientations for land use planning and classification of functions zones and environment.	**Economic-technical numeral indicators of the plan** • Population size and population structure. • Land area and standards for types of land. • Indicators for land use, construction density, land use coefficient and high level for each of functional zones. • Spatial distribution. • Land use planning.
5	**Establishment of construction plan**	• Classify functional zones and organize regional space: -Economic development area classification; -Organize network of urban areas and rural population quarters. • System of centres, social infrastructure works. • Orientation for technical infrastructure system development. • Priorities for investment projects. • Mechanism for regional development management.	• Orientation for spatial arrangement. • Orientation for urban development environmentally technical infrastructure development. • Construction planning for the first stage. • Proposals of requirements for urban planning management.	• Arrange spaces for planning, architecture and landscape. • Planning for technical infrastructure network. • Integrate investment cost. • Proposals of requirements for urban planning management.

No.	Step	Regional construction planning	General Urban Planning	Detailed and Zoning Planning
6	**Assessment and approval**	**Compile the final construction plan** **Assessment and approval**	**Compile the final construction plan** **Assessment and approval**	**Compile the final construction plan** **Assessment and approval**
7	**Plan and Implementation and management**	**Plan and implementation and management.**	**Plan and implementation and management.**	**Plan and implementation and management.**

4. USER NARRATIVES

Under the Use Scenarios described in Section 3, Users will employ the Tool to answer key questions and fill residual gaps for incorporating climate change considerations into the planning process. This section describes User Narratives—the specific steps Users may take when employing the Tool and how those steps may vary from situation to situation.

4.1. PROCESS OVERVIEW

We envision Users to undergo five basic steps to arrive at actionable climate information. Organized into a series of navigable sections, the Tool would consolidate and filter multiple sources and types of climate information to ultimately present the User with project-specific climate impact and guidance summaries. In this section, we overview the envisioned process of using the Tool and how the Tool organization and function supports that process.

4.1.1. USER STEPS

Tool Users will proceed through four basic steps when using the Tool (illustrated in Figure 4-1):

1. Input of basic information on the project, such as the name and type of plan to which the Tool will apply (e.g., general plan for Hai Phong).
2. Specification of the project's lifespan, or planning horizon.
3. Determination of the project's climate-related hazard exposure through consultation of spatial impacts information.
4. Consideration of anticipated climate impacts to the project and response strategies.

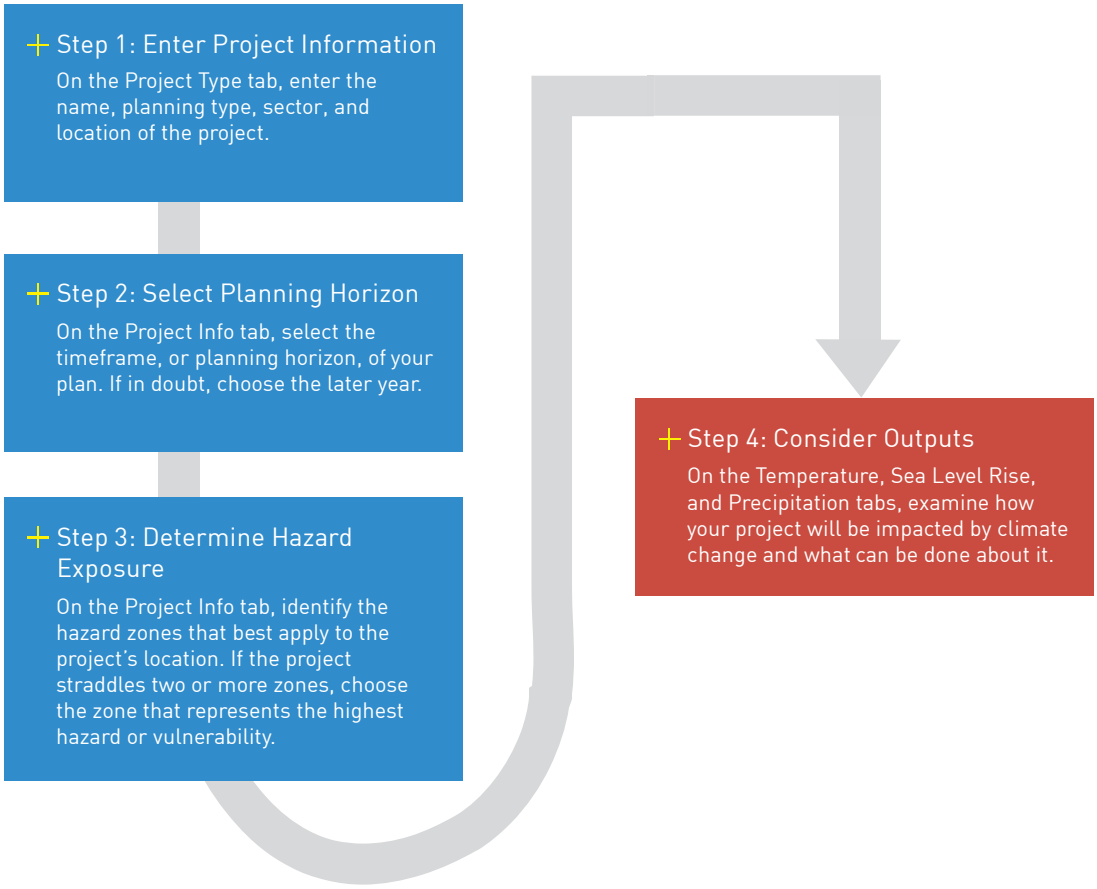


Figure 4-1. Basic Steps for Using the Tool

4.1.2. TOOL ROADMAP

The tool would be organized into input and output tabs. In the Input tabs, Users would enter information described in Steps 1 through 3 (see **Figure 4-1** for a description of steps). Users would then complete Step 4, consideration of climate impacts and guidance outputs, using the output tabs.

Each output tab would be organized by the type of climate impact (temperature, precipitation, and sea level rise). The user would consult spatial tabs to identify project hazard zones. The hazard zones of a project would inform the content and language of the output tabs. Two reference tabs would provide further information on the tool's information sources.

INPUT TABS

Where the user enters information on the type of project, its design lifespan, and location.

OUTPUT TABS

Where the tool provides summaries of climate impacts and guidance.

REFERENCE TABS

Details on the tool's information sources.

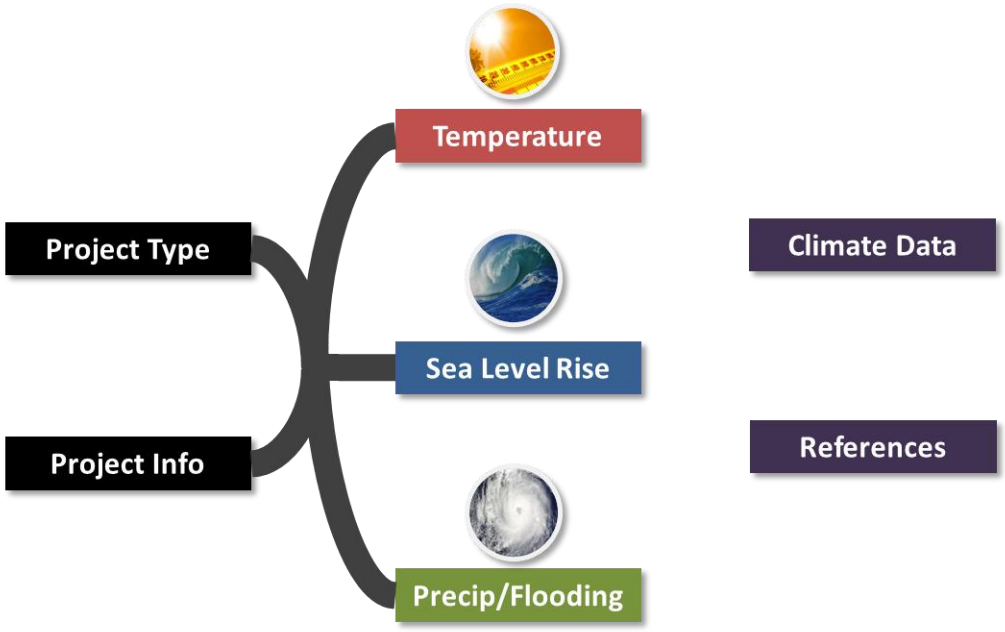


Figure 4-2. The Proposed User-Facing Sections of the Tool

4.1.3. INFORMATION PROCESSING

The tool would compile multiple sources of locally-relevant information—including reports, policies, and maps—and filter that information based on simple user inputs. This way, the user would see only information that is relevant and useful for the task at hand, as opposed to the alternative: wading through a 100-page guidance or policy document in search of pertinent information. This efficiency would make the Tool quick, simple, and practical.

4.1.5.2. INFORMATION TYPES

The Tool would synthesize, simplify, and integrate different types and sources of climate-related information. Embedded information that would already be built into the tool, listed in Figure 4-3 below, include the following:

- Projected primary climate impacts from the latest climate modeling and science.
- Local spatial analyses of projected climate hazards, exposures, and risks.
- Reports on projected sector-specific secondary impacts and good practices for building resilience to those impacts.
- Integrated guidance from local, state/provincial, and national stakeholders, regulations, and policies.

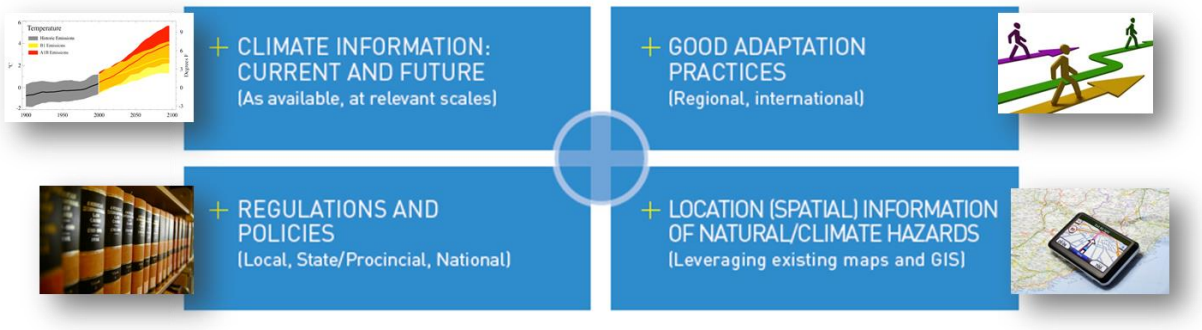


Figure 4-3. Pre-wired Tool Information Sources

For more information on the specific information sources that would be used in the Tool, please consult the accompanying *Information Sources Plan and Spatial Information Plan* documents.

4.1.5.3. USER INPUTS AND OUTPUTS

Information on climate projections, hazards, and sector-specific impacts and guidelines are embedded in the tool. When users add information on their project's plan type, sector, lifespan, jurisdiction, and location within hazard zones, the tool produces output information specific to that project. Output information includes bullet-point summaries of primary climate impact projections, secondary sector-specific impacts, and sector-specific guidelines and recommendations. These outputs can be considered summaries of the problem (how climate change will affect your project) and the solution (what you can do about it). Figure 4-4 on the following page illustrates how user inputs and information programmed into the tool result in user-specific tool outputs.

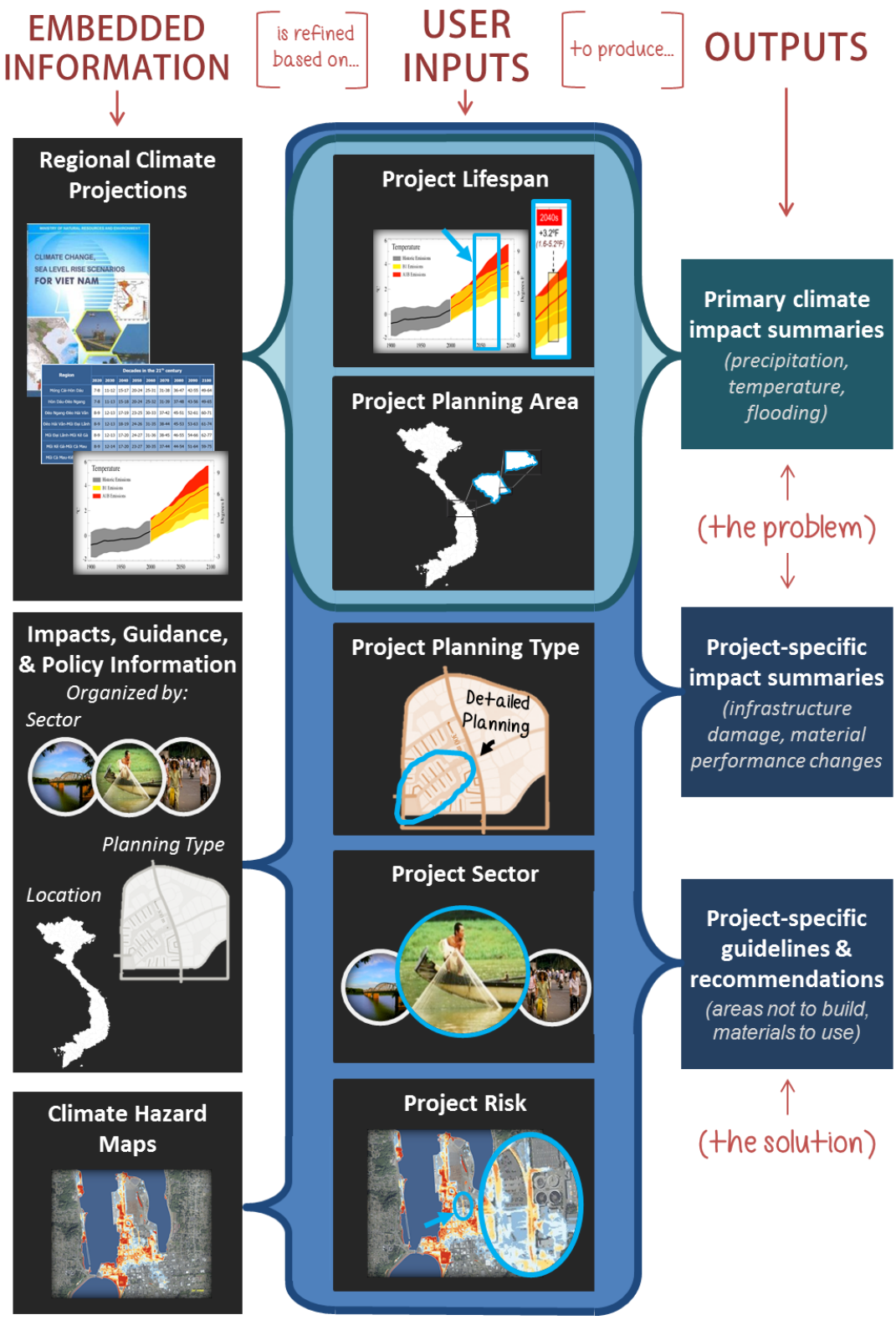


Figure 4-4. Tool Information Processing and Outputs

4.2. TOOL USE, STEP BY STEP

The following sections describe the tool's use under three potential user scenarios:

USER SCENARIOS: INTRODUCTION

Scenario 1. Provincial Regional Plan for Son La Province
An urban planner at VIUP is seeking to create a provincial regional plan for Son La Province, located in the northern central highlands of Vietnam. The plan would cover all sectors, including spatial planning, land use planning, and urban design, and would cover the entirety of the province for 20 years to 2035.

Scenario 2. Specialized Technical Infrastructure Plan for Transportation in Ho Chi Minh City
An urban planner from the Korean International Cooperation Agency (KOICA) has been contracted to create a specialized technical infrastructure plan for the centrally controlled city of Ho Chi Minh. The plan intends to cover just one sector, transportation, for the entirety of the city for 15 years, to 2030.

Scenario 3. Zoning Plan for the Provincial City of Tam Ky in Quang Nam Province
An urban planner from a local planning institute in Quang Nam Province has been commissioned to create a zoning plan for the provincial city of Tam Ky. The plan would cover all sectors, including spatial planning, land use planning, and urban design, and would cover the coastal tourism zone of the province for 10 years to 2025.

4.2.1 BASIC PROJECT INFORMATION

First, the User would enter basic information on the project, including the project name. These inputs are for informational purposes only—they would not inform any subsequent steps or outputs of the Tool—and therefore are straightforward and without need for further discussion.

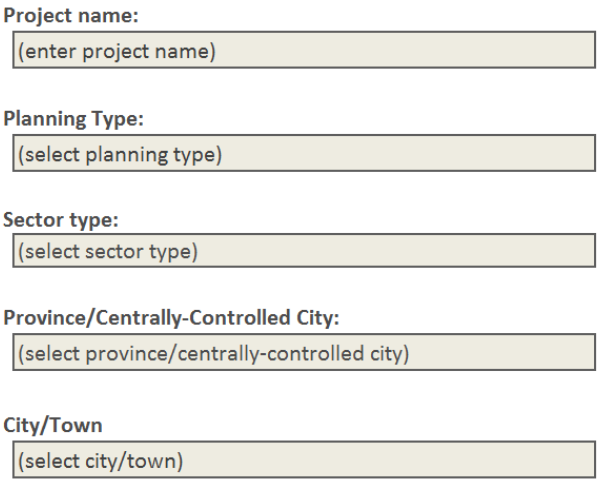
USER SCENARIOS: PROJECT INFORMATION

Scenario 1. Provincial Regional Plan for Son La Province
The User would enter "Provincial Regional Plan for Son La Province" for the Project Name.

Scenario 2. Specialized Technical Infrastructure Plan for Transportation in Ho Chi Minh City
The User would enter "Ho Chi Minh City Transportation Specialized Technical Infrastructure Plan" for the Project Name.

Scenario 3. Zoning Plan for the Provincial City of Tam Ky in Quang Nam Province
The User would enter "Zoning Plan for Tam Ky" for the Project Name.

4.2.2 PLANNING TYPE, JURISDICTION, AND SECTOR



With basic project information provided, the User could then enter information on the project's planning type, sector, and jurisdiction (see example mock-up on page 16). These inputs would inform the maps that are provided to the User as well as the project-specific impacts and guidance information on the output tabs of the tool. This proposed relationship is summarized in **Figure 4-6** on page 18, and detailed by input in the following sections.

4.2.2.1 PLANNING TYPE

The planning type indicated by the User would dictate the presented sector and jurisdiction choices (summarized in Table 4-1):

- Regional plans would be presented with a choice of 63 provinces for the project's jurisdiction and all 11 sectors listed in Figure 4-6 for the project's sector.
- Master plans and Zoning/Detailed plans would be presented with a choice of over 760 cities and towns (including the five centrally-controlled cities) for the project's jurisdiction and all and all 11 sectors listed in Figure 4-6 for the project's sector.
- Specialized technical infrastructure plans would be presented with a choice of the five centrally-controlled cities for the project's jurisdiction and all and the 8 infrastructure-related sectors listed in Figure 4-6 for the project's sector.

Table 4-1. Planning Types and Resultant Jurisdictional and Sector Choices

Plan Type	Jurisdictional Choice	Sectoral Choice
Regional	63 provinces (including the 5 centrally-controlled cities)	All 11 listed in Figure 4-6
Master	Over 760 cities and towns (including the 5 centrally-controlled cities)	
Zoning/Detailed		
Specialized Technical Infrastructure	5 centrally-controlled cities	8 infrastructure-related sectors in Figure 4-6

4.2.2.2 JURISDICTION

The Tool provides maps, impact summaries, and guidance information specific to the project's jurisdiction. Depending on the chosen planning type (see Table 4-1 above), Users can specify either the city/town or province of their plan. Specifically, Users can choose one of the following jurisdictions:

- An urban area of Class V or above (total of over 760 cities/towns, including the 5 centrally-run cities).
- A province (total of 63, including the 5 centrally-run cities).

A more detailed discussion on how the choice of jurisdiction can inform the climate hazard maps available to the User is provided in the accompanying Spatial Information Plan document.

4.2.2.3 SECTOR

The Tool provides impact summaries and guidance information specific to sectors. In urban planning in Vietnam, regional, general, and detailed/zoning plans cover all 11 sectors listed in **Figure 4-6**, while specialized technical infrastructure plans cover only one sector. However, to optimize the User's understanding of climate information as it relates to particular sectors, all impact summaries and guidance information in the Tool is sector-specific. In other words, the User can only view impacts and guidance relevant to one sector at a time.

Depending on the chosen planning type (see Table 4-1 above), Users can choose from a list of either 11 or 8 sectors (see Figure 4-6 for an illustration of planning type and sector relationships). The chosen sector dictates the content of the project-specific impact summaries and guidance information.

4.2.2.4 CLIMATE IMPACT OVERVIEW

After inputting basic project information, Tool Users are presented with a high-level overview of anticipated primary climate impacts for their project. The Primary Climate Impacts box provides a province-specific overview of climate impact projections from the latest IMHEN report, as well as a high-level spatial representation of those impacts over the entire country (see mock-up Figure 4-7 on page 19).

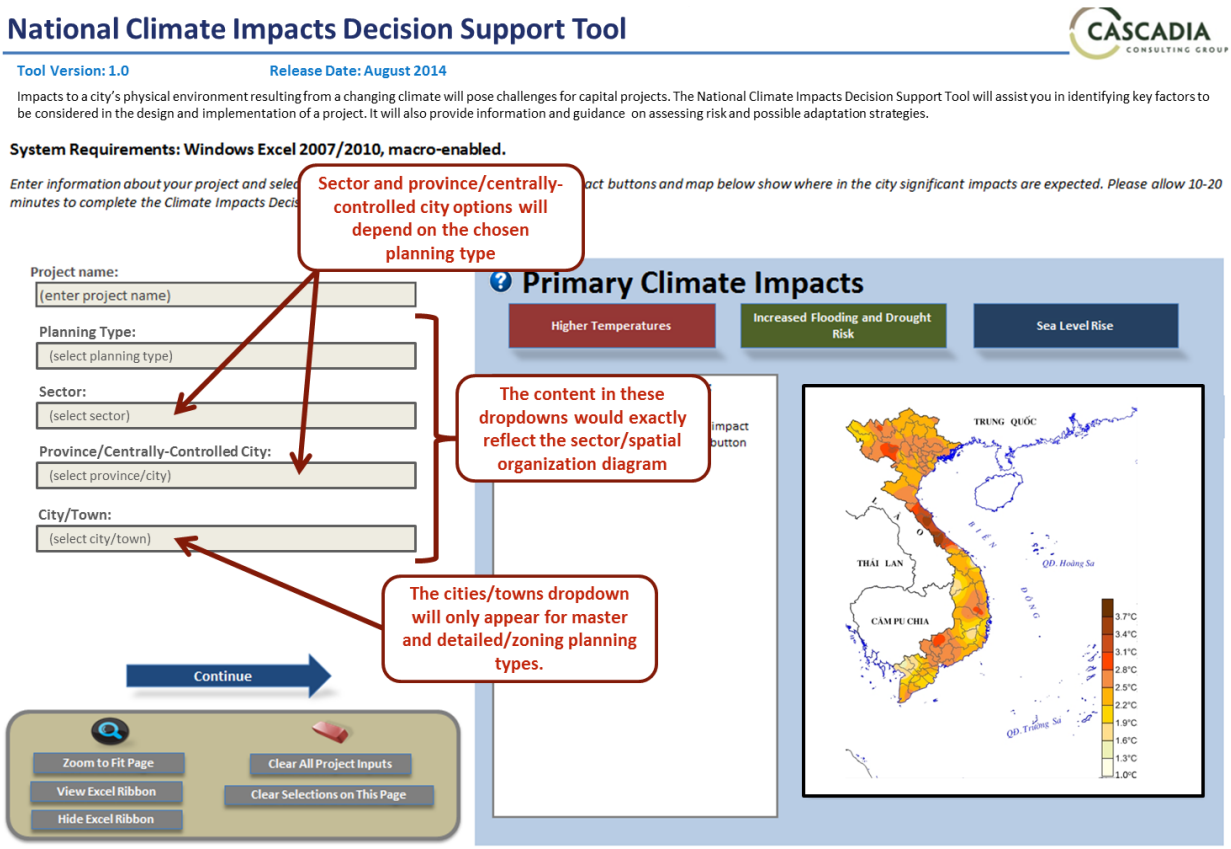
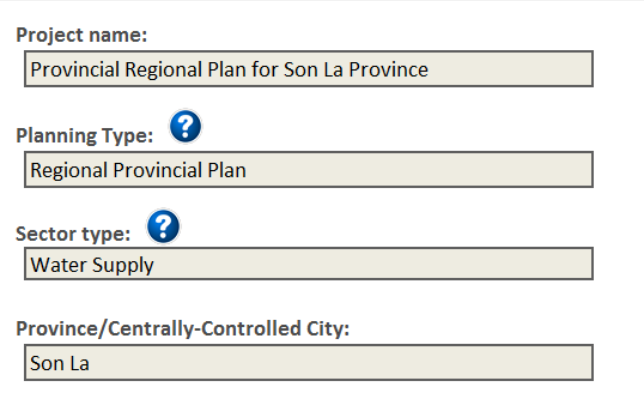


Figure 4-5. Mock-Up of the Project Type Tab of the Tool, Where Users Input the Project Name, Planning Type, Sector, and Jurisdiction

USER SCENARIOS: PLANNING TYPE, JURISDICTION, AND SECTOR

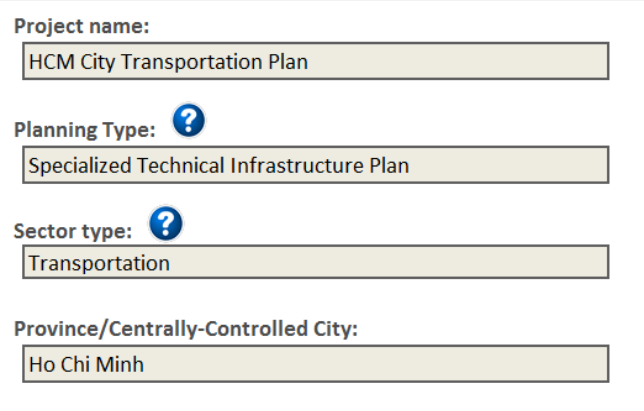
Scenario 1. Provincial Regional Plan for Son La Province

The User would select "Provincial Regional Planning" for the Planning Type and "Son La" for the Province/Centrally-Controlled City dropdown menu. Because provincial regional planning is conducted at the province-level, the User would not need to specify an input for the City/Town dropdown menu. Regional planning covers all sectors, so the User could simply indicate a sector of interest and then return to the menu later to view information for other sectors.



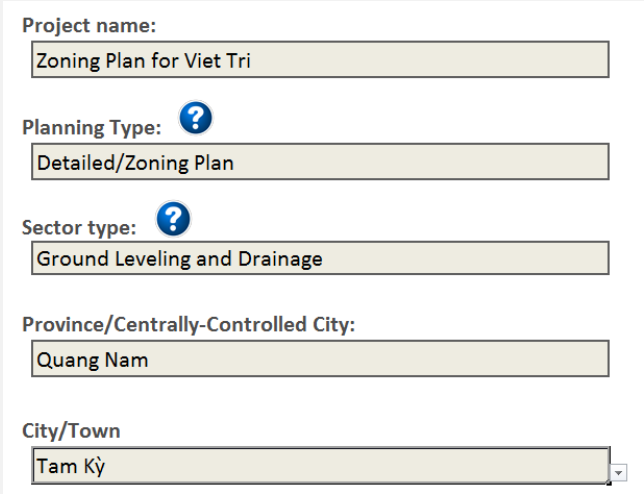
Scenario 2. Specialized Technical Infrastructure Plan for Transportation in Ho Chi Minh City

The User would select "Specialized Technical Infrastructure Planning" for the Planning Type and "Ho Chi Minh City" for the Province/Centrally-Controlled City dropdown menu. Because specialized technical infrastructure is only conducted for centrally-controlled cities, the User would not need to specify an input for the City/Town dropdown menu. The User would select "Transportation" for the Sector.



Scenario 3. Zoning Plan for the Provincial City of Tam Ky in Quang Nam Province

The User would select "Detailed/Zoning Planning" for the Planning Type and "Quang Nam" for the Province/Centrally-Controlled City dropdown menu. Based on this input, the User could then need to specify "Tam Ky" for the City/Town dropdown menu, which would be refined based on the selected province. Zoning planning covers all sectors, so the User could simply indicate a sector of interest and then return to the menu later to view information for other sectors.



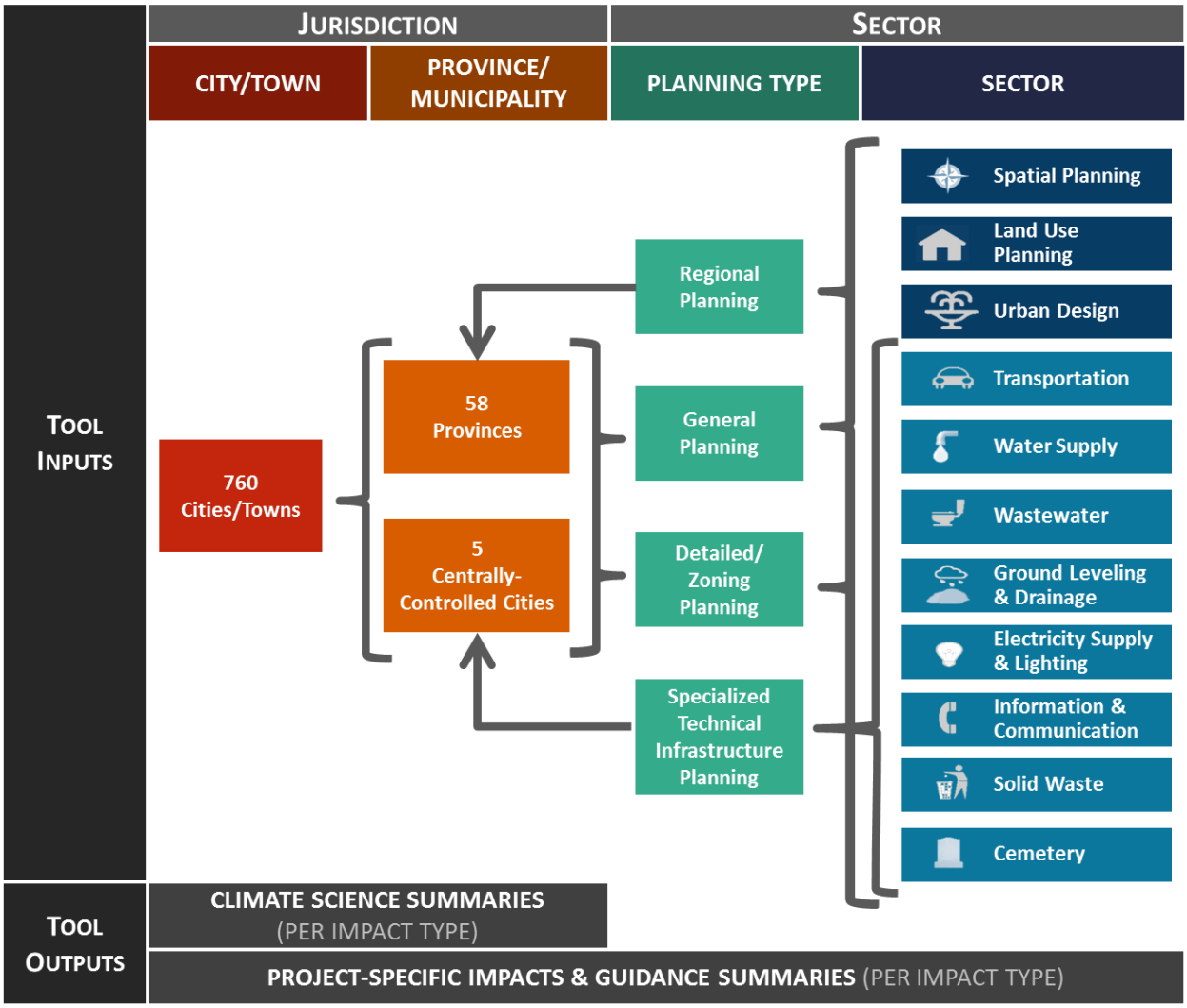


Figure 4-6. Planning Type, Sector, and Jurisdiction Tool Inputs and Resultant Outputs

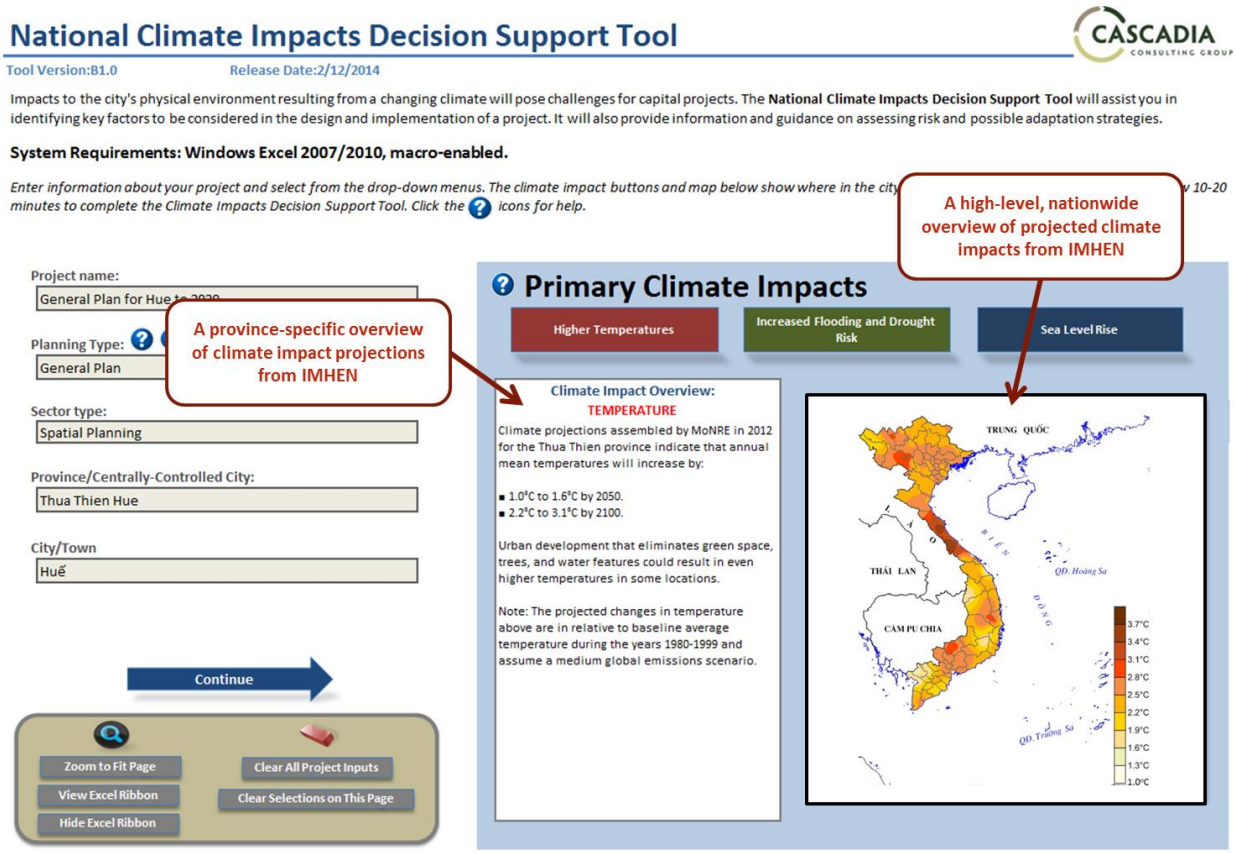
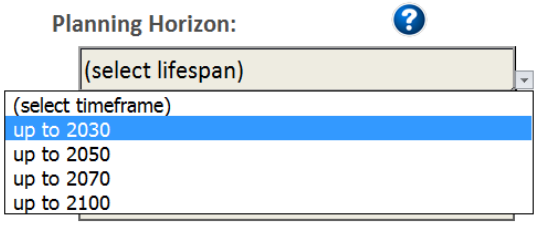


Figure 4-7. Mock-Up of the Primary Climate Impacts Overview Section of the Project Type Tab of the Tool

4.2.3 PROJECT LIFESPAN/PLANNING HORIZON



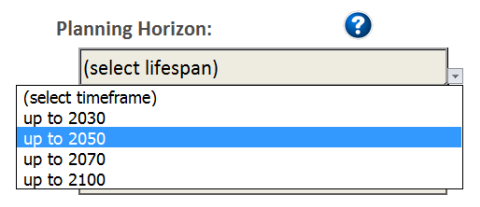
The project lifespan, or planning horizon, is another factor that weighs into the project-specific impact summaries and guidance information in the Tool. This factor also dictates the primary climate impacts information provided to the User.

Projects with longer lifespans will need to withstand more severe climate impacts. For a project to survive to 2050, for example, the projected must be designed to withstand the projected impacts in 2050—such as a 1°C increase in temperature. If that same project was designed to survive only until 2030, then the project would only need to withstand the projected impacts in 2030, which could be something like A.5°C increase in temperature. The impact summaries in the tool reflect these differences.

USER SCENARIOS: PLANNING TYPE, JURISDICTION, AND SECTOR

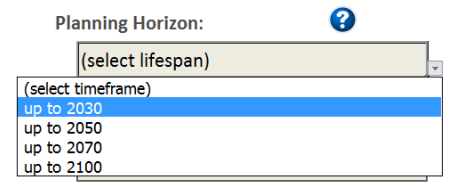
Scenario 1. Provincial Regional Plan for Son La Province

Because the planning horizon for the plan is for 20 years to 2035, the User would select the most immediate timeframe that still includes 2030 , which would be the choice "Up to 2050."



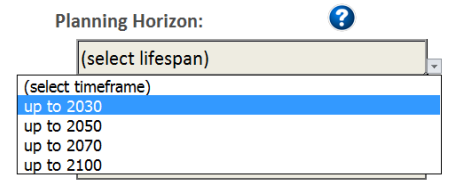
Scenario 2. Specialized Technical Infrastructure Plan for Transportation in Ho Chi Minh City

Because the planning horizon for the plan is for 15 years to 2030, the User would select the most immediate timeframe that still includes 2030, which would be the choice "Up to 2030."

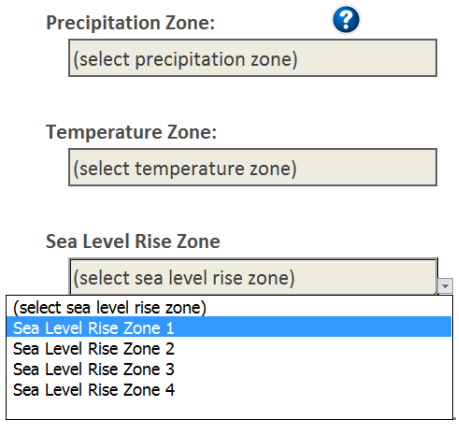


Scenario 3. Zoning Plan for the Provincial City of Tam Ky in Quang Nam Province

Because the planning horizon for the plan is for 10 years to 2025, the User would select the most immediate timeframe that still includes 2025, which would be the choice "Up to 2030."



4.2.4 PROJECT HAZARD EXPOSURE



The final variable to inform the tool's impact summaries and guidance information is the relative exposure of that project to projected climate hazards. For this variable, the User consults hazard maps to identify to hazard zone of their project.

For the national Tool, we hope to include the following climate hazard maps, as available:

- Temperature (e.g., changes in annual and seasonal temperatures, temperature extremes, and urban heat islands)
- Precipitation (e.g., changes in annual and seasonal rates, extremes, including changes in flood depths and drainage rates if local hydrological studies are available)
- Sea level rise (e.g., low and high inundation scenarios, salinity intrusion)

To begin, the tool provides example maps for each climate impact. These maps, located on the Project Info tab of the tool, are meant to familiarize the user with the types of maps included in the tool and the delineation of those maps into hazard zones. Users can click through the various climate impacts to preview maps for each climate impact type.

Once familiarized with the concepts and contents of the maps, Users can click on hyperlinks to be guided to individual climate impact maps relevant to their planning area. Users must consult hazard zone maps for reach climate impact (e.g., precipitation, temperature) in order to identify their project risk. For example, to identify the flood risk of a project, a User would consult the flood zone map, which would delineate flood zones by color (see example in Figure 4-8 on the following page). The highest flood hazard zone within which the project is located would then be chosen as the project's hazard zone, or risk level (e.g., 0.2 to 0.5 meter flood zone).

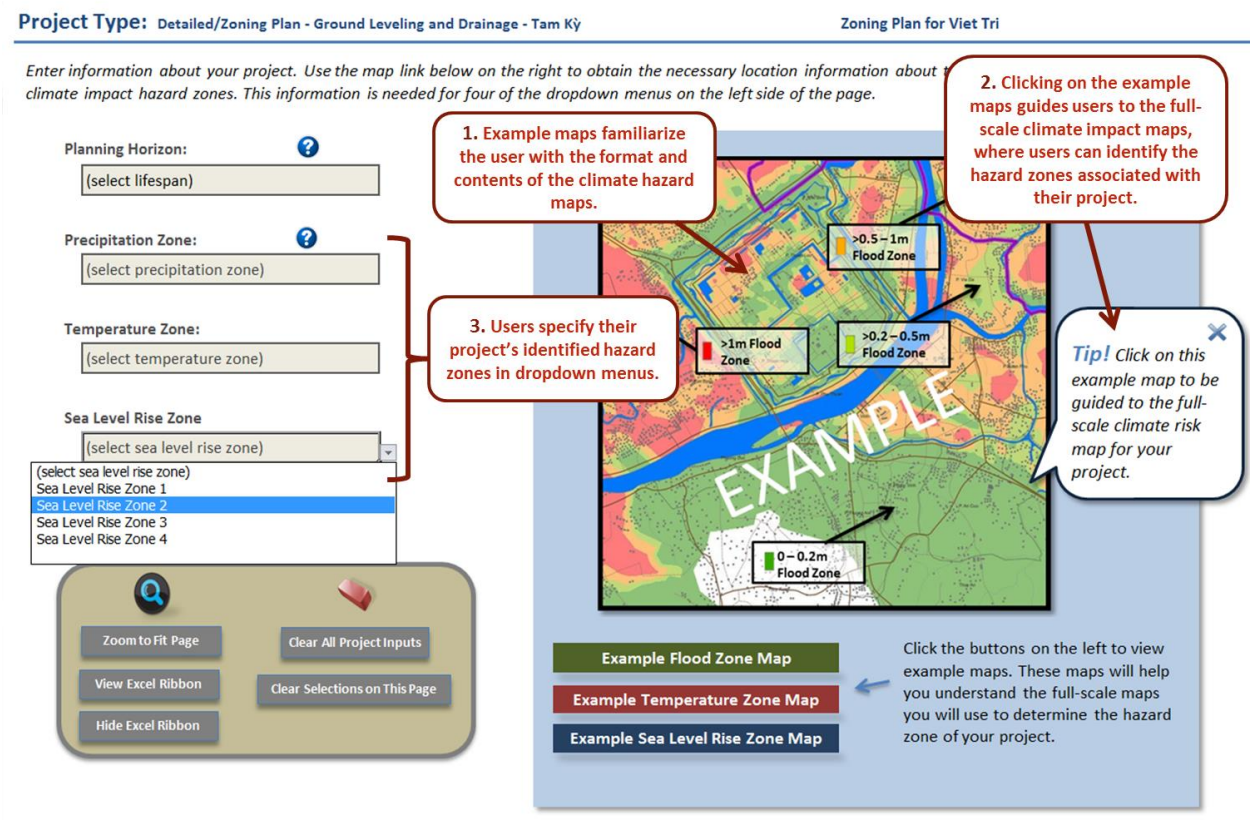


Figure 4-8. Layout of the Project Info Tab, Where Users Identify and Select Their Project's Hazard Zones

Hazard zones can be threshold-based, policy-based, or arbitrary. For example, if it is known that certain actions must be taken in locations where temperatures rise over 5oC above normal, then a separate hazard zone could be created for ">5oC." For simplicity, the tool dropdown menus classify hazard zones into four general zones. The values associated with each of these zones are specified on keys within the individual maps. In cases in which maps are not available for a particular location, or that location will not be affected by a particular impact, the tool will automatically specify "Zone 1," which means "not within a risk zone for the project timeframe."

For more information on the hazard maps of the tool, including their organization and sources, please consult the accompanying Spatial Information Plan document.

Once specified, the project hazard zone is integrated with the other project inputs to create the project-specific climate impacts and guidance information. For example, if a user chooses hazard zone 2 (which say is associated with a ≥1m flood zone), then the project guidance might say "highways should not be located within a 1 meter or higher flood zone."

The User Scenarios below examine how users may identify their project's level of sea level rise inundation risk.

USER SCENARIOS: PROJECT HAZARD EXPOSURE – SEA LEVEL RISE

Scenario 1. **Provincial Regional Plan for Son La Province**

Because Son La is not near the coast, IMHEN did not create a sea level rise map for the province. Therefore, the tool automatically selects "Sea Level Rise Zone 1," which corresponds to the project not being within a risk zone during the project timeframe.

Scenario 2. **Specialized Technical Infrastructure Plan for Transportation in Ho Chi Minh City**

As depicted in Figure 4-9, parts of Ho Chi Minh City are projected to be inundated by a 100-cm sea level rise. By using the key included in the map, the User can therefore select "Sea Level Rise Zone 2" from the dropdown on the Project Info tab.

Scenario 3. **Zoning Plan for the Provincial City of Tam Ky in Quang Nam Province**

As depicted in Figure 4-10, the User would zoom into the Quang Nam provincial map to identify that the coastal zone of Tam Ky is projected to be inundated by a 100-cm sea level rise. By using the key included in the map, the User can therefore select "Sea Level Rise Zone 2" from the dropdown on the Project Info tab.

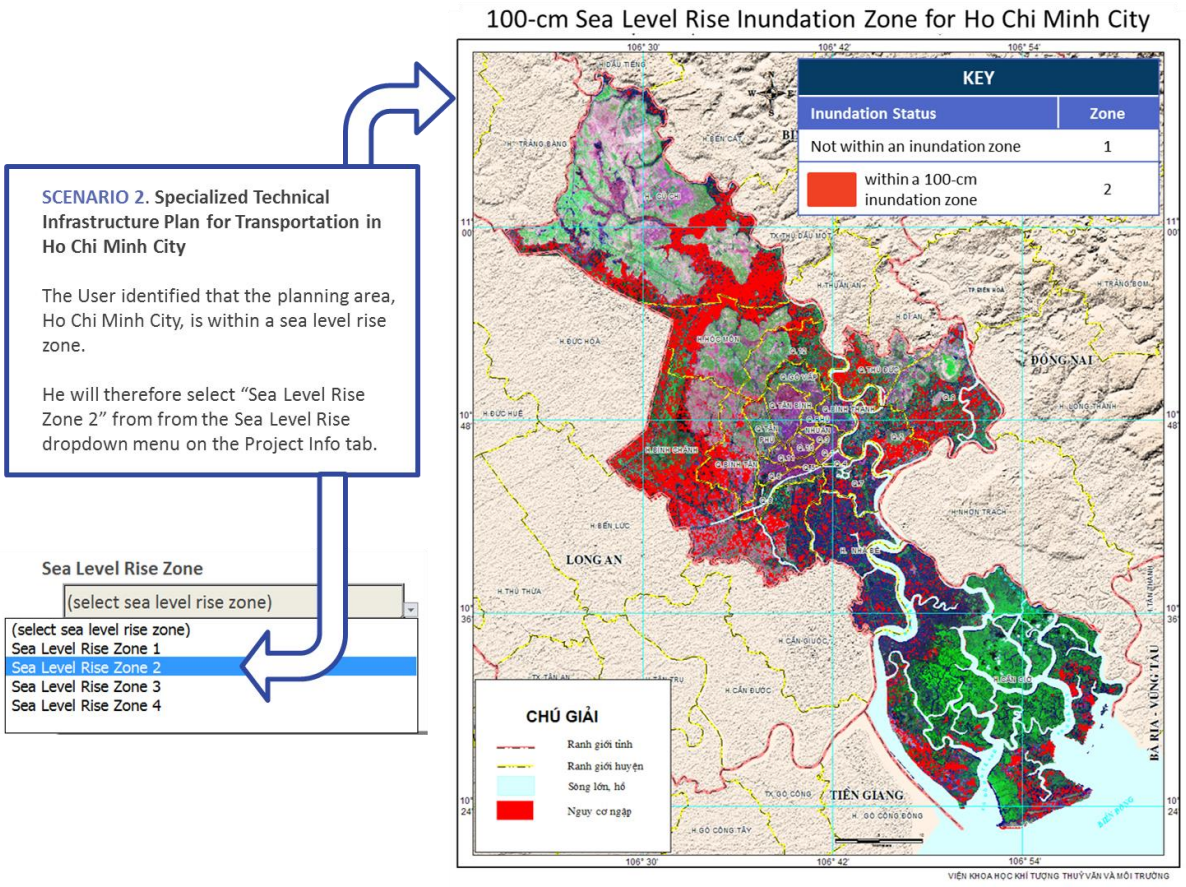


Figure 4-9. Hazard Zone Maps in the Tool and their Relationship to Project Description Inputs: User Scenario 2

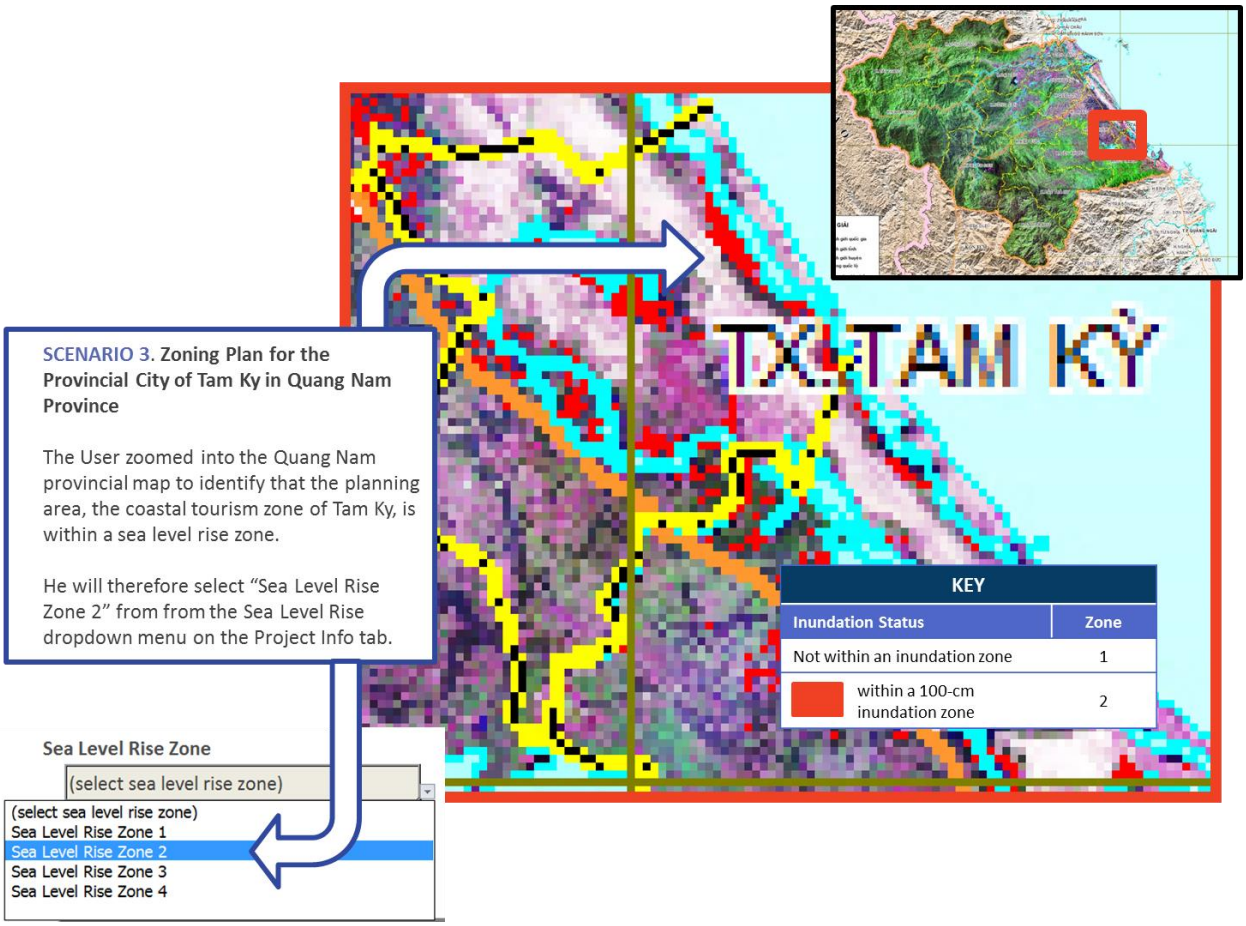


Figure 4-10. Hazard Zone Maps in the Tool and their Relationship to Project Description Inputs: User Scenario 3

4.2.6 IMPACTS AND GUIDANCE OUTPUTS

With all project inputs complete, Users are guided to the project-specific impacts and guidance summaries. As reviewed in Figure 4-4 on page 12, the tool provides three key outputs:

1. Primary climate impacts (titled "Projected Impacts and Exposure")
2. Project-specific secondary climate impacts (titled "Impact Overview")
3. Project-specific guidance information (titled "Guidance Information")

4.2.5.1. PRIMARY CLIMATE IMPACTS

Primary climate impact summaries *(precipitation, temperature, flooding)*

The Projected Impacts and Exposure section provides quantitative, non-sector specific climate impact information. This section has two parts: 1) the Projected Range of Impact and 2) the Potential Exposure.

Projected Range of Impact

Outputs	Quantitative summary of latest climate projections
Specific to	Project planning horizon and project jurisdiction (province)

The projected range of impact summarizes the latest climate projections for the time period of interest. It summarizes the extent of projected climatic changes specific to the project area. In this case, the most localized climate data available from IMHEN are at the provincial-level, so the information provided in this section would be generalized for the province in which the planning project is located.

Potential Exposure

Outputs	Quantitative summary of project risk to climate change impacts
Specific to	Project planning horizon and risk (location within hazard zones)

The potential exposure section summarizes the risk of the project to climate change impacts as a result of its planning horizon and location within the hazard maps (see Figure 4-11 on page 26 for an illustration of this relationship). Generally, longer-term projects within more hazardous zones will have higher potential exposure and risk to climate change impacts.

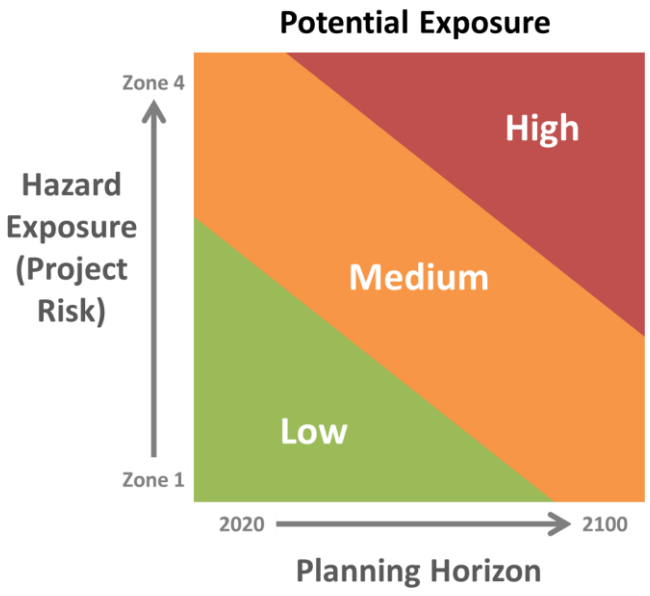


Figure 4-11. Using Project Risk and Planning Horizon to Identify Potential Exposure

USER SCENARIOS: PRIMARY CLIMATE IMPACT SUMMARIES – SEA LEVEL RISE

Scenario 1. Provincial Regional Plan for Son La Province

Because Son La is not near the coast, and IMHEN only created sea level rise projections for coastal provinces, this project would not be provided with any sea level rise-related tool outputs. The Projected Range of Impact would read:

"There are no projected sea level rise impacts to your project area."

The Potential Exposure would read:

"No potential exposure to direct inundation from sea level rise during project lifespan."

The User would then note that sea level rise will not be an issue for the project.

Scenario 2. Specialized Technical Infrastructure Plan for Transportation in Ho Chi Minh City

Ho Chi Minh City resides within the "Mui Ke Ga – Mui Ca Mau" study region in the 2012 IMHEN report (see regions and sea level rise chart on the following page). Based on this location and the planning horizon of the project (to 2030), the Projected Range of Impact would read:

"The latest MoNRE reports predict that annual mean sea level in 2030 will be between +12 and +14cm higher than the baseline time period for the Mui Ke Ga to Mui Ca Mau region. During extreme high tides and storms, sea levels will be temporarily higher."

Based on the relatively short-term planning horizon (to 2030) yet relatively high project risk (within 100-cm inundation zone), the Potential Exposure would likely read:

"MODERATE potential exposure to sea level rise. Location is near or within projected inundation area. Without preventive measures, periodic saltwater inundation is likely to occur during extreme high tides and/or high wind events."

The User would take note of this information and, in response, potentially alter design specifications for transportation infrastructure or redirect major infrastructure zoning locations.

Scenario 3. Zoning Plan for the Provincial City of Tam Ky in Quang Nam Province

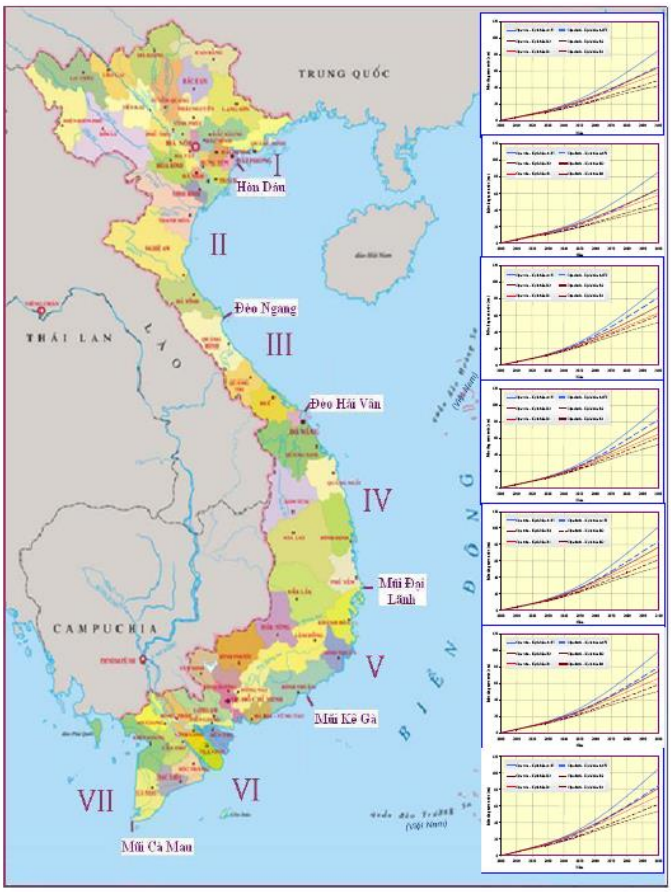
Ho Chi Minh City resides within the "Deo Hai Van – Mui Dai Lanh" study region in the 2012 IMHEN report (see regions and sea level rise chart on the following page). Based on this location and the planning horizon of the project (to 2025), the Projected Range of Impact would read:

"The latest MoNRE reports predict that annual mean sea level in 2030 will be between +12 and +13cm higher than the baseline time period for the Deo Hai Van to Mui Dai Lanh region. During extreme high tides and storms, sea levels will be temporarily higher."

Based on the relatively short-term planning horizon (to 2030) yet relatively high project risk (within 100-cm inundation zone), the Potential Exposure would likely read:

"MODERATE potential exposure to sea level rise. Location is near or within projected inundation area. Without preventive measures, periodic saltwater inundation is likely to occur during extreme high tides and/or high wind events."

The User would take note of this information and, in response, potentially alter design specifications for nearshore infrastructure or incorporate buffer areas near the coastal zones.



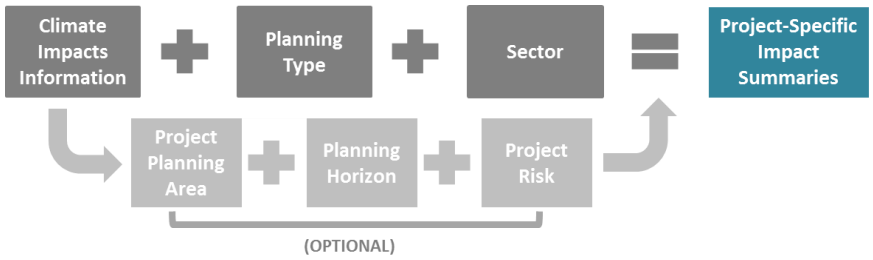
Hình 3.50. Kịch bản nước biển dâng cho các khu vực ven biển Việt Nam

Figure 4-12. Sea Level Rise Regions and Projections from 2012 IMHEN Report

Region	Decades in the 21th century								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
Móng Cái-Hòn Dáu	7-8	11-12	15-17	20-24	25-31	31-38	36-47	42-55	49-64
Hòn Dáu-Đèo Ngang	7-8	11-13	15-18	20-24	25-32	31-39	37-48	43-56	49-65
Đèo Ngang-Đèo Hải Vân	8-9	12-13	17-19	23-25	30-33	37-42	45-51	52-61	60-71
Đèo Hải Vân-Mũi Đại Lãnh	8-9	12-13	18-19	24-26	31-35	38-44	45-53	53-63	61-74
Mũi Đại Lãnh-Mũi Kê Gà	8-9	12-13	17-20	24-27	31-36	38-45	46-55	54-66	62-77
Mũi Kê Gà-Mũi Cà Mau	8-9	12-14	17-20	23-27	30-35	37-44	44-54	51-64	59-75
Mũi Cà Mau-Kiên Giang	9-10	13-15	19-22	25-30	32-39	39-49	47-59	55-70	62-82

Table 4-2. Projected sea level rise (cm) relative to 1980-1999 baseline under the medium emission scenario (B2)

4.2.5.2. PROJECT-SPECIFIC SECONDARY CLIMATE IMPACTS



Outputs | Quantitative summary of project risk to climate change impacts

Specific to | Project planning horizon and risk (location within hazard zones)

Project-specific impact summaries *(infrastructure damage, material performance changes*

The Impact Overview section provides sector-specific qualitative summaries of potential climate change impacts to the project. These impact summaries—which are informed by multiple local, regional, and international policies, reports, and projects—are specific to the project planning type and sector, and have the capacity, if desired or applicable, to be specific to the project planning area, planning horizon, and risk.

The project-specific impact summaries are organized into individual bullet points, each referenced by its originating source. References are represented by numbers in brackets at the end of each summary. Information on which numbers refer to which source are presented in the "References" tab of the tool (see example figure below).

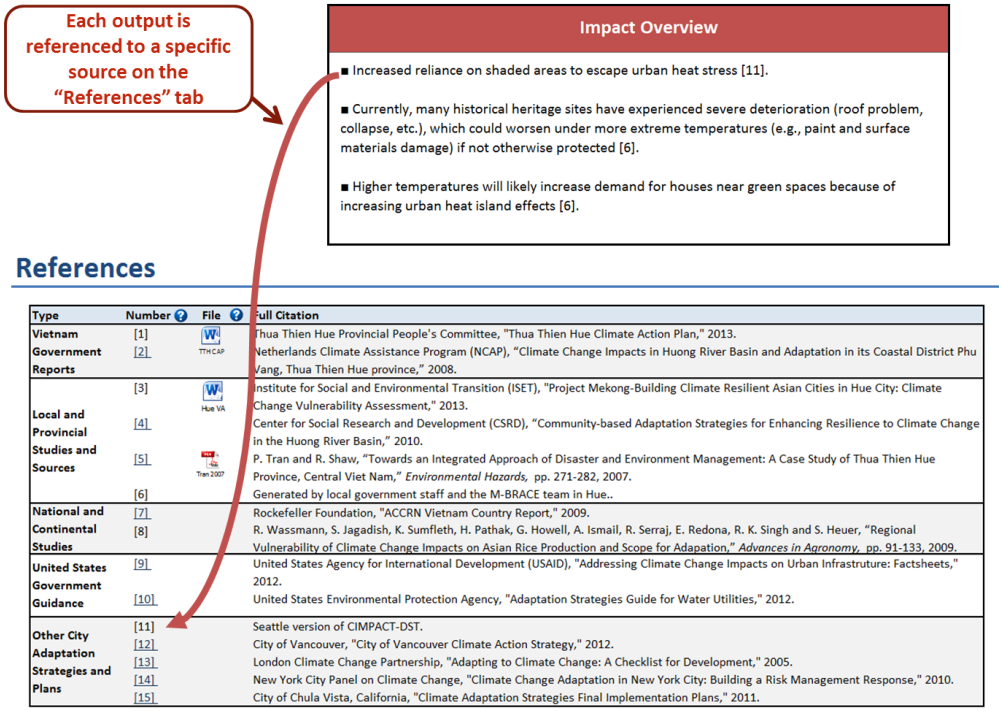


Figure 4-13. Source Tracking in the Impact Overview Section of the Tool

User Scenarios: Project-Specific Impact Summaries

Scenario 1. Provincial Regional Plan for Son La Province

Although a provincial regional plan covers all 11 sectors at once, the User would view one sector at a time in the tool. For this example, the User would select the "Water Supply" sector and, along with other project inputs, receive the following impact summary for temperature:

Impact Overview

- Increased water losses could occur during storage, such as evaporation from reservoirs [9].
- Increased demand could reach capacity limitations of existing infrastructure (pumps, pipes, storage, and treatment facilities) [9].
- Water quality during storage and distribution could ecrease [9].
- Higher temperatures could reduce performance and lifespan of water conveyance infrastructure materials [11].
- Increased cooling demand for central pumping electrical systems and possible system safety concerns related to overheating [6].
- Increased water treatment requirements and costs to address lower water quality (e.g., increased algal blooms and bacterial and fungal content) [9].

The User would record and take note of these impacts when making planning decisions.

Scenario 2. Specialized Technical Infrastructure Plan for Transportation in Ho Chi Minh City

Given the planning type (specialized technical infrastructure), sector (transportation), and other project specifications (lifespan, planning area), the User may view the following impact summary for precipitation:

Impact Overview

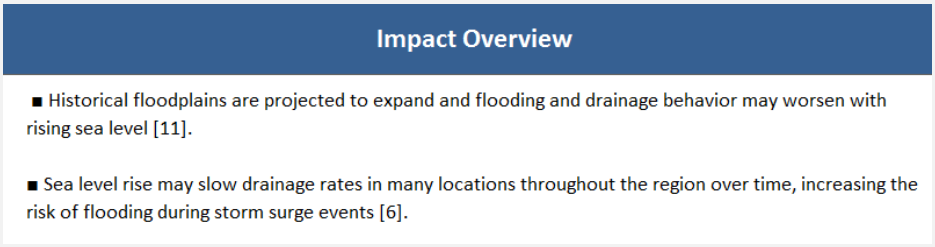
- Transportation routes in flood-prone areas will likely become increasingly inaccessible and damaged during more intense flood and storm events [11].
- Higher stormwater and stream flows (faster flow rates) will increase erosion of riverside roadways and will likely create new flood patterns if increase water flow cannot be accommodated by current infrastructure location and design [11].
- Some materials will likely be degraded if frequently inundated by floodwaters and reduce both lifespan and load carrying capacity [11].
- Roads and transportation infrastructure in flood drainage areas have a greater risk of damage resulting in higher maintenance costs [6].
- Precipitation increases could cause localized flooding and water damage to electrical transportation systems [11].

The User would record and take note of these impacts when making planning decisions.

USER SCENARIOS: PROJECT-SPECIFIC IMPACT SUMMARIES, CONT'D

Scenario 3. **Zoning Plan for the Provincial City of Tam Ky in Quang Nam Province**

Although a zoning plan covers all 11 sectors at once, the User would view one sector at a time in the Tool. For this example, the User would select the "Ground Leveling and Drainage" sector and, along with other project inputs, receive the following impact summary for sea level rise:



The User would record and take note of these impacts when making planning decisions.

4.2.5.4. PROJECT-SPECIFIC GUIDANCE INFORMATION

Outputs	Quantitative summary of project risk to climate change impacts
Specific to	Project planning horizon and risk (location within hazard zones)

Project-specific guidelines & recommendations *(areas not to build, materials to use)*

The Guidance Information section provides recommendations and suggestions for taking action to address and build resilience within the plan to climate change impacts. The guidance, which includes information related to the physical system of the project, people or communities that may be affected, and the project's underlying institutions, proposes ways to ensure that the project "stands the test of time." Like the Impact Overview section, Users do not necessarily need to take action on all listed recommendations. Instead, this section should be thought of as a checklist of actions to consider and evaluate further.

Like the impact summaries, the project-specific guidelines and recommendations are organized into individual bullet points, each referenced by its originating source with bracketed numbers.

USER SCENARIOS: PROJECT-SPECIFIC GUIDANCE INFORMATION

Scenario 1. Provincial Regional Plan for Son La Province. Although a provincial regional plan covers all 11 sectors at once, the User would view one sector at a time in the tool. For this example, the User would select the "Water Supply" sector and, along with other project inputs, receive the following guidance information for temperature:

Guidance Information

PHYSICAL SYSTEM:

- If possible, integrate recycled water and/or onsite water reuse systems to reduce water demand during the dry season [15, p. 14].

- Evaluate the need for a retrofit of water intakes in Hue river to accommodate future lower flow or water levels (in areas where streamflow declines, water levels may fall below intakes for water treatment plants) [10, p. 22].

The User would record and consider following these guidelines in their planning decisions.

USER SCENARIOS: PROJECT-SPECIFIC GUIDANCE INFORMATION, CONT'D

Scenario 1. **Specialized Technical Infrastructure Plan for Transportation in Ho Chi Minh City**

Given the planning type (specialized technical infrastructure), sector (transportation), and other project specifications (lifespan, planning area), the User may view the following guidance information for precipitation:

Guidance Information

PHYSICAL SYSTEM:

■ Consider floodway direction and drainage capacity of the city when designing transportation routes [3]. Incorporate landscape and drainage designs that can reduce soil erosion and localized flooding. For example, consider the use of permeable materials [15] or increase the use of detention bulges on streets where appropriate [12, p. 41]. Resolve barriers that constrain streets draining to parks [12, p. 41].

■ Ensure infrastructure and electrical system components at risk of inundation are rated for a wet environment [14].

■ Structures in hazard zones should be designed or reinforced to handle new loads from increased stormwater runoff and associated debris flows. For example, stronger infrastructure such as larger bridges may be required [11].

■ Consider adding back-up power to key traffic signals [12].

■ Most roadways are flooded during big floods, which impacts traffic. Need to improve flood drainage for rural roadways. Improve major roadways parallel to Huong River is one of the solutions to guaranteeing transportation in flood season. Raising the road surface level not only prevents floods but also assist people in urgent evacuation during floods. However, under-roadway drainage needs to be carefully designed so as not to create higher flood risk downstream [6].

The User would record and consider following these guidelines in their planning decisions.

Scenario 2. **Zoning Plan for the Provincial City of Tam Ky in Quang Nam Province**

Although a zoning plan covers all 11 sectors at once, the User would view one sector at a time in the Tool. For this example, the User would select the "Ground Leveling and Drainage" sector and, along with other project inputs, receive the following guidance for sea level rise:

Guidance Information

PHYSICAL SYSTEM:

■ Integrate natural buffers such as parks and green space into areas that may be subject to future inundation from sea level rise, such as along waterfronts and in low-lying areas [11].

INSTITUTIONAL:

■ Consider projected—as opposed to current—floodplains and drainage behaviors when planning for new development or redevelopment [11].

The User would record and consider following these guidelines in their planning decisions.

5. CONCLUSION

The Vietnam Climate Impacts Decision Support Tool will provide a quick and simple means for identifying locally specific climate impacts and adaptation strategies for urban planning. All Users of the Tool, which include all individuals and organizations who make urban planning decisions for Vietnam, including VIUP, IRURE, and foreign and domestic consultancies, would follow four steps to complete the tool: 1) project type specification, 2) project planning horizon specification, 3) project risk identification, and 4) assessment of projected climate impacts and resilience strategies. To follow these steps, Users would progress through input tabs and output tabs of the Tool. Embedded information in the Tool—including regional climate projections; impacts, guidance, and policy information; and climate hazard maps—would then be refined and filtered based on User inputs to arrive at climate impacts and guidance output information that can inform urban planning decision-making.

The User experience would vary depending on the User's project planning type, sector, planning area, and planning horizon. Specifically, the input options and maps presented to the User, as well as the output information for consideration, would reflect the unique combination of User-specified project characteristics.

APPENDIX A: INFORMATION SOURCES PLAN

A.1. EXECUTIVE SUMMARY

This *Information Sources Plan* arrives at the following key points, decisions, and outcomes:

1. Because they provide quantitative estimates that can be used directly to inform design and planning specifications, we will incorporate the following data from the 2012 IMHEN *Climate Change, Sea Level Rise Scenarios for Vietnam* report into the primary impact summaries of the national CIMPACT-DST tool:

    a. Change in average temperature (°C), both annual and seasonal, by province
    b. Change in average precipitation (%), both annual and seasonal, by province
    c. Change in extreme daily precipitation (%), by region
    d. Change in sea level (cm), by region

2. The following information sources will be integrated into the project-specific impacts and guidance sections of the Tool. Emphasis will be on integrating sources in the primary list, while integration of items from the secondary and tertiary list will be contingent on available time and resources:

Primary Sources	
1	*Guideline for Integrating Climate Change Response into Urban Planning in Vietnam*. VIUP. 2013.
2	*Guidance for Integrating Climate Change Considerations into the Strategic Environmental Assessment (SEA) of Urban and Construction Plans in Vietnam*. The Danish Center for Environmental Assessment (DCEA), IRURE, and Integra Consulting. 2013.
3	*AdaptHCMC: Guidelines on Climate Change Adapted Urban Planning and Design for Ho Chi Minh City/ Vietnam*. Brandenburg University of Technology Department of Urban Planning and Spatial Design. 2013.
4	*Climate Change Impacts on Urban Infrastructure* (Phase I & II).IRURE. 2013

Secondary Sources	
5	Cascadia Consulting Group (including Seattle CIMPACT-DST)
6	*Climate Change Impacts in Huong River Basin and Adaptation in its Coastal District Phu Vang, Thua Thien Hue province*. Netherlands Climate Assistance Program (NCAP). 2008.
7	*Project Mekong – Building Climate Resilient Asian Cities in Hue City: Climate Change Vulnerability Assessment*. ISET. 2013.
8	*ACCRN Vietnam Country Report*. Rockefeller Foundation. 2009.
9	*Regional Vulnerability of Climate Change Impacts on Asian Rice Production and Scope for Adaptation*. Wassmann et al. 2009.
10	*Addressing Climate Change Impacts on Urban Infrastructure: Factsheets*. USAID. 2012.
11	*Adaptation Strategies Guide for Water Utilities*. US Environmental Protection Agency (USEPA). 2012.
12	*Adapting to Climate Change: A Checklist for Development*. London Climate Chg Partnership. 2005.
13	*City of Vancouver Climate Action Strategy*. City of Vancouver. 2012.
14	*Climate Change Adaptation in New York City: Building a Risk Management Response.* New York City Panel on Climate Change. 2010.
15	*Climate Adaptation Strategies Final Implementation Plans*. City of Chula Vista, California. 2011

Tertiary Sources	
16	*Synthesis Report: Support to Improve Capacity to Respond to Climate Change in Selected Provinces*. IMHEN. 2013
17	*Impacts of Climate Change on Water Resources and Adaptation Measures*. IMHEN. 2010.
18	*PlaNYC: A Stronger, More Resilient New York*. The City of New York. 2013.
19	*Regional Climate Change Effects: Useful Information for Transportation Agencies*. United States Federal Highway Administration. 2010.
20	*Policy Guide on Planning and Climate Change*. The American Planning Association. 2011.

3. We will also review the following relevant national Vietnamese policies for pertinent guidance information, and in doing so, ensure that guidance strategies in the Tool are consistent with Vietnamese law:

Construction Planning Policies
The Law of Construction (No. 16/2003/QH11)
Decree No. 08/2005/ND-CP on Construction Planning
Circular No. 07/2008/TT-BXD on Guidelines for Formulation, Appraisal, Approval, and Management of Construction Plans
Decision No. 03/2008/QD-BXD on Contents of Maps and Reports for Construction Planning

Urban Planning Policies
The Law of Urban Planning (No. 32/2009/AH12)
Decree No. 37/2010/ND-CP on Formulation, Evaluation, Approval and Management of Urban Planning
Circular No. 10/2010/TT-BXD on Contents of Urban Planning Types

Other Relevant Policies
Circular No. 01/2011/TT-BXD on Guidelines for SEA for Construction/Urban Planning Projects
The Law of the Land (No. 13/2003/QH11)
Decision No.2623-QD-TTg on Urban Development Response to Climate Change 2013 – 2020

A.2. OVERVIEW

Cascadia Consulting Group (Cascadia) on behalf of the U.S. Agency for International Development (USAID), in collaboration with the Vietnam Institute for Environmental Planning, Urban-Rural Infrastructure (IRURE) and the Vietnam Institute for Urban-Rural Planning (VIUP), plans to configure, test, and deploy Cascadia's Climate Impacts Decision Support Tool (CIMPACT-DST, the "Tool") at the national level in support of integrating climate change considerations into planning activities in cities and provinces in Vietnam.

This *Information Sources Plan,* a supporting document for the project's *Use Scenarios and User Narratives*, details the information sources that will be consulted and integrated into the primary climate impact and project-specific impact and guidance summaries of the Tool.

For each information source, this document provides a brief summary of its contents, geographic foci, and sector foci, as well as example content from that source that could be integrated into the Tool.

A.3. THE TOOL'S EMBEDDED INFORMATION

CIMPACT-DST compiles, consolidates, and streamlines many different types of climate information from a variety of sources, including (also see Figure A-1 below):

- Projected primary climate impacts from the latest climate modeling and science
- Local spatial analyses of projected climate hazards, exposures, and risks
- Reports on projected project-specific secondary impacts and good practices for building resilience to those impacts
- Integrated guidance from local, state/provincial, and national stakeholders, as well as from regulations and policies

These different types of climate information are synthesized and embedded into the Tool in three primary forms: 1) climate projections, 2) impacts, guidance, and policy information, and 3) spatial information.[1] Based on Tool User inputs, this embedded information is filtered to present the User with only information that is relevant and useful for the task at hand.

When users add information on their project's lifespan, planning area, planning type, sector, and location within climate hazard zones (i.e., project "risk"), the Tool produces output information. Output information includes bullet-point summaries of primary climate impact projections, secondary project-specific impacts, and project-specific guidelines and recommendations. You can think of these outputs as summaries of the problem (how climate change will affect a project) and the solution (what can be done about it). Figure A-2 on page 39 illustrates how user inputs and embedded information result in user-specific Tool outputs.

In this document, we discuss two type of embedded information in the Tool: 1) regional climate projections and 2) impacts, guidance, and policy information. For more information on the third type of information, spatial climate hazard information, please see the accompanying document Spatial Information Plan.

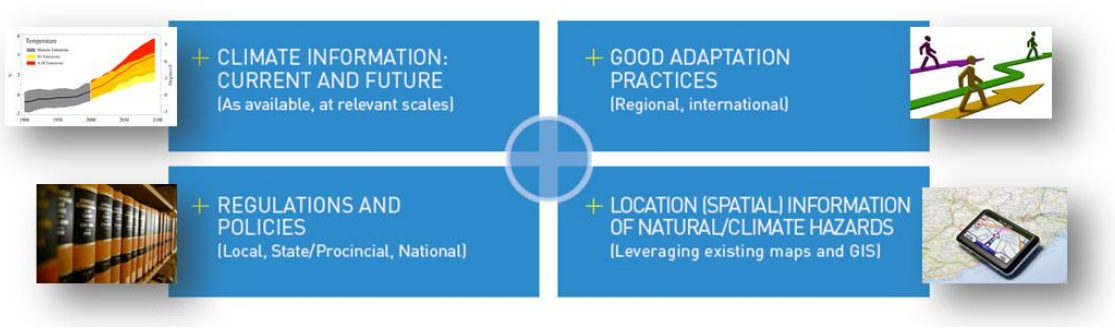


Figure A-1. Overview of the Tool's Embedded Information and Sources

1 Spatial information is not presented as a Tool output, but is used to inform a key Tool input: project risk.

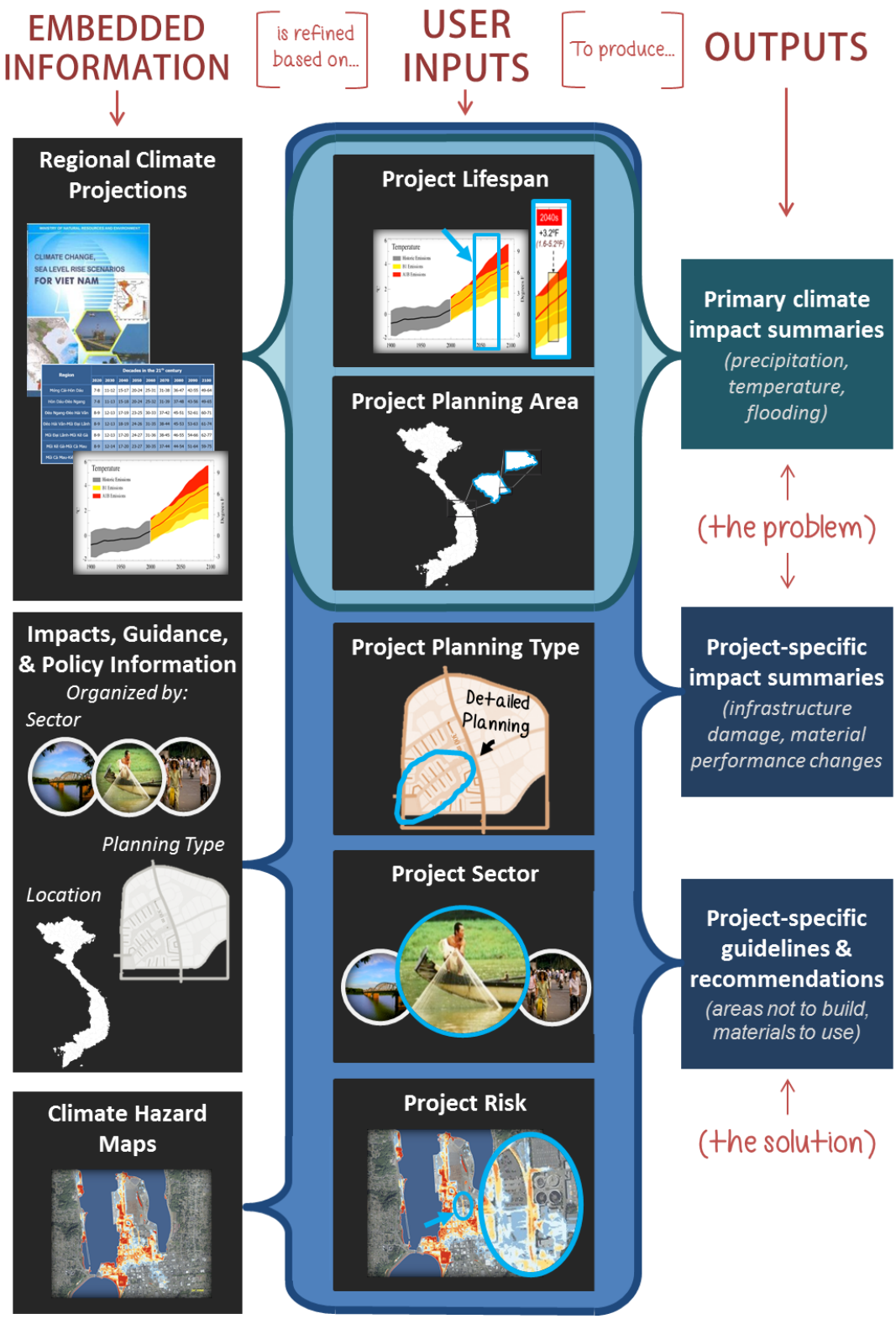


Figure A-2.CIMPACT-DST Information Processing and Outputs

A.4. REGIONAL CLIMATE PROJECTIONS

The primary source for regional climate projections in the national Tool will be the latest version of IMHEN's *Climate Change, Sea Level Rise Scenarios for Vietnam* (2012).

The 2012 IMHEN report contains the following detailed climate impact data (also see Table A-1 on the following page for detail on each of these variables):

- **Change in average temperature (°C), both annual and seasonal, by province**
- **Change in average precipitation (%), both annual and seasonal, by province**
- **Change in extreme daily precipitation (%), by region**
- **Change in sea level (cm), by region**
- Area at risk of sea level rise inundation (%), by region
- Length of roadways at risk of sea level rise inundation (%), by region
- People at risk of sea level rise inundation (% of total population), by region

Because they provide quantitative estimates that can be using directly to inform design and planning specifications, we will incorporate the bolded data in the above list into the initial version of the national CIMPACT-DST.

Table A-1. Climate Impact Projections Available From IMHEN (2012)

Table #	Page #	Climate Variable	Seasonality	Scenario(s)	Years	Intervals	Level of Detail	Values
TEMPERATURE								
3.1	38	Change in annual mean temperature (°C)	Annual	B2	2020-2100	10-year	Province (n=63)	Includes ranges for 2050 and 2100
A2-5	85-87	Change in seasonal mean temperature (°C)	Seasonal (4 seasons)	B2	2020-2100	10-year	Province (n=63)	Only middle values
PRECIPITATION								
3.2	52	Change in annual rainfall (%)	Annual	B2	2020-2100	10-year	Province (n=63)	Includes ranges for 2050 and 2100
A6-9	89-92	Change in seasonal rainfall (%)	Seasonal (4 seasons)	B2	2020-2100	10-year	Province (n=63)	Only middle values
3.3	53	Change in maximum daily rainfall (%)	N/A	B2	2100	N/A	Region (n=7)	Includes record and average values
SEA LEVEL RISE								
3.4-3.6	54-55	Sea Level Rise (cm)	N/A	B2, B1, A1FI	2020-2100	10-year	Region (n=7)	Includes ranges for all
4.1	57	Area at risk of inundation (%)	N/A	0.5-1m	N/A	10-cm	Delta (n=4)	Only middle values
4.2	57-58	Lengths of highway, provincial roadway, and railway at risk of inundation (%)	N/A	0.5-1m	N/A	10-cm	Delta (n=4)	Only middle values
4.5	57	People at risk of being directly affected by sea level rise inundation (% of total population)	N/A	0.5-1m	N/A	10-cm	Delta (n=4)	Only middle values

A.5. IMPACT, POLICY AND GUIDANCE INFORMATION

A.5.1. PURPOSE

The purpose of project-specific impact and guidance information is to provide a summary of anticipated climate impacts and adaptation measures specific to a particular planning project. The impacts and guidance information in the Tool will be specific to the project's planning type, timeframe, location within climate hazard zones, and sector of interest (see list of sectors below).

A.5.2. SECTORS

This document uses the following icons to depict sectors:


Spatial Planning


Land Use Planning


Urban Design


Information & Communication


Cemetery


Solid Waste


Electricity Supply & Lighting


Water Supply


Wastewater


Ground Leveling & Drainage


Transportation

A.5.3. SOURCE OVERVIEW

The following list outlines the information sources that will be integrated into the Tool. Emphasis will be on integrating sources in the primary list, while integration of items from the secondary and tertiary list will be contingent upon available time and resources. This list has been reviewed and approved by IRURE and VIUP.

A.5.3.1. PRIMARY SOURCES

The following sources will be first priority for integration into the Tool:

1. *Technical Guidance to Integrate the Impact of Climate Change in Urban Planning in Vietnam*. IRURE. 2013.
2. *Guidance for Integrating Climate Change Considerations into the Strategic Environmental Assessment of Urban and Construction Plans in Vietnam*. The Danish Center for Environmental Assessment (DCEA), IRURE, and Integra Consulting. 2013.
3. *AdaptHCMC: Guidelines on Climate Change Adapted Urban Planning and Design for Ho Chi Minh City/ Vietnam*. Brandenburg University of Technology Department of Urban Planning and Spatial Design. 2013.
4. *Climate Change Impacts on Urban Infrastructure (Phase I & II)*.IRURE. 2013.

A.5.3.2. SECONDARY SOURCES

To the extent possible, we will include information from sources used to develop the Hue CIMPACT-DST. These sources include the following:

5. Cascadia Consulting Group (including Seattle CIMPACT-DST)
6. *Climate Change Impacts in Huong River Basin and Adaptation in its Coastal District Phu Vang, Thua Thien Hue province*. Netherlands Climate Assistance Program (NCAP). 2008.
7. *Project Mekong – Building Climate Resilient Asian Cities in Hue City: Climate Change Vulnerability Assessment*. ISET. 2013.
8. *ACCRN Vietnam Country Report*. Rockefeller Foundation. 2009.
9. *Regional Vulnerability of Climate Change Impacts on Asian Rice Production and Scope for Adaptation*. Wassmann et al. 2009.
10. *Addressing Climate Change Impacts on Urban Infrastructure: Factsheets*. USAID. 2012.
11. *Adaptation Strategies Guide for Water Utilities*. US Environmental Protection Agency (USEPA). 2012.
12. *Adapting to Climate Change: A Checklist for Development*. London Climate Change Partnership. 2005.
13. *City of Vancouver Climate Action Strategy*. City of Vancouver. 2012.
14. *Climate Change Adaptation in New York City: Building a Risk Management Response*. New York City Panel on Climate Change. 2010.
15. *Climate Adaptation Strategies Final Implementation Plans*. City of Chula Vista, California. 2011.

Because these secondary sources have already been vetted and described in the process of developing the Hue CIMPACT-DST, this document will not include any further detail on these sources.

A.5.3.3. TERTIARY SOURCES

As time and resources allow, we will also strive to integrate information from other recent, relevant reports, including the following:

16. *Synthesis Report: Support to Improve Capacity to Respond to Climate Change in Selected Provinces*. IMHEN. 2013.
17. *Impacts of Climate Change on Water Resources and Adaptation Measures*. IMHEN. 2010.
18. *PlaNYC: A Stronger, More Resilient New York*. The City of New York. 2013.
19. *Regional Climate Change Effects: Useful Information for Transportation Agencies*. United States Federal Highway Administration. 2010.
20. *Policy Guide on Planning and Climate Change*. The American Planning Association. 2011.

A.5.3.4. POLICY SOURCES

We will also review the following relevant national Vietnamese policies for pertinent guidance information, and in doing so, also ensure that guidance strategies in the Tool are consistent with Vietnamese law. For more information on these policies, please see the *Needs Assessment* planning document.

A.5.3.5. CONSTRUCTION POLICIES

- **The Law of Construction (No. 16/2003/QH11)** stipulates construction activities and the rights and obligations of organizations and individuals investing in construction of works and engaging in construction activities.
- **Decree No. 08/2005/ND-CP on Construction Planning** provides detail on the tasks, timelines, jurisdictions, contents, and processes for each construction planning type.
- **Circular No. 07/2008/TT-BXD on Guidelines for Formulation, Appraisal, Approval, and Management of Construction Plans** elaborates on Decree No. 08/2005/ND-CP with more specific guidelines and requirements for objectives, tasks, considerations, and content of plans for each construction planning type.
- **Decision No. 03/2008/QD-BXD on Contents of Maps and Reports for Construction Planning** provides further detail specifically on the drawings and maps produced through the construction planning process, including a breakdown of content by sector.

A.5.3.6. URBAN PLANNING POLICIES

- **The Law of Urban Planning (No. 32/2009/AH12)** stipulates the various types of urban plans, urban hierarchies, and administrative levels in Vietnam, including specifications around the contents, scales, timeframes, and bases for each urban planning type and administrative level combination.
- **Decree No. 37/2010/ND-CP on Formulation, Evaluation, Approval and Management of Urban Planning** discusses in more detail the content of general, zoning, detailed, specialized technical infrastructure plans, including differentiation among plans for various administrative levels.
- **Circular No. 10/2010/TT-BXD on Contents of Urban Planning Types** defines the tasks and schemes for each urban planning type, including requirements on the plan's general explanation and drawing components.

A.5.3.7. OTHER RELEVANT POLICIES

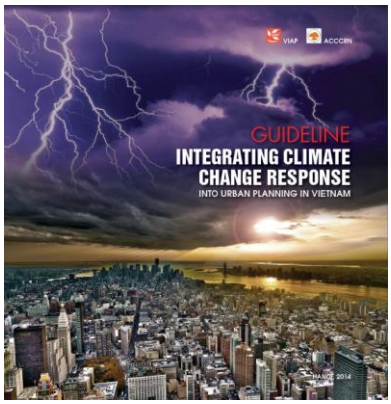
- **Circular No. 01/2011/TT-BXD on Guidelines for SEA for Construction/Urban Planning Projects** provides guidance on the strategic environmental assessment (SEA) of construction and urban plans, including specific guidance on the steps, contents, reporting of SEA. SEA contents are provided for each planning type.
- **The Law of the Land (No. 13/2003/QH11)** stipulates the powers and responsibilities of the Government in owning and leasing of the land of Vietnam.

- **Decision No.2623-QD-TTg on Urban Development Response to Climate Change 2013 – 2020** details the scope, timeline, obligations, and tasks for implementing urban development programs and projects that respond to climate change.

A.5.4. SOURCE DETAILS

A.5.4.1. PRIMARY SOURCES

1. GUIDELINE FOR INTEGRATING CLIMATE CHANGE RESPONSE INTO URBAN PLANNING IN VIETNAM



Year: 2013

Author(s): VIUP

Geographic Focus: National

Sectors:

Relevant Pages: All

Example Info:

- Increases in rainfall could cause flooding and erosion, especially in mountainous cities [p 38].
- Link canals with floodplains [p 45].
- Use reflective materials for roofs and surface works [p 44].

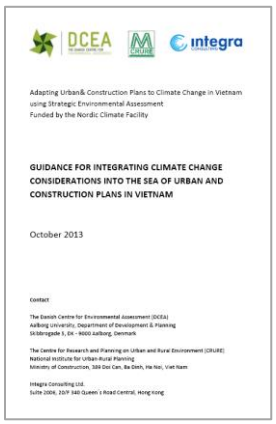
SUMMARY:

This report lays out the content and methods for integrating climate change into the general, zoning, detail, and infrastructure planning processes in Vietnam. Intended audiences are planners, plan evaluators, and managers. The report includes the following elements:

- Overview of current urban planning structure, process, and policies in Vietnam; climate change impacts; role of urban planning in addressing climate change; and what other cities/countries are doing
- Description of approaches and priorities for adaptation planning and risk management, including "soft" (e.g., making room for water) and "technical" (dykes) approaches
- Examples of progress to date in Vietnam (e.g., Can Tho, Da Nang)
- Underlying principles, approaches, and methodology for mainstreaming climate change into planning
- Impacts, solutions, and integration processes for various urban planning sectors

Specifically, we will integrate the sector-specific impacts and solutions from this report (final bullet point above) into the Tool.

2. GUIDANCE FOR INTEGRATING CLIMATE CHANGE CONSIDERATIONS INTO THE STRATEGIC ENVIRONMENTAL ASSESSMENT OF URBAN AND CONSTRUCTION PLANS IN VIETNAM



Year: 2013

Author(s): The Danish Center for Environmental Assessment (DCEA), IRURE, and Integra Consulting

Geographic Focus: National

Sectors:

Relevant Pages: 30-41; 57-59; 74-77

Example Info:

- Increased risk of heat waves [p 30].
- Ensure that any existing or planned essential infrastructure is protected from heat exhaustion [p 30].

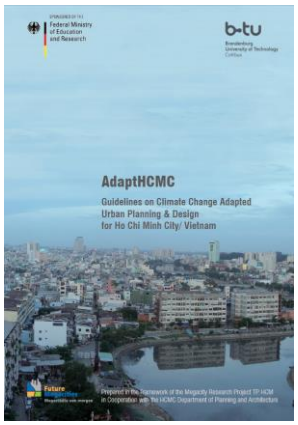
SUMMARY:

This guidance document focuses on using Vietnam's required Strategic Environmental Assessment as a tool for integrating climate change considerations into urban planning process. Specifically, the document aims to:

- Raise awareness about the importance of addressing climate change adaptation and mitigation in the development and appraisal of urban & construction plans;
- Explain how climate change adaptation and mitigation can be integrated into SEA practices based on the requirements laid out in the MOC SEA guidelines;
- Provide inspiration about the types of climate change adaptation and mitigation measures that might be relevant to consider in urban & construction plans; and,
- Provide a framework for analysing whether an SEA report has adequately addressed climate change related concerns.

Relevant to the Tool, the document provides examples of potential adaptation measures for various climate impacts and sectors, including increased risks of extreme heat events, droughts, extreme rainfall events, storms, landslides, and tidal surge.

3. ADAPTHCMC: GUIDELINES ON CLIMATE CHANGE ADAPTED URBAN PLANNING AND DESIGN FOR HO CHI MINH CITY/VIETNAM



Year: 2013

Author(s): Brandenburg University of Technology Department of Urban Planning and Spatial Design

Geographic Focus: Municipality (Ho Chi Minh City)

Sectors:

Relevant Pages: 10-27

Example Info:

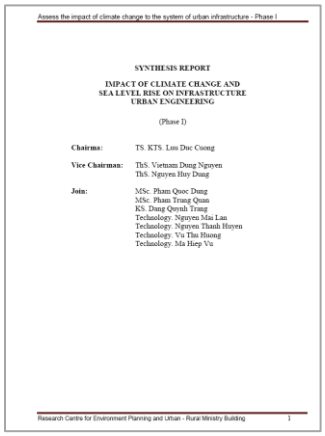
- To cool down urban areas and provide fresh air for heat-stressed zones, emphasize fresh air corridors such as through green areas and canals, motorways, and rail tracks [p 20].

SUMMARY:

This report provides guidelines and recommendations for sustainable and climate-adapted urban planning and design. **The focus is on the site and building level, but also takes the city and district level into consideration.** They consider two primary climate impacts: extreme heat events and flooding.

For managing flood risk, the report provides step-by-step guidelines for managing flood risk, including consideration of zone-wide regulations for flood-prone areas, division of preserved floodplains on development sites, and structural flood protection for high priority development areas. Within these guidelines, the report provides straightforward options and guidance for fulfilling these steps, such as identifying and creating "buffer zones" in flood-prone areas, introducing backfill controls, and decentralizing urban basins. City-level guidelines for temperature include introducing fresh air-flow corridors and a high ratio of vegetated areas.

4. CLIMATE CHANGE IMPACTS ON URBAN INFRASTRUCTURE (PHASE I & II)


Assess the impact of climate change to the system of urban infrastructure - Phase I

SYNTHESIS REPORT

IMPACT OF CLIMATE CHANGE AND SEA LEVEL RISE ON INFRASTRUCTURE URBAN ENGINEERING

(Phase I)

Chairma: TS. KTS. Luu Duc Cuong

Vice Chairman: ThS. Vietnam Dung Nguyen
ThS. Nguyen Huy Dung

Join: MSc. Pham Quoc Dung
MSc. Pham Trung Quan
KS. Dung Quynh Trung
Technology. Nguyen Mai Lan
Technology. Nguyen Thanh Huyen
Technology. Vu Thu Huong
Technology. Ma Hiep Vu

Research Centre for Environment Planning and Urban - Rural Ministry Building 1

Year: 2013

Author(s): IRURE

Geographic Focus: 10 cities/towns: Thinh Long, Hue, Hoi An, Rach Gia, Vi Thanh, Cam Pha, Diem Dien, Cua Lo, Phan Ri Cua, and Bac Lieu

Sectors:

Relevant Pages: 138-9; 144; 284-326

Example Info:

- Increased floods and landslides may increase occurrence of water pipeline corrosion and destruction [p 139].
- Minimize the dispersion of small water supplies [p 299].

SUMMARY:

This two-phased study reviews and assesses climate change impacts on urban infrastructure and proposes measures and action plans for responding to those impacts. It focuses on 10 case study cities that were selected based on their exposure to sea level rise or potential flooding impacts, representative urban infrastructure and environmental characteristics, and sensitivity.

For each city, the study reports on the following:

- State of current infrastructure
- Impact, likelihood, risk, and resilience, and vulnerability levels
- Anticipated general climate impacts and solutions (e.g., quantitative increases in temperature/precipitation, qualitative flooding changes, saltwater intrusion)

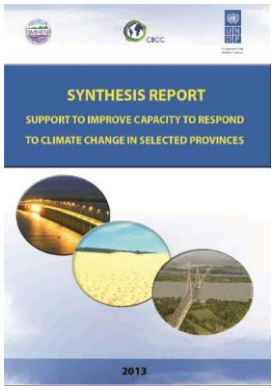
Climate-related risks are listed for the transportation system, water supply, wastewater, and urban construction sectors. Adaptive solutions are proposed generally and for each pilot city for water supply, wastewater, urban construction, drainage, and transportation infrastructure. The solutions are also divided into technical and non-technical solutions, as well as into different solution types, such as planning, policy, technical engineering, design, and "other" solutions.

A.5.4.2. SECONDARY SOURCES

Because these secondary sources have already been vetted and described in the process of developing the Hue CIMPACT-DST, this document will not include any further detail on these sources.

A.5.4.3. TERTIARY SOURCES

5. SYNTHESIS REPORT: SUPPORT TO IMPROVE CAPACITY TO RESPOND TO CLIMATE CHANGE IN SELECTED PROVINCES



Year: 2013

Author(s): IMHEN

Geographic Focus: Binh Dinh, Binh Thuan, Can Tho

Sectors:

Relevant Pages: 15-34

Example Info:

- Increased heavy rainfall will lead to flooding in Can Tho with higher frequency [p 24].
- Adjust infrastructure planning to build pilot resettlement in An Binh Ward for flood prevention [p 34].

SUMMARY:

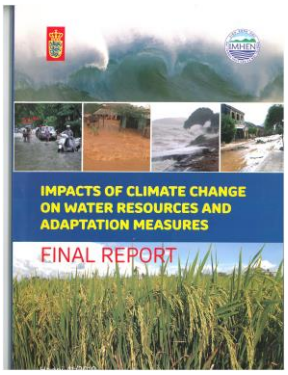
This IMHEN report summarizes findings from a UNDP-funded project that assessed high-resolution climate change impacts, identified and selected adaptation measures, and developed action plans for three provinces: Binh Dinh, Binh Thuan, and Can Tho. Outcomes from this project also include climate change impact estimations over various time frames, including extreme events.

Relevant to the Tool, the report includes sector-specific impact summaries and adaptation options for each focus area (based on those sectors that will be most affected by climate change):

- **Can Tho:** agriculture, fisheries, infrastructure planning
- **Binh Thuan:** water resources, fisheries, tourism
- **Binh Dinh:** agriculture, rural development, aquaculture, tourism

Especially relevant are urban planning-related adaptation options for An Binh Ward, Ninh Kieu District, Can Tho City. Other adaptation options include water resource management in Binh Thuan and groundwater management in Phu Quy island.

6. IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES AND ADAPTATION MEASURES



Year: 2010

Author(s): IMHEN

Geographic Focus: Red-Thai Binh, Ca, Thu Bon, Ba, Dong Nai, and Cuu Long Delta river basins

Sectors:

Relevant Pages: 20-21; 77-79; 85-93

Example Info:

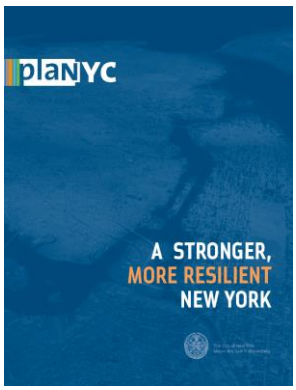
- In Cuu Long Delta, the saliferous area (salinity concentration >1‰) accounts for over 2,500,000 ha in 2050. With increased flooding projected in the mid-21st century, the inundated area of Cuu Long River Delta increases to over 3,500,000 ha, accounting for nearly 90% of its area [p 20].
- Shift crop and livestock pattern based on land-use planning [p 21].

SUMMARY:

This report summarizes findings from a research project that focused on climate change impacts on water resources of the seven major river basins of the Red–Thai Binh, Ca, Thu Bon, Ba, Dong Nai, and Cuu Long River. The report includes discussions on river flow, temperature, salinity, and flooding impacts based on projections from the high and medium emission scenarios (A2, B2). Two sectors are discussed in detail: 1) impacts to agriculture and 2) impacts to hydropower.

The report concludes with a detailed discussion of proposed adaptive measures for each basin. Most measures deal more with water-related capital infrastructure projects than with urban planning, but a few urban planning-related strategies could be integrated into the Tool.

7. PLANYC: A STRONGER, MORE RESILIENT NEW YORK



Year: 2013

Author(s): The City of New York

Geographic Focus: Municipality (New York City)

Sectors:

Example Info:

- Increased storm surge intensity and frequency will pose increasing risk of flooding to telecommunications facilities [p 169].
- Explore options for creating a redundant and resilient conduit infrastructure. [p 172].

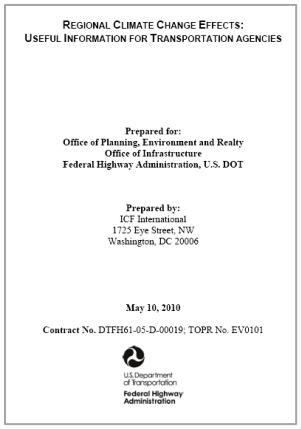
SUMMARY:

New York City's new climate adaptation plan is arguably the most comprehensive municipal adaptation plan available. This plan, largely in response to the impacts of recent Hurricane Sandy, includes detailed climate impact analyses, vulnerability and risk assessments, cost-benefit analyses, and resilience-building strategies, all categorized by the following sectors:

- Buildings
- Insurance
- Utilities
- Liquid Fuels
- Healthcare
- Telecommunications
- Transportation
- Parks
- Water and Wastewater

Although the plan is specific to New York City, many of the impacts and resilience strategies can also be applied to Vietnam – especially for Vietnamese locations in risk of increased storm frequency and intensity.

8. REGIONAL CLIMATE CHANGE EFFECTS: USEFUL INFORMATION FOR TRANSPORTATION AGENCIES


REGIONAL CLIMATE CHANGE EFFECTS:
USEFUL INFORMATION FOR TRANSPORTATION AGENCIES

Prepared for:
Office of Planning, Environment and Realty
Office of Infrastructure
Federal Highway Administration, U.S. DOT

Prepared by:
ICF International
1725 Eye Street, NW
Washington, DC 20006

May 10, 2010

Contract No. DTFH61-05-D-00019; TOPR No. EV0101

U.S.Department of Transportation
Federal Highway Administration

Year: 2010

Author(s): US Federal Highway Administration (FHWA)

Geographic Focus: United States

Sectors:

Example Info:

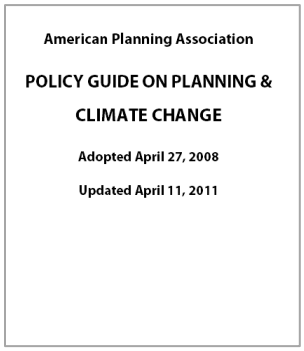
- Temperature increases can cause vehicle overheating and tire degradation [p 8].

SUMMARY:

Although focused on the United States, this report provides a thorough review of anticipated impacts of climate change on transportation infrastructure and operations. Because the US will experience some climate impacts similar to Vietnam, much of the content from this report could also be applied to Vietnam for use in the Tool.

This report does not provide adaptation guidance, only impact descriptions.

9. POLICY GUIDE ON PLANNING AND CLIMATE CHANGE



Year: 2010

Author(s): American Planning Association

Geographic Focus: United States

Sectors:

Example Info:

- Certain types of agriculture may not be feasible in drought conditions [p 69].
- New crops can replace those which are no longer viable [p 69].

SUMMARY:

This report discusses the role of planners in mitigating and adapting to climate change and provides overviews of policies and strategies for mitigating and adapting to climate change impacts in the following sectors:

- Land Use
- Transportation
- Energy
- Green Development
- Natural Resources
- Economic Development
- Hazards Management
- Public Health
- Public Infrastructure

Although created with the American audience in mind, policies and strategies discussed in this document are of sufficient generality to be considered for inclusion in the Tool.

A.6. CONCLUSION

The sources listed in this document are diverse and represent a substantial proportion of currently available climate impacts and adaptation best practices applicable to Vietnam. They include impacts and guidance information relevant to diverse impact types, geographies, and sectors, from storm surge impacts to telecommunication infrastructure in New York City, to water supply impacts of precipitation changes in Vietnam's Ca River Basin. They originate from a variety of governments, organizations, and programs, from Vietnam's Center for Research and Planning on Urban and Rural Environment (IRURE), to Germany's Brandenburg University of Technology Department of Urban Planning and Spatial Design. They vary in detail as well, from quantitative, model-based sea level rise analyses, to qualitative overviews of resiliency initiative and strategies.

However diverse, we acknowledge that this list of primary, secondary, and tertiary sources to be included in the Tool is not comprehensive. Time and resource constraints limit the ability to integrate various other locally- or nationally-pertinent climate studies, projects, and plans, such as those listed in **A.7 Other Sources for Consideration**. After initial Tool dissemination in August 2014, VIUP and IRURE, who will assume primary responsibility for maintaining and updating the Tool, may consider integrating these and other locally relevant reports into the Tool's impact and guidance summaries.

A.7. OTHER SOURCES FOR CONSIDERATION

The following list details other sources for consideration in future iterations of the Tool:

- Asian Development Bank, *Vietnam Environment and Climate Change Assessment*, 2013.
- Asian Development Bank, Japanese International Cooperation Agency, and United Nations Development Programme, *Climate Risks and Adaptation in Asian Coastal Megacities: A Synthesis Report*, 2010, http://siteresources.worldbank.org/EASTASIAPACIFICEXT/Resources/226300-1287600424406/coastal_megacities_fullreport.pdf.
- Global Facility for Disaster Reduction and Recovery, *Vulnerability, Risk Reducation, and Adaptation to Climate Change: Vietnam*, 2011.
- ICEM, *Ho Chi Minh City Adaptation to Climate Change Study Report Volume 2*, April 2009.
- Institute for Strategy and Policy on Natural Resources and Environment (ISPONRE), *Vietnam Assessment Report on Climate Change* (Hanoi, Vietnam, 2009).
- Peter Chaudhry and Greet Ruysschaert, *Climate Change and Human Development in Vietnam: A Case Study*, 2007.
- United States Agency for International Development (USAID), *Adapting to Climate Variability and Change: A Guidance Manual for Development Planning*, 2007, http://pdf.usaid.gov/pdf_docs/PNADJ990.pdf.

APPENDIX B: SPATIAL INFORMATION PLAN

B.1. EXECUTIVE SUMMARY

This *Spatial Information Plan* arrives at the following key points, decisions, and outcomes:

1. The role of spatial information in the Tool is to enable Users to identify the extent of projected climate impacts associated with their project area. The Tool is to be used as a factor for consideration in the development of an urban or construction plan; it is not meant to replace the urban planning process itself, which requires the development and consultation of separate maps such as topographic, land use, and infrastructure maps.
2. The first priority for identifying, compiling, and, if necessary, customizing the Tool's spatial information will be to satisfy the Tool's primary purpose, as outlined above.
3. We will strive to include the following climate impact maps, where reasonably available, and will establish a foundation for incorporating any missing information should it become available:
    - Temperature
    - Precipitation
    - Sea level rise
    - Erosion and landslide areas
    - Vulnerable population areas
4. Because the primary purpose of the Tool's spatial information will be to identify climate hazards associated with a planning area, the resolution requirements for the Tool's associated climate impact maps will be lower than for spatial information used directly for urban and construction planning purposes. Specifically, the climate impact maps in the Tool would ideally have *at least* inter-provincial resolution for provincial regional planning (≤30 km) and *at least* inter-municipal resolution for general and specialized technical infrastructure planning (≤5 km). The Tool could also have intra-zonal or –district resolution for detailed/zoning planning; however, the constraints of climate models limit this possibility.
5. Ultimately, the resolution of the Tool's climate impact maps will be limited to that of the underlying climate data or model. For the Tool, currently available IMHEN spatial data are based on climate model statistical downscaling that is resolved to the 25-km level; therefore, all Tool maps based on these IMHEN data will be limited to this resolution.
6. As possible, the Tool (or associated map portal) will contain maps that collectively cover the entirety of Vietnam. Ideally, those maps would allow for sufficiently detailed viewing of the 58 provinces, 5 centrally-controlled cities, and over 760 provincial cities, towns, and townships throughout the country.

7. Where possible, we recommend including the following layers in the Tool's associated climate impact maps, which each contribute significantly toward satisfying the spatial information's primary objectives within the Tool:
    a. Climate impacts
    b. Provincial boundaries
    c. City/district boundaries
    d. Commune boundaries

8. Other layers that could be included as part of the climate impact maps, but only insofar as they do not encumber the Tool or reduce the efficiency of its use, include the following:
    a. Roads and waterways
    b. Topography
    c. Land use classifications
    d. Existing sector-specific infrastructure systems
    e. Current spatial development orientations and land use plans
    f. Current infrastructure plans

9. At this time, the majority of maps to which our team has access are only available in pdf format derived directly from IMHEN reports; however, Decision No. 2623 QD-TTg on Urban Development Response to Climate Change 2013 – 2020 may soon make detailed, GIS-compatible formats of IMHEN's spatial information available in the coming decade.

10. Other regional or local climate studies produced outside of IMHEN may provide more detailed and higher-resolution climate impact projections than those provided by the IMHEN reports. We will strive to incorporate such sources, as available; however, we expect that many of these local studies will not be included as part of the Tool's initial deployment due to limited ability to identify, vet, and customize such spatial information within the project's allotted time and budget.

11. Given the variation and uncertainty in availability, time, and resource requirements for the Tool's maps and layers, we propose three paths for acquiring and customizing the Tool's spatial information. For the initial dissemination of the Tool, we will pursue the Current Project Path, which involves taking the pdf maps that we currently have available and customizing them to the provincial-level, without digital manipulation or incorporation of any additional layers. Future Options #1 and #2 could be pursued after initial Tool deployment, which involve progressing levels of digitization, optimization, and customization of available spatial information.

12. Because file size limitations restrict the ability to integrate hundreds of maps directly into the Tool, the preferred approach for housing the maps would be to use an online map library that is accessible by Tool Users.

We propose that VIUP assume primary responsibility for maintaining and updating the spatial information in the Tool after final dissemination in August 2013.

B.2. OVERVIEW

Cascadia Consulting Group (Cascadia) on behalf of the U.S. Agency for International Development (USAID), in collaboration with the Vietnam Institute for Environmental Planning, Urban-Rural Infrastructure (IRURE) and the Vietnam Institute for Urban-Rural Planning (VIUP), plans to configure, test, and deploy Cascadia's Climate Impacts Decision Support Tool (CIMPACT-DST, the "Tool") at the national level in support of integrating climate change considerations into planning activities in cities and provinces in Vietnam.

This *Spatial Information Plan,* a supporting document for the project's *Use Scenarios and User Narratives*, outlines the Tool's spatial information needs, how current availability aligns with those needs, and potential next steps for obtaining and compiling the Tool's spatial information.

The document begins with an overview of key points, decisions, and outcomes of the document and then follows with descriptions of the following:

- Maps to include either directly in the Tool or in a "map portal"
- The appropriate scale, resolution, scope, and level of detail of Tool spatial information
- Availability of maps and a plan for obtaining them
- A plan for integration of spatial information into the Tool or an accompanying portal
- A plan for maintaining and updating spatial information with future Tool updates

B.3. THE ROLE OF SPATIAL INFORMATION

The primary purpose of the Tool's spatial information is to **enable Tool Users to identify the climate impacts associated with their project area**. The degree to which climate may impact the planning area (in the Tool this is known as the project's location within specified climate impact "zones") informs the qualitative guidance and impact information outputs of the Tool. To achieve identification of location-specific impacts, the Tool's maps must satisfy two criteria:

- The maps must be of sufficient resolution to distinguish planning area impacts; and
- The maps must include two core components: a) orientation information that facilitates identification of the planning area (e.g., administrative boundaries); and b) climate impact zones.

The secondary purpose of the Tool's spatial information is to increase the User's awareness of climate change impacts to a particular region and the spatial arrangement of those impacts, with the ultimate goal of **directly influencing spatial planning decisions**. In this case, rather than being used indirectly as an informing factor to the Tool's qualitative outputs, the maps are used directly to discern appropriate areas for development, agriculture, conservation, etc. Compared to the primary use described above, this use of the Tool's maps requires consideration of several additional factors, such as current land use, locations of vital infrastructure, and soil type. For example, beyond simply understanding that a project is in "Flooding Zone 2" or a "Moderate Flood Zone," a User would determine that flooding risk in their planning area is much higher than in an adjacent area, and so perhaps residential zoning should be moved to an alternate location, which might be in an area currently zoned for something like agriculture.

Our first priority will be to achieve the spatial information's primary purpose for the Tool: facilitated identification of climate impact zones.[2] As resources are available, we will also seek to include map features that facilitate direct use of climate impact maps to inform urban planning orientations and spatial analysis.

2 In other words, this Tool does not necessarily eliminate the need for additional mapping resources to support urban planning. The climate impact maps in the Tool should not be seen as a substitute for those needed for the other aspects of urban planning, such as flood risk or land use analysis.

B.4. APPROACH

The following steps describe our approach to identifying, obtaining, and customizing spatial information for the Tool:

1. **Define the Ideal Maps.** First, we identify and describe ideal climate impact maps for inclusion in the Tool, along with their desired level of detail and attributes.
2. **Assess Availability.** Next, we identify which climate impact maps and/or attributes are currently available, which may be attainable in the future, and in what forms (e.g., GIS, pdf).
3. **Plan for Acquisition.** Based on our understanding of current availability, we then identify near-term steps for obtaining the most critical layers for the Tool, as well as long-term steps for arriving at digital forms of all relevant spatial information.
4. **Plan for Integration.** With Tool maps identified and described, we then assess strategies for integrating maps, directly or indirectly, into the Tool interface and function.
5. **Plan for Maintenance.** Finally, we outline steps and assurances for maintaining the Tool after official transfer and dissemination.

B.4.1. DEFINE THE IDEAL MAPS

There are two sections of the Tool where spatial information can be used (see Figure B-1 and Figure B-2 on the following pages):

1. The *Climate Impacts Overview* section of the *Project Type* page
2. The *Project Information* page, where Users are guided to detailed impact maps that identify project climate hazard zones.

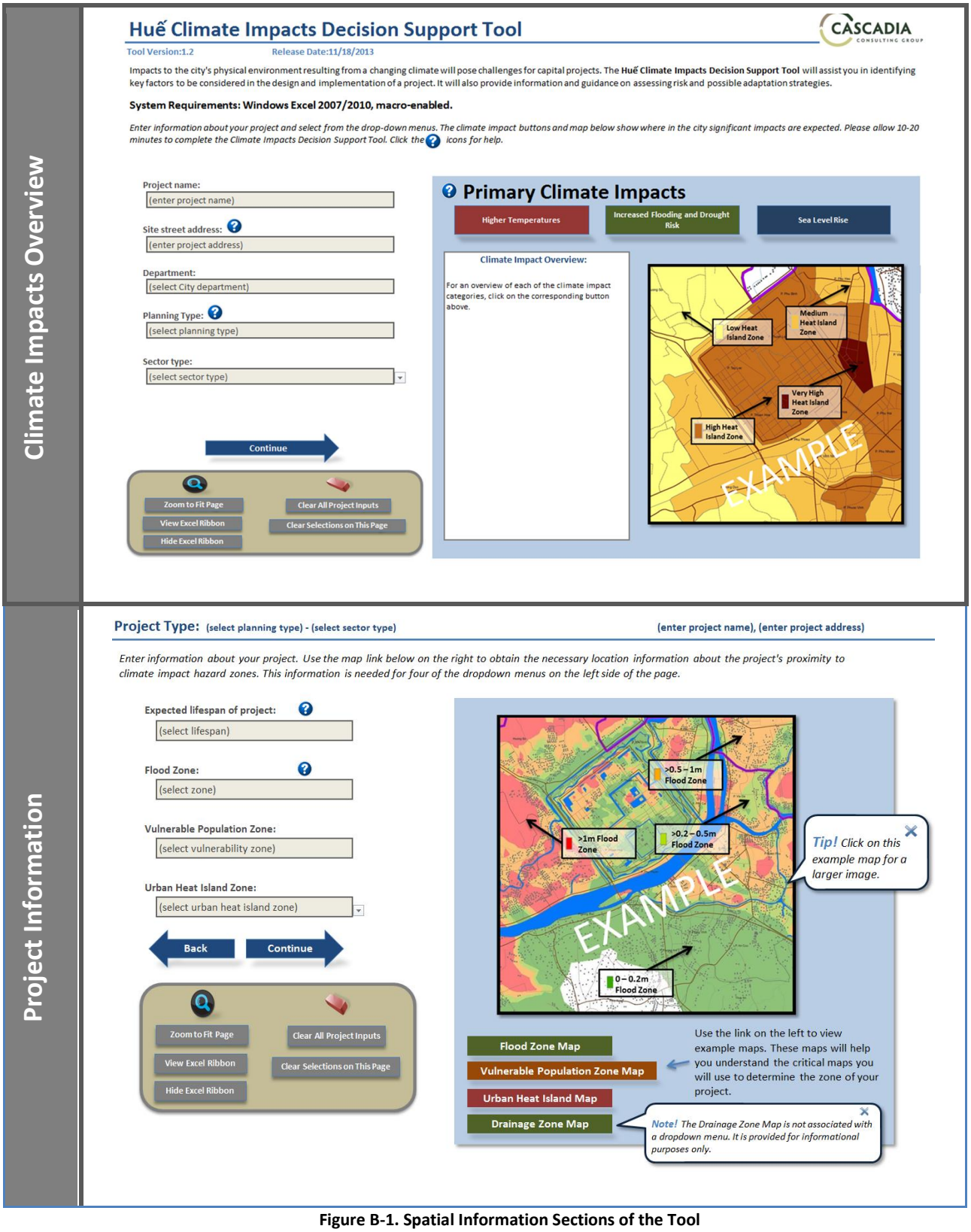


Figure B-1. Spatial Information Sections of the Tool

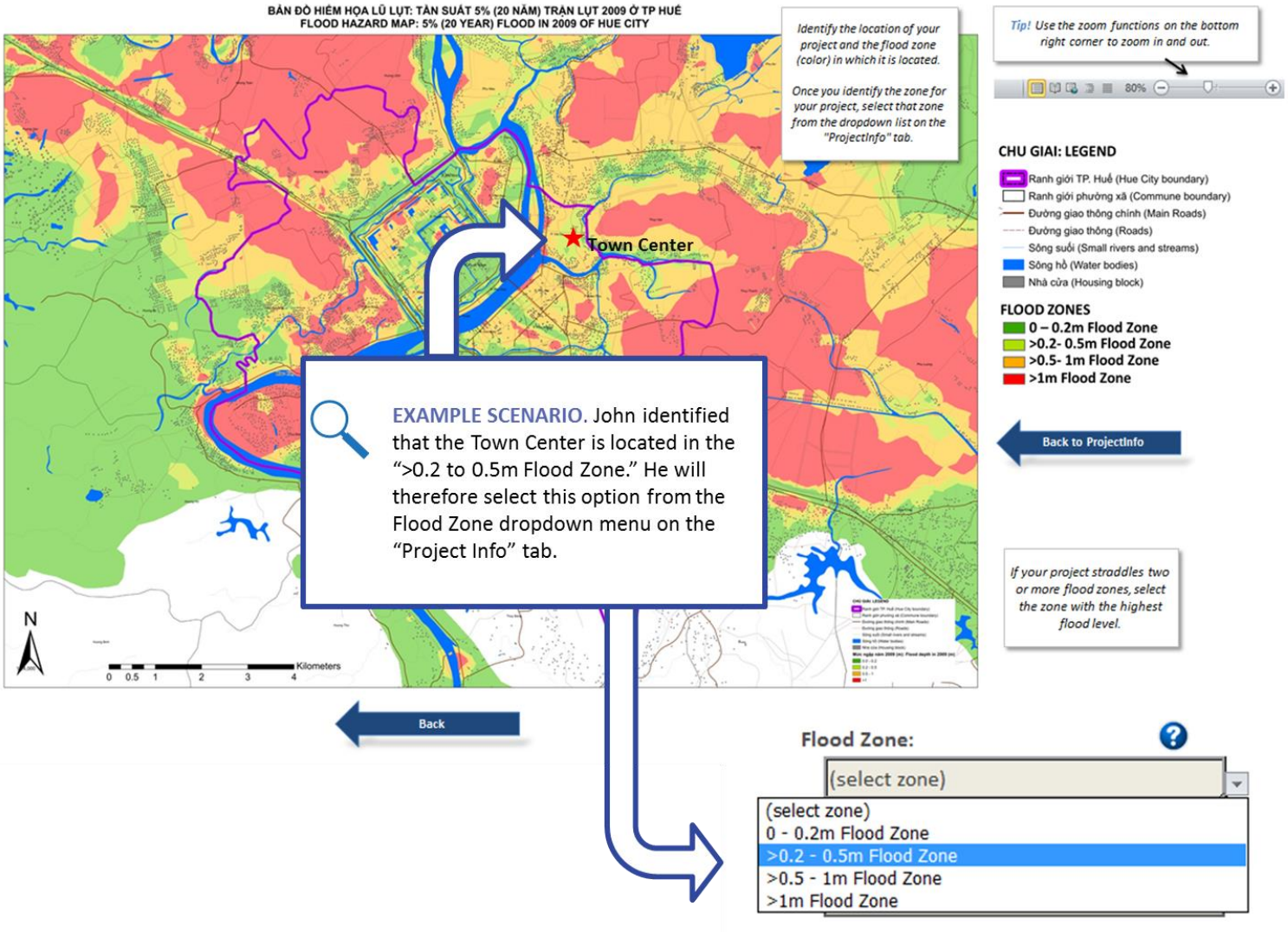


Figure B-2. Detailed Maps in the Tool and their Relationship to Project Description Inputs

Maps in the *Climate Impacts Overview* section should provide an introduction to the primary climate impacts expected for the overall area (in this case, Vietnam).

Maps linked to the *Project Information* page are used to complete required project hazard inputs. Specifically, maps connected to the *Project Information page* must allow Users to identify climate hazards associated with an urban planning project. These maps may exist outside the Tool itself, such as in a web portal or GIS system, or they may reside as images, such as a pdf or jpg, directly within the Tool.

In the following sections, we describe characteristics of the Tool's climate impact maps that would be most ideal for optimized use and effectiveness.

B.4.1.1. CLIMATE VARIABLES

Currently, the pilot Hue version of CIMPACT-DST houses one citywide map for each of the following climate impacts (used both for the *Climate Impacts Overview* section and the *Project Information* page):

- Flooding – depth and duration
- Urban heat island
- Vulnerable populations

Because the Vietnam CIMPACT-DST will span a much wider geographic area than the Hue CIMPACT-DST, the national Tool will need to include additional climate impacts. For example, although we did not need to include sea level rise maps for the city of Hue (the city is not at risk of direct inundation), we will need to incorporate such maps into the national Tool. Specifically, we plan to incorporate spatial information on the following primary climate impacts, as available:

- Temperature (e.g., changes in annual and seasonal temperatures, temperature extremes, and urban heat islands)
- Precipitation (e.g., changes in annual and seasonal rates, extremes, including changes in flood depths and drainage rates if local hydrological studies are available),
- Sea level rise (e.g., low and high inundation scenarios, salinity intrusion)

The following additional secondary impacts may also be included, where spatial data are available:

- Known erosion/landslide zones
- Vulnerable population zones

This initial assessment revealed that a large amount of needed spatial information may not currently be available for all areas of the country at a sufficient level of detail. **We will incorporate what is reasonably available and establish a foundation for incorporating further information should it become available.**

The Role of Spatial Information in CIMPACT-DST

The primary use for spatial information within or linked to the Tool is to identify the extent to which a planning area may be exposed to future climate hazards. This identification is most commonly conducted through consultation of spatial information in the form of *maps*. But it could also be done through the use of *local, anecdotal knowledge* of common local hazard areas.

For example, if urban heat island maps are not available for a planning area, then the Tool User could discuss with local representatives, citizens, or experts the areas of the jurisdiction that are known to experience extreme temperatures. The User would then specify in the Tool whether or not their planning area is in a known "heat island" area.

In this document, we explore the availability of spatial information in the form of maps. One should remember, however, that in the absence of maps, anecdotally-sourced spatial information could also consulted for the Tool's climate hazard identification process.

Ideally, the series of maps referred to in this document and used with the national level CIMPACT-DST will be housed within a dedicated web-based map portal that is accessible by Tool Users. This could be a simple web repository of static climate exposure maps (pdf or jpeg files) covering all provinces, or a more advanced web-GIS platform with the appropriate climate exposure GIS layers viewable at a variety of scales, depending on the planning application (regional, general, detailed).

Climate Map Characteristics: Defined

Our discussion of climate impact maps in the Tool may reference the following characteristics:

- **Climate Variable** refers to the specific type of climate impact being measured
- **Seasonality** refers to the seasonal timeframe in which the climate variable is presented (annual versus seasonal changes)
- **Scope** is the geographic coverage represented (the entire nation versus one region)
- **Resolution** is the spatial granularity of the climate model (e.g., "intra-provincial" resolution means that the data model can detect differences within a province)
- **Timeframe** refers to the temporal resolution of the climate data (future years for which climate impacts have been predicted)
- **Scenario** refers to the scenario used by the underlying climate model to predict future human behavior (ranging from A1FI, which assumes high levels of future fossil fuel use, to B2, which assumes a more sustainable and environmentally conscious future world economy)

B.4.1.2. SCALE AND RESOLUTION

According to Vietnam Decree No. 08-2005 ND-CP, urban planning projects in Vietnam generally require maps that range from 1:2,000 scale for detailed/zoning planning to 1:50,000 scale for provincial regional planning (Table B-1 and Figure B-3 on the following pages). It is important to note that these scales assume consistently sized maps, which means that scale and resolution can be considered interchangeable. Thus, regional planning maps have lower resolution requirements than general planning maps, which have lower resolution requirements than detailed/zoning maps, and so on. Please see the "Understanding Image Scale and Resolution" textbox for a discussion on the difference between map scale and resolution.

Table B-1. Scope and Scale of Maps for Urban Planning in Vietnam

Planning Type	Scope	Scale
Provincial Regional	Single Province	1:25,000 – 1:50,000
General	Single Municipality	1:5,000 – 1:25,000
Detailed/Zoning	Single District	1:2,000 – 1:5,000
Specialized Technical Infrastructure	Single Municipality	1:5,000 – 1:25,000

Although the above scales are required of urban planning maps, they are not necessarily required for the climate impact maps in the Tool. The difference is in their underlying objectives: while urban planning maps must be of sufficient detail to inform the design or direction of more detailed urban or construction plans, Tool climate impact maps must only be of sufficient detail for identifying the projected climate impacts of a planning area.

Understanding Image Scale and Resolution

Both "scale" and "resolution" influence the detail that can be seen on an image or map; however, it should be noted that the two terms are not synonymous.

The *scale* of an image or map refers to the relative difference in size or distance between two features on an image and on the ground. For example, a scale of 1:100,000 means 1 cm on the map equals 100,000 cm (1 km) on the ground.

The *resolution* of an image or map usually refers to spatial resolution, which is an indication of the size of a pixel in terms of ground dimensions. For example, a spatial resolution of 30 meters means that one pixel represents an area 30 m by 30 m.
Spatial resolution provides an indication of the *potential* detail of an image. The *actual* detail of an image is a combination of the image's spatial resolution and the scale at which the image is printed or viewed.

For example, if a high-resolution image (e.g., 1-m resolution) is printed at a small scale (e.g., 1:500,000), then the detail of that image will be minimal because it is printed too small. Likewise, if a low-resolution image is printed at a large scale, then the detail will still be minimal because the extra detail will be lost through large, individual pixels.

Although one could keep increasing the scale at which an image is viewed, there is a point at which individual pixels can be seen, and increasing the scale beyond that point does not provide any increase in detail. At this point, the image becomes so coarse that it could be difficult to interpret.

Source: Biodiversity Informatics Facility

Resolution of Climate Data

For climate models, spatial resolution refers to the size (in degrees latitude and longitude or in km or miles) of the grid cells in the climate model. The spatial resolution – or pixel size – of a climate impact map is therefore limited by its underlying climate model. The generation of high spatial resolution outputs from climate models requires much more computing power than lower resolution outputs. As a general rule, increasing the resolution of a model by a factor of two means about ten times as much computing power will be needed.

Due to this computing power limitation, many modern global climate models (GCMs) generate spatial resolutions that range from 250 to 600 km. Models used to generate the 2007 IPCC Assessment Report, for example, used a 110-km wide grid cell.

Techniques known as "downscaling" have allowed for the generation of finer resolution climate information from coarser GCM outputs. By understanding the relationships between local and large-scale climate, downscaling can provide more realistic scenarios of climate change at finer spatial resolutions than GCMs. Generally, spatial downscaling techniques can be divided into empirical/statistical methods, statistical/dynamical methods, and higher resolution modelling, such as regional climate modeling (RCMs).

IMHEN's 2012 *Climate Change, Sea Level Rise Scenarios for Vietnam* report used a statistical downscaling method to estimate climate impacts at the provincial and sub-provincial levels. This technique allowed for climate model outputs with a relatively high 25-km spatial resolution.

Source: Environment Canada, National Center for Atmospheric Research

Climate Impact Overview Maps

Because the *Climate Impacts Overview* section of the Tool provides a high-level overview of climate impacts, it need not be of high detail. National- or regional-level primary impact maps would suffice for this section of the Tool.

Project Information Maps

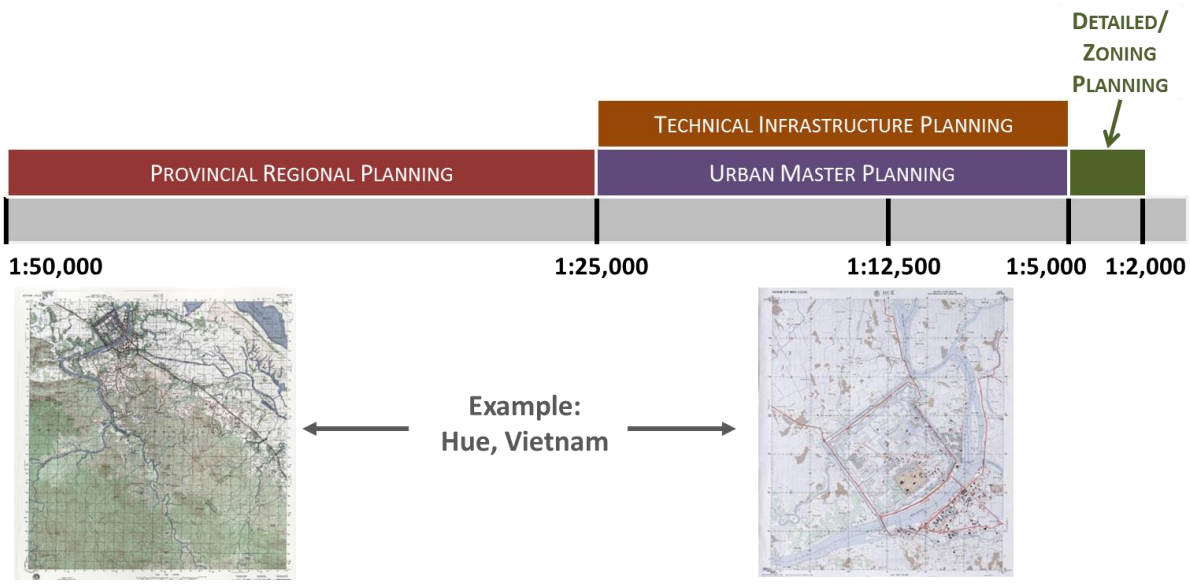
Urban planning projects for the Tool will vary in spatial scope from provincial regional planning, which comprises a single province, to detailed/zoning planning, which comprises a single district. Due to this variation, the resolution most appropriate for these maps in the Tool will vary by planning type.

Because the primary objective for Tool Users will be to identify the projected climate impacts associated with their planning area, the resolution of Tool maps would ideally allow for, at the very least, variation in climate impacts among planning areas. For example, if the planning area is the entire province of Thua Thien Hue, then a single pixel of the climate impact map should be *at most* the size of the province (this is referred to as "inter-provincial" resolution).

The climate impact maps in the Tool would therefore ideally have *at least* inter-provincial resolution for provincial regional planning (≤30 km) and *at least* inter-municipal resolution for general and specialized technical infrastructure planning (≤5 km) (as depicted in Figure B-4 on page 67). The Tool maps would ideally also have intra-zonal or intra-district resolution for detailed/zoning planning; however, the constraints of climate models limit this possibility.

Ultimately, the resolution of a climate impact map will be limited to that of the underlying climate data or model (see "Resolution of Climate Data" textbox). For the Tool, available IMHEN spatial data are based on climate model statistical downscaling that is resolved to the 25-km level (IMHEN, 2012). Therefore, all Tool maps based on these IMHEN data will be limited to this resolution.

Figure B-3. Scales of Maps for Urban Planning in Vietnam



B.4.1.3. SCOPE

As possible, the Tool (or associated map portal) will contain maps that collectively cover the entirety of Vietnam. Ideally, those maps would allow for sufficiently detailed viewing of the 58 provinces, 5 centrally-controlled cities, and over 760 provincial cities, towns, and townships throughout the country. [3] An overview of these locations and their relationships to Vietnam's planning types is depicted in Figure B-4 on the following page.

3 For determining climate hazard exposure specifically for detailed/zoning planning, Tool Users will be asked to use the municipal-level maps for climate impact identification.

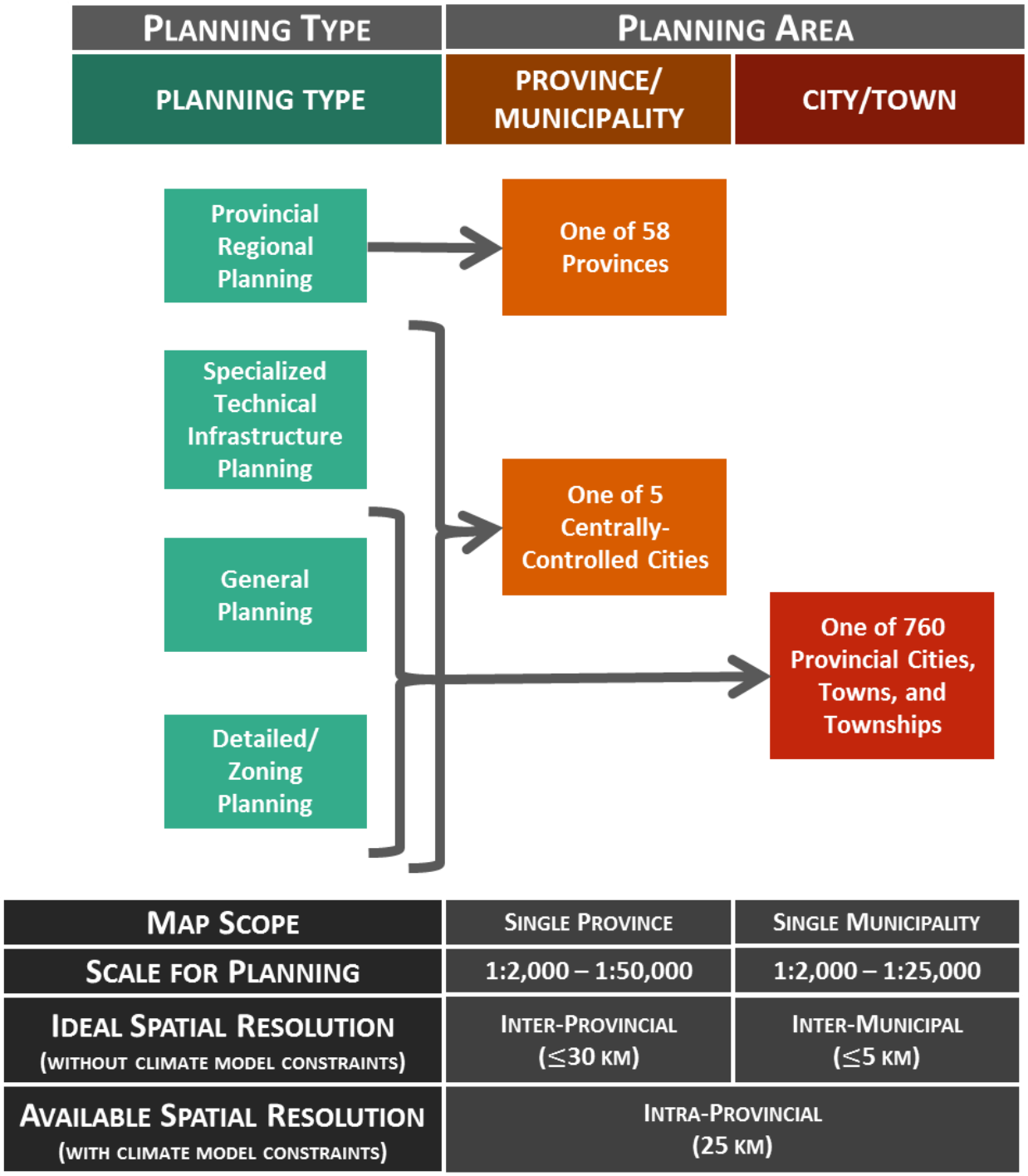


Figure B-4. Locations Covered by the Tool's Maps, their Relationship to Planning Types, and Implications for Map Resolution and Scale

B.4.1.4. MAP ATTRIBUTES/LAYERS

The attributes, or layers, for inclusion in the climate impact maps vary by planning and climate impact type. Table B-2 on page 69 describes the layers that we recommend including in the Tool's climate impact maps and their relative priorities for optimizing Tool use.

B.4.1.5. HIGH PRIORITY LAYERS

At a minimum, we recommend including the following layers in the Tool's associated climate impact maps, each of which contribute significantly toward identifying climate hazards associated with a Tool User's planning area:

- Climate impacts (as defined on page 61)
- Provincial boundaries
- City/district boundaries
- Commune boundaries (for all but regional provincial planning)

Tool Users will be able to reference available spatially-referenced climate information to determine whether their project is within a known climate hazard zone. Once this is determined, the Tool can be used independently of any additional spatial data to produce impact summaries and recommendations. The number of climate hazard types a Tool User can evaluate will depend on both climate data availability for that particular location and the project's proximity to nearby climate hazard zones that have been mapped (either through modeling or historical observations).

Administrative boundaries, such as provincial, city, district, and commune boundaries, can assist a Tool User in orienting a project's location in relation to a climate hazard zone; although, if other spatial data are more readily available (e.g., topographic features, aerial photos, road networks and waterways), then those can often be effectively used to orient a project's location in relation to a climate hazard zone.

B.4.1.6. OPTIONAL LAYERS

Other layers that may be considered for inclusion, but are not crucial to the Tool's use, include the following:

- Roads and waterways (helpful for determining proximity to climate hazard zones)
- Topography (helps to clarify flooding and erosion/landslide maps)
- Land use classifications (e.g., agriculture, forest, urban)
- Sector-specific infrastructure systems (e.g., electricity, wastewater)
- Current spatial development orientations and land use plans (e.g., agricultural zones, tourism zones)
- Current infrastructure plans (e.g., transportation system plans)

These optional layers could be included as part of the climate impact maps, but only insofar as they do not encumber the Tool or reduce the efficiency of its use. The Tool is to be used as a factor for consideration in the development of an urban or construction plan.; it is not meant to replace the urban planning process itself, which requires the development and consultation of separate topographic, land use, and infrastructure maps, for example. We therefore recommend that factors such as these be considered and spatially represented separately from the Tool.

Table B-2. Ideal Map Layers

This table describes the ideal maps and layers for inclusion in the Tool.

Planning Type	Map	Ideal Resolution	Climate Impact	Provincial boundaries	City/district boundaries	Commune boundaries	Roads and waterways	DEM (Topography)	Land Use	Existing Sector-specific Infrastructure System	Current spatial development orientations, land use & infrastructure plans
Provincial Regional Planning	Temp (avg/extreme)	30 km	×	×	×		×		×	×	×
	Temp (urban heat islands)		×	×	×		×		×	×	×
	Precip (seasonal/annual)		×	×	×		×	×	×	×	×
	Precip (flooding)		×	×	×		×	×	×	×	×
	SLR, inundation		×	×	×		×	×	×	×	×
	SLR, salinity intrusion		×	×	×		×		×	×	×
	Erosion/landslides		×	×	×		×	×	×	×	×
	Vulnerable populations		×	×	×		×		×	×	×
Urban Master Planning/ Specialized Technical Infrastructure Planning	Temp (avg/extreme)	5 km	×		×	×	×		×	×	×
	Temp (urban heat islands)		×		×	×	×		×	×	×
	Precip (seasonal/annual)		×		×	×	×	×	×	×	×
	Precip (flooding)		×		×	×	×	×	×	×	×
	SLR, inundation		×		×	×	×	×	×	×	×
	SLR, salinity intrusion		×		×	×	×		×	×	×
	Erosion/landslides		×		×	×	×	×	×	×	×
	Vulnerable populations		×		×	×	×		×	×	×
Detailed/ Zoning Planning	Temp (avg/extreme)	<5km	×		×	×	×		×	×	×
	Temp (urban heat islands)		×		×	×	×		×	×	×
	Precip (seasonal/annual)		×		×	×	×	×	×	×	×
	Precip (flooding)		×		×	×	×	×	×	×	×
	SLR, inundation		×		×	×	×	×	×	×	×
	SLR, salinity intrusion		×		×	×	×		×	×	×
	Erosion/landslides		×		×	×	×	×	×	×	×
	Vulnerable populations		×		×	×	×		×	×	×

Key:

(blank) Inclusion is not needed

× Ideal to include

High priority for tool

B.4.2. ASSESS AVAILABILITY

The following sections describe the current and potential availability of maps that can be used with the Tool. First, we provide a summary of current availability across climate impact types. The sections that describe availability specifically for each climate impact type. A summary of current map availability across climate impact types is provided in Table B-3on page 86. The concluding section, "Availability Implications," explores what our findings on current availability might mean for the types and number of maps that could ultimately be linked to the Tool.

B.4.2.1. SHARED CHARACTERISTICS OF CURRENTLY AVAILABLE MAPS

At this time, the majority of maps to which our team has access are only available in pdf format derived directly from IMHEN reports (see Table B-3on page 86). Although originally developed using GIS software, copies of these maps in customizable GIS-compatible formats are not currently available (for more information on the availability of customizable formats, see Plan for Acquisition on page 88).

A new policy, Decision No. 2623 QD-TTg on Urban Development Response to Climate Change 2013-2020, may soon make detailed, GIS-compatible formats of IMHEN's spatial information more available. Part of the policy calls for MONRE (the parent organization of IMHEN) to assist in developing an "Urban and Climate Atlas" mapping system for urban climate risks, to be completed by 2020. Because the details and development timelines of these maps is not yet known, however, we assume in this assessment that only currently-available IMHEN spatial information will be accessible for the initial few years of Tool deployment.

The majority of available maps are also limited to a relatively coarse spatial resolution. According to MONRE's 2012 *Climate Change, Sea Level Rise Scenarios for Vietnam* report, statistical downscaling of climate models allowed for climate impacts to be projected at a 25-km spatial resolution. **All currently available climate impact maps described in this document are therefore limited to this resolution.**[4]

Other local or regional climate studies exist that may provide more detailed and higher-resolution climate impact projections than those provided by the IMHEN reports. For example, the Japanese International Cooperative Agency (JICA) conducted a detailed hydrological study that produced anticipated flood impact maps for Thua Thien Hue Province that discerns impacts down to the street-level (see Figure B-5 below). The recent 2013 Climate Adaptation Strategy for Ho Chi Minh City also provides high-resolution climate impact information, including spatial projections for anticipated land subsidence and flooding that is resolved to the district-level (Vietnam Climate Adaptation Partnership (VCAPS) - constortium, 2013). **We will strive to incorporate these and other local sources, as available. However, we expect that many of these local studies will not be integrated as part of the Tool's initial deployment due to limited ability to identify, vet, and customize such spatial information within the project's allotted time and budget.**

[4] A 25-km resolution represents a best-case scenario. Unless the original GIS-based images can be obtained, the map resolution will be limited to that of the available pdf-based map.

Table B-3. Current Identified Sources of Climate Impact Spatial Information

Source	Climate Impact	Scope	Resolution
IMHEN Sources			
IMHEN (2012): *Climate Change, Sea Level Rise Scenarios for Vietnam*	Temperature	Entire Country	Intra-provincial (25 km)
	Precipitation	Entire Country	Intra-provincial (25 km)
	Sea Level Rise Inundation	Coastal Provinces	Intra-district (≤25 km)
IMHEN (2010): *Impacts of Climate Change on Water Resources and Adaptation Measures*	Flooding	4 water basins (Ba, Thu Bon, Dong Nai, Cuu Long)	2 intra-district 2 intra-provincial
	Sea Level Rise Salinity Intrusion	Cuu Long Basin	
IMHEN (2010): *Sea Level Rise Scenarios and Possible Risk Reduction in Vietnam*	Sea Level Rise Salinity Intrusion	2 water basins (Red, Mekong)	Intra-provincial
Other Sources			
JICA (2011): *Integrated Flood Management Plan of Huong River Basin, Thua Thien Hue Province (IFMP) to 2020*	Flooding	City of Hue	Intra-district
VCAPS-consortium (2013): *Climate Adaptation Strategy for Ho Chi Minh City*	Subsidence (Flooding)	Ho Chi Minh City	Intra-district

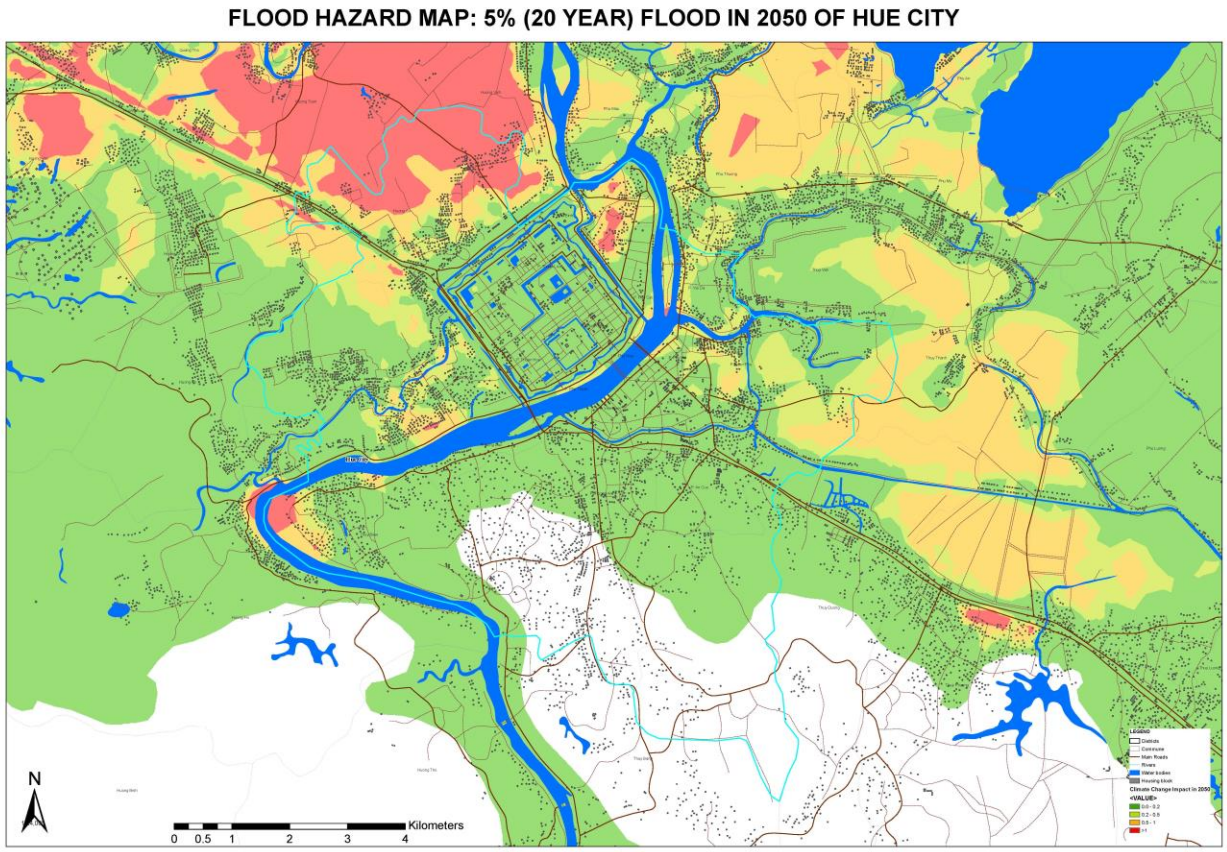


Figure B-5. Flood Hazard Map for Hue, Vietnam[5]

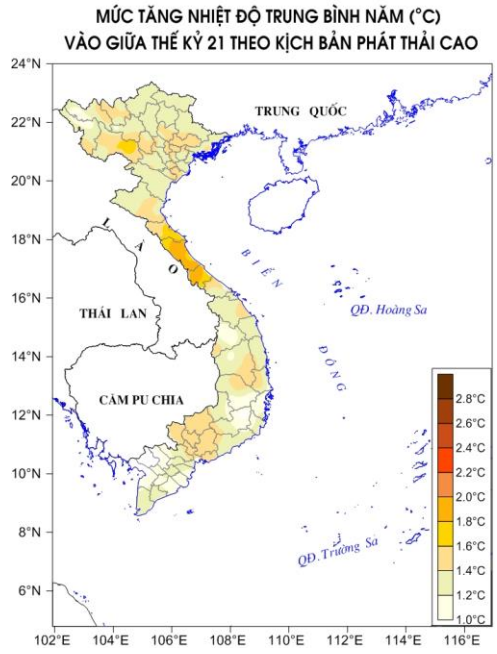
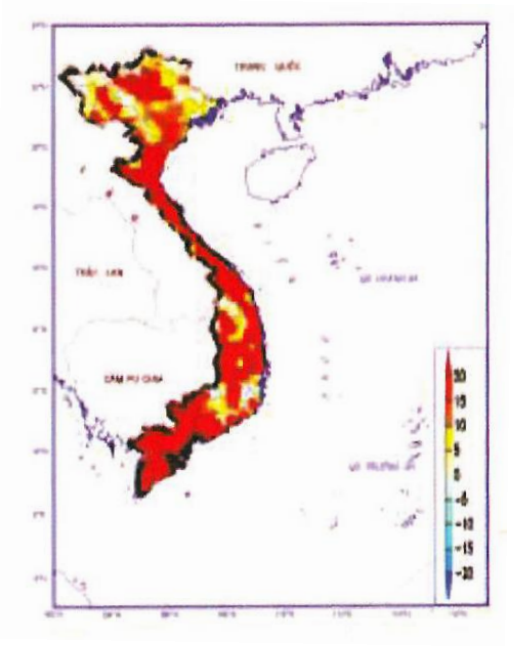
[5] Source: Japanese International Cooperative Agency (2011)

.4.2.2. TEMPERATURE

IMHEN's 2012 *Climate Change, Sea Level Rise Scenarios for Vietnam* report provides many national-level maps on anticipated temperature changes due to climate change, including the following climate variables (also see Figure B-6 below):

- Change in average daily average, low, and high temperature (°C)
- Change in number of days above 35°C

Figure B-6.Examples of Available Temperature Maps

Change in Daily Average Temperature to 2050, A2 Scenario	Change in Number of Days > 35°C to 2100, B2 Scenario
	

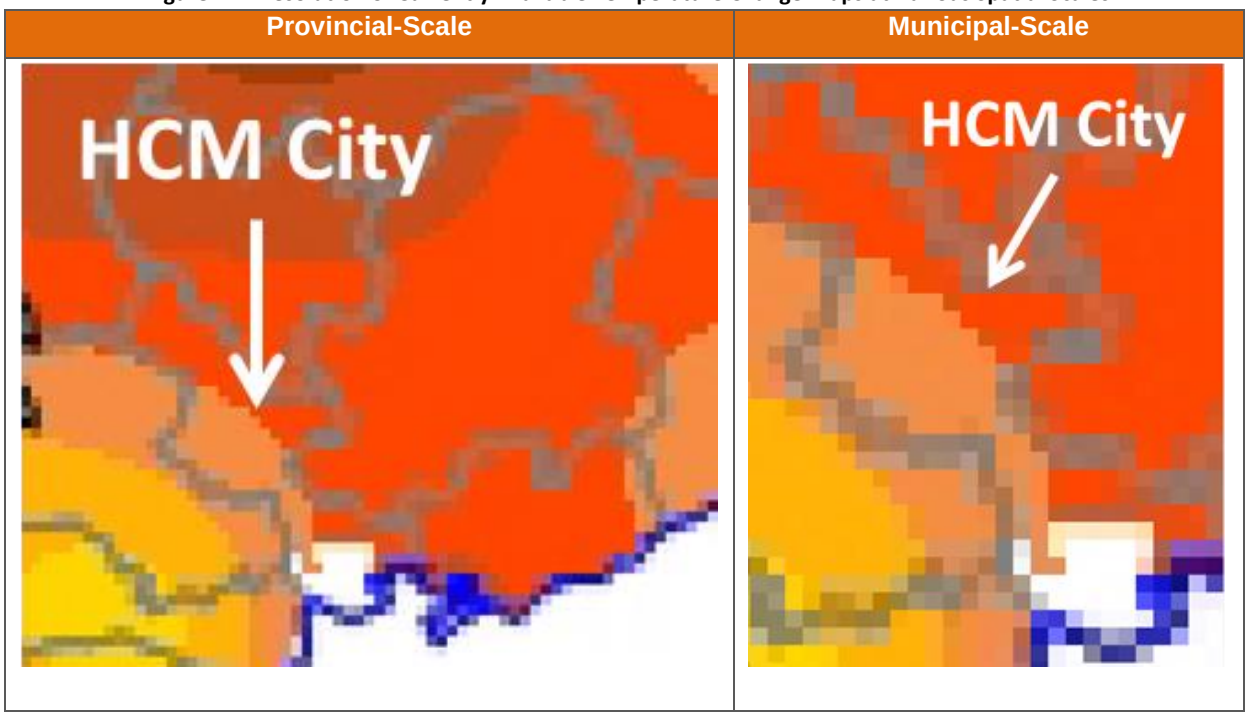
Annual and seasonal average daily temperature maps are available for years 2050 and 2100 for the B1, B2, and A2 scenarios (see Table B-4 below). Annual and seasonal maps for average daily low and high temperatures are also available for years 2050 and 2100, but only for the B2 scenario. The extreme temperature map is only available for year 2100 and the B2 scenario.

Table B-4. Summary of Available Temperature Maps

Climate Variable	Seasonality	Scope	Resolution	Timeframe	Scenario(s)
Avg. Daily Avg. Temp (Δ°C)	Annual, Seasonal (4)	Vietnam	Intra-provincial	2050, 2100	B1, B2, A2
Avg. Daily Low Temp (Δ°C)	Annual, Seasonal (2)	Vietnam	Intra-provincial	2050, 2100	B2
Avg. Daily High Temp (Δ°C)	Annual, Seasonal (2)	Vietnam	Intra-provincial	2050, 2100	B2
Days >35°C (# days)	Annual	Vietnam	Intra-provincial	2100	B2

The intra-provincial resolution of these maps may be appropriate for provincial regional planning and, if "zoomed" to the municipal level, for general and specialized technical infrastructure planning (see Figure B-7 below). The resolution of these maps is likely not ideal for identifying district-scale impacts for detailed/zoning planning.

Figure B-7. Resolution of Currently Available Temperature Change Maps at Various Spatial Scales



The spatial resolution of the seasonal and extreme temperature change maps is much lower than that of the average temperature change maps (see Figure B-6). It is possible that the original GIS versions of these maps are much higher resolution (~25 km) than shown in the currently available pdf. We will therefore work with IMHEN to obtain the original, higher-resolution data. However, for the time being, because each map covers the entirety of Vietnam, they would be appropriate for use in the *Climate Impacts Overview* section of the Tool.

IMHEN's temperature maps depict anticipated temperature change zones and provincial and national boundaries. At this time, no maps have been identified that contain overlays of roads, waterways, land uses, infrastructure systems, or spatial development orientations.

Although currently available temperature projections are at a relatively coarse granularity (e.g., intra-provincial resolution), the identification of more nuanced district-scale temperature risks is possible. By applying local knowledge of current district-scale temperature fluctuations (e.g., "this area of the city tends to be hotter than others"), one could identify local urban heat islands (UHI) and areas where temperature changes may present serious risks to infrastructure and human health (see "The Role of Spatial Information in CIMPACT-DST" textbox on page 62).

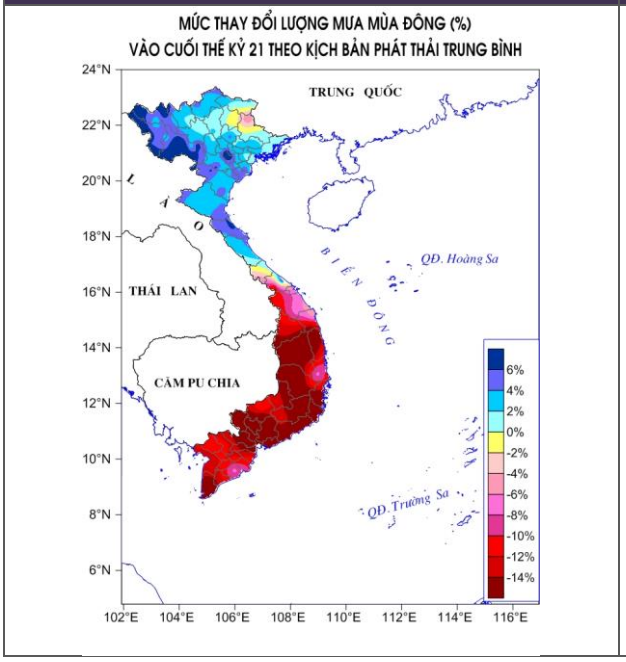
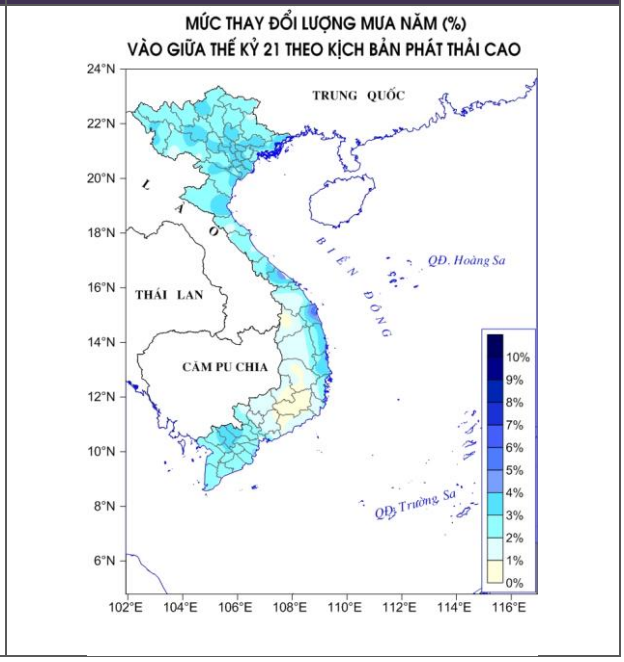
Aside from the anecdotal development of urban heat island profiles, there are currently no comprehensive or single-study sources of urban heat island information for Vietnam. If possible, obtaining remote sensing data from NASA may be a viable option for including urban heat island spatial information in the Tool.

B.4.2.3. PRECIPITATION

Currently, there is no comprehensive spatial dataset for precipitation-driven flooding. IMHEN's 2012 *Climate Change, Sea Level Rise Scenarios for Vietnam* report provides the following national-level maps on percent rainfall changes anticipated with climate change (also see examples in Figure B-8 below):

- Change in annual and seasonal rainfall (%)
- Change in maximum daily rainfall (%)

Figure B-8. Examples of Available Precipitation Maps

Change in Total Winter Rainfall (%) to 2100, B2 Scenario	Change in Annual Rainfall (%) to 2050, B2 Scenario
	

Annual and seasonal total precipitation maps are available for years 2050 and 2100 for the B1, B2, and A2 scenarios (see Table B-5below). The extreme precipitation map is only available for year 2100 and the B2 scenario. New data from IMHEN on precipitation extremes is anticipated later in 2014.

Table B-5. Summary of Available Precipitation Maps

Climate Variable	Seasonality	Scope	Resolution	Timeframe	Scenario(s)
Rainfall (% change)	Annual, Seasonal (4)	Vietnam	Intra-provincial	2050, 2100	B1, B2, A2
Maximum Daily Rainfall (% change)	At 2100	Vietnam	Intra-provincial	2100	B2

The intra-provincial resolution of the available precipitation maps may be appropriate for provincial regional planning and, if "zoomed in" to the municipal level, for general and specialized technical infrastructure planning (similar to that shown for temperature in Figure B-7). The resolution of these maps is likely not ideal for identifying district-scale impacts for detailed/zoning planning. However, because these maps cover the entire country, they could perhaps also be useful for the *Climate Impacts Overview* section of the Tool.

IMHEN's precipitation maps depict anticipated precipitation change zones and provincial and national boundaries. At this time, no maps are available that also contain overlays of roads, waterways, land uses, infrastructure systems, or spatial development orientations.

B.4.2.4. PRECIPITATION-DRIVEN FLOODING

IMHEN has also conducted studies in select basins on projected precipitation- and sea level rise-driven flooding. Maps for the Thu Bon, Ba, Dong Nai, and Cuu Long deltas show projected flooding in future year scenarios (see Table B-6 and Figure B-9 below, from IMHEN's 2010 *Impacts of Climate Change on Water Resources and Adaptation Measures* report). Two of the maps – for the Thu Bon and Ba River basins – are at district-level scales, while the Dong Nai and Cuu Long delta maps are at the regional or provincial-level scales.

Other "unofficial" detailed flooding studies may also be available. For example, the JICA Integrated Flood Management Plan conducted for Thua Thien Hue Province provides future 20-year flood depths under the B2 scenario (Japanese International Cooperation Agency, 2011). The recent 2013 Climate Adaptation Strategy for Ho Chi Minh City also provides maps of future ground subsidence with expected declines in groundwater (Vietnam Climate Adaptation Partnership (VCAPS) - constortium, 2013).

Table B-6. Summary of Available Precipitation-Driven Flooding Maps

Climate Variable	Scope	Resolution	Timeframe	Scenario(s)
Flooding	Thu Bon, Ba, Dong Nai, and Cuu Long delta	Intra-basin (2 district-level, 2 region-level)	Various	Various
	Thua Thien Hue Province	Intra-district	2050, 2100	B2

The available precipitation-driven flooding maps from IMHEN provide more detailed attribute layers than the precipitation-only or temperature maps, with some district-level boundaries and DEM-derived elevation layers included.

Flooding in Select River Basins

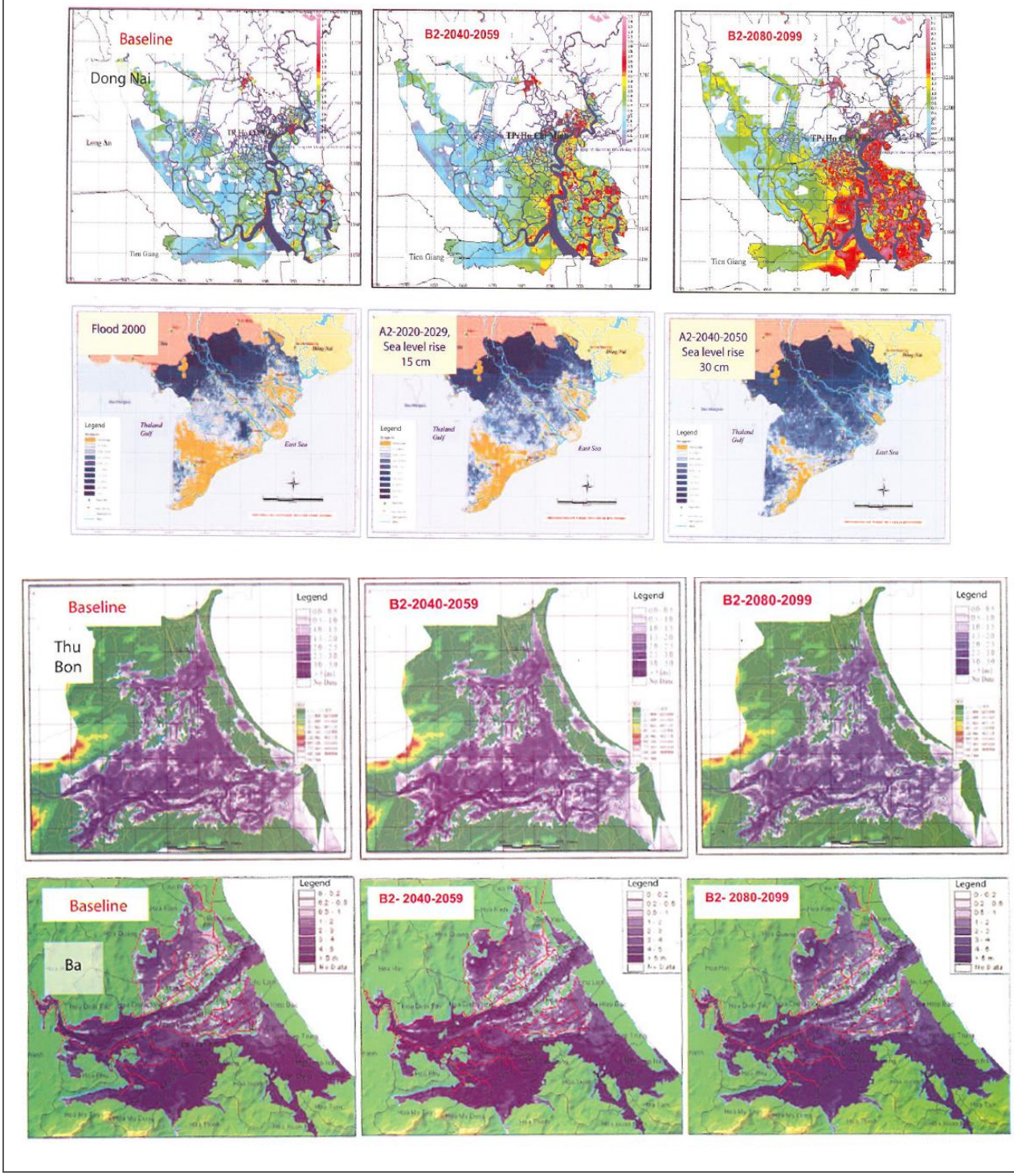


Figure B-9. Examples of Available Flooding Maps

IMHEN's 2012 *Climate Change, Sea Level Rise Scenarios* report provides regional, provincial, city, and district-level maps of projected sea level rise inundation for all coastal provinces and municipalities. Maps are available in 10-cm increments for 50-100cm sea level rise (see example maps in Figure B-10 below). The years associated with these inundation levels are provided in the 2012 *Climate Change, Sea Level Rise Scenarios* IMHEN report, which indicates ranges of sea level rise (in cm) for every decade from 2020 to 2100 for the B1, B2, and A1FI model scenarios (see Table B-7 for an example of the B2 scenario table).

Figure B-10. Examples of Available Sea Level Rise Inundation Maps

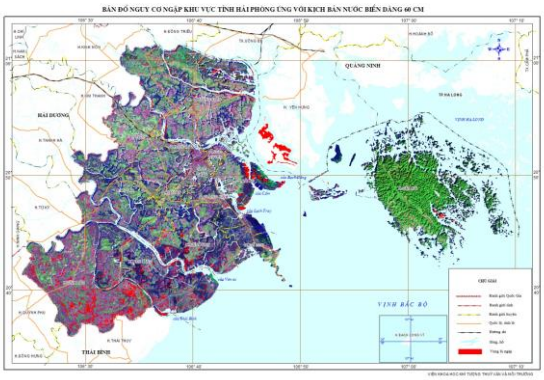
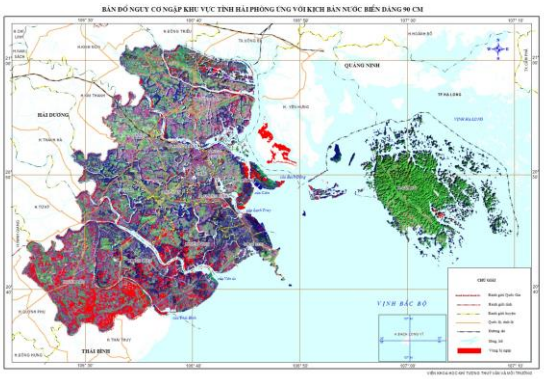
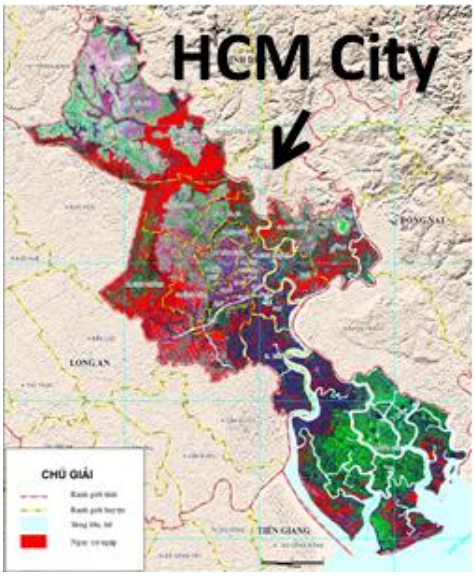
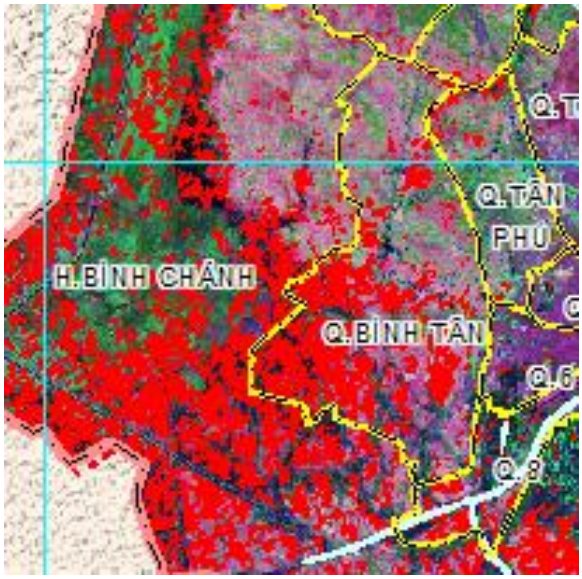
Inundation in Hai Phong Province with 60-cm Sea Level Rise	Inundation in Hai Phong Province with 90-cm Sea Level Rise
	

Table B-7. IMHEN 2012 Sea Level Rise Projections for B2 Scenario

Region	Decades in the 21th century								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
Móng Cái-Hòn Dáu	7-8	11-12	15-17	20-24	25-31	31-38	36-47	42-55	49-64
Hòn Dáu-Đèo Ngang	7-8	11-13	15-18	20-24	25-32	31-39	37-48	43-56	49-65
Đèo Ngang-Đèo Hải Vân	8-9	12-13	17-19	23-25	30-33	37-42	45-51	52-61	60-71
Đèo Hải Vân-Mũi Đại Lãnh	8-9	12-13	18-19	24-26	31-35	38-44	45-53	53-63	61-74
Mũi Đại Lãnh-Mũi Kê Gà	8-9	12-13	17-20	24-27	31-36	38-45	46-55	54-66	62-77
Mũi Kê Gà-Mũi Cà Mau	8-9	12-14	17-20	23-27	30-35	37-44	44-54	51-64	59-75
Mũi Cà Mau-Kiên Giang	9-10	13-15	19-22	25-30	32-39	39-49	47-59	55-70	62-82

With major roads, district boundaries, and topography included, these sea level rise maps should have sufficient detail for regional, general, specialized technical infrastructure, and likely zoning/detailed planning projects considered with the Tool (see Figure B-11).

Figure B-11. Resolution of Currently Available Sea Level Rise Inundation Maps at Various Spatial Scales

Municipal-Scale	District-Scale
	

B.4.2.6. SEA LEVEL RISE SALINITY INTRUSION

IMHEN has also produced basin-specific maps of projected salinity intrusion for the Mekong, Red River, and Cuu Long deltas (see Figure B-12 below, from IMHEN's 2010 *Sea Level Rise Scenarios and Possible Risk Reduction in Vietnam* report; Cuu Long delta salinity intrusion is presented in IMHEN's 2010 *Impacts of Climate Change on Water Resources and Adaptation Measures* report). The intra-provincial resolution of these maps would likely suffice for provincial regional planning, and if "zoomed" to the municipal level, for general and specialized technical infrastructure planning. The resolution may not be sufficient for identification of climate impacts within detailed/zoning planning areas.

Figure B-12. Examples of Available Sea Level Rise Salinity Intrusion Maps

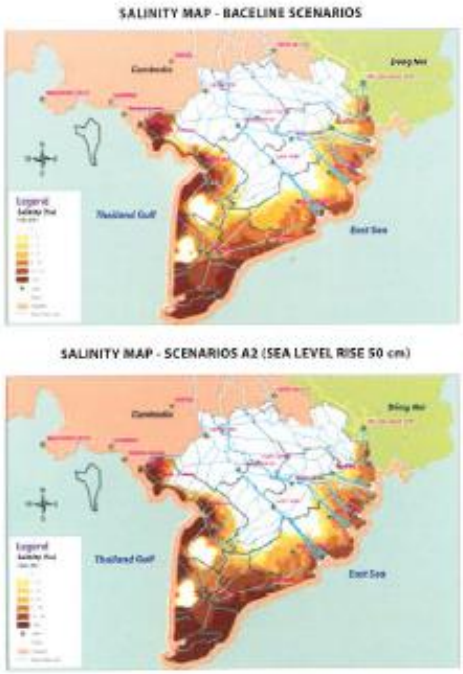
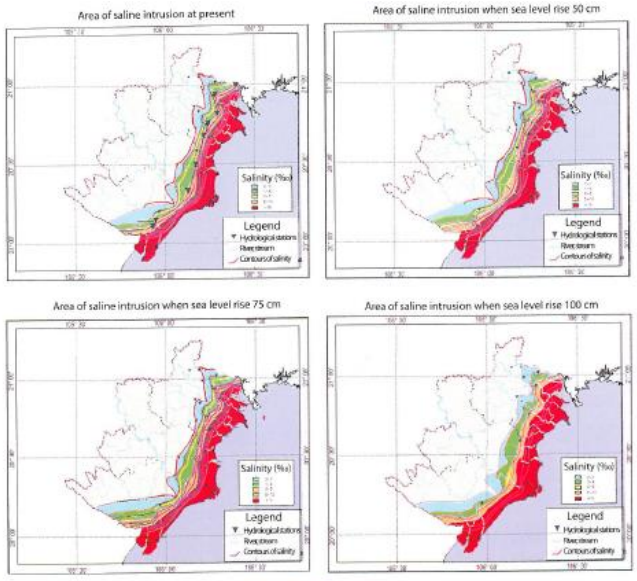
Salinity Intrusion in the Mekong River Delta, Baseline to 50-cm SLR Scenario	Salinity Intrusion in the Red River Delta, Baseline to 100-cm SLR Scenario
 Figure 3-2 Salinity contour in Me Kong delta	 Figure 3-1 Contours of salinity on the River Red River Delta

Table B-8 below summarizes the available maps for visualizing sea level rise inundation and salinity intrusion impacts.

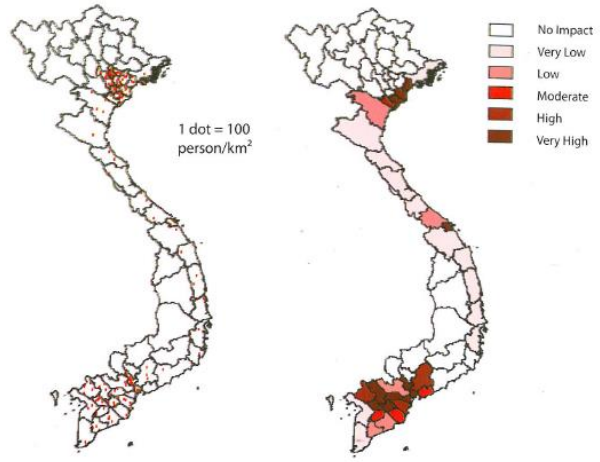
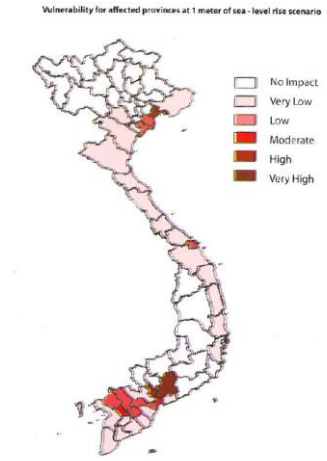
Table B-8. Summary of Available Sea Level Rise Maps

Climate Variable	Scope	Resolution	Timeframe	Scenario
Sea level rise (permanently inundated areas)	Coastal Vietnam (40 provinces)	Intra-district	Not specified (50 – 100cm, in 10-cm increments)	B1, B2, A1FI
Salinity Intrusion	Red River Delta	Intra-provincial	Not specified (50,75, and 100-cm)	B2
	Mekong River Delta	Intra-provincial	Not specified (50-cm)	A2
	Cuu Long River Delta	Intra-provincial	2030, 2040, 2050 (15-33cm)	A2, B2

B.4.2.7. VULNERABLE POPULATIONS

IMHEN's 2010 *Sea Level Rise Scenarios and Possible Risk Reduction in Vietnam* report provides two national-scale vulnerability maps: 1) a *Social Vulnerability* map that depicts provincial population densities, and 2) an *Economic Vulnerability* map that depicts percent composition of GDP in commerce, services, agriculture, and industry for each province (see these two maps in Figure B-13 below).

Figure B-13.Examples of Available Vulnerable Population Maps

Social Vulnerability to Sea Level Rise, By Population Density	Economic Vulnerability to Sea Level Rise, by percent GDP in Vulnerable Sectors
 Figure 4-3 Population density and social vulnerability in SLR 100 cm scenario	 Figure 4-2 Economic vulnerability in SLR scenario of 100cm

The inter-provincial resolution of the above maps may be appropriate for provincial regional planning, but would likely be insufficient for general, specialized technical infrastructure, or detailed/zoning planning. Because the only maps available cover the entire country, they could perhaps be useful for the *Climate Impacts Overview* section of the Tool.

IMHEN's vulnerable population maps depict vulnerability zones and provincial and national boundaries. At this time, no maps are available that contain overlays of district boundaries, roads, waterways, land uses, infrastructure systems, or spatial development orientations.

Table B-9. Summary of Available Vulnerable Population Maps

Climate Variable	Scope	Resolution
Social Vulnerability (Population density)	Vietnam	Inter-provincial
Economic Vulnerability (% GDP in commerce, services, agriculture, and industry)	Vietnam	Inter-provincial

B.4.2.8. EROSION/LANDSLIDES

Currently, limited-to-no spatial information exists for erosion or landslide impacts of climate change in Vietnam.

B.4.2.9AVAILABILITY IMPLICATIONS

Types and Layers of Maps
Based on our assessment on currently available climate impact maps, Table B-10 on page 85 summarizes the maps that are available to include in the *Climate Impact Overview* section of the Tool and Table B-11 on page 86 summarizes the maps and layers that are currently available for the *Project Information* page of the Tool. In general, a variety of climate impact maps are available, but most lack sufficient detail and resolution for optimized use in the Tool – especially for general and specialized technical infrastructure planning.

Number of Maps
Based on our understanding of current availability and Tool scope of use, Table B-12 on page 87 lists the number of maps that could be included for the *Project Information* pages of the Tool. The total number of maps varies from 7 to over 4,000. This variation is primarily due to uncertainty around the scope and resolution of maps available for each planning type.

If very high-resolution versions of the national-level maps become available, national-level maps could be effectively "zoomed" to needed scales, such as the provincial- or municipal-level, with a sustained ability to discern climate impacts. **If high-resolution national-level maps that can effectively "zoom" to the planning levels of interest become available, then the number of maps needed for the Tool would drop significantly.**

Given these variables and unknowns, we assessed the number of maps needed for the Tool under three scenarios:

- **Scenario 1:** Assumes that "zoomable" high-resolution national- or provincial-level maps could be appropriate for all planning types.
- **Scenario 2:** Assumes that "zoomable" high resolution national maps will not become available, and so general, specialized technical infrastructure, and detailed/zoning planning types may require separate municipal-level maps, while provincial regional planning may require separate provincial-level maps.
- **Scenario 3.** Assumes that all maps could be integrated onto one interactive online venue (e.g., online GIS interface) that allows for customized zooming and "selectable" layers.

For the initial deployment of the Tool, we will operate under Scenario 1. After initial deployment, if high-resolution national maps are not available and separate maps that "zoom" to the provincial- and/or municipal- level are needed for effective Tool use, then the number of maps integrated into the Tool will also largely depend on the **ability for either IMHEN or VIUP to create new maps that "zoom" into custom scales**. Further discussion of this topic is the following section, "Plan for Acquisition".

Table B-10. Climate Impacts Overview Maps

This table provides a summary of climate impact maps that are currently available for integration into the Climate Impacts Overview section of the Tool (pictured in the figure below).

Impact	Map(s)
Temperature	□ Annual and seasonal changes in daily average, low, and high temperatures (°C) □ Change in number of days above 35°C
Precipitation	□ Change in annual and seasonal rainfall (%) □ Change in maximum daily rainfall (%)
Sea level rise	□ Projected sea level rise inundation
Erosion/landslides	Not available

Figure B-14. Climate Impacts Overview Section of the Pilot Hue Tool

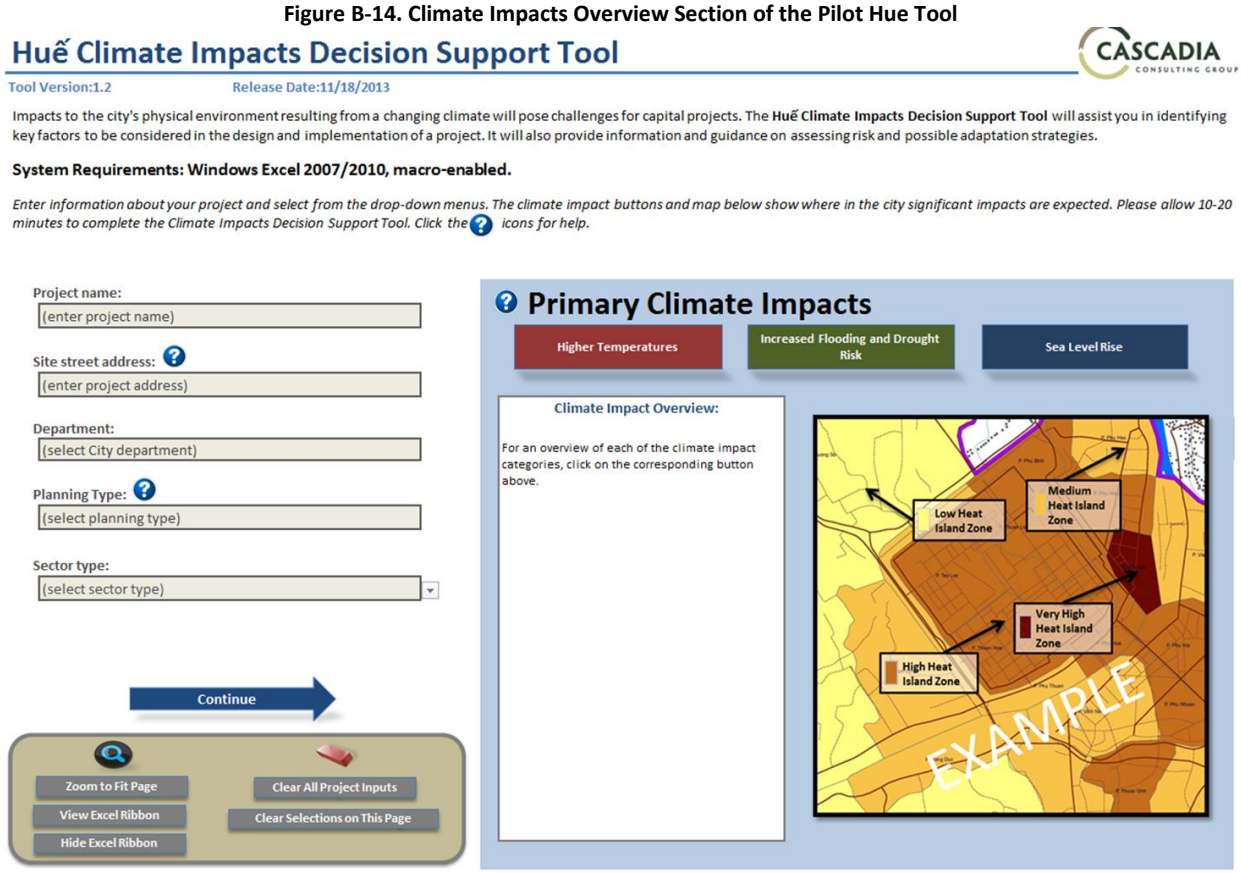


Table B-11. Summary of Currently Available Maps and Layers

This table describes the climate impact maps that are currently available (all in pdf format). It includes information on the maps' layers and the spatial extent (e.g., country-wide or only for select basins).

Key:		
area-specific*	**country-wide**	
(blank)	(blank)	Inclusion is not recommended
	×	Ideal to include, but not avail. in pdf form
○	●	Have in pdf form
		High priority for Tool

* not widely available, but local departments could fill in gaps

Planning Type	Map	Spatial Resolution of Climate Impact	Climate Impact	Provincial boundaries	City/district boundaries	Commune boundaries	Roads and waterways	DEM (Topography)	Land Use	Existing sector-specific Infrastructure System	Current spatial development orientations, land use & infrastructure planning
Provincial Regional Planning	Temp (avg/extreme)	Intra-provincial	●	●	×		×		×	×	×
	Temp (urban heat islands)	N/A	×	×	×		×		×	×	×
	Precip (seasonal/annual)	Intra-provincial	●	●	×		×	×	×	×	×
	Precip (flooding)	Intra-provincial	○	○	×		×	○	×	×	×
	SLR, inundation	Intra-district	●	●	●		●	●	×	×	×
	SLR, salinity intrusion	Intra-provincial	○	×	×		○		×	×	×
	Erosion/landslides	N/A	×	×	×		×	×	×	×	×
	Vulnerable populations	Inter-provincial	●	●	×		×		×	×	×
Master Planning/ Specialized Technical Infrastructure	Temp (avg/extreme)	Intra-provincial	●		×	×	×		×	×	×
	Temp (urban heat islands)	N/A	×		×	×	×		×	×	×
	Precip (seasonal/annual)	Intra-provincial	●		×	×	×	×	×	×	×
	Precip (flooding)	Intra-provincial	○		×	×	×	○	×	×	×
	SLR, inundation	Intra-district	●		●	×	●	●	×	×	×
	SLR, salinity intrusion	Intra-provincial	○		×	×	○		×	×	×
	Erosion/landslides	N/A	×		×	×	×	×	×	×	×
	Vulnerable populations	Inter-provincial	●		×	×	×		×	×	×
Detailed/ Zoning	Temp (avg/extreme)	Intra-provincial	×		×	×	×		×	×	×
	Temp (urban heat islands)	N/A	×		×	×	×		×	×	×
	Precip (seasonal/annual)	Intra-provincial	×		×	×	×	×	×	×	×
	Precip (flooding)	Intra-provincial	○		×	×	×	○	×	×	×
	SLR, inundation	Intra-district	●		●	×	●	●	×	×	×
	SLR, salinity intrusion	Intra-provincial	○		×	×	○		×	×	×
	Erosion/landslides	N/A	×		×	×	×	×	×	×	×
	Vulnerable populations	Inter-provincial	×		×	×	×		×	×	×

Table B-12. Project Information Maps

*This table draws from the pool of available climate impact maps to arrive at an estimate of how many maps will be needed for the Tool, as well as the number of separate pages that will be needed to house those maps (assuming that we will only direct Users to one page per impact). Estimates were generated for three potential scenarios that vary by available map resolution.*The number of municipal-scale inundation maps will be lower than 760 because not all cities/towns will be exposed to sea level rise inundation.*

Impact	Planning Level/Type			Number of Maps			Number of Pages		
	Provincial Regional	**General/ Specialized Technical Infrastructure**	**Detailed/ Zoning**	**Scenario 1.** Provincial Maps for All Planning Types	**Scenario 2.** City/Town and Provincial Maps	**Scenario 3.** Online interactive map	**Scenario 1.** Provincial Maps for All Planning Types	**Scenario 2.** City/Town and Provincial Maps	**Scenario 3.** Online Interactive map
Temperature, Average	**58-63** (1 per province)	**0 - 760** (same as regional, or zoom of city/town)	**0** (same as general and technical infrastructure planning) ←	**63**	**818**	**1**	**63**	**818**	**1**
Temperature, Extreme	**58-63** (1 per region or province)	**0 - 760** (same as regional, or zoom of city/town)		**63**	**818**	**1**			
Temperature, Urban Heat Islands	**Not Available**	**Not Available**		**N/A**	**N/A**	**N/A**			
Precipitation, seasonal/annual	**58-63** (1 per province)	**0 - 760** (same as regional, or guided to zoom of city/town)		**63**	**818**	**1**	**63**	**818**	
Precipitation, flooding	**4** (we have maps for 4 deltas - 2 are district-level and 2 are regional)	**0-8** (same as regional, or zoom of city/town)		**4**	**12**	**1**			
Sea level rise, inundation	**40** (1 per province)	**0 - 760*** (same as regional, or zoom of city/town)		**40**	**800**	**1**	**40**	**800**	
Sea level rise, salinity intrusion	**4** (we have maps for 4 deltas)	**0-20** (same as regional, or zoom of city/town)		**4**	**24**	**1**	**4**	**24**	
Erosion/landslides	**Not Available**	**Not Available**		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	
Vulnerable Populations	**58-63** (1 per province)	**0 - 760** (same as regional, or zoom of city/town)		**63**	**818**	**1**	**63**	**818**	
Total	**300**	**3,828**	←	**300**	**4,108**	**7**	**233**	**3,278**	**1**

B.4.3. PLAN FOR ACQUISITION

Our assessment of existing spatial information revealed that a large number of existing maps are of insufficient detail and resolution for most effective use with the Tool. The Cascadia team has acquired many of the existing climate impact maps in pdf form, and we are investigating options for customizing and amending these maps to improve the level of detail and resolution. Obtaining map data in GIS-compatible forms is the most preferred approach because such data are more easily customized for Tool use. However, we will seek to leverage any spatial data we receive that has primary relevance to the Tool User. It is important to recall that the primary objective of the Tool's spatial data is to determine a project's proximity to a climate exposure zone; thus, the data needs are not extensive.

B.4.3.1. CURRENT AND FUTURE LAYER AVAILABILITY

Based on our current understanding, obtaining high-resolution GIS-based spatial information that covers all 63 provinces in Vietnam may be challenging (and/or expensive). Because the release of digital data is prohibited in official government data requests, digital spatial data is generally obtained within government agencies through manual digitization of paper maps.

The following sections provide an overview of current and possible future availability of digital map layers for the Tool (also summarized in Table B-13 and Table B-14 and on pages 90 and 91, respectively). It should be noted that this assessment does not take into account the future maps that could become available through the new climate and urban planning policy, Decision No. 2623 QD-TTg.

Climate Impacts (high priority for Tool)

IMHEN maintains the official climate data layers that describe changes in sea level rise, precipitation, and temperature. Recent conversations with IMHEN indicate that higher resolution climate data beyond that which our team has already acquired may be available. Furthermore, Decision No. 2623 QD-TTg, which mandates that MONRE assist in developing a climate impact spatial information database in the coming years, will likely also add to the future availability of locally relevant, high-resolution climate impact spatial data.

Although not currently available from IMHEN, flooding and erosion hazard maps may be acquired from local departments of agriculture and rural development (DARD). However, because the process of obtaining these data would be tedious and time-consuming, VIUP recommends that they obtain and integrate these maps as needed on a project-by-project basis. Creating and providing broad access to a national level web portal of climate maps, such as the "Urban Climate Atlas" created through Decision No. 2623 QD-TTg, could be helpful in this regard.

High-resolution remote sensing data help to accurately define the spatial boundaries of urban heat islands (UHIs), though on the ground measurement or other types of proxy data can be used to designate UHIs. Although not currently available, remote sensing data may become available through a partnership program between USAID and the U.S. National Aeronautics and Space Administration (NASA). Cascadia will continue to explore this as a possible data resource.

Administrative Boundaries (high priority for Tool)

VIUP has all administrative boundaries (national, provincial, city/district, commune) updated to 2010 and boundary layers for 10 provinces in the Greater Hanoi region updated to 2013. Because some commune and district boundaries have changed since 2010, however, updated information must be obtained from MONRE at an estimated cost of $700 per province. All data are available in Shapefile format.

Roads and Waterways

Digital road and waterway data are available from the standard topographic maps produced by MONRE. The accessibility and costs of this information varies by scale. National-scale topographic information (1:1,000,000) is available as a Micro Station file (easily translated to a Shapefile by VIUP) from MONRE for an estimated

$1,000. Provincial-scale information (1:50,000) is available from MONRE as Shapefiles for $2,200 per province ($138,600 total). City/District-scale road and waterway information is available from MONRE, also as Shapefiles, for $800 each, totaling an estimated $600,000 for 750 cities and towns.

Digital Elevation Models (DEM)
IMHEN already supplies DEMs within its sea level rise inundation maps. If the Cascadia team is unable to obtain GIS-based versions of these DEMs, VIUP can digitize paper copies of these. Through this process, VIUP expects to create higher-resolution DEM images from IMHEN at no cost.

Land Use Classification
Classified land use data can be obtained two ways: 1) through classification of remote sensing data, or 2) through reclassification of MONRE's current land use data to the MOC classification scheme. Obtaining remote sensing data directly from the Vietnamese government is the more expensive option: 10m to 20m resolution, 1:50,000 scale multispectral images cost $1,400 each. With an average of one image per city, that price amounts to over $1 million for all cities and towns.

Current land use classification maps from MONRE are also expensive, although less so than remote sensing data. Available as Micro/Tab files from MONRE, current land use maps that use MONRE classification schemes can be obtained at $1,000 per province, or $63,000 for all provinces. This option also requires that VIUP reclassify the land use maps from the MONRE to the MOC classification scheme.

Sector-Specific Infrastructure System
Data on existing sector-specific infrastructure systems (e.g., wastewater, water supply) are available from DOC or VIUP on a project-by-project basis. Because no central location or agency exists that could provide these data in bulk, the process for obtaining them would be difficult and time-consuming. If deemed helpful for the Tool's use, VIUP recommends that this information could be integrated into the Tool slowly over time, adding new maps with each new urban planning project.

Spatial Development Orientations and Land Use/Infrastructure Planning
Like for sector-specific infrastructure, spatial orientations and land use/infrastructure planning layers are available from DOC or VIUP on a project-by-project basis. If deemed helpful for facilitating the Tool's use, VIUP recommends that this information could be integrated into the Tool slowly over time, adding new maps with each new urban planning project.

Table B-13. Current and Future Availability of Digital Map Layers

This table describes the availability of digital climate impact maps and layers. It includes information on available map layers, the spatial extent of those layers (e.g., country-wide or only for select basins), and the ability to eventually obtain layers that are not currently available.

Key:

area-specific*	country-wide	
(blank)	(blank)	Inclusion is not needed
	×	Ideal to include, but cannot get/not avail. in GIS format
□	■	Can get in GIS format, but may take time/money
○	●	Have in GIS form
		High priority for Tool

*not widely available, but local departments could potentially fill in gaps

Planning Type	Map	Climate Impact	Provincial boundaries	City/district boundaries	Commune boundaries	Roads and waterways	DEM (Topography)	Land Use	Sector-specific Infrastructure System	Spatial development orientations, land use & infrastructure planning
Regional Planning	Temp (avg/extreme)	■	■	■		■		■	□	□
	Temp (urban heat islands)	×	■	■		■		■	□	□
	Precip (seasonal/annual)	■	■	■		■	■	■	□	□
	Precip (flooding)	□	■	■		■	■	■	□	□
	SLR, inundation	■	■	■		■	■	■	□	□
	SLR, salinity intrusion	□	■	■		■		■	□	□
	Erosion/landslides	×	■	■		■	■	■	□	□
	Vulnerable populations	■	■	■		■		■	□	□
Master Planning/ Specialized Technical Infrastructure Planning	Temp (avg/extreme)	■		■	■	■		■	□	□
	Temp (urban heat islands)	×		■	■	■		■	□	□
	Precip (seasonal/annual)	■		■	■	■	■	■	□	□
	Precip (flooding)	□		■	■	■	■	■	□	□
	SLR, inundation	■		■	■	■	■	■	□	□
	SLR, salinity intrusion	■		■	■	■		■	□	□
	Erosion/landslides	×		■	■	■	■	■	□	□
	Vulnerable populations	■		■	■	■		■	□	□
Detailed/Zoning Planning	Temp (avg/extreme)	×		■	■	■		■	□	□
	Temp (urban heat islands)	×		■	■	■		■	□	□
	Precip (seasonal/annual)	×		■	■	■	■	■	□	□
	Precip (flooding)	□		■	■	■	■	■	□	□
	SLR, inundation	■		■	■	■	■	■	□	□
	SLR, salinity intrusion	■		■	■	■		■	□	□
	Erosion/landslides	×		■	■	■	■	■	□	□
	Vulnerable populations	×		■	■	■		■	□	□

Table B-14. Map Layer Costs under Various Scenarios

This table describes the costs of obtaining layers for the digital climate impact maps by scenario and path (more information on paths in the following section). Layers considered to be critical for the Tool's functionality and ease-of-use are highlighted in blue. All costs are in US dollars.

Scenario	Metric	Climate Impact	Provincial boundaries	City/district boundaries	Commune boundaries	Roads and waterways	DEM (Topography)	Land Use	Existing sector-specific Infrastructure System	Current spatial development orientations, land use & infrastructure planning	**Total:** Current Project Path	**Total:** Future Option #1	**Total:** Future Option #2
1: Provincial Maps for All Planning Types	Quantity	?	63 provinces + 760 cities/towns			63 provinces	$0	750 images	? Would acquire on a project-by-project basis		**$0 -$1,500**		
	Unit Price ($)		N/A			$2,200		$1,400					
	Total ($)		**$1,500**			**$138,600**		**$1,050,000**				**$140,100**	**$1,190,100**
2: City/Town and Provincial Maps	Quantity		63 provinces + 760 cities/towns			760 cities/ towns		750 images					
	Unit Price ($)		N/A			$800		$1,400					
	Total ($)		**$1,500**			**$608,000**		**$1,050,000**				**$609,500**	**$1,659,500**
3: Online Interactive Map	Quantity		63 provinces + 760 cities/towns			760 cities/ towns		750 images					
	Unit Price ($)		N/A			$800		$1,400					
	Total ($)		**$1,500**			**$608,000**		**$1,050,000**				**$609,500**	**$1,659,500**

B.4.3.2. PATHS FOR MAP ACQUISITION AND DEVELOPMENT

Given the variation and uncertainty in availability, time, and resource requirements for the Tool's maps and layers, we propose three paths for acquiring and customizing the Tool's spatial information. These paths, which progress from least to most ideal for maximizing the Tool's use and effectiveness, vary in their cost, time requirements, and assumptions around future digital data availability:

- **The Current Project Path** assumes no GIS-based digitization of current climate impact layers;
- **Future Option #1** allows for limited GIS-based digitization of only the lowest cost and highest priority maps and layers; and
- **Future Option #2** allows for fully customizing the maps with GIS-based layers.

Outcomes from these three paths are summarized below and detailed in Table B-15 (page 95):

	Path	Outcome
1	Future Option #2	GIS layers for the whole country, fully customized and detailed by VIUP or IMHEN (preferably VIUP)
2	Future Option #1	High-resolution digital maps (e.g., GIS-based) that are of appropriate resolution and include high-priority layers (e.g., administrative boundaries)
3	Future Option #1	The above, in pdf form
4	Current Project	The above, without any additional layers

For the initial dissemination of the Tool, we will pursue the Current Project Path. After technology transfer is complete, Future Options #1 or #2 may be pursued, which will contribute towards development of fully detailed, high-resolution climate impact maps for the Tool.

Current Project Path

Outcomes	Pdf versions of currently available maps, zoomable to the provincial-level
Assumptions	Inability for IMHEN and/or VIUP to customize maps through manipulation of digital data
Data Cost	Very Low ($0 to $1,500)
Time	Very Low (1 to 3 months)

This path involves taking the pdf maps that we currently have available and making them effectively "zoomable" to the provincial-level, without digital manipulation or incorporation of any additional layers. Without the ability to zoom into custom scales, the Tool could also just include a high-resolution national-level map, at which point the User would identify the project's location within the country-wide extent, although this option is only suitable if we can obtain higher resolution spatial data.

The begin on this path, our first action will be to inquire as to whether IMHEN may be able to provide 1) digital climate impact data, 2) custom mapping services, and/or 3) high-resolution versions of their current maps. We will then pursue customization of the highest resolution maps we have available.

Future Option #1

Outcomes	Pdf and/or digital versions of moderate-detail maps, zoomed to the provincial- or municipal-level
Assumptions	Willingness of IMHEN to provide GIS layers or new custom maps; ability to supplement GIS versions of climate impact layers with additional high priority layers, such as district boundaries
Data Cost	Medium ($2,000 for national-scale to $600,000 for city/town-scale)
Time	Moderate (6 months to 1 year)

This path involves direct manipulation of digital climate impact layers by either VIUP or IMHEN to arrive at appropriately detailed, high-resolution climate impact maps. If IMHEN is willing to customize their current climate impact maps, then those customized pdf maps could be used in this case.

Alternatively, if VIUP could obtain the climate impacts spatial information (either directly from IMHEN or through digitization of high resolution pdf maps), then VIUP could customize their own maps with desired layers and scaling. This is the preferred option, as it would establish a foundation for the long-term path towards fully-customized and sufficiently detailed maps.

Future Option #2

Outcomes	Digital versions of highly-detailed maps, "zoomable" to the provincial level
Assumptions	Ability to acquire needed GIS layers
Data Cost	High ($1 million to $1.5 million)
Time	High (1 to 3 years)

This path involves VIUP acquiring and incorporating all layers deemed relevant to the Tool's use – potentially including road networks, land use, and infrastructure systems – to the highest-resolution versions of the climate impact maps. Because these layers are expensive and time-consuming to digitize, acquire, and/or customize, this path will require significantly more time and funding to complete.

Table B-15. Prioritized Spatial Information Outcomes

This table draws from the pool of available climate impact maps to arrive at a list of map options, in order of most to least ideal. In general, GIS files are most ideal and unchanged static pdfs are least ideal. The term "customized by VIUP" means zoomable to the region of interest and with additional priority data layers.

Impact	Planning Level/Type		
	Regional Planning	**General Planning/ Specialized Technical Infrastructure Planning**	**Detailed/ Zoning Planning**
Temperature, average/ extreme	**1. Zoomable GIS layers for whole country, customized by VIUP, or** 2. High-resolution pdf-based maps that are zoomable to the provincial-level and with additional layers, 3. The above without additional layers, or 4. The above with currently available resolution.	**1. Zoomable GIS layers for whole country, customized by VIUP, or** 2. High-resolution pdf-based maps that are zoomable to the municipal-level and with additional layers, 3. The above without additional layers, or 4. The above with currently available resolution.	**← Same as General and Specialized Technical Infrastructure Planning**
Precipitation, seasonal/ annual	***(Same as temperature)*** **1. Zoomable GIS layers for whole country, customized by VIUP, or** 2. High-resolution pdf-based maps that are zoomable to the provincial-level and with additional layers, 3. The above without additional layers, or 4. The above with currently available resolution.	***(Same as temperature)*** **1. Zoomable GIS layers for whole country, customized by VIUP, or** 2. High-resolution pdf-based maps that are zoomable to the municipal-level and with additional layers, 3. The above without additional layers, or 4. The above with currently available resolution.	
Precipitation, flooding	**1. GIS layers for the four examined deltas, customized by VIUP, or** 2. Higher resolution pdf maps of the delta areas with comparable scales and additional layers, 3. The above without comparable scales or additional layers, or 4. The above with currently available resolution.	**1. GIS layers for the four examined deltas, customized by VIUP, or** 2. Higher resolution pdf maps of the delta areas with comparable scales, additional layers, and zoomed to the municipal-level, 3. The above without comparable scales or additional layers, or 4. The above with currently available resolution	
Sea level rise, inundation	**1. Zoomable GIS layers for whole country, customized by VIUP, or** 2. High-resolution pdf maps that are zoomable to the provincial-level and with additional layers, or 3. The above without additional layers.	**1. GIS layers for whole country, customized by VIUP, or** 2. High-resolution pdf maps that are zoomable to the municipal-level and with additional layers, or 3. The above without additional layers.	
Sea level rise, salinity intrusion	**1. Zoomable GIS layers for the four examined deltas, customized by VIUP, or** 2. Higher resolution pdf maps of the delta areas with comparable scales and additional layers, 3. The above without comparable scales or additional layers, or 4. The above with currently available resolution.	**1. Zoomable GIS layers for the four examined deltas, customized by VIUP, or** 2. Higher resolution pdf maps of the delta areas with comparable scales and additional layers, and zoomable to the municipal-level, 3. The above without comparable scales or additional layers, or 4. The above with currently available resolution.	
Vulnerable Populations	***(Same as temperature)*** **1. Zoomable GIS layers for whole country, customized by VIUP, or** 2. High-resolution pdf-based maps that are zoomable to the provincial-level and with additional layers, 3. The above without additional layers, or 4. The above with currently available resolution.	***(Same as temperature)*** **1. Zoomable GIS layers for whole country, customized by VIUP, or** 2. High-resolution pdf-based maps that are zoomable to the municipal-level and with additional layers, 3. The above without additional layers, or 4. The above with currently available resolution.	
Erosion/ landslides	**Not Available**	**Not Available**	

B.4.4. PLAN FOR INTEGRATION

File size limitations restrict the ability to integrate a large number of maps directly into the Tool. The preferred solution would be to use an **online map library** that is accessible by Tool Users. The online library could be organized by province and/or municipality. Nothing complex is needed – just a very simple repository with a simple directory will suffice. A more advanced spatial data web portal, such as The Nature Conservancy's Coastal Resilience Network website, could eventually be deployed to support Tool Users in a future phase.

In addition to providing an easier venue for tracking, maintaining, and updating information, an online system for the Tool's maps could also carry the following benefits:

- Ability for all climate impacts and layers to be housed on a single interface, by simply "checking" and "unchecking" layers as desired by the User
- Expanded ability for the User to "zoom" to various project areas (without having separate "zoomed in" maps)
- Reduced time and resource requirements for map generation and new data incorporation

B.4.5. RECOMMENDATIONS FOR MAINTENANCE

We propose that VIUP and IRURE assume primary responsibility for maintaining and updating the spatial information in the Tool after initial dissemination in August 2013. We recommend that major version updates be conducted on a predefined, regular basis (e.g., annually) and minor updates be conducted as-needed.

Responsibilities of VIUP could include, but are not limited to, the following:

Annually

- Update existing maps with new layers, as needed
- Add new maps, as available
- Review and conduct quality assurance measures on new and updated maps
- Integrate changes responsive to User feedback

Ongoing

- Solicit User feedback
- Troubleshoot problems

B.5. CONCLUSION

Spatial information will be a vital component of the Vietnam National CIMPACT-DST. To allow Tool Users to identify the presence and extent of projected climate impacts associated with their planning area, the climate impact maps associated with the Tool must contain the right type of information at the right level of detail and resolution. Although currently available IMHEN maps serve as an important starting point, their low spatial resolution and static, uncustomizable pdf format may prohibit their optimal use with all target planning types. To address this shortcoming, we propose two Future Options that pave a path towards eventual full customization, compilation, and presentation of high-resolution, GIS-based climate impact spatial information that is of optimal format and function for use with the Tool and, if possible, for use in informing the standard urban and construction planning process.

B.6. LITERATURE CITED

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U.S. Agency for International Development

1300 Pennsylvania Avenue, NW

Washington, DC 20523

Tel: (202) 712-0000

Fax: (202) 216-3524

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