Danang People's Committee
Japan International Cooperation Agency

GIS Seminar for Danang City

27 March 2010
Danang City
JICA Study Team

GIS Application for Urban Planning

1. General Design
2. Base Map Preparation
3. Collection of Thematic Maps Related to Urban Planning
4. Data Input of Basic City Survey
5. GIS Database Construction for Supporting Urban Planning
6. Data Processing and Analysis
7. Final Mapping and Dissemination of Data Maps
8. Recommendations to Urban Planning

1. General Design

- Understanding of Urban Planning Area
- Clarification of GIS Database Development
- Clarification of Data Collection and Generation Items
- Clarification of Data Analysis
- Clarification of Hardware and Software Configuration
- Cost Estimation (data collection, digitization, manipulation, computer, software, and total operation)

1. Check Point for General Design

- Base Map Scale
- Necessary Data Items
- Data Generation Items or Updating
- Available Data Format (digital, hard copy etc.)
- Main Subject of Data
- Total Work Volume for GIS Database Construction (data collection, digitization, and processing)
- Analysis (development constraints, potential etc.)
- System Configuration (computer, GIS software, plotter, scanner etc.)

2. Base Map Preparation

- Collection of Topographical Map such as;
  - ✓ 1:2,000
  - ✓ 1:5,000
  - ✓ 1:10,000
  - ✓ 1:25,000
  - ✓ 1:100,000 etc. in digital format (if available)
  - ✓ For urban facility management, 1:500, 1:1,000 will be necessary

2. Base Map Preparation

- Collection of Satellite Imagery such as:
- ✓ IKONOS
- ✓ Quick bird
- ✓ SPOT (high resolution imagery)
- ✓ Collection of Aerophotography

2. Check Point for Base Map Preparation

- Date of map compilation, scale, projection, and necessity of updating
- Updating means new map compilation by digital mapping

3. Collection of Thematic Maps related to Urban Planning

Natural Condition

- Elevation
- Slope
- Landform classification
- Geology
- Soil condition (engineering soil map)
- River system, catchment area /watershed
- Soil map
- Vegetation
- Natural disaster distribution (flood prone area etc.)

3. Collection of Thematic Maps related to Urban Planning

- Salt water intrusion
- Land subsidence area
- Ecological zone including animal habitat
- Wetland area
- Strong high tide
- Landslide distribution
- Climate(rainfall distribution), bioclimate

3. Social Condition

- Existing land use
- Road network
- Railway/ seaport/airport
- Urban facility (water pipeline, sewage network etc.)
- Public facility
- Urban land use
- Population (Census Data)
- Administrative boundary
- Main economic activities, Poverty
- Restricted area
- Land use plan, etc.

3. Environmental Condition

- Water pollution
- Air pollution
- Heavy metals and toxic materials
- Source of pollution
- Ecological zone
- Saltwater intrusion Monitoring Data
- Preservation area
- National park
- Sanitary landfill site

3. Check Point for Data Collection

- Map scale and accuracy
- Map projection
- Date of compilation and agency
- Methodology
- Necessity of updating

4. Data Input for Basic City Survey

- Each building use and related existing urban condition will be surveyed based on large scale topographical map.
- Survey result will be input into GIS database to generate urban planning indicator such as Coverage Ratio, FAR etc.

5. GIS Database Construction for Supporting Urban Planning

- Contents analysis of collected data
- Digitization of map data (polygon, point, line and attributes)
- Error correction of input data
- Preparation of clean file

5. Check Point for GIS Database Construction

- Map legend
- Classification method
- Unification of map scale
- Reorganization of map legend
- Use of available digital file (Conversion of CAD file to GIS file)
- Scanning
- Discrepancies correction of map features and attributes

6. Data Processing and Analysis

- Primary Data Processing
- Mapping of existing natural, environmental condition based on input data
- Statistical mapping such as population, and socio-economic condition

6. Data Processing of Basic City Survey

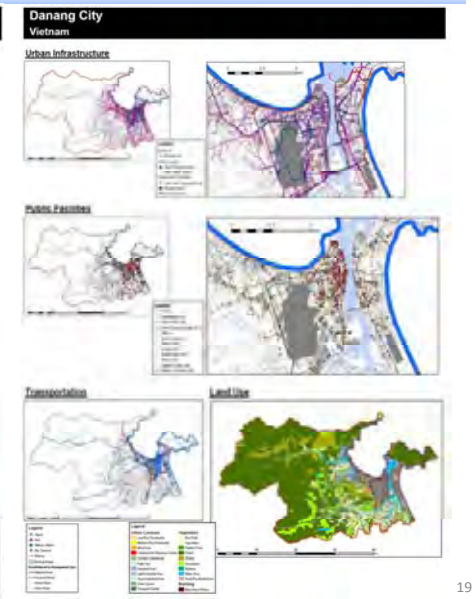
- Generation of urban planning indicator such as;
- Building use
- Building coverage ratio
- FAR
- Open space ratio
- Park ratio
- Road ratio
- Disaster management facility
- Health facility
- Energy /telecommunication facility etc.

Urban Karte

- A set of indicators were selected based on 5 living condition evaluation factors (Convenience, Safety / Security, Health / Wellbeing, Amenity, Capability)
- For each set of indicators, objective indicators and subjective indicators (mainly the people's assessment based on the results from the Household Interview Survey done in August to October 2008).

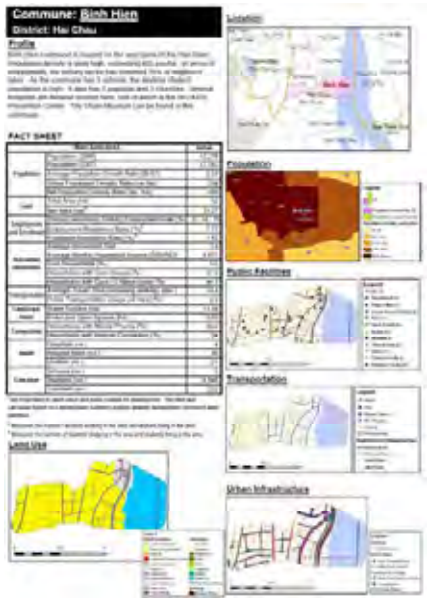
Objective Indicators (current living conditions)	**Subjective Indicators** (people's assessment)
For example, for "Convenience"…	
• Households with Electricity Connectivity (%)	• Power Supply
• Road Area Ratio (%)	• Traffic Situation
• "To Work" Travel Time (min.)	• Travel Time to Work
• "To Work" Trips by Public Transportation	• Public Transport Convenience
• Motor Vehicles per 1,000 Pop	• Convenience of Transport
• TV Sets per 1,000 Pop	• Telecommunications
• Telephone per 1,000 Pop	• Telecommunications
• etc.	• etc.

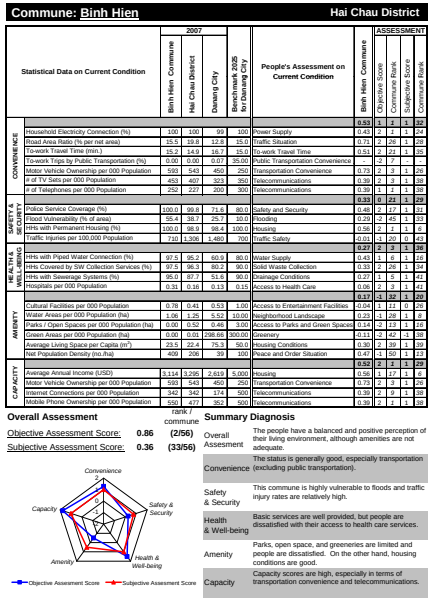
Example of Urban Karte - whole city (1/2)



Example of Urban Karte – whole city (2/2)

Example of Urban Karte - commune





Commune: Binh Hien — **Hai Chau District**

Statistical Data on Current Condition	Binh Hien Commune (2007)	Hai Chau District (2007)	Danang City (2007)	Benchmark 2025 for Danang City	People's Assessment on Current Condition	Binh Hien Commune	ASSESSMENT: Objective Score	Objective Score Commune Rank	Subjective Score	Subjective Score Commune Rank
						0.53	1	2	1	32
CONVENIENCE: Household Electricity Connection (%)	100	100	99	100	Power Supply	0.43	2	1	1	24
CONVENIENCE: Road Area Ratio (% per net area)	15.5	19.8	12.8	15.0	Traffic Situation	0.71	2	26	1	29
CONVENIENCE: To-work Travel Time (min.)	15.2	14.9	16.7	15.0	To-work Travel Time	0.51	2	21	1	35
CONVENIENCE: To-work Trips by Public Transportation (%)	0.00	0.00	0.07	35.00	Public Transportation Convenience	-	2	7	-	-
CONVENIENCE: Motor Vehicle Ownership per 000 Population	560	543	450	250	Transportation Convenience	0.71	2	3	1	29
CONVENIENCE: # of TV Sets per 000 Population	453	407	323	350	Telecommunications	0.39	2	3	1	38
CONVENIENCE: # of Telephones per 000 Population	252	227	200	300	Telecommunications	0.39	2	3	1	38
						0.33	0	21	1	29
SAFETY & SECURITY: Police Service Coverage (%)	100.0	99.8	71.6	80.0	Safety and Security	0.48	2	17	1	31
SAFETY & SECURITY: Flood Vulnerability (% of area)	55.4	38.7	25.7	10.0	Flooding	0.29	2	45	1	33
SAFETY & SECURITY: HHs with Permanent Housing (%)	100.0	98.9	98.4	100.0	Housing	0.56	2	11	1	8
SAFETY & SECURITY: Traffic Injuries per 100,000 Population	710	1,306	1,480	700	Traffic Safety	-0.01	1	20	0	43
						0.27	2	3	1	36
HEALTH & WELL-BEING: HHs with Piped Water Connection (%)	97.5	95.2	60.9	80.0	Water Supply	0.43	1	6	1	16
HEALTH & WELL-BEING: HHs Covered by SW Collection Services (%)	97.5	96.3	80.2	90.0	Solid Waste Collection	0.33	2	26	1	24
HEALTH & WELL-BEING: HHs with Sewerage Systems (%)	95.0	87.7	51.6	90.0	Drainage Conditions	0.27	1	5	1	41
HEALTH & WELL-BEING: Hospitals per 000 Population	0.31	0.16	0.13	0.15	Access to Health Care	0.06	2	3	1	41
						0.17	1	12	1	29
AMENITY: Cultural Facilities per 000 Population	0.78	0.41	0.53	1.00	Access to Entertainment Facilities	-0.04	1	11	0	26
AMENITY: Water Areas per 000 Population (ha)	1.06	1.25	5.52	10.00	Neighborhood Landscape	0.23	1	28	1	8
AMENITY: Parks / Open Spaces per 000 Population (ha)	0.00	0.52	0.46	3.00	Access to Parks and Green Spaces	0.14	2	13	1	18
AMENITY: Green Areas per 000 Population (ha)	0.00	0.01	298.68	300.00	Greenery	-0.11	2	42	-1	38
AMENITY: Average Living Space per Capita (m²)	23.5	22.4	15.3	50.0	Housing Conditions	0.30	2	39	1	39
AMENITY: Net Population Density (nu./ha)	409	206	39	100	Peace and Order Situation	0.47	2	50	1	13
						0.52	2	2	1	29
CAPACITY: Average Annual Income (USD)	3,114	3,295	2,619	5,000	Housing	0.56	1	17	1	6
CAPACITY: Motor Vehicle Ownership per 000 Population	560	543	450	250	Transportation Convenience	0.71	2	3	1	29
CAPACITY: Internet Connections per 000 Population	342	342	174	500	Telecommunications	0.39	2	3	1	38
CAPACITY: Mobile Phone Ownership per 000 Population	550	477	352	500	Telecommunications	0.39	2	3	1	38

Overall Assessment

		rank / commune
Objective Assessment Score:	0.86	(2/56)
Subjective Assessment Score:	0.36	(33/56)

Summary Diagnosis

Overall Assesment	The people have a balanced and positive perception of their living environment, although amenities are not adequate.
Convenience	The status is generally good, especially transportation (excluding public transportation).
Safety & Security	This commune is highly vulnerable to floods and traffic injury rates are relatively high.
Health & Well-being	Basic services are well provided, but people are dissatisfied with their access to health care services.
Amenity	Parks, open space, and greeneries are limited and people are dissatisfied. On the other hand, housing conditions are good.
Capacity	Capacity scores are high, especially in terms of transportation convenience and telecommunications.

6. Secondary Data Processing

- Mapping of spatial distribution of development constraints by overlay of existing condition
- Slope
- Flood prone area/natural disaster distribution
- Surface erosion
- Ecological zone
- Preservation area
- Cultural /historical sites etc.
- High density area

6. Tertiary Data Processing

- Development suitability mapping
- Preservation suitability mapping

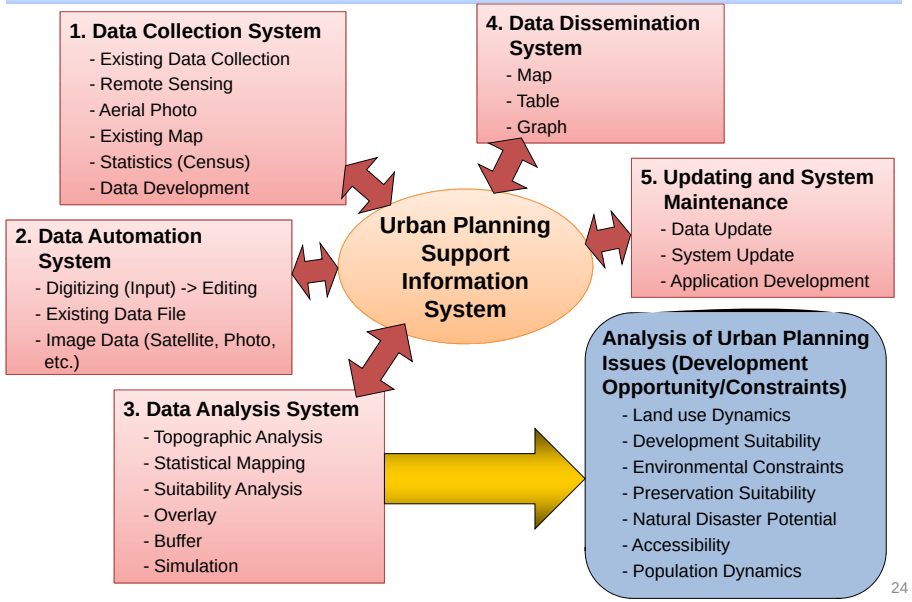
By overlay of constraints maps

Buffer zone generation

Mathematical analysis or simulation results can be mapped based on GIS for further analysis.

Based on DaCRISS GIS, Data Processing will be explained as follow;

System Components of GIS Database



Basic Items for DaCRISS GIS Database (1/5)

Category		Title	Item	Shp Type	Scale	Data Source	Source Year
Administrative Boundary	1	Administrative Boundary	City	Polygon	1:5,000 / 1:10,000	Topo map	2006
			District	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Commune	Polygon	1:5,000 / 1:10,000	Topo map	2006
		Socio-economic Condition from GSO	Population	Table	Non Scale	GSO	2007
Natural Conditions	1	Topography	Contour	Polyline	1:5,000 / 1:10,000	Topo map	2006
			Height Spot	Point	1:5,000 / 1:10,000	Topo map	2006
	2	Geology	Geology	Polygon	1:200,000	Geological Survey of Vietnam	1996
	3	Groundwater	Groundwater Condition	Polygon	1:75,000	DONRE	2008
	4	Water System	River	Polyline/Polygon	1:5,000 / 1:10,000	Topo map	2006
			Lake/Reservoir	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Sea (Coastal Line)	Polyline	1:5,000 / 1:10,000	Topo map	2006
	5	Existing Natural Land Use	Wetland Area	Polygon	1:10,000	Topo map	2006
			Agriculture Area	Polygon	1:10,000	Topo map	2006
			Vegetation	Polygon	1:10,000	Topo map	2006
	6	Forest Area	Protected Forest	Polygon		DARD	2008
			Endangered Species	Polygon		DARD	2008

Basic Items for DaCRISS GIS Database (2/5)

Category		Title	Item	Shp Type	Scale	Data Source	Source Year
Natural Conditions (Cont'd)	7	Eco-system (Sea)	Coral Reef	Polygon	1:10,000	DOST	2008
	8	Eco-system (Land)	Protected Animal Habitat	Point	No Scale	DARD	2008
Environmental Management	1	Environment Monitoring Station	Water Quality	Point	1:5,000	DONRE	2008
			Air Quality	Point	1:5,000	DONRE	2008
			Soil Sampling	Point	1:5,000	DONRE	2008
			Meteorology	Point	1:5,000	Topo map	2006
	2	Environment Monitoring Data	Environment Monitoring Data	Table		DONRE	
	3	Disaster Mitigation Method	Dyke	Polyline	1:5,000	PIIP	2006
			Culvert	Point	1:5,000	Topo map	2006
Hazard/Risk Records	1	Historical Trend	Historical Flood Affected Area	Point	1:10,000	PIIP	2007
			Regularly Flooding Area	Polygon			
Landuse	1	Urban Land Use	Industrial Area (existing)	Polygon	1:5,000	Study Team	2008
			Residential Area				
			Commercial Area				
			Public Use Area				

Basic Items for DaCRISS GIS Database (3/5)

Category		Title	Item	Shp Type	Scale	Data Source	Source Year
Urban Transportation	1	Transportation Network	Railway	Polyline	1:5,000 / 1:10,000	Topo map	2006
			Road	Polyline	1:5,000 / 1:10,000	Topo map	2006
			Bridge	Point	1:5,000 / 1:10,000	Topo map	2006
			Port	Point/ Polygon	1:5,000 / 1:10,000	Topo map	2006
			Airport	Point/ Polygon	1:5,000 / 1:10,000	Topo map	2006
			Railway Station	Point/ Polygon	1:5,000 / 1:10,000	Topo map	2006
			Bus Terminal	Point/ Polygon	1:5,000 / 1:10,000	Topo map	2006
	2	Public Transport	Bus Route	Polygon	1:50,000	DOT	2008
			Bus Stop				
	3	Traffic Management	Signalized Intersection	Point	1:5,000	DOT	2008
	4	Traffic Accident	Frequent Accident Point	Point	1:5,000	DOT	2005
Urban Utilities	1	Water Supply	Water Supply Network	Polyline	1:5,000	PIIP	2007
			Water Supply Service Area	Polygon			
	2	Sewerage & Drainage	Sewerage Network	Polyline			
			Waste Water Catchments Area	Polygon			

Basic Items for DaCRISS GIS Database (4/5)

Category		Title	Item	Shp Type	Scale	Data Source	Source Year
Urban Utilities (Cont'd)	3	Power Supply	High-tension Line	Polyline	1:5,000	Topo map	2006
	4	Solid Waste Management	Dumping Site	Polygon	1:5,000	URENCO	
	5	Treatment Facility	Water Supply	Point	1:5,000	PIIP	2007
			Drainage	Point	1:5,000	DOT	
			Sewerage	Point	1:5,000	PIIP	2007
			Pumping Station	Point	1:5,000	DOT	
Public Facilities	1	Education	Primary School	Point	1:5,000 / 1:10,000	Topo map, DOE	2008
			Secondary and Above School	Point	1:5,000 / 1:10,000	Topo map, DOE	2008
	2	Healthcare	Hospital	Point	1:5,000 / 1:10,000	Topo map, DOH	2008
			Clinic	Point	1:5,000 / 1:10,000	Topo map, DOH	2008
	3	Market	Market	Polygon	1:5,000 / 1:10,000	Topomap, DOIT	2008
			Wholesale Market	Polygon	1:5,000 / 1:10,000	Topomap, DOIT	2008
			Large-scale Retailing	Polygon	1:5,000 / 1:10,000	Topomap, DOIT	2008

Basic Items for DaCRISS GIS Database (5/5)

Category	Title		Item	Shp Type	Scale	Data Source	Source Year
Public Facilities (Cont'd)	4	Administrative Facilities	PC Office	Point	1:5,000 / 1:10,000	Topo map	2006
			Danang City Office	Point	1:5,000 / 1:10,000	Topo map	2006
			Police Station	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Post Office	Polygon	1:5,000 / 1:10,000	Topo map	2006
Cultural Facilities	1	Historical Site	Citadel	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Museum	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Monument	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Historical Cemetery	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Martyr Site	Polygon	1:5,000 / 1:10,000	Topo map	2006
	2	Religious Facility	Pagoda	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Temple	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Church	Polygon	1:5,000 / 1:10,000	Topo map	2006
	3	Recreational Site	Park	Polygon	1:5,000 / 1:10,000	Topomap	2006
			Teatre	Polygon	1:5,000 / 1:10,000	Topomap	2006
			Cinema	Polygon	1:5,000 / 1:10,000	Topomap	2006
			Garden	Polygon	1:5,000 / 1:10,000	Topomap	2006
	4	Sport Site	Stadium	Polygon	1:5,000 / 1:10,000	Topomap	2006
			Tennis Court	Polygon	1:5,000 / 1:10,000	Topomap	2006
			Pool	Polygon	1:5,000 / 1:10,000	Topomap	2006
			Sports Center	Polygon	1:5,000 / 1:10,000	Topomap	2006
Buildings	1	Building	Building with Number of Floors	Polygon	1:5,000 / 1:10,000	Topo map	2006
			Yards	Polygon	1:5,000 / 1:10,000	Topo map	2006

Set Up of GIS Environment for DaCRISS

GIS Software

- ArcView of ESRI, software vendor in USA which is now widely accepted GIS package software in the world.

Projection and Coordinate System

- WGS_1984_UTM_Zone_49N is applied for DaCRISS GIS Database.
- However, it will be converted to VN2000, the official coordinate system in Vietnam, after completion of DaCRISS GIS Database development.

Hardware and Software Prepared

- The following hardware and software were installed to operate the DaCRISS GIS Database in the Study. Those will be transferred to the counterpart agency after completion of the Study.
  - ArcView: 3 licenses
  - Personal computer: 3 units (Acer L3600, CPU E4600, HD320GB)
  - Large format plotter: 1 units (HP Designjet T610 44in)

Analysis of Urban Planning Issues

- Development Suitability
- Environmental Constraints
- Preservation Suitability
- Natural Disaster Potential

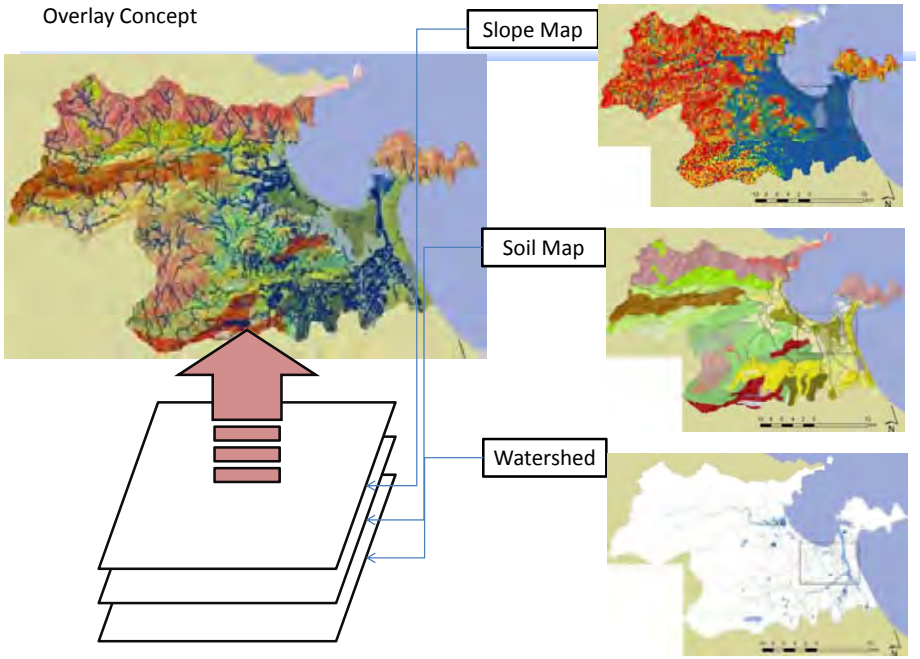
Development Suitability Analysis

Objective

- For regional planning of Da Nang City, environmental consideration is one of the key issues to be analyzed. In order to understand environmental constraints and development opportunities in Da Nang City, various data analysis is conducted to support urban and regional planning work with the integrated DaCRISS GIS Database developed in the Study.

Methodology

1. Primary Data Analysis: Based on the developed DaCRISS GIS Database, physical and environmental data are mapped to understand existing condition of the Study area.
2. Secondary Data Analysis: Environmental constraints and problem area for development of the Da Nang City are interpreted and mapped based on the collected data.
3. Tertiary Analysis: Those processed data will be totally combined and overlay to determine for development suitability of the Study Area.

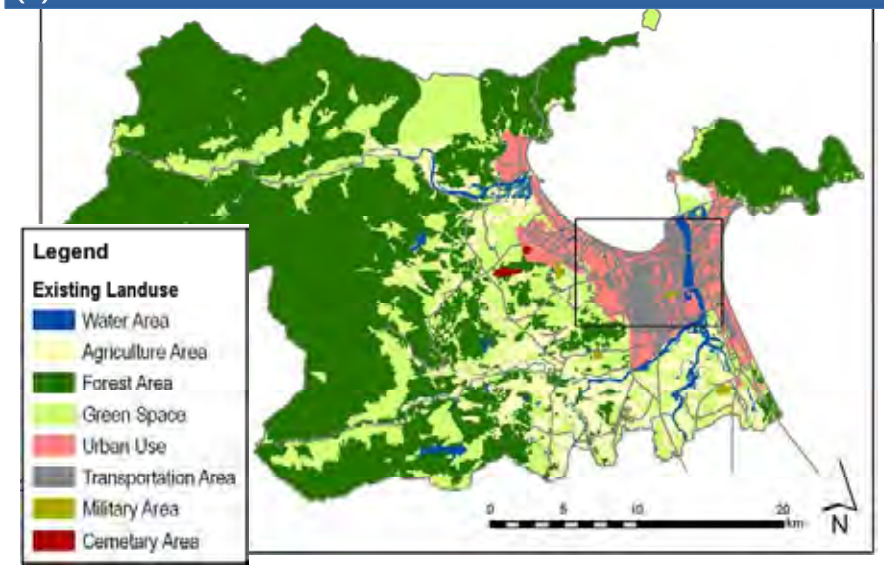


Structure of Development Suitability Analysis

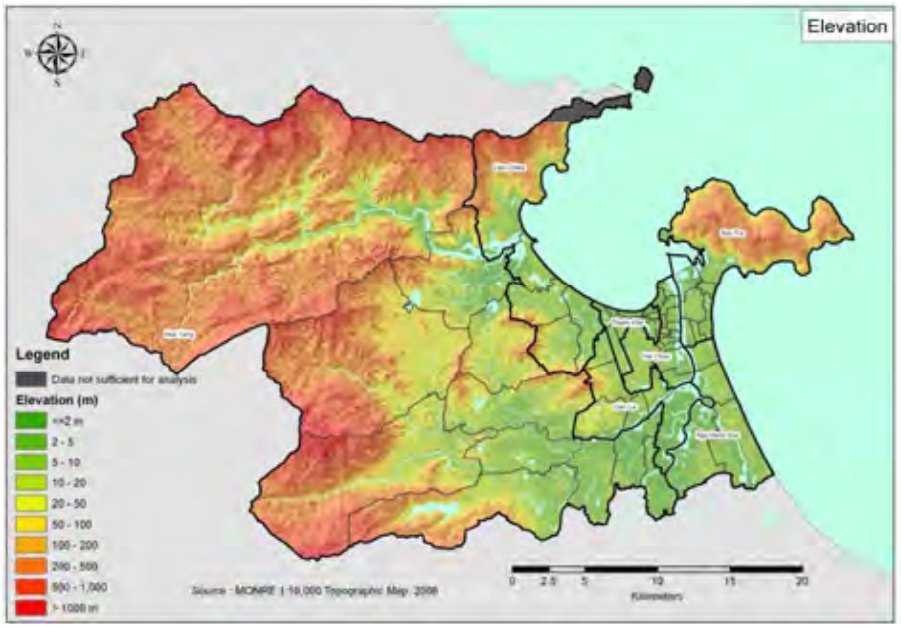
Base Data	Primary Processing	Secondary Processing	Tertiary Processing
	Detail Contour	Estimated Submerged Area	
Elevation Spot Height	Slope	Erosion Potential	Development Suitability Area
	3D View		
	City Boundary		
Administrative Boundary	District Boundary		Area Calculation Table
	Commune Boundary		
Geology			
Groundwater Condition	Potential Saltwater Intrusion Area		Development Constraints Map
Coast Line	Coastal Buffer Zone (250m from Coastal Line)	Potential Coastal Erosion Area	
River System	River Buffer Zone (200m from River Bank)	Potential River Erosion Area	Area Calculation Table
	Abandoned River Channels		
Flash Flood and Erosion Location			Conservation Suitability Area
	Agriculture Area	Agriculture Area	
Existing Landuse	Vegetation		
	Urban Landuse		Area Calculation Table
Forest Area	Forest Preservation Area		
Micro-geomorphology		Potential Flood Prone Area	
Protected Animal Habitat Coral Reef Protection Area	Ecological Preservation Area		

Primary Data Analysis

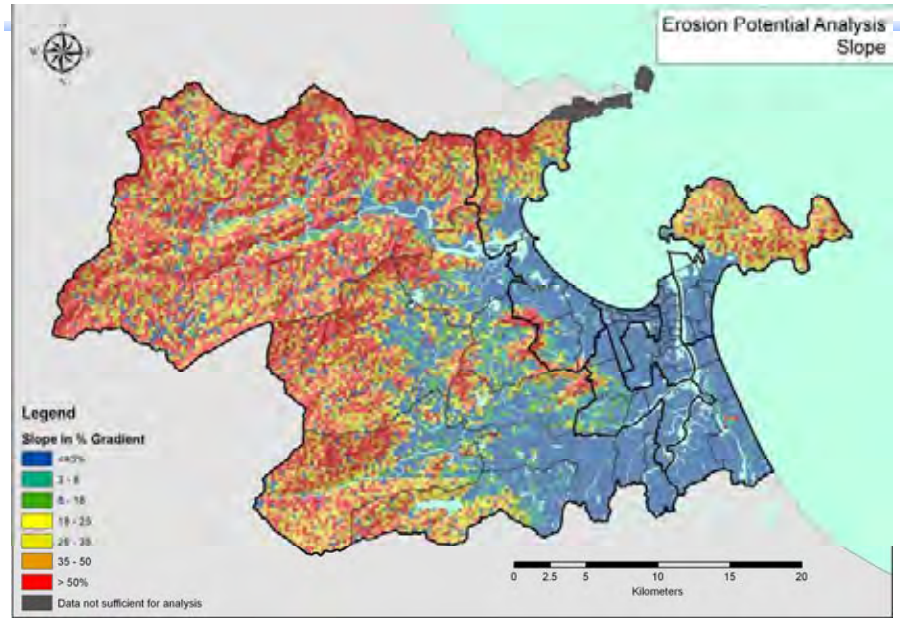
(1) Landuse



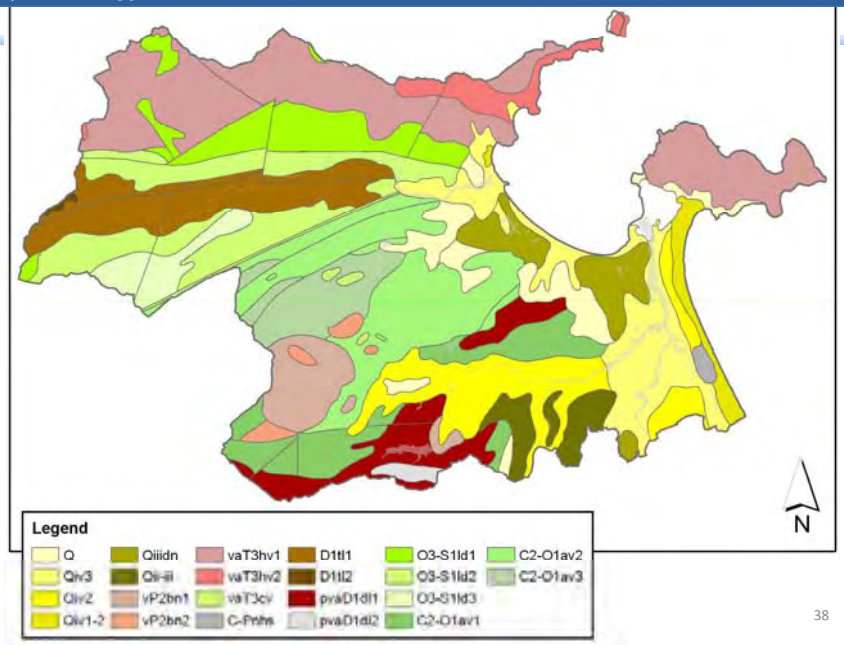
(2) Elevation



(3) Slope



(4) Geology



Secondary Data Analysis

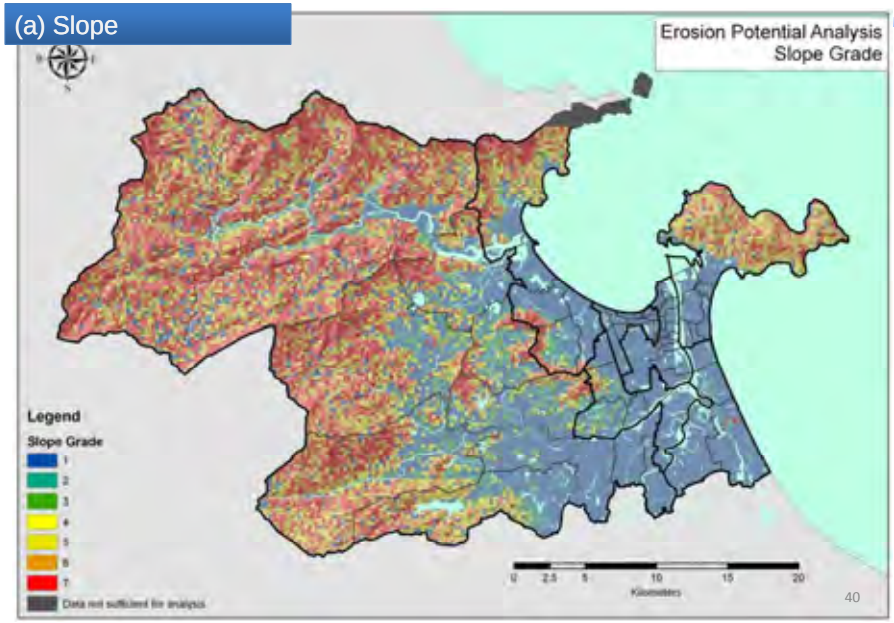
(1) Erosion Potential Analysis

- Those data identified in the primary data analysis will be combined and overlay to determine for potential areas of disasters or problems. A 250m x 250m grid system was developed to cover the study area.
- Indicators selected for analysis will be reclassified into several grades. For Erosion Potential Analysis, (a) Slope, (b) Geology, and (c) Vegetation are selected and set the grades as follows;

		0	1	2	3	4	5	6	7
Slope (%)			0~3	3~8	8~18	18~25	25~35	35~50	>50
Geology	First Step	Alluvium	Diluvium	-	Tertiary Mesozoic	-	Paleozoic		
	Second Step	-	-	-	-	-	Granite Schist		
Vegetation		Rice Field, Agriculture, Wetland	-	-	Planted Trees, Forest	Grasslands	Shrubs		

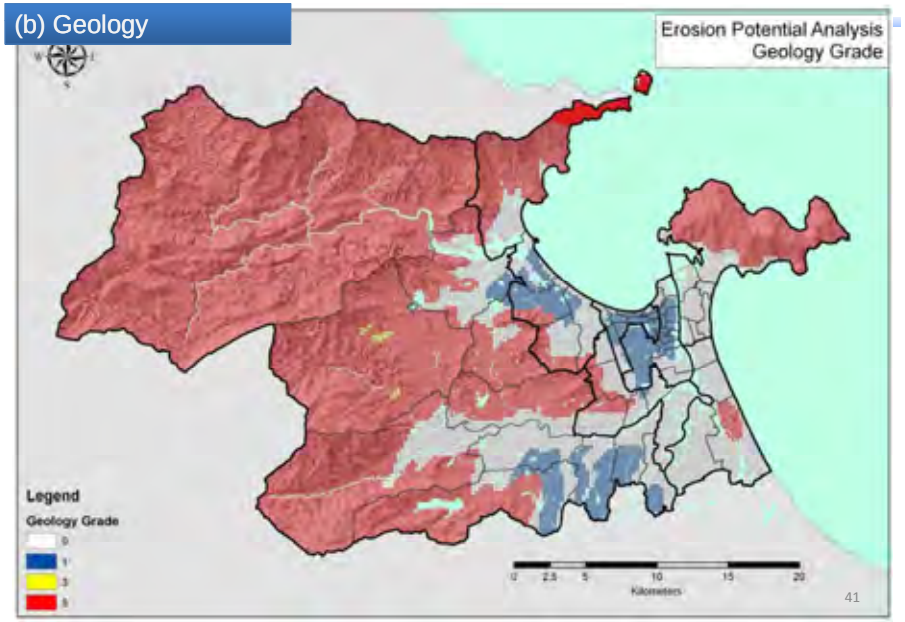
(1) Erosion Potential Analysis

(a) Slope



(1) Erosion Potential Analysis

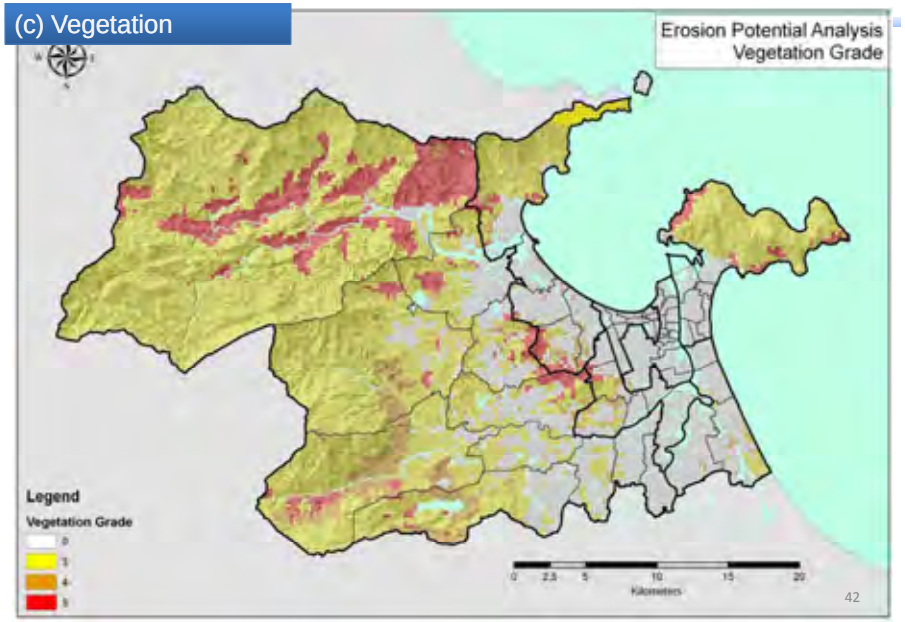
(b) Geology



41

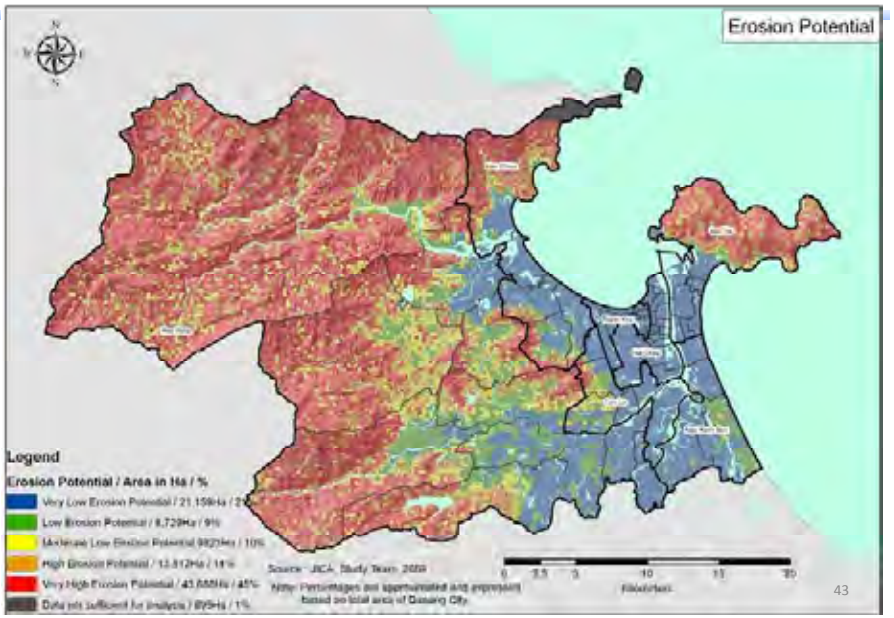
(1) Erosion Potential Analysis

(c) Vegetation



42

(1) Erosion Potential Area



43

Secondary Data Analysis

(2) Potential Flood Prone Area

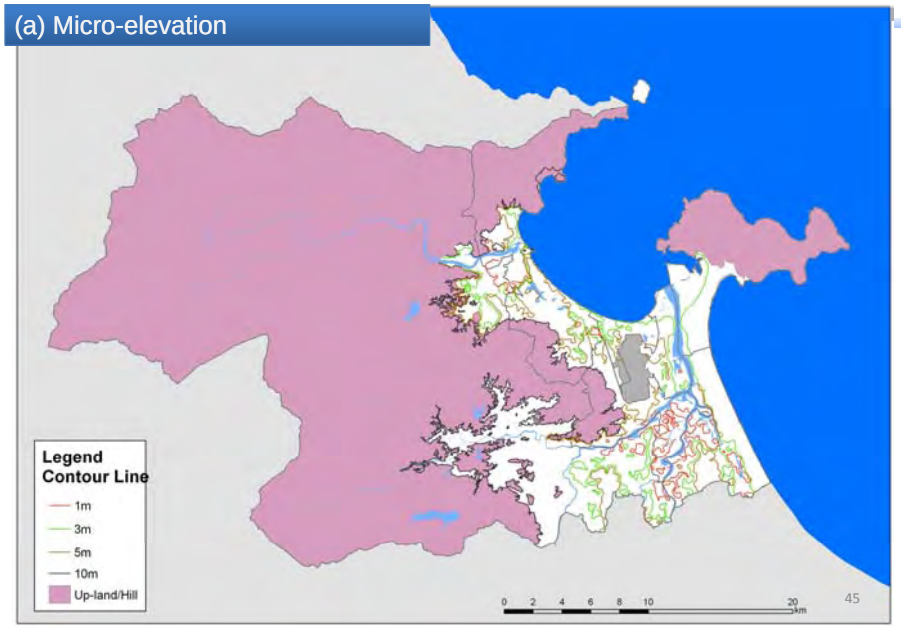
- Applying same methodology with the erosion potential analysis, potential flood prone area is evaluated.
- Indicators selected for analysis are reclassified into several grades. For Potential Flood Prone Area Analysis, (a) Micro-geomorphology is selected and set the grades as follows;

	0	1	2	3	4	5
Micro-geomorphology	Up-land/ Hill	Old Sand Bar and Low Sand Dune	-	Flood Plain	New Sand Bar	Deltaic Low-land, Lagoon Low-land, Abandoned River Channel

44

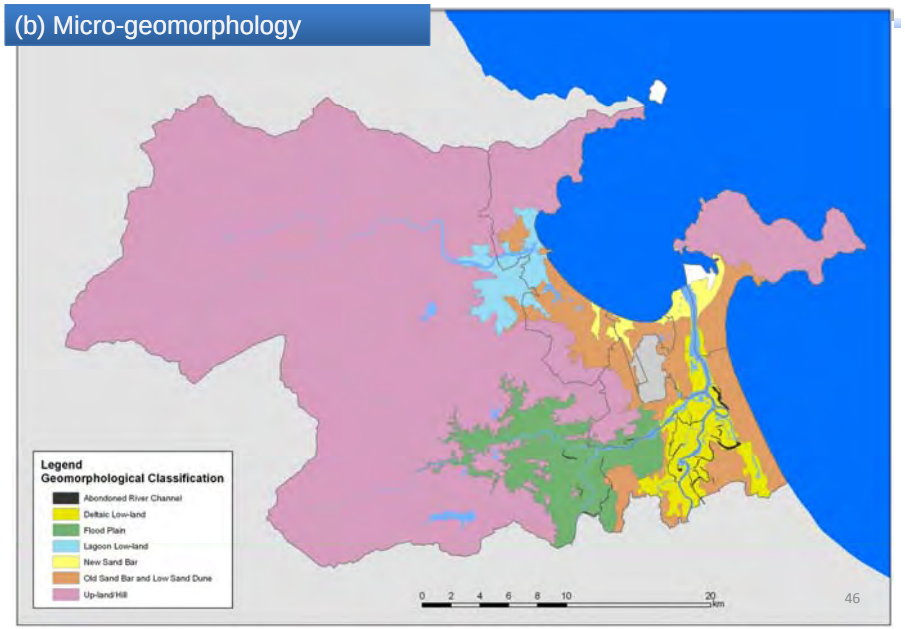
(2) Potential Flood Prone Area

(a) Micro-elevation



(2) Potential Flood Prone Area

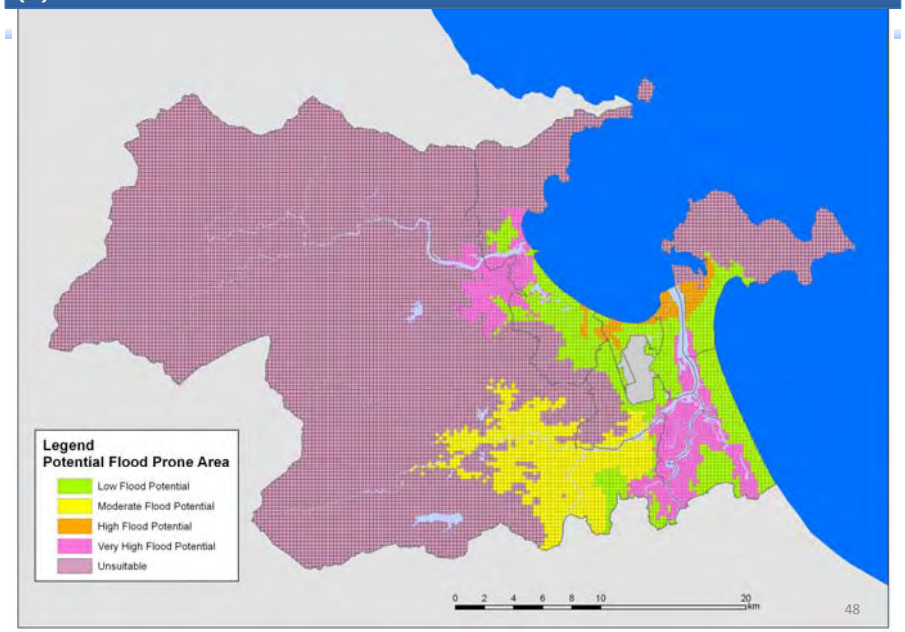
(b) Micro-geomorphology

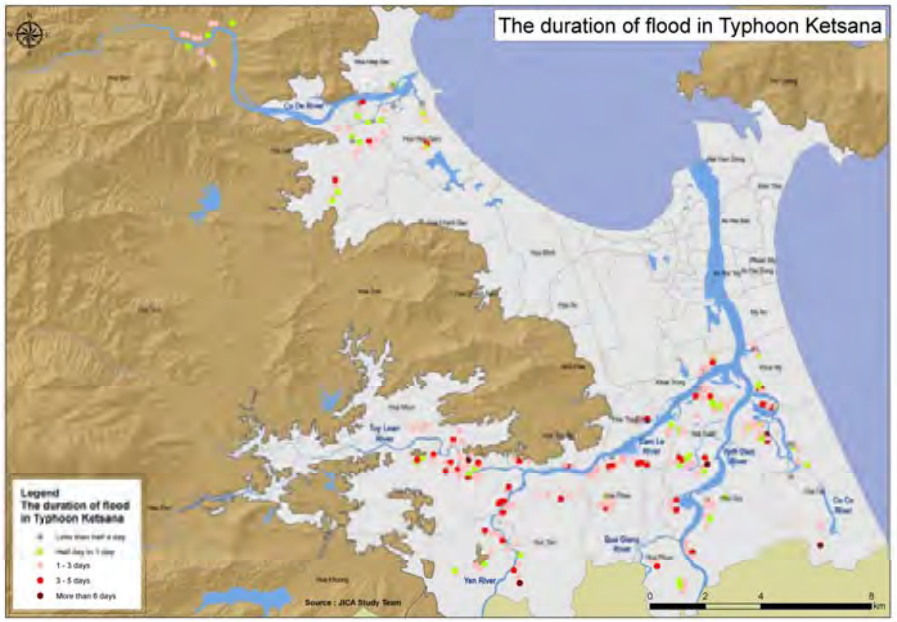


(2) Potential Flood Prone Area

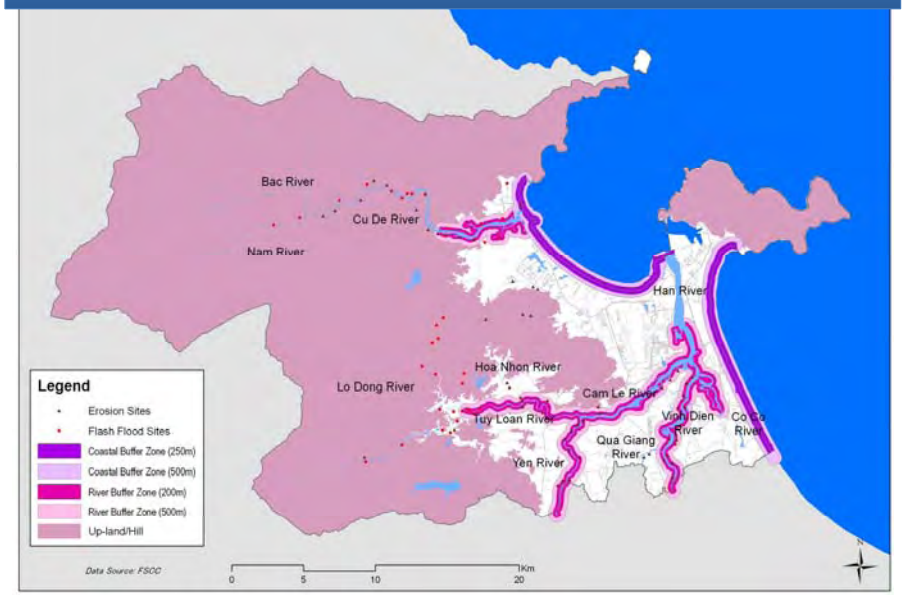
(c) Wide-area Satellite Map

(2) Potential Flood Prone Area

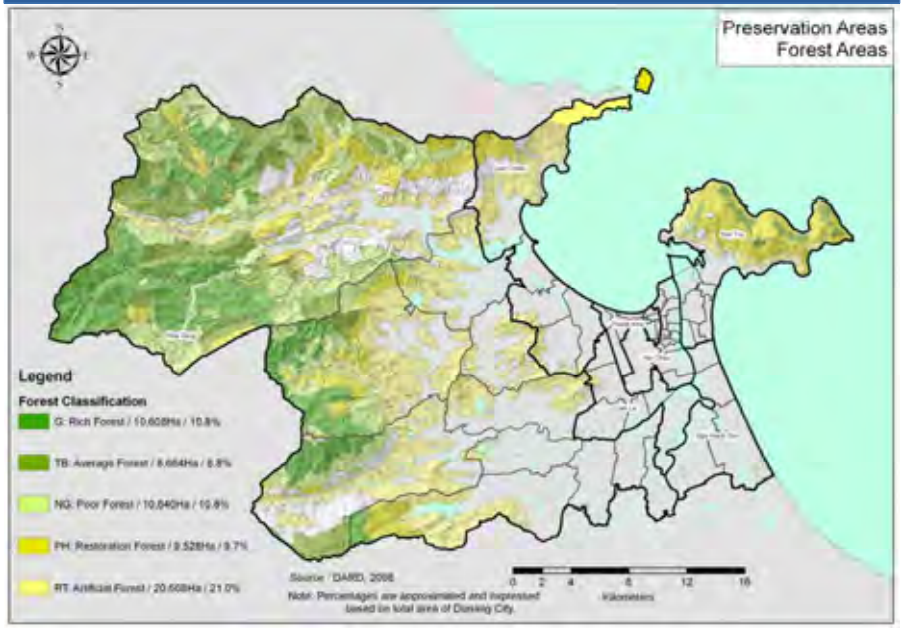




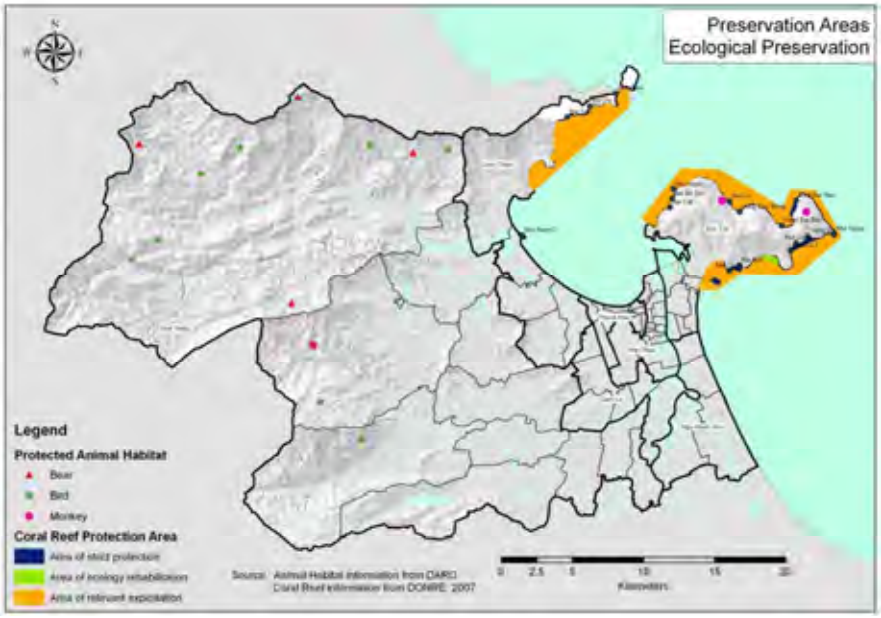
(3) Coastal and River Buffer Zone and Flash Flood and Erosion Location



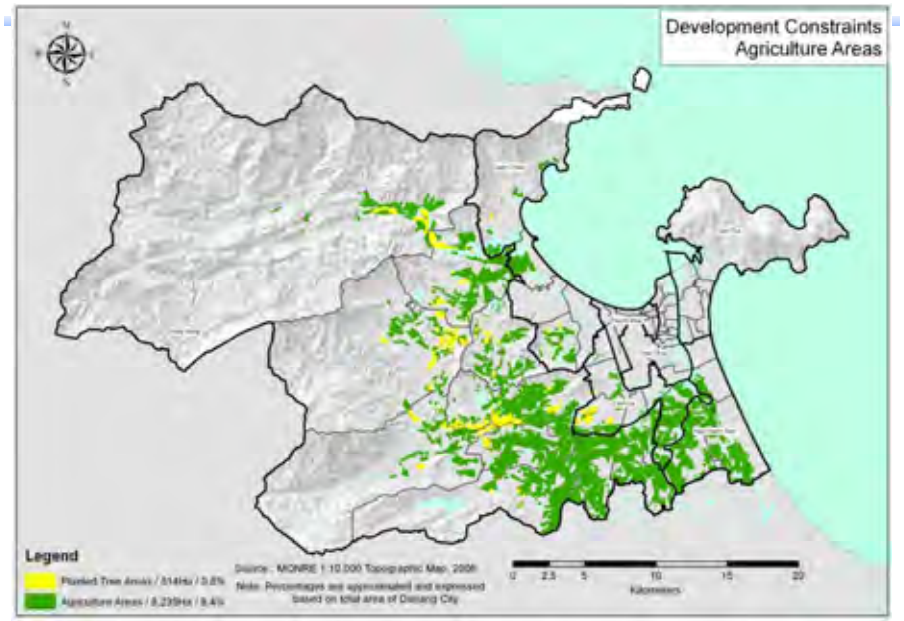
(4) Forest Area



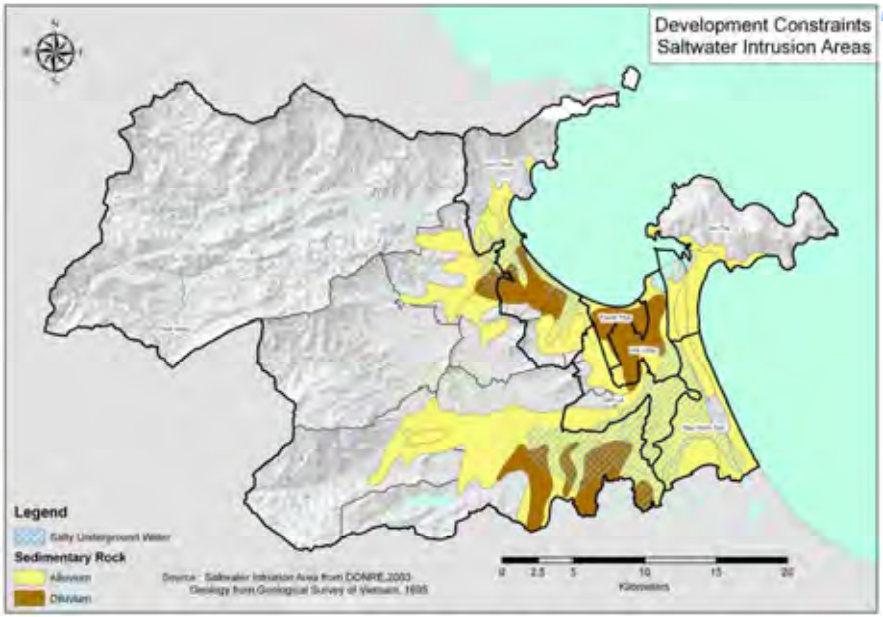
(5) Ecological Preservation Areas



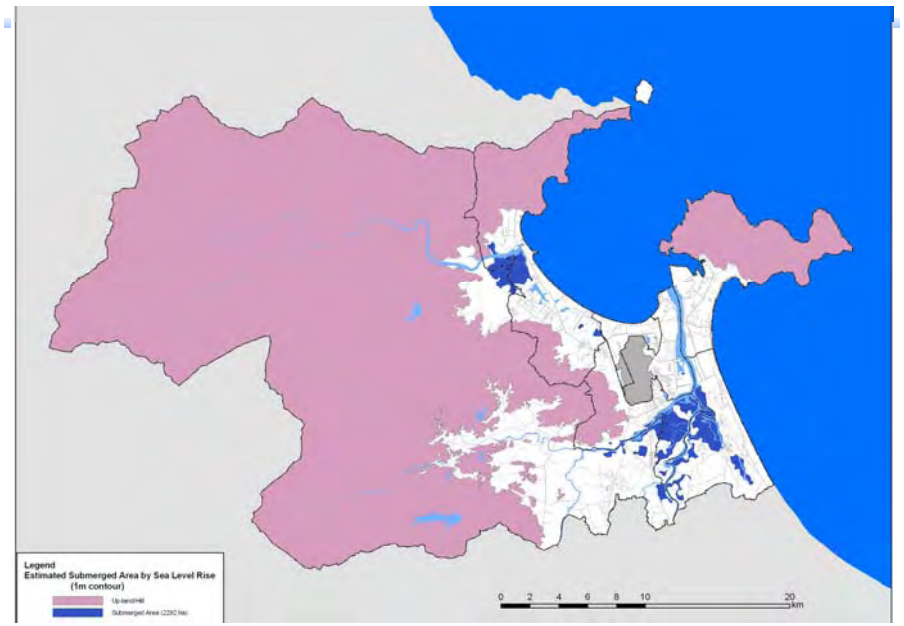
(6) Agriculture Areas



(7) Saltwater Intrusion Areas



(8) Estimated Submerged Area by Sea Level Rise



Tertiary Analysis

Processed data are classified into the following three (3) categories;

1) Development Suitability Area: Area where any development shall be accepted without constraints
- Erosion Potential Area
- Potential Flood Prone Area

2) Development Constraints Map: Area where developments shall be needed considerations
- Coastal and River Buffer Zone
- Agricultural Area
- Saltwater Intrusion Area
- Submerged Area by Sea Level Rise

3) Preservation Area: Area where no development shall be accepted
- Forest Area
- Ecological Preservation Area

Criterion of Development Suitability

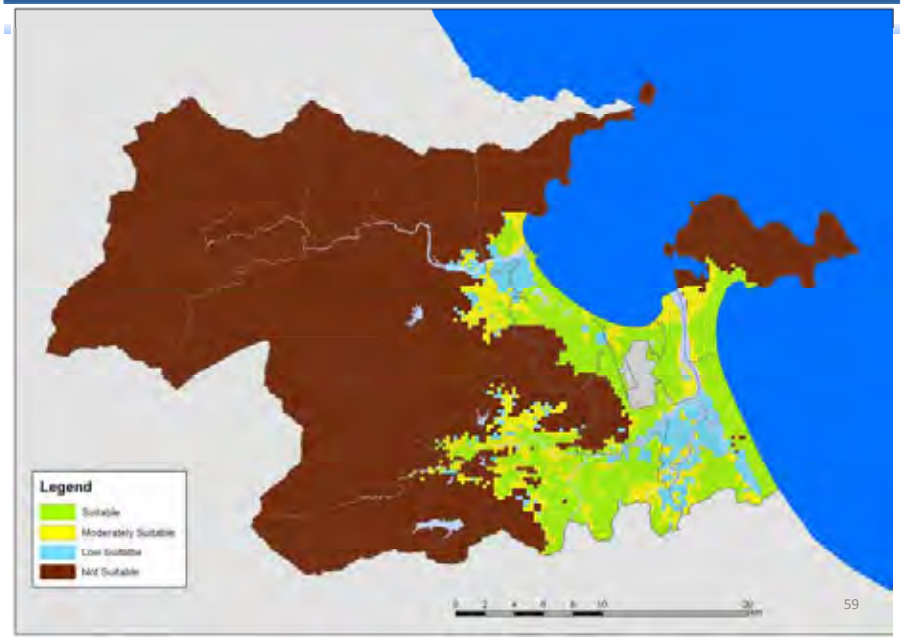
- Indicators used for Development Suitability Analysis are (A) Erosion Potential Area, (B) Potential Flood Prone Area, and (C) Potential Submerged Area. Those are interpreted and reorganized the map legend to formulate development suitability map.

(A) Erosion Potential Area	(B) Potential Flood Prone Area	Development Suitability	Grade (A+B)	Distribution	
				%	km2
1~3 => 1	1	Suitable	2~4	13	120
4~7 => 3	3	Moderately Suitable	5~7	6	60
8~10 => 5	4	Low Suitable	8~10	3	33
	(C) Potential Submerged Area	Low Suitable			
11~17	5	Unsuitable		75	718
		River & Lake		2	20
		Total		100	950

Aggregation of Erosion + Flood

Unconditionally classified to "Unsuitable" or "Low Suitable"

Development Suitability Area



Development Suitability Area by Commune

	Area (ha)						Distribution toTotal Area by Commune (%)					
Commune Name	Suitable	Moderately Suitable	Low Suitable	Unsuitable	River / Lake	Total Area	Suitable	Moderately Suitable	Low Suitable	Unsuitable	River / Lake	Total Area
P. Binh Hien	22	13	-	-	14	50	45%	27%	0%	0%	29%	100%
P. Binh Thuan	38	7	-	-	7	52	74%	13%	0%	0%	13%	100%
Hoa Thuan Tay	844	0	-	-	-	844	100%	0%	0%	0%	0%	100%
Hoa Thuan Dong	72	14	-	-	22	108	66%	13%	0%	0%	21%	100%
P. Hai Chau I	70	2	-	-	20	92	76%	2%	0%	0%	22%	100%
P. Hai Chau II	35	-	-	-	-	35	100%	0%	0%	0%	0%	100%
Hoa Cuong Bac	159	114	12	-	64	350	46%	33%	3%	0%	18%	100%
Hoa Cuong Nam	118	58	0	-	37	213	56%	27%	0%	0%	17%	100%
P. Nam Duong	24	-	-	-	-	24	100%	0%	0%	0%	0%	100%
P. Phuoc Ninh	26	11	-	-	17	54	48%	20%	0%	0%	31%	100%
P. Thanh Binh	0	74	-	0	1	75	0%	99%	0%	0%	1%	100%
P. Thuan Phuoc	-	61	-	1	48	111	0%	56%	0%	1%	43%	100%
P. Thach Thang	29	57	-	1	15	102	29%	56%	0%	1%	15%	100%
Hai Chau	**1,439**	**412**	**12**	**2**	**245**	**2,110**	**66%**	**21%**	**1%**	**0%**	**12%**	**100%**
P. Chinh Gian	74	-	-	-	-	74	100%	0%	0%	0%	0%	100%
P. Tam Thuan	14	37	-	-	-	50	27%	73%	0%	0%	0%	100%
P. Thac Gian	66	-	-	-	12	78	85%	0%	0%	0%	15%	100%
P. Tan Chinh	36	1	-	-	-	37	98%	2%	0%	0%	0%	100%
P. Vinh Trung	50	-	-	-	1	52	97%	0%	0%	0%	3%	100%
P. Xuan Ha	55	28	-	-	-	83	66%	34%	0%	0%	0%	100%
P. An Khe	177	34	-	-	-	211	84%	16%	0%	0%	0%	100%
Hoa Khe	132	8	-	-	-	141	94%	6%	0%	0%	0%	100%
Thanh Khe Tay	46	63	9	-	-	119	39%	53%	8%	0%	0%	100%
Thanh Khe Dong	32	50	-	-	-	82	39%	61%	0%	0%	0%	100%
Thanh Khe	**684**	**221**	**9**	**-**	**13**	**927**	**73%**	**24%**	**1%**	**0%**	**1%**	**100%**
P. An Hai Bac	237	89	-	1	22	349	68%	26%	0%	0%	6%	100%
P. An Hai Tay	17	49	-	-	40	106	16%	46%	0%	0%	38%	100%
P. An Hai Dong	81	0	-	-	-	81	100%	0%	0%	0%	0%	100%
P. Man Thai	88	19	-	-	-	107	82%	18%	0%	0%	0%	100%
P. Nai Hien dong	-	172	-	200	48	420	0%	41%	0%	48%	11%	100%
P. Phuoc My	204	-	-	-	-	204	100%	0%	0%	0%	0%	100%
P. Tho Quang	324	117	-	4,309	-	4,750	7%	2%	0%	91%	0%	100%
Son Tra	**951**	**446**	**-**	**4,510**	**110**	**6,017**	**15%**	**8%**	**0%**	**75%**	**2%**	**100%**

Conclusions

- The area suitable for development is spread in the eastern part of Da Nang City where has been formed by Old Sand Bar and Low Sand Dune.
- The area of Up-land/Hill which covers 75% of the City is not suitable for development.
- Even the plain land in the eastern part of the City, there has been much potentials of flooding, especially around the interflow point of Vinh Dien River and Cam Le River.
- This area is also overlaid in less than 1m contour area. Such area can be regarded as an Estimated Submerged Area by Sea Level Rise caused by worldwide Climate Change.
- Management of the water is the most important issue for Da Nang City's development.

Check Point for Data Processing

- In each data processing stage, analysis criteria should be set by user
- Map legend system and colouring system also be set.
- Area,density, frequency, and distance within specific feature will be calculated and table or graph will be generated.
- Data manipulation is totally depending on user's specific know how, how to use GIS for planning
- Users have to build analysis model by themselves based on their own view point, there is still no standard analysis model yet.

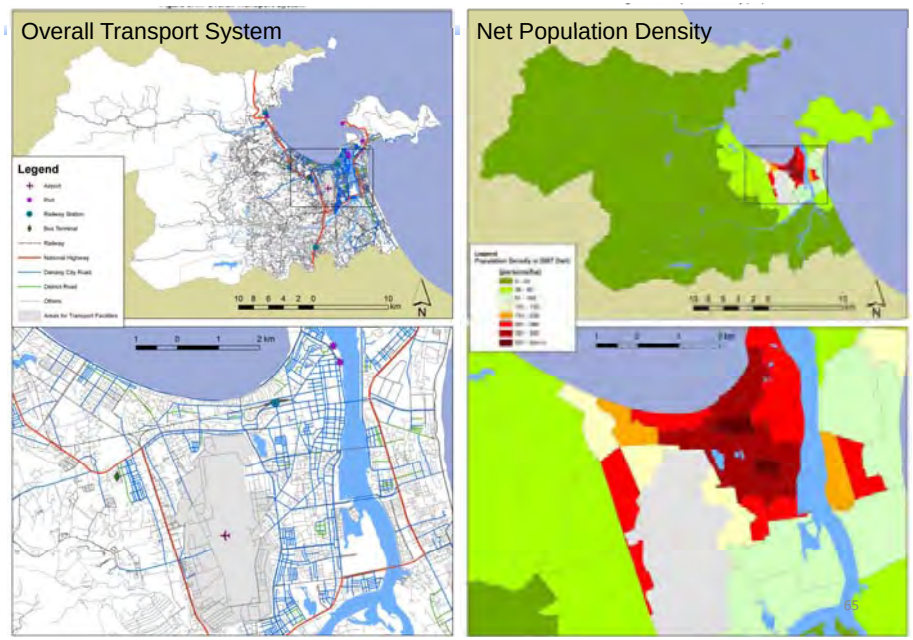
7. Final Mapping and Dissemination of Data Maps

- Map production by plotter
- Generation of Map Atlas
- Objective Data supply for Compilation of Urban Karte
- Data file service through GIS database to support urban planning works.

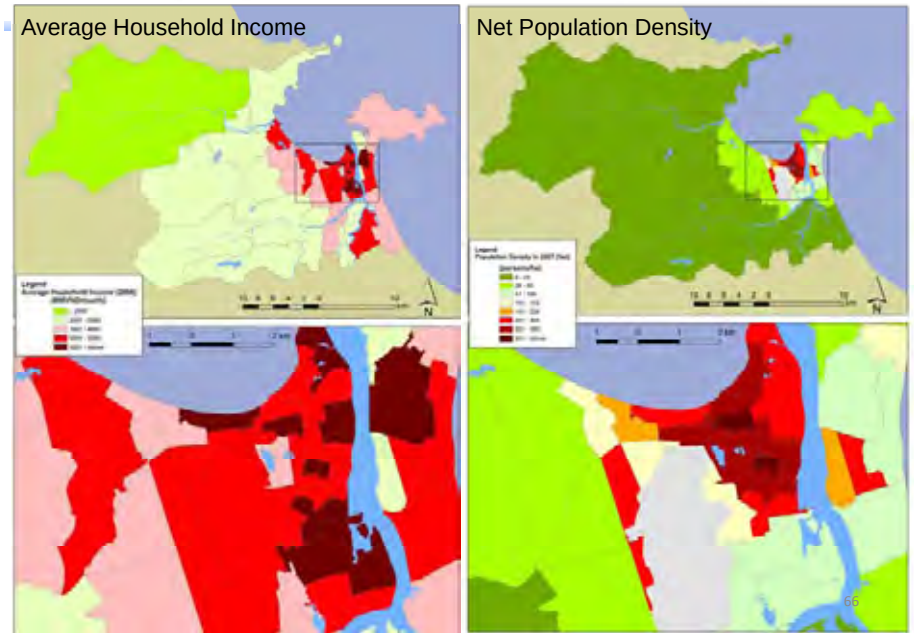
8. Recommendations to Land Use Zoning

- Environmentally critical area will be identified
- Natural disaster potential area will be identified
- Development suitable area and Conservation area will be identified
- Land use zoning framework will be indicated

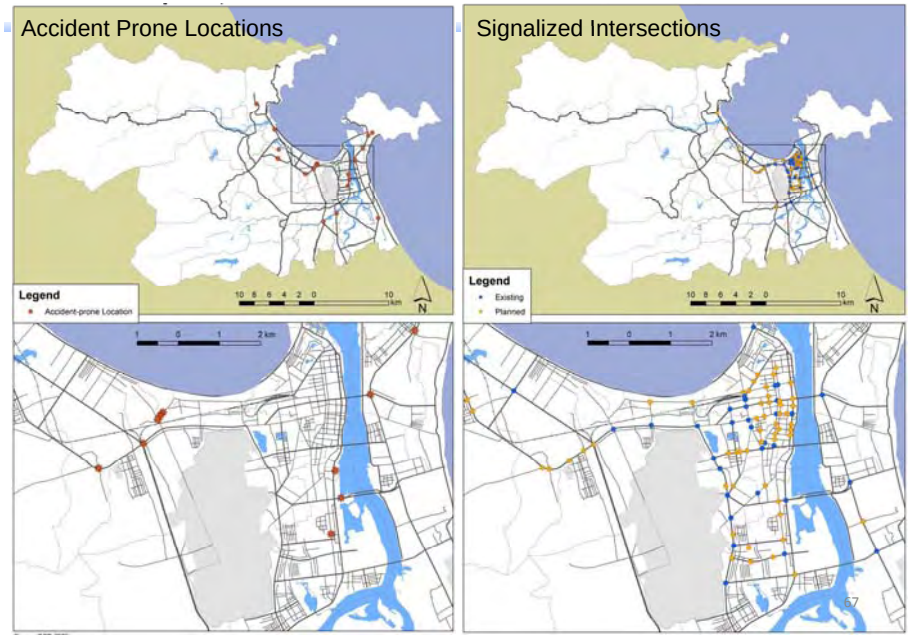
Example of Socio Economic Indicators



Example of Socio Economic Indicators



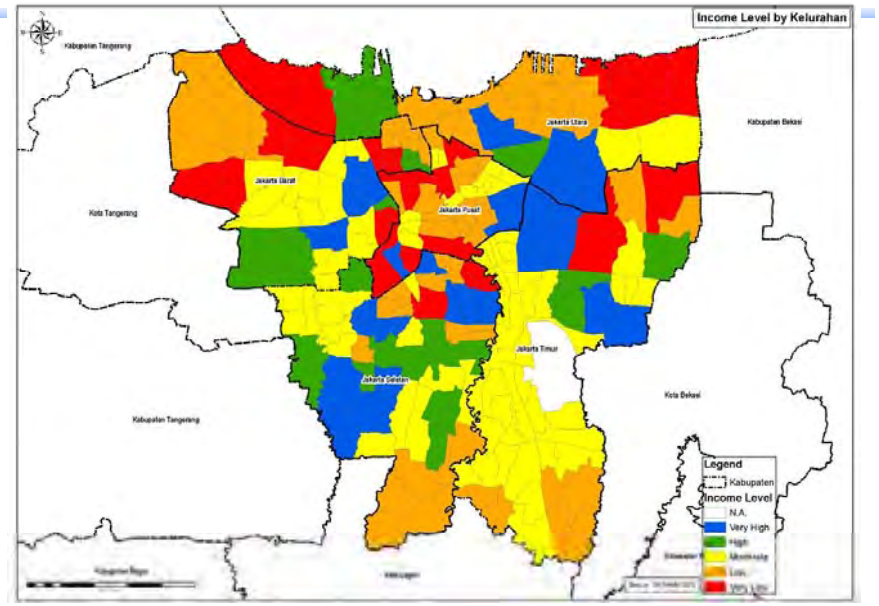
Example of Socio Economic Indicators



9. System Maintenance

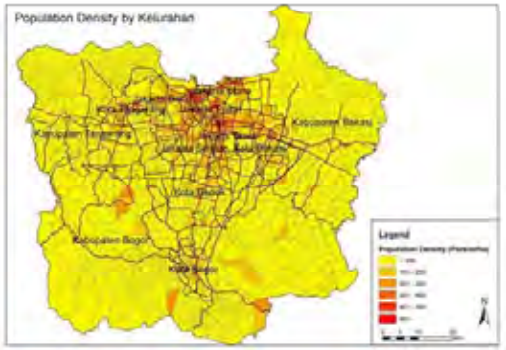
- Data updating for necessary items
- Application system development
- Establishment for data exchange system among the related agencies
- Hardware and software updating
- Improvement of data service
- DaCRISS GIS can be applicable to various aspects of Urban Management such as; land use management, infrastructure planning, development control and management, disaster management

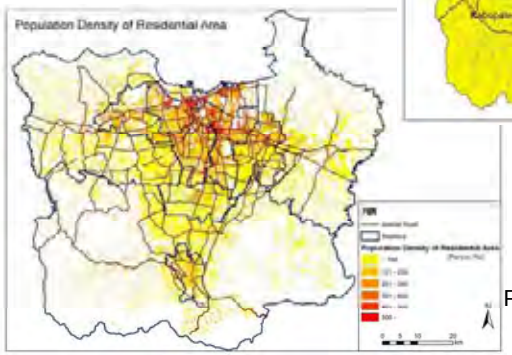
Income Distribution by Kelurahan



Population

Population Density by Kelurahan

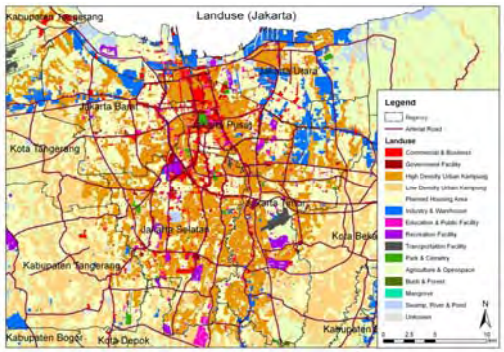




Population Density of Residential Area

Landuse and Transport System

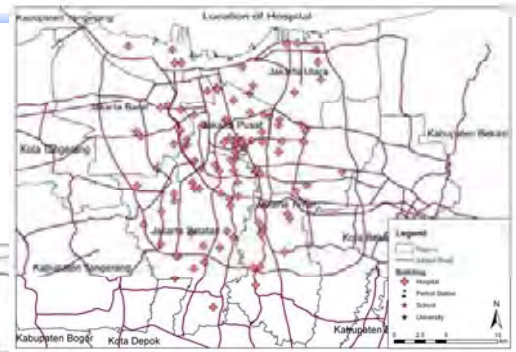
Landuse

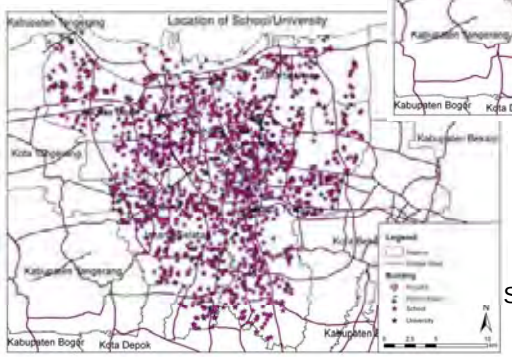


Transport System

Location of Hospital and School / University

Hospital

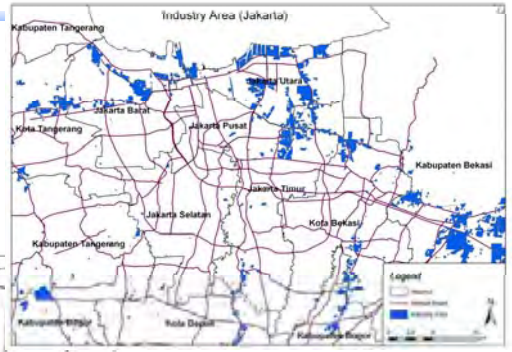


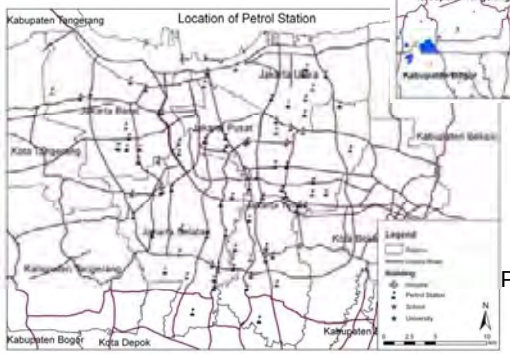


School / University

Industrial Area and Location of Petrol Station

Industrial Area

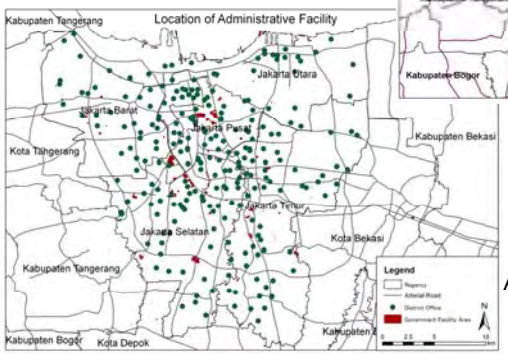




Petrol Station

Park & Open Space and Location of Administrative Facility

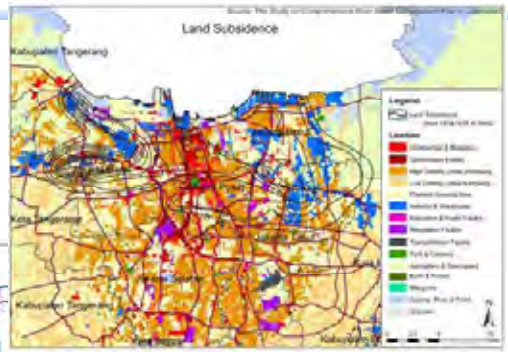
Park & Open Space

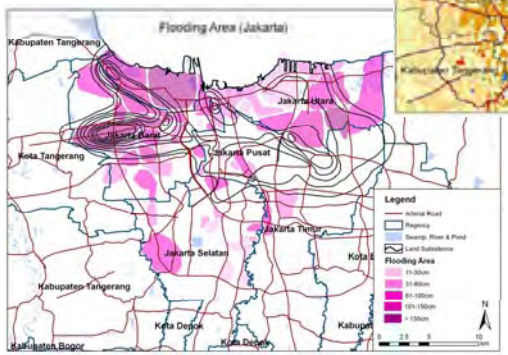


Administrative Facility

Land Subsidence and Flooding Area

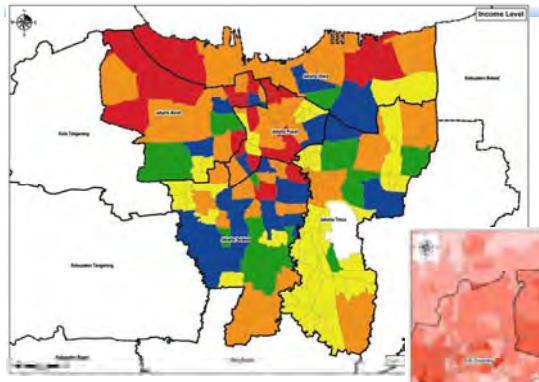
Land Subsidence



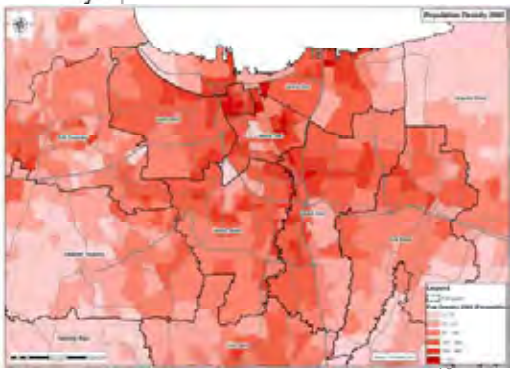


Flooding Area

Examples of Urban Vulnerability Map



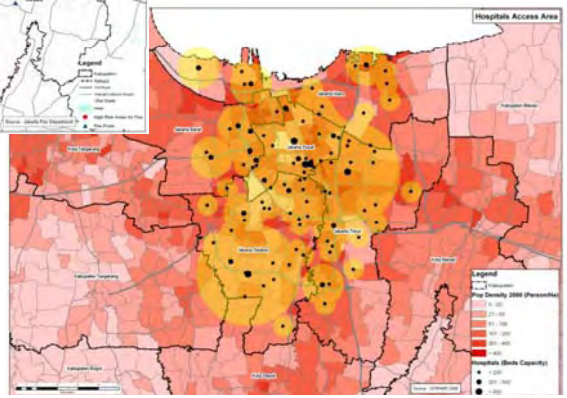
Income Level : Social Vulnerability



Population Density : Social Vulnerability

Coping Capacity

Fire Posts & Location of Fire Risk Area identified by Fire Fighting Department



Hospital Access Area