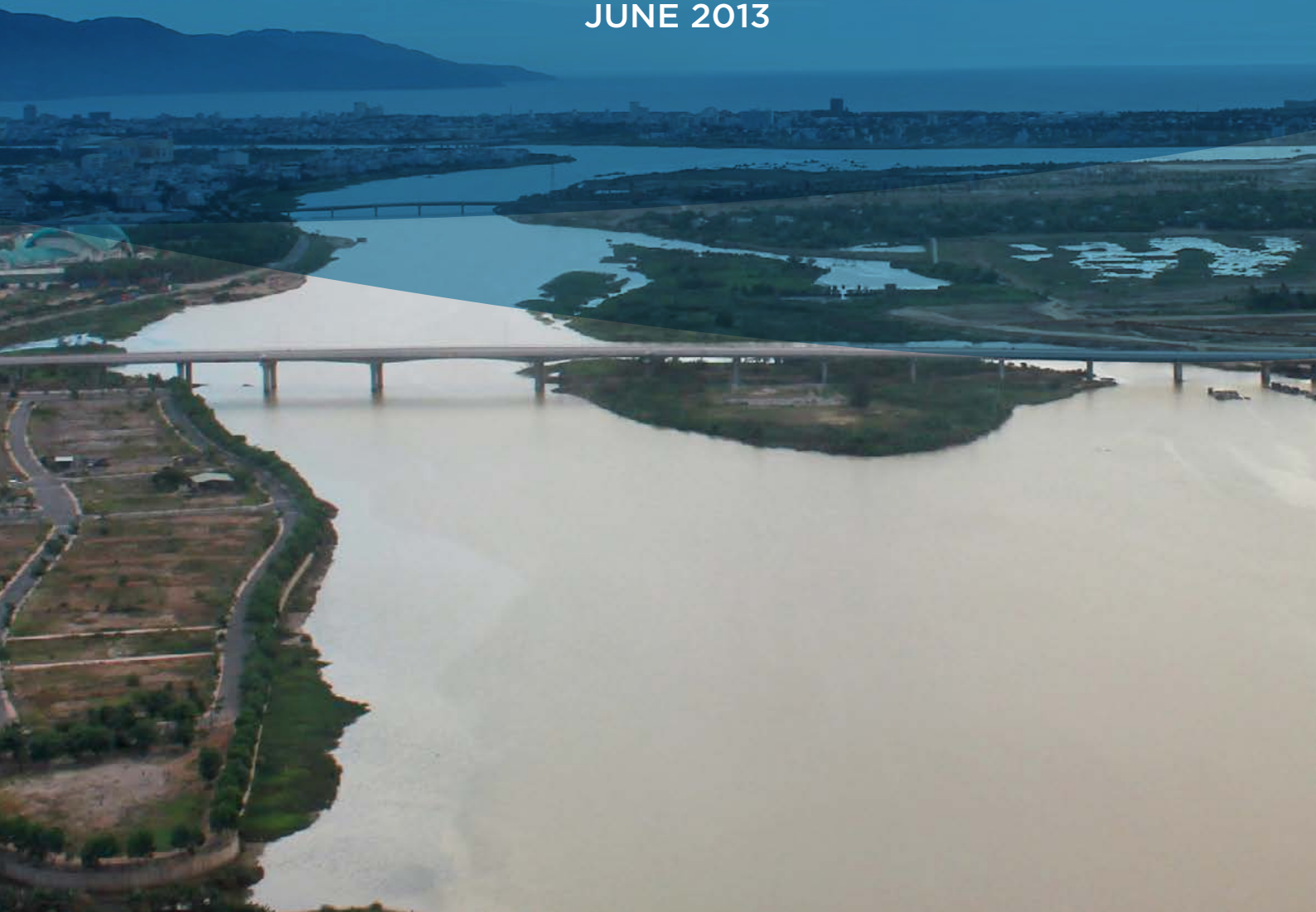


BUILDING CLIMATE RESILIENCE FROM RESULTS OF HYDROLOGY AND URBAN DEVELOPMENT SIMULATION MODEL PROJECT

DA NANG CITY
JUNE 2013



Project title:

Da Nang Hydrology and Urban Development Simulation Model

Project coordinator:

ISET-International

Lead partner:

Da Nang Department of Construction

Duration:

January 1, 2011 to June 30, 2013

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KEY MESSAGES FROM PROJECT RESULTS

- Construction in floodplain and floodway areas increases flood levels, changes flood patterns, and leads to more severe flood events in urban areas and low-lying flood-prone areas of Da Nang.
- Climate change and sea level rise will increase the intensity and frequency of extreme rainfall events in Da Nang and its surroundings.
- Flooding is a critical issue that needs to be addressed step by step.
- People living in flood plain areas highly exposed to flood risks will suffer from increases in flood damages and recovery costs.
- Floods can affect the city's reputation and future land prices.
- The local government will face higher costs to repair urban infrastructure.
- In the context of climate change and considering plans for future urban development, relying on warning levels of historical floods and hydrological data from the Hydro-meteorological Centre of Middle Central Vietnam in the preparation and appraisal of urban infrastructure plans (especially land filling and water drainage plans) is risky.
- If the "Da Nang Development Plan until 2030 with vision to 2050" (Development Plan) is used to inform urban planning in the southern area of the city, flood levels are likely to increase and may lead to serious urban flood issues in the future.
- International practices in urban planning, suggests protection of floodplains is necessary for emergency flood retention and can also be used for recreational or agricultural purposes.

1. PROJECT OBJECTIVES

Under the “Asian Cities Climate Change Resilience Network” program funded by the Rockefeller Foundation, Da Nang’s Department of Construction (DOC) and the Institute for Social and Environmental Transition-International (ISET-International) joined efforts to develop an urban flood-modeling project with the following objectives:

- Develop a database on Da Nang’s socioeconomic development to assist in the management of urban development, climate change and sea level rise;
- Develop a hydrologic-hydraulic model, and simulate urban flood maps under different urban development, climate change and sea level rise scenarios;
- Contribute to steering city urban plans towards sustainable development in the context of exacerbating climate change and sea level rise;
- Build awareness among organizations and local people about the potential impacts of climate change and sea level rise on urban development;
- Build the capacity of staff in relevant agencies, in the application of hydrologic-hydraulic modeling.



“Workshop on Urban Planning in Da Nang City-Solutions to flood issues” was organized in Da Nang City on March 18, 2014 with participation from Ministry of Construction, Da Nang People’s Committee, ISET, NISTPASS and relevant departments.

Photo: ISET-International, 2014

2. PROJECT RESULTS

The project started in 2011 and was completed in 2013, with results and key products are described in the section below.

2.1 MODEL DATABASE

Historical, present and future Digital Elevation Maps (DEMs) of Da Nang city were simulated based on current maps. These were then overlaid with elevation plans and drainage maps (June 2011) and draft modifications of the Development Plan.

2.2 HYDROLOGIC-HYDRAULIC MODEL

Using the city’s historic flood data (2007, 2009, 2010), historical DEMs, and MIKE NAM and MIKE FLOOD models, a set of hydrologic-hydraulic parameters were developed, which provided the basis for developing flood maps for Da Nang city.

The flood maps of historic floods showed that flood levels and flood depths at Cam Le station and flood-warning levels are almost consistent with real data. Therefore the set of parameters identified are qualified as a basis for developing flood maps during different flood frequency events and different climate change and sea level rise scenarios.

2.3 FLOOD SCENARIOS BASED ON CLIMATE CHANGE AND FREQUENCY FLOOD EVENTS SCENARIOS

Flood maps were developed corresponding to different climate change and sea level rise scenarios and different frequency flood scenarios (P = 1%, 2%, 3%, 5%, 10%). The maps were developed using the overlaid map of elevation and drainage system until June 2011, and the draft Development Plan using the set of selected parameters.

FIGURE 1. DRAFT ADJUSTMENTS OF DA NANG’S DEVELOPMENT PLAN* USED IN THE “HYDROLOGIC-HYDRAULIC AND URBAN DEVELOPMENT SIMULATION MODEL” (2011 FLOOD LEVEL DATA)



* Circled areas are proposed residential development areas in the southern floodplain.

2.4 EVALUATION OF PROJECT RESULTS

Results of flood simulation based on climate change scenarios for 2030 and 2050, and of sea level rise in 2030, 2050 and 2100 based on the 2007 flood shows that:

- i. Flows of Yen, Cam Le, and Qua Giang rivers will rise steadily, consistent to historical trends; and
- ii. Water levels at Cam Le will also increase accordingly.

Results show that climate change will lead to a 0.105 cm increase in water levels at Cam Le in 2030 and 0.62 cm if the entire southern area of Da Nang is fully developed as planned in the modifications to Da Nang's Development Plan (infilling and raising to 4-6.5 m elevation in areas along Cam Le, Yen, and Qua Giang rivers).

Specifically, water level at Cam Le monitoring station will be 3.98 m if the southern area is not urbanized, and 4.6 m if it is fully urbanized. It is critical that the modifications to Da Nang's Development Plan together with its structural components be reviewed to prevent increases in flood levels and severe urban flooding in the future.

FIGURE 2B. CURRENT DIGITAL ELEVATION MAP (DEM) OF DA NANG CITY

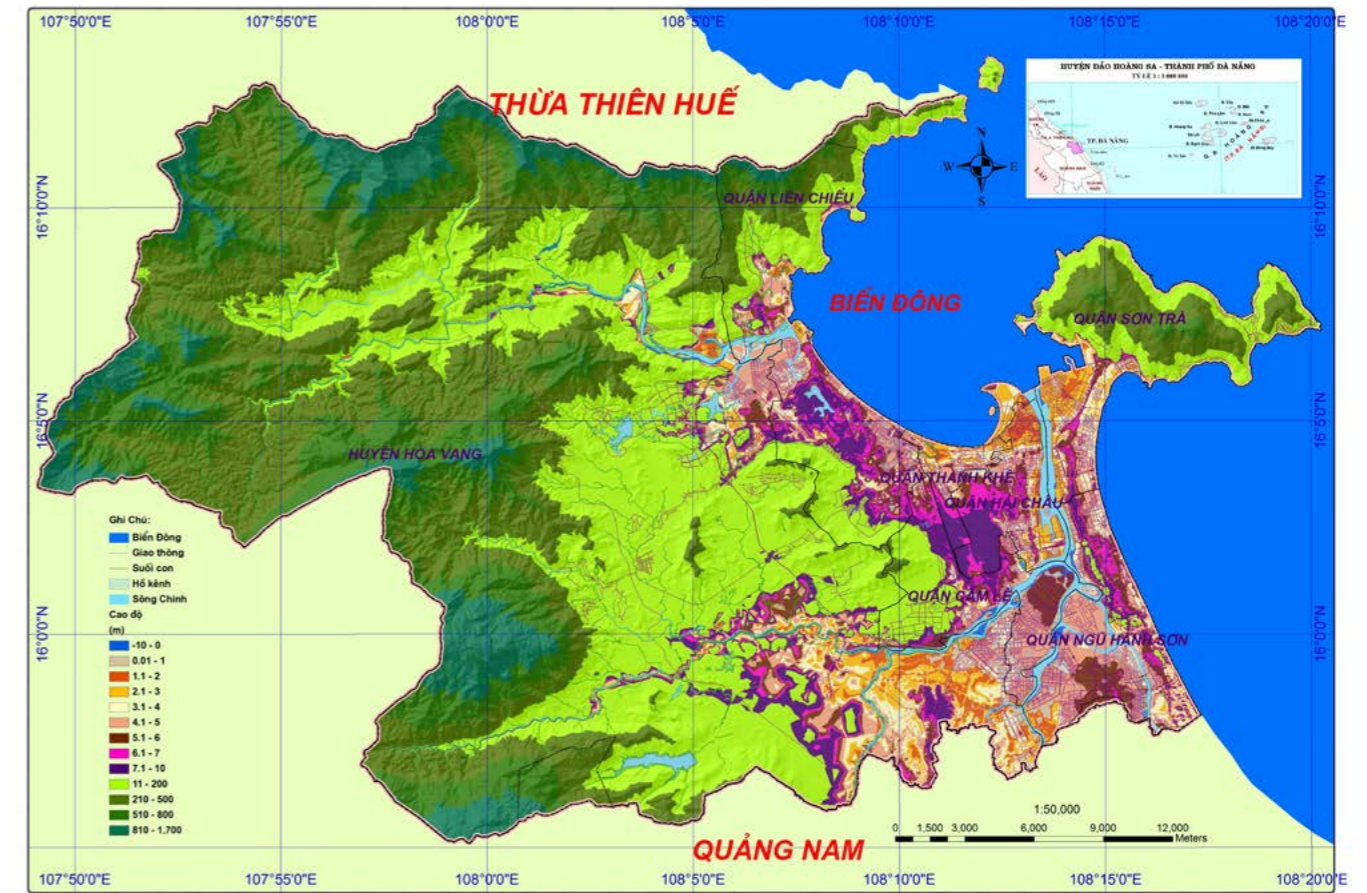


FIGURE 2A. HISTORICAL DIGITAL ELEVATION MAP (DEM) OF DA NANG CITY



FIGURE 2C. FUTURE DIGITAL ELEVATION MAP (DEM) OF DA NANG CITY

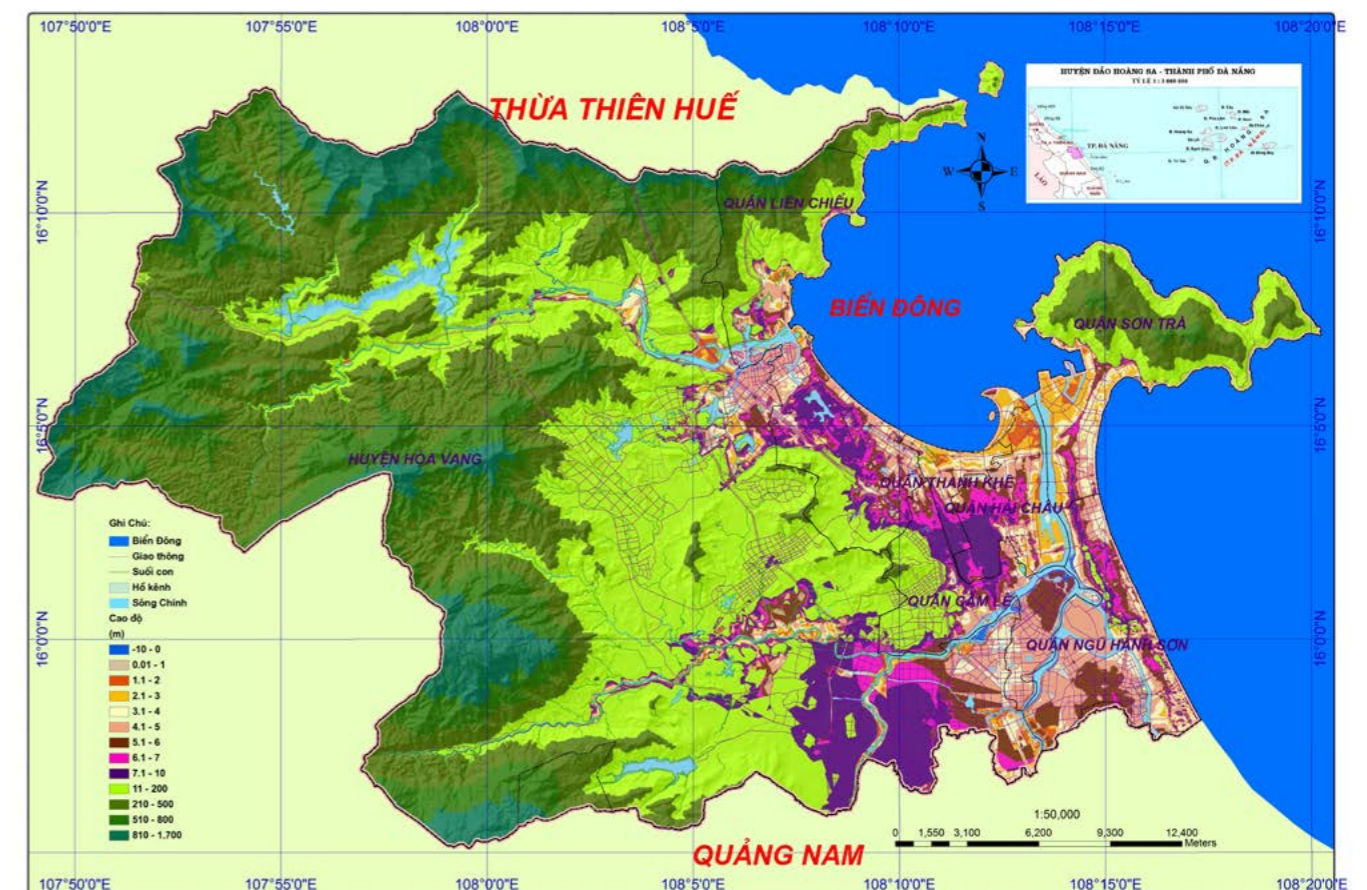
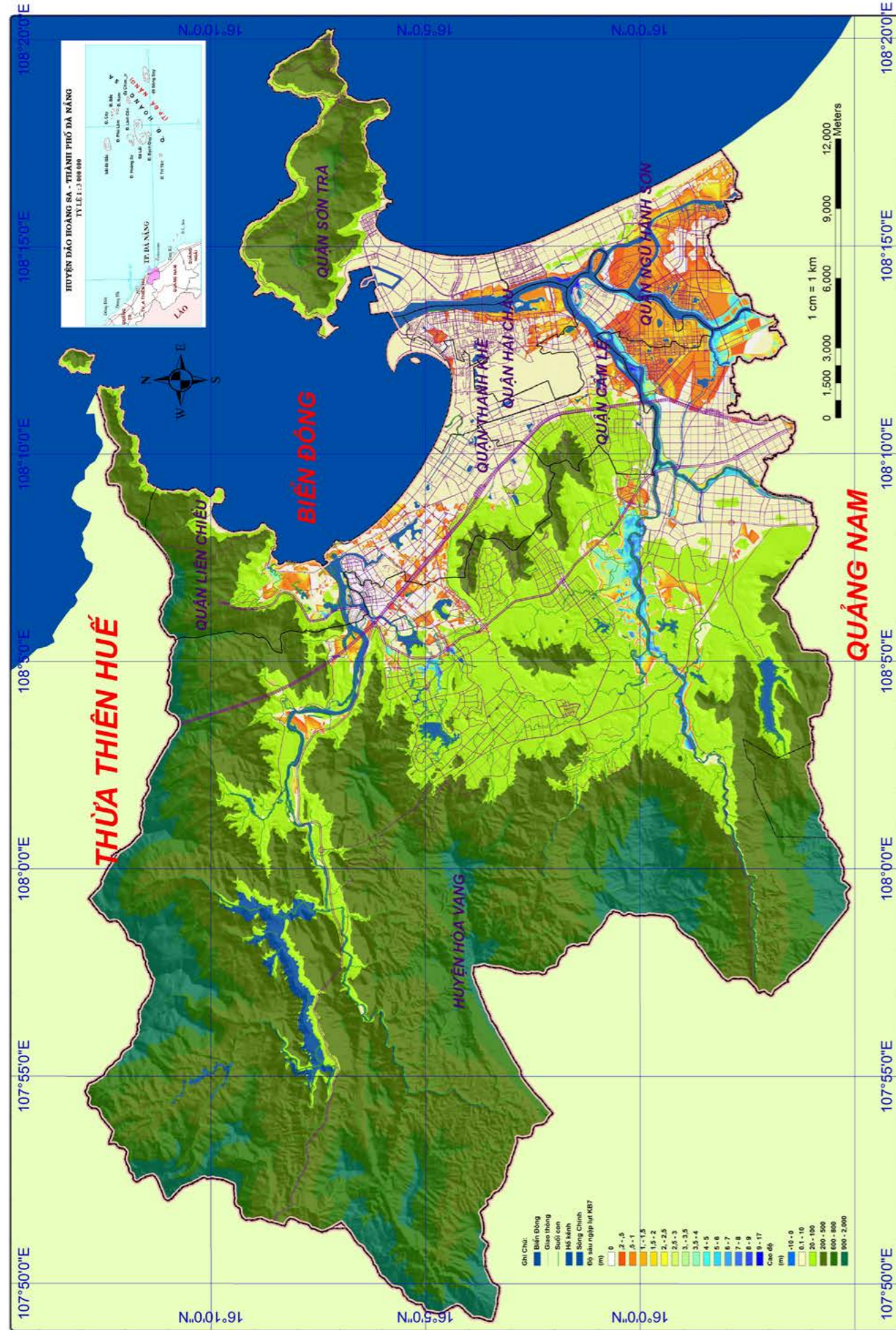


FIGURE 3. FLOOD MAP BASED ON PROJECTED ELEVATION BASED ON VISION OF 2050, PRECIPITATION LEVEL OF 2007 COMBINED WITH THE INCREASE IN RAINFALL AND SEA LEVEL RISE



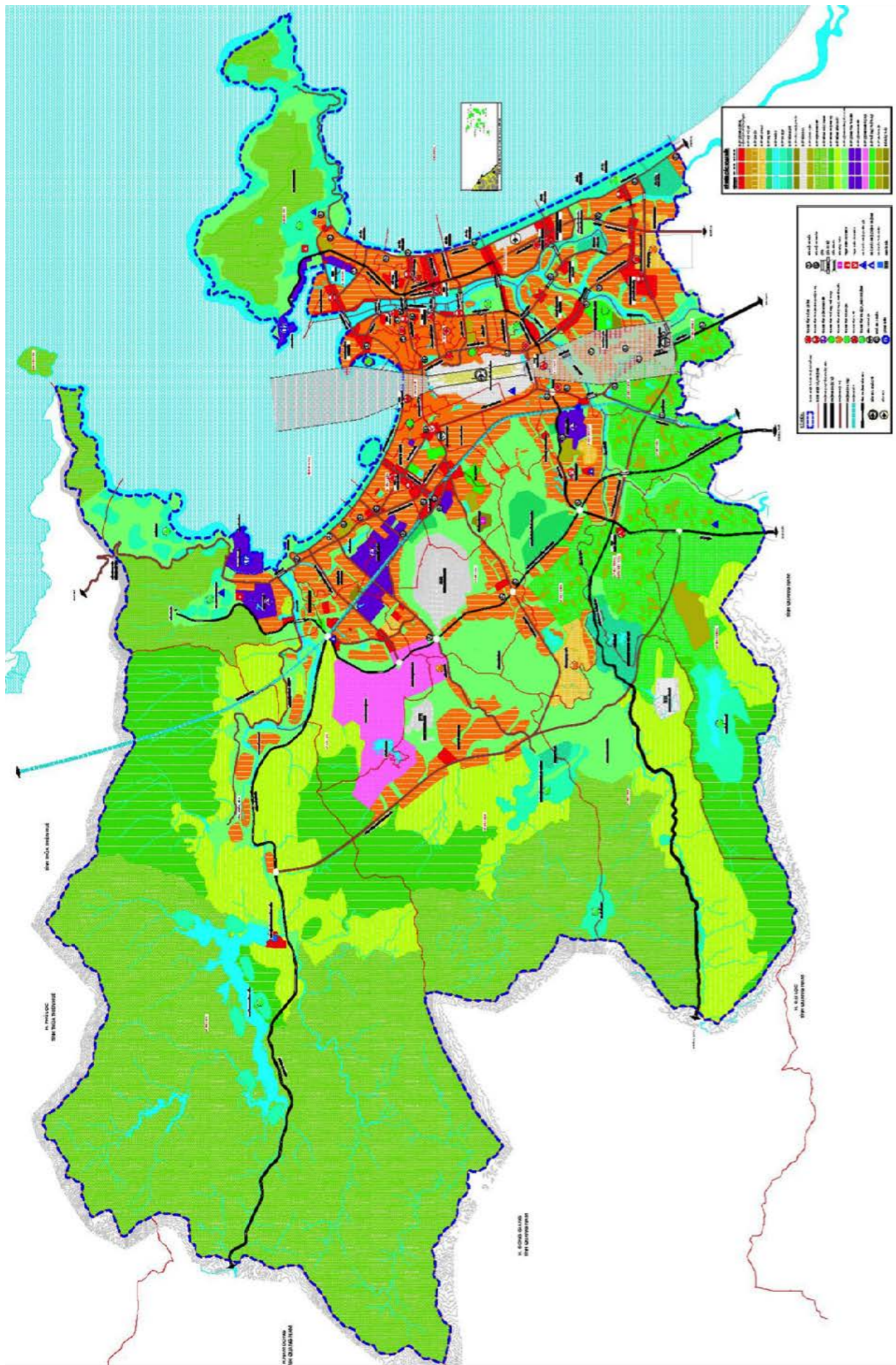
3. SUGGESTED MODIFICATIONS TO DA NANG'S DEVELOPMENT PLAN BASED ON RESULTS OF THE HYDROLOGIC-HYDRAULIC MODEL

3.1 APPROACH TO ADJUSTING URBAN PLAN IN THE SOUTHERN AREA OF DA NANG AS SUGGESTED BY ISET-INTERNATIONAL EXPERTS

In order to reduce urban flooding, it is necessary to widen the floodway along rivers and in low-lying areas, and develop clusters of high-rise buildings to minimize flood barriers. Low-lying areas with low population densities and low-rise houses should be designed to facilitate flood drainage. Figure 4 illustrates the planning option to reduce urban flood as suggested by ISET-International experts.

FIGURE 4. PLAN FOR THE SOUTHERN AREA OF DA NANG SUGGESTED BY ISET-INTERNATIONAL EXPERTS





3.2 MODIFICATIONS TO THE DRAFT OF DA NANG'S CITY MASTER PLAN UNTIL 2030 WITH VISION TO 2050

DOC worked with Da Nang Urban Planning Institute, using the aforementioned model and approach to adjust the Development Plan. This included working towards widening the floodways and maintaining/improving existing low-lying rural areas for flood drainage, and adjusting land use plans in riverine areas to adapt to and minimize future urban floods. On December 04, 2013, the Prime Minister approved the modifications to Da Nang's Development Plan under decision no. 2357/QĐ-TTg (see figure 5).

3.3 NEXT STEPS

a. **Implement the zoning plan, and construct the technical infrastructure component of the plan** (including elevation and water drainage), focusing on the following tasks:

- **Conduct surveys and analysis to identify areas affected/not affected by floods**, and adjust land use plans accordingly. Special care should be given to low-lying areas along Yen river, Tuy Loan river, Qua Giang river, Cam Le river and Cu De river;
- **Investigate further expansion of the southern floodway area, considering structural solutions:** such as embankment and buffer zones to function as natural riverine reserves; and urban green belts to reduce water level and speed of flood flow;
- In new development areas, **provide recommendations for elevation levels**, appropriate drainage solutions and embankments;
- **Investigate expansion of the urban lake system** to reduce pressure on the drainage system and minimize urban flooding;
- **Investigate structural solutions for existing settlements** in low-lying floodplain areas, such as flood shelters, pumping stations for flood control, and flood protection dykes;
- **Invest in a natural disaster warning center** for the region;
- **Communicate and build awareness** among local communities of how to build resilience to floods;
- **Develop house designs suitable for existing settlements in floodplain areas**, provide training and encourage people to use designs appropriate to their location;
- **Research, develop, and implement strategies on green building development;** and
- **Pilot models of green building** and green urban areas.

Results from the hydrologic-hydraulic model provide an important basis for the establishment, evaluation and approval of urban spatial plans and urban infrastructure plans. This includes plans for transportation, water supply, rainwater drainage, waste-water drainage, green areas, and lighting system.

This product was prepared and funded by:



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The “Da Nang Hydrology and Urban Development Simulation Model” was funded under the Rockefeller Foundations, Asian Cities Climate Change Resilience Network (ACCCRN) program. The project ran for over two years through to June 30, 2013, and was implemented by the Da Nang Department of Construction (DOC) and the Institute for Social and Environmental Transition-International.

Using the results of the model and the approach suggested by ISET-International experts, DOC worked with the Da Nang Urban Planning Institute to adjust Da Nang’s Development Plan. This included widening the floodways and maintaining/improving most of the existing low-lying rural areas; and adjusting land use planning in riverine areas to adapt to and minimize risks from future urban flooding. On December 04, 2013, the Prime Minister approved the modifications to Da Nang’s Development Plan under decision no. 2357/QĐ-TTg.

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