



Introduction to GIS

Geographic Information System

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Training Objectives

- To learn basic GIS
- To access, organize and manipulate DaCRISS GIS data using the ArcGIS software
- To be able to prepare thematic maps and do various analysis



Course Outline

Day 1 (8:30am-12pm / 2pm-4:30pm)

- GIS Overview
- Introduction to ArcGIS
 - ArcGIS Desktop
 - Shapefile
 - Other data formats
- ArcCatalog Basics
- ArcMap Basics
 - ArcMap Document (.mxd)
 - Exploring/Displaying Maps and Data
 - Coordinate Systems
- Data Creation and Editing
 - Creating/Editing Features and Tables
 - Georeferencing
- Working with Rasters
 - Displaying Raster Data
 - Raster to Shapefile Conversion
- Queries
- Geoprocessing
 - Buffer
 - Dissolve
 - Merge
 - Clip
 - Intersect
 - Union
 - Spatial join
- Map Layout and Printing



Course Outline

Day 2 (8:30am-11:30am / 1:30pm-4:pm)

- DaCRISS GIS
 - Introduction
 - File System
 - Database
 - Atlas
 - Map Viewer
- Case Studies (Hands on)
 - Data Digitizing
 - Thematic Mapping



Course Outline

Day 3 (8:30am-11:30am / 1:30pm-4pm)

- Case Studies (Hands on, Continuation)
 - Thematic Mapping
 - Analysis



GIS: An Overview



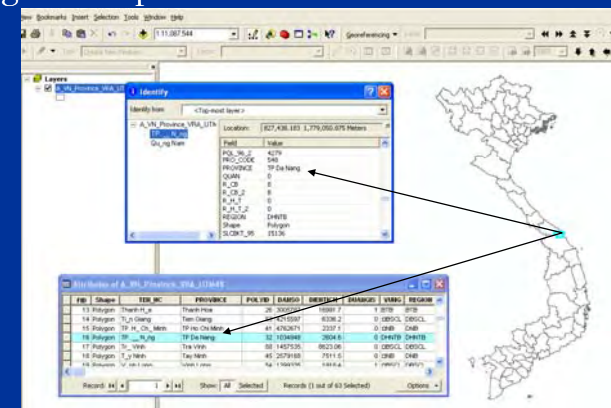
What is GIS?

Geographic Information System is an organized collection of computer hardware, software, geographic data, and personnel to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.



What is GIS?

- It is computerized decision-support system which integrates maps and databases.



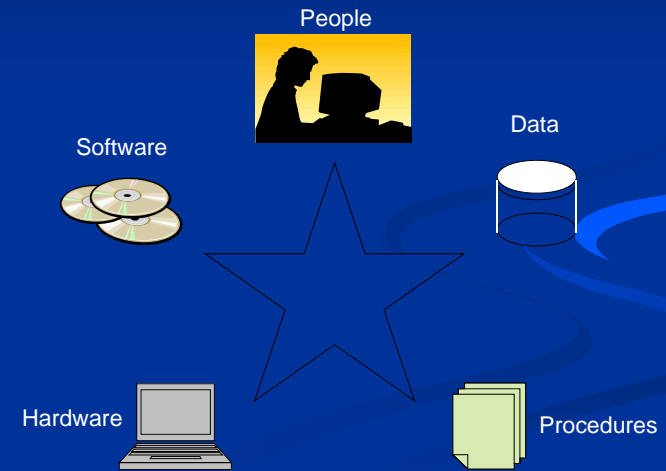


What is GIS?

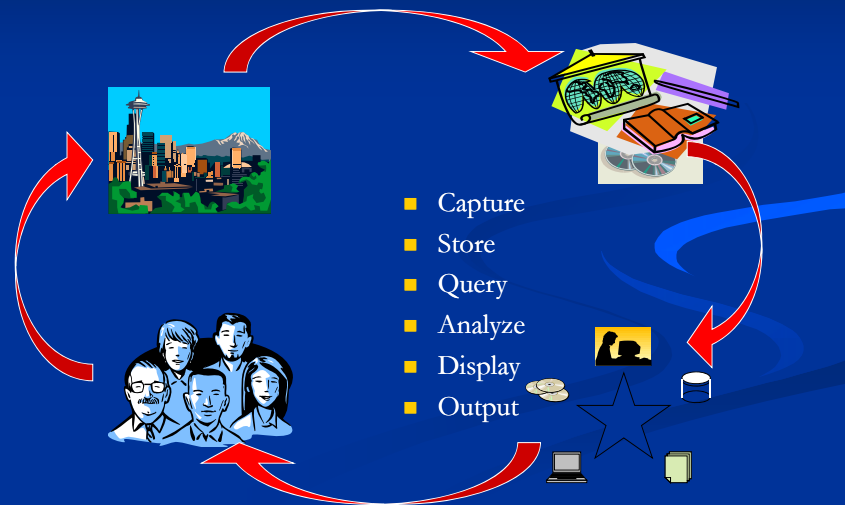
The bottom line is to make better decisions!



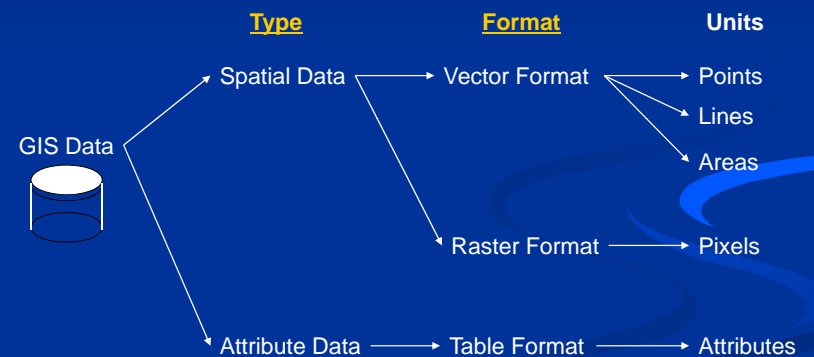
GIS Components



Functions of GIS



GIS Data Storage





Spatial vs. Attribute Data

Spatial Data - location and shape

e.g. Road Centerlines

Attribute Data - characteristic (attributes) of spatial data

e.g. Road Name, Type, Length



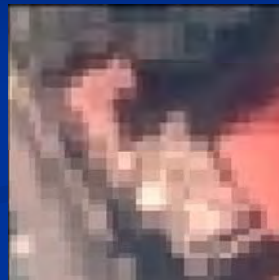
Spatial vs. Attribute Data

Spatial or Attribute?

- Building Name
- Elevation
- Barangay Boundary
- Lake
- Contour Lines
- Population



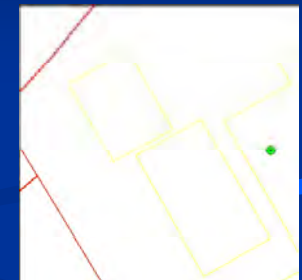
Vector vs. Raster Format



- defines space as an array of **equally sized cells** arranged in rows and columns
- comprised of single or multiple bands



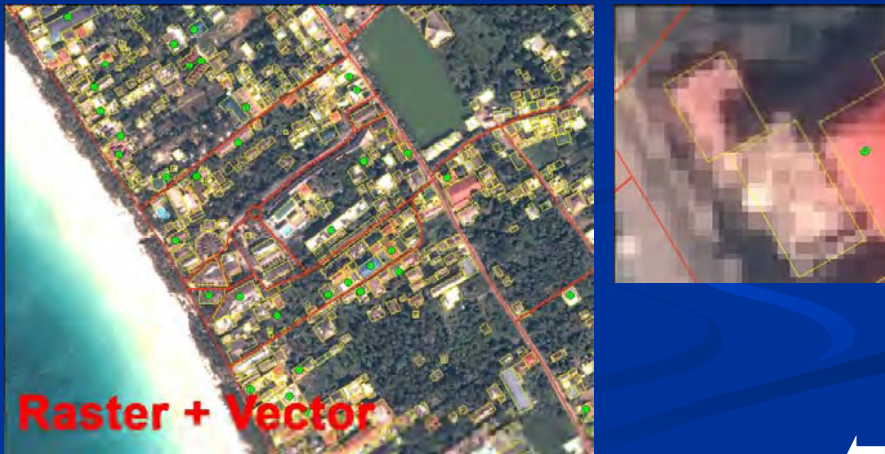
Vector vs. Raster Format



represents geographic features as single coordinate pair (**point**) or as ordered lists of vertices (**line** and **polygon**)



Vector vs. Raster Format



Raster + Vector



Attribute Data: Table Format

CITY_NAME_V	DIST_NAME_E	DIST_NAME_V	COM_NAME_E	COM_NAME_V	TYPE	POP8	POP9	POP01
Bà N_ung	Hai Chau	H_oi Chau	Binh Nam	Ph_ung Binh Nam	0	12276	12882	12782
Bà N_ung	Hai Chau	H_oi Chau	Binh Thuan	Ph_ung Binh Thuan	0	14450	14770	14884
Bà N_ung	Hai Chau	H_oi Chau	Hoa Cuong Nam	Ph_ung Hoa C_ung Nam	0	10745	10718	11787
Bà N_ung	Hai Chau	H_oi Chau	Hoa Thuan Tay	Ph_ung Hoa Thuan Tay	0	10374	8130	10550
Bà N_ung	Hai Chau	H_oi Chau	Hai Chau 1	Ph_ung Hai Chau 1	0	15575	15926	14815
Bà N_ung	Hai Chau	H_oi Chau	Hai Chau 2	Ph_ung Hai Chau 2	0	15354	13554	14114
Bà N_ung	Hai Chau	H_oi Chau	Hoa Cuong Bac	Ph_ung Hoa C_ung B_c	0	16363	32091	17800
Bà N_ung	Hai Chau	H_oi Chau	Nam Duong	Ph_ung Nam D_ung	0	9344	10917	11250
Bà N_ung	Hai Chau	H_oi Chau	Phuoc Ninh	Ph_ung Phuoc Ninh	0	13108	13265	13365
Bà N_ung	Hai Chau	H_oi Chau	Thanh Binh	Ph_ung Thanh Binh	0	21695	19282	19545
Bà N_ung	Hai Chau	H_oi Chau	Thuan Phuoc	Ph_ung Thuan Phuoc	0	13730	19475	19550
Bà N_ung	Hai Chau	H_oi Chau	Thach Thang	Ph_ung Thach Thang	0	17295	17949	18180
Bà N_ung	Hai Chau	H_oi Chau	Hoa Thuan Dong	Ph_ung Hoa Thuan Dong	0	13668	18604	13900
Bà N_ung	Thanh Khe	Thanh Khe	An Khe	Ph_ung An Khe	0	13979	19588	18009
Bà N_ung	Thanh Khe	Thanh Khe	Chinh Gian	Ph_ung Chinh Gian	0	18653	19913	20326
Bà N_ung	Thanh Khe	Thanh Khe	Tam Thuan	Ph_ung Tam Thuan	0	18589	18525	19050
Bà N_ung	Thanh Khe	Thanh Khe	Thanh Khe Dong	Ph_ung Thanh Khe Dong	0	10341	26091	11529
Bà N_ung	Thanh Khe	Thanh Khe	Thac Gian	Ph_ung Thac Gian	0	16681	18470	18653
Bà N_ung	Thanh Khe	Thanh Khe	Tan Chinh	Ph_ung Tan Chinh	0	14613	16105	16229
Bà N_ung	Thanh Khe	Thanh Khe	Vinh Trung	Ph_ung Vinh Trung	0	18366	18492	18692
Bà N_ung	Thanh Khe	Thanh Khe	Xuan Ha	Ph_ung Xuan Ha	0	20634	17881	17669
Bà N_ung	Thanh Khe	Thanh Khe	Hoa Khe	Ph_ung Hoa Khe	0	10209	8041	13153
Bà N_ung	Thanh Khe	Thanh Khe	Thanh Khe Tay	Ph_ung Thanh Khe Tay	0	11564	73086	12893
Bà N_ung	Son Tra	Son Tra	An Hai Bac	Ph_ung An Hai Bac	0	17918	22910	23176
Bà N_ung	Son Tra	Son Tra	An Hai Tay	Ph_ung An Hai Tay	0	13727	14679	14692
Bà N_ung	Son Tra	Son Tra	An Hai Dong	Ph_ung An Hai Dong	0	14976	15726	16300
Bà N_ung	Son Tra	Son Tra	Man Thai	Ph_ung Man Thai	0	11003	13112	13269
Bà N_ung	Son Tra	Son Tra	Nai Han Dong	Ph_ung Nai Han Dong	0	14476	14751	14856
Bà N_ung	Son Tra	Son Tra	Phuoc My	Ph_ung Phuoc My	0	11409	14977	15250
Bà N_ung	Son Tra	Son Tra	Tho Quang	Ph_ung Tho Quang	0	19653	22158	22436

Querying and Analyzing GIS Data

- What is this? (Identification)
- Which features satisfy this condition? (Identification)
- Where is this feature? (Location)
- Where has it changed? (Temporal Analysis)
- What relationships exist? (Spatial Analysis)
- Where is it best? (Suitability Analysis)
- What if...? (Simulation)



Display and Output

- Maps
 - Paper Maps
 - Digital Files
- Tables
- Reports
- Graphs/Charts



Introduction to ArcGIS



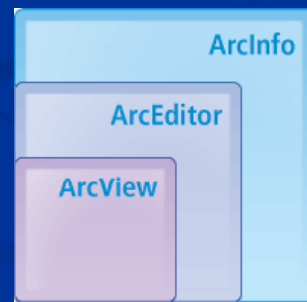
ArcGIS

- It is a system or family of GIS products produced by ESRI.



ArcGIS Desktop

- ArcView (*entry level*)
- ArcEditor (*mid level*)
- ArcInfo (*full featured*)



Note: ArcGIS ArcView and ArcGIS ArcInfo are different from ArcView GIS and ARC/INFO, respectively.



ArcGIS Arcview

- ArcMap**
 - For mapping and editing tasks, as well as for map-based analysis
- ArcCatalog**
 - For managing spatial data holdings and database designs, and for recording and viewing metadata
- ArcReader**
 - allows users to view, explore, and print maps and globes
- ArcGlobe** and **ArcScene**
 - Specialized 3D visualization and analysis.



Shapefile

- It is a vector data storage format for storing the location, shape, and attributes of geographic features.
- It is a **collection** of files on a common prefix name.



Shapefile Components

Required

- .shp - the main file that stores the feature geometry
- .shx - the index file that stores the index of the feature geometry
- .dbf - the dBASE table that stores the attribute information of features

Some Optional Files

- .sbn and .sbx - the files that store the spatial index of the features
- .prj - the file that stores the coordinate system information



Some Compatible Data Format

- Geodatabase (*.mdb, *.gdb)
- CAD Dataset (*.dwg)
- MS Excel (*.xls)
- Comma-separated Values (*.csv)
- Database Table (*.dbf)
- Raster Image (*.tif, *.jpg, *.img)
- Layers (*.lyr)



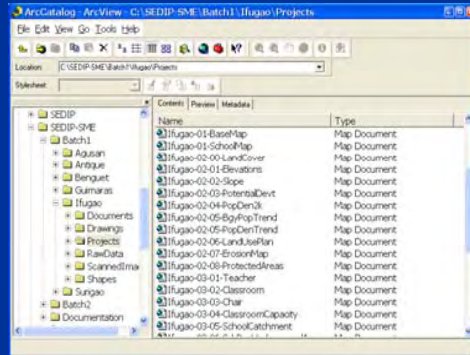
ArcCatalog Basics



ArcCatalog



- A window into the database
- Create New Data
- Browse data
- Manage data
- Create and view data documentation



Browsing Data

- Folder Connections
- Contents
- View Data Properties
- Preview
 - Geography
 - Table
- Metadata



Data Management

- Create Folder
- Copy
- Paste
- Delete



ArcMap Basics



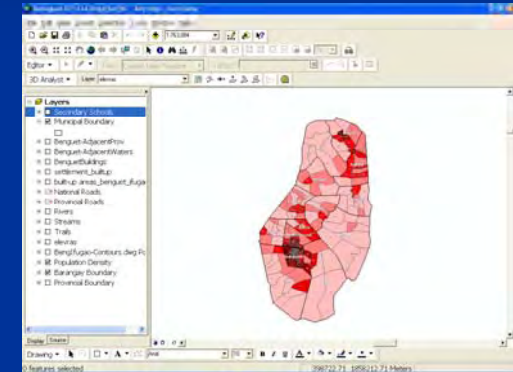
ArcMap

- Primary display application
- Perform map-based tasks
 - Display
 - Edit
 - Query
 - Analysis
 - Charts
 - Reports



ArcMap Document (.mxd)

- A file containing a map, its layers, display information, and other elements used in ArcMap



Exploring Maps

- Open
- Select
- Pan
- Zoom
- Scale
- Table of Contents
- Switching Views
- Save



Exploring Data/Layers

- Identify Features
- View Attributes
- Find Features
- Measure



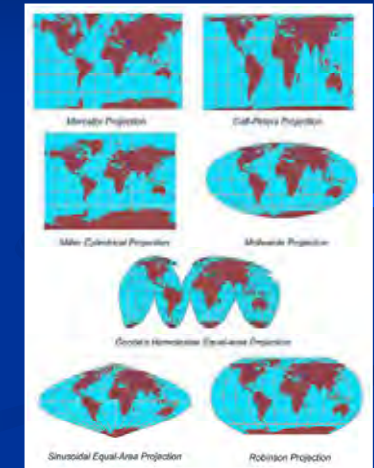
Displaying Data/Layers

- Add / remove data
- Layer properties
 - Symbology
 - Label
 - Hyperlinks
 - Others
- Drawing / layer order
- Save layer file



Coordinate Systems

- Consists of a set of points, lines, and/or surfaces, and a set of rules, used to define the positions of points in space in either two or three dimensions



Coordinate Systems Encountered in Vietnam

- **Geographic Coordinate System**
 - GCS WGS 1984
- **Projected Coordinate System**
 - UTM WGS 1984
 - VN2000
 - Pulkovo



Data Creation and Editing



Data Creation

- Create New Data
 - a. Digitizing in ArcMap
 - b. Digitizing in CAD
- Set Coordinate System
- Define/Edit Attributes



Common Field Types

- Short Integer
- Long Integer
- Float
- Double
- Text
- Date



Short Integer vs. Long Integer vs. Float vs. Double

Data type	Storable range
Short integer	-32,768 to 32,767
Long integer	-2,147,483,648 to 2,147,483,647
Single-precision floating-point number (float)	approximately -3.4E38 to 1.2E38
Double-precision floating-point number (double)	approximately -2.2E308 to 1.8E308



The Editor Toolbar



- Editor
- Target
- Edit Tool
- Tools
- Tasks
- Split Tool
- Rotate
- Attributes
- Properties



Tables

- Opening/Loading Tables
 - Shapefile
 - Independent
- Add/Delete Fields
- Input/Edit Records
- Find & Replace



Tables

- Field Calculations
- Calculate Geometry
- Statistics
- Graphs
- Linking Tables
 - Join
 - Relate



Georeferencing

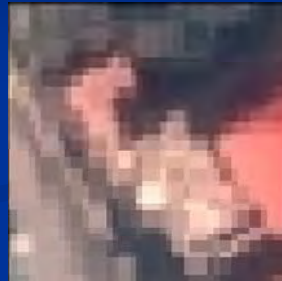
- establishing a relationship between the data displayed in the GIS software and its real-world location



Working with Rasters



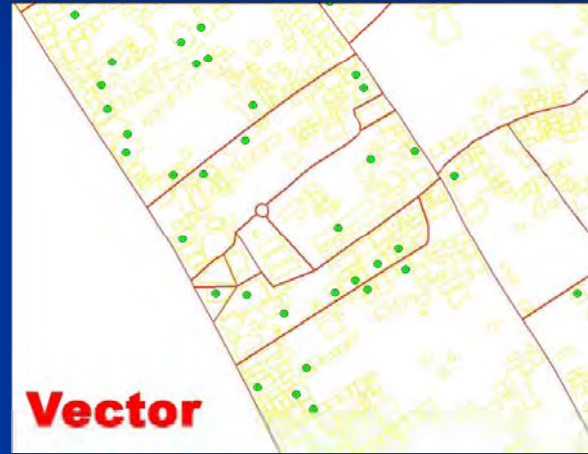
Vector vs. Raster Format



- defines space as an array of **equally sized cells** arranged in rows and columns
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Vector vs. Raster Format



represents geographic features as single coordinate pair (**point**) or as ordered lists of vertices (**line** and **polygon**)



Vector vs. Raster Format



Some Data that can be Displayed in Raster Format

- Elevation
- Slope
- Temperature
- Land Use
- Land Cover
- Moisture Content Monitoring



Raster Pyramids (.aux, .rrd)

- a reduced resolution layer that copies the original data in decreasing levels of resolution to enhance performance



Raster to Shapefile

Raster to Point

- Any cell size, any valid raster dataset

Raster to Polyline

- Any cell size, any valid integer raster dataset

Raster to Polygon

- Any cell size, any valid integer raster dataset



Queries



Select Data

- Select by Attributes
- Select by Location
- Select by Graphics



Sample SQL Queries for Shapefiles

- "COM_NAM_E" = 'Hoa An'
- NOT "COM_NAM_E" = 'Hoa An'
- "COM_NAM_E" <> 'Hoa An'
- "COM_NAM_E" LIKE 'Hoa%'
- "POP07" >=20000
- "POP07" <= 10000
- "AREA"> 100 OR "POP07" >15000
- "AREA"> 100 AND "POP07" >15000



Definition Query

- Display features based on filtered attributes
- Features that do not satisfy the query are only hidden from display and are not deleted

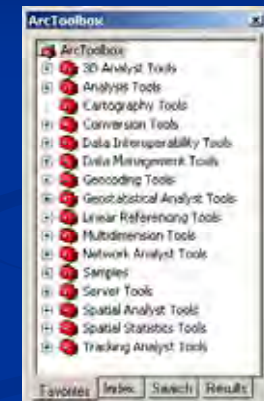


Geoprocessing



ArcToolbox

- A user interface in ArcGIS used for accessing, organizing, and managing a collection of geoprocessing tools, models, and scripts





Geoprocessing

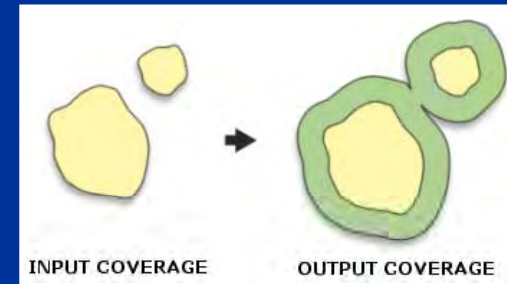
- Buffer
- Dissolve
- Merge
- Clip
- Intersect
- Union
- Spatial join



Buffer

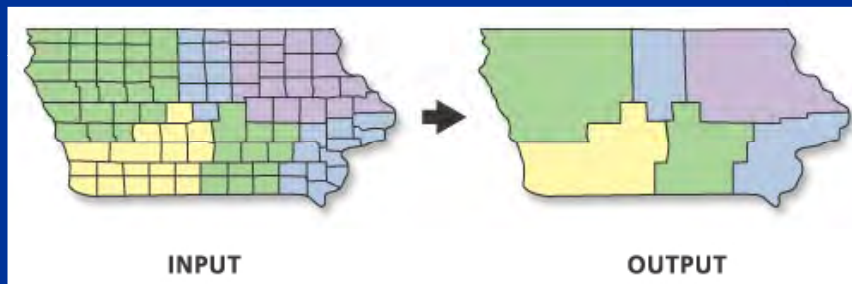
ArcToolbox > Analysis > Proximity > Buffer

ArcToolbox > Analysis > Proximity > Multiple Buffer



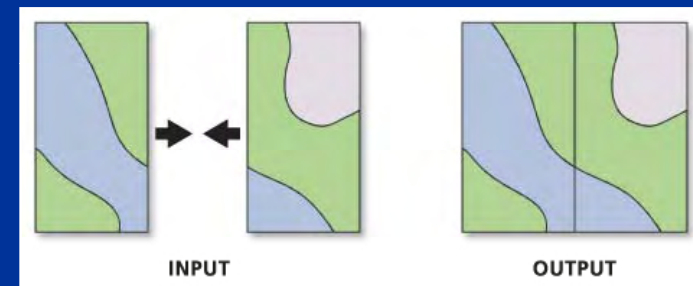
Dissolve

ArcToolbox > Data Management > Generalization > Dissolve



Merge

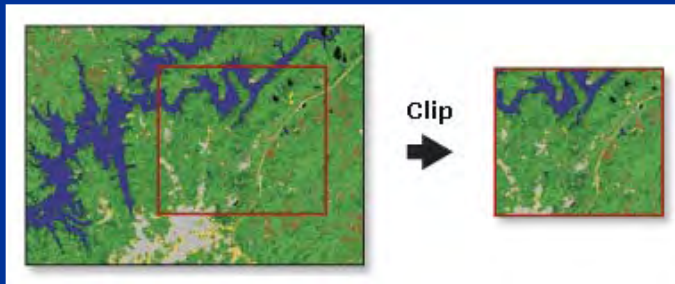
ArcToolbox > Data Management > General > Merge





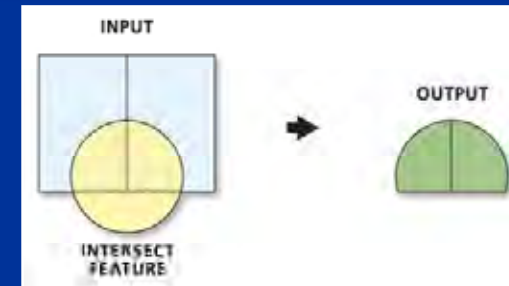
Clip

ArcToolbox > Analysis > Extract > Clip



Intersect

ArcToolbox > Analysis > Overlay > Intersect



Union

ArcToolbox > Analysis > Overlay > Union



Spatial Join

ArcToolbox > Analysis > Overlay > Spatial Join

- Creates a table join in which fields are appended based on the relative locations of the features in the layers



Exercise 3 & 4



Map Layout and Printing



Map Layout and Printing

- The Layout View
- Adding Map Elements
 - Gridlines
 - Guides
 - North Arrow
 - Scale Bar
 - Legend
 - Title
 - Graphics
- Page Set-up
- Printing
- Exporting



Exercise 5

The DaCRISS GIS Database

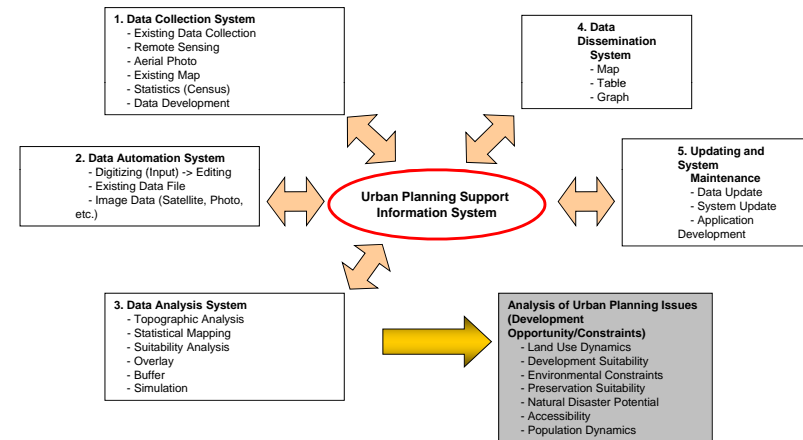
Outline

- Objectives
- Components of DaCRISS GIS Database
- Main Features of DaCRISS GIS Database
 - Hardware and Software
 - Danang GIS Database
 - Thematic Mapping
 - Land Use Analyses
 - Identification of areas suitable for development
 - Identification of areas for preservation
- Planning Tools produced based on the DaCRISS GIS Database
 - City Atlas
 - Map Viewer

Objectives of DaCRISS GIS

- A comprehensive GIS database system was developed in DaCRISS to understand the existing conditions of the study area and to know the spatial distribution of development constraints and opportunities to support the development of a comprehensive master plan for Danang City. Based on this GIS database, two kinds of analysis were conducted. The first is development suitability analysis including environmental zoning, while the second analysis is urban land-use analysis and mapping.

Components of DaCRISS GIS



Features of DaCRISS GIS Database

- Hardware and Software
- Danang GIS Database
- Thematic Mapping
- Land Use Analyses

Features:

Hardware and Software

- Hardware, software, and the DaCRISS database will be fully transferred to the counterpart agency after completion of DaCRISS.
- The hardware and software installed to operate the DaCRISS GIS database in the study are listed below:
 - Software:
 - Arc View: 3 licenses.
 - Personal Computer
 - Personal Computer: 3 units (ACER L3600, CPU E4600, RAM 1G, HDD 320GB VGA 256 MB share INTEL, DVD-RW).
 - Large-format Plotter:
 - 1 unit (HP DesignJet T610 44in, Color LFP, up to 44 inch, up to 2400 x 1200 optimized dpi with 6 Vivera pigmented inks, 128MB memory, roll & sheet feed, hi-speed USB 2.0 certified port & EIO slot, HP-GL2/RTL, CALS/G4, HP PCL3GUI).

Features :

Danang GIS Database

- The GIS database developed for DACRISS has the following features:
 - Standardized format & coordinate system:
 - Format ; ESRI Shapefile Format
 - Coordinate Sytem VN 2000
 - Categorized Data Layers
 - Baseline Layers
 - Urban Planning Layers

DaCRISS GIS Database:

Categorized Data Layers

- Baseline Layers
 - Administrative Boundary
 - Natural Conditions
 - Environmental Management
 - Hazard/Risk Records
 - Land Use
 - Urban Transportation
 - Urban Utilities
 - Urban Facilities
 - Administrative Facilities
 - Social Facilities
 - Cultural Facilities

DaCRISS GIS Database:

Categorized Data Layers

- Urban Planning Layers
 - Ongoing Projects
 - Master Plan by DOC
 - Master Plan by DaCRISS

Features:

Thematic Mapping in DaCRISS

Thematic maps of Danang focus on specific ideas or themes. Each thematic map illustrates a particular subject and in contrast to a general map. While general reference maps show where something is in space, thematic maps tell a story about that place. This helps planners better visualize the conditions and spatial patterns of Danang City.

Categories of Thematic Maps

- 1 BASE MAP
- 2 ADMINISTRATIVE BOUNDARY
- 3 NATURAL CONDITION
- 4 SOCIO-ECONOMIC CONDITION
- 5 EXISTING LAND USE
- 6 URBAN TRANSPORT
- 7 URBAN UTILITIES
- 8 URBAN FACILITIES
- 9 ENVIRONMENTAL MANAGEMENT
- 10 NATURAL DISASTER POTENTIAL
- 11 DEVELOPMENT SUITABILITY
- 12 CURRENT MASTER PLAN

Thematic Maps

1.Base Map



1.1 Index of 1:5,000 and 1:10,000 Scale
Topographic Maps of Danang City

1.2 Index of 1:50,000 Scale
Topographic Maps Danang City
Surrounding Area (Thua Thien
Hue, Danang, Quang Nam, Quang Ngai)



Thematic Maps

2. Administrative Boundaries



Thematic Maps

3. Natural Conditions

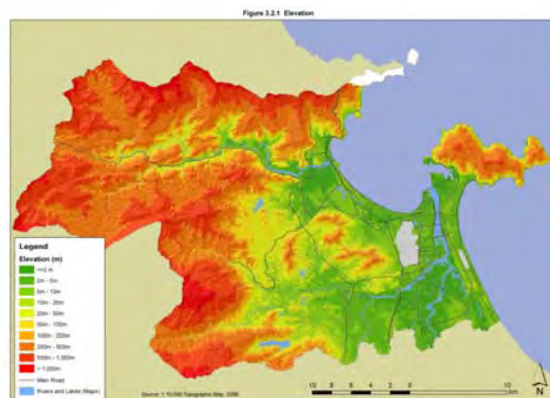


- 3.1 Water Network
- 3.2 Topography
 - 3.2.1 Elevation
 - 3.2.2 Slope
- 3.3 Geology
 - 3.3.1 Geology
 - 3.3.2 Micro-geomorphology

Natural Conditions

Elevation

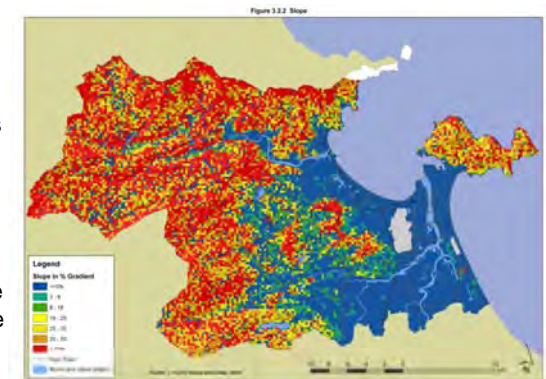
The elevation of the Danang City ranges from 0m of seaside to 1,670m in the mountainous area in western part of the City. The eastern part of Danang city faces the sea and having the alluvial flatland, the western part is covered by the relatively high mountains.



Natural Conditions

Slope

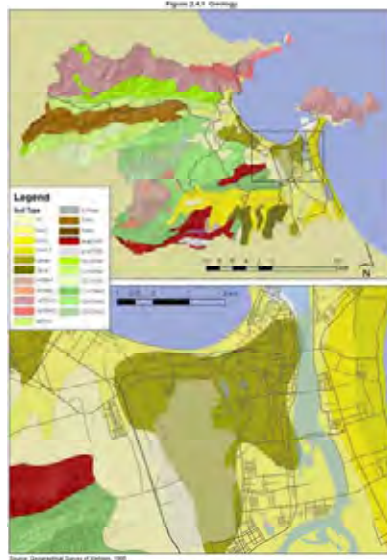
Based on contour data, slope distribution is calculated to generate important indicator for development suitability. For the convenience of calculation, 250m grid cell is applied. Slope degrees are classified into seven (7) categories according to international standard. The distribution of slope is also showing the flatlands in the eastern part along the coastal line and Han River. According to slope map, 36% area (342km²) is showing less than 3% which means almost flat land, while steep slope area more than 50% is showing 27% (257km²) of the study area.



Natural Conditions

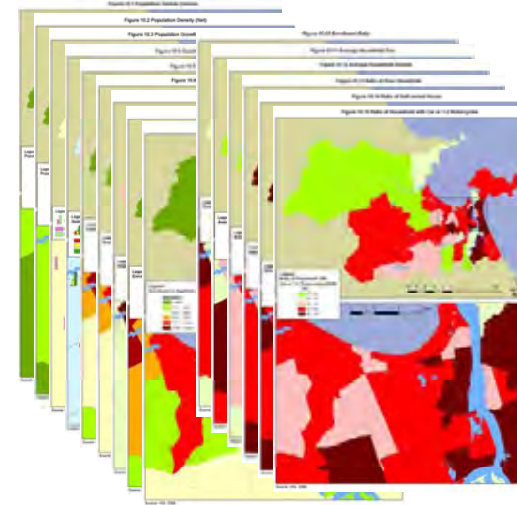
Geology

The distribution of the geology in Danang city is shown in Figure 3.2.5 and the classification of the rock type is shown in Table 3.2.3. Based on the classification of rock type by sedimentary rock and by Volcanic/Plutonic, the distributions are shown in Figure 3.2.6. According to the area calculation by GIS, 22% of Danang City land is laying on the Alluvium around the down stream area. On the contrary, the mountain-ous areas are composed from Paleozoic which covers 49% of the city and Mesozoic which covers 19% of the city



Thematic Maps

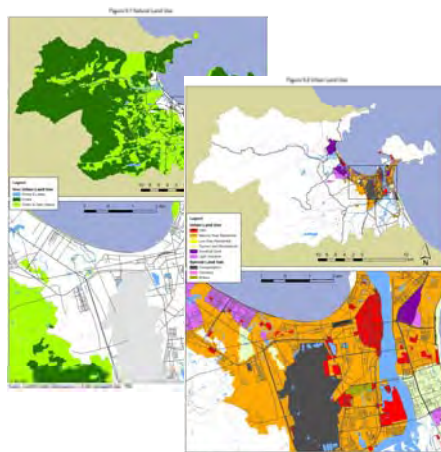
4.Socio Economic Conditions



- 4.1 Population**
 - 4.1.1 Population Density (Gross)
 - 4.1.2 Population Density (Net)
 - 4.1.3 Population Growth Rate (2000-2007)
- 4.2 Employment**
 - 4.2.1 Employment at workplace in Daytime
 - 4.2.2 Employment at workplace in Nighttime
 - 4.2.3 Employment Ratio
- 4.3 Enrollment**
 - 4.3.1 Enrollment at schoolplace in Daytime
 - 4.3.2 Enrollment at schoolplace in Nighttime
 - 4.3.3 Enrollment Ratio
- 4.4 Household**
 - 4.4.1 Average Household Size
 - 4.4.2 Average Household Income
 - 4.4.3 Ratio of Poor Households
- 4.5 Property**
 - 4.5.1 Ratio of Self-owned House
 - 4.5.2 Ratio of Household with Car or 1-2 Motorcycles

Thematic Maps

5.Existing Land Use



- 5.1 General Land Use
- 5.2 Natural Land Use
- 5.3 Urban Land Use

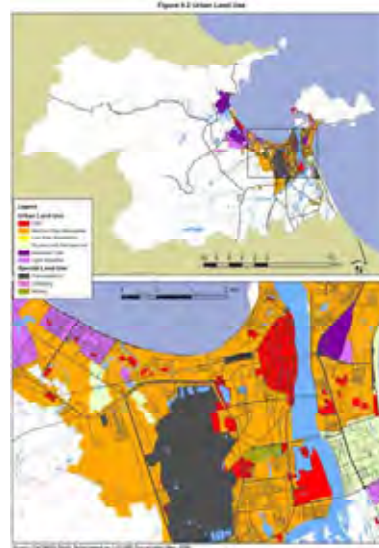
Existing Land Use

General Landuse



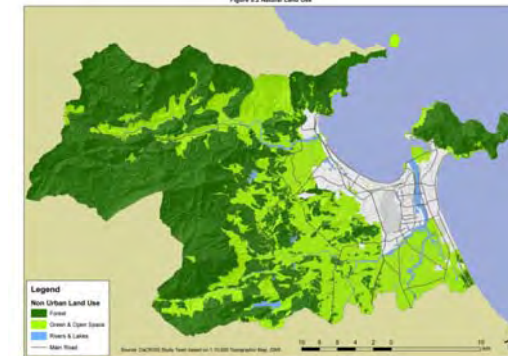
Existing Land Use Urban Landuse

Urban landuse in Danang covers 9% (88km²).

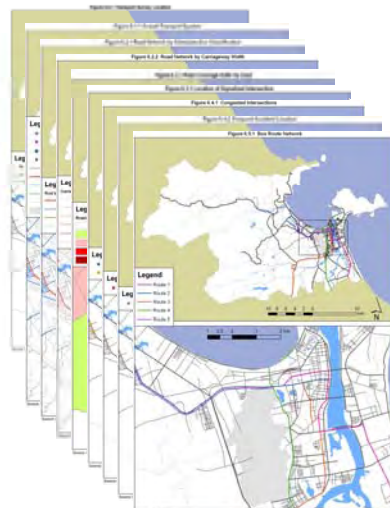


Existing Land Use Natural Landuse

River/Lake		1:10,000 Topographic Map
Agriculture	Rice Field	1:10,000 Topographic Map
	Cultivated Tree	1:10,000 Topographic Map
Forest		1:10,000 Topographic Map
		Protective Forest Area Map by DARD
Green Space	Shrubs	1:10,000 Topographic Map
	Grass-lands	1:10,000 Topographic Map
	Wet Land	1:10,000 Topographic Map



Thematic Maps 6.Urban Transport



- 6.1 Transport System
 - 6.1.1 Overall Transport System
- 6.2 Road Network and Facilities
 - 6.2.1 Road Network by Administrative Classification
 - 6.2.2 Road Network by Width
 - 6.2.3 Road Coverage Ratio by Zone
 - 6.2.4 Culvert Locations
- 6.3 Road Traffic Management
 - 6.3.1 Location of Signalized Intersection
- 6.4 Road Traffic Characteristics
 - 6.4.1 Congested Intersections
 - 6.4.2 Frequent Traffic Accident Location
- 6.5 Public Transport System
 - 6.5.1 Bus Route Network
- 6.6 Traffic Survey
 - 6.6.1 Traffic Survey Location

Thematic Maps 7.Urban Utilities



- 7.1 Water Supply
- 7.2 Sewerage and Drainage
- 7.3 Power Supply
- 7.4 Solid Waste Management

Thematic Maps

8. Urban Facilities



8.1 Administrative Facilities

- 8.1.1 PC Offices
- 8.1.2 Departments of Danang City
- 8.1.3 Police Stations
- 8.1.4 Postal Service Facilities

8.2 Social Facilities

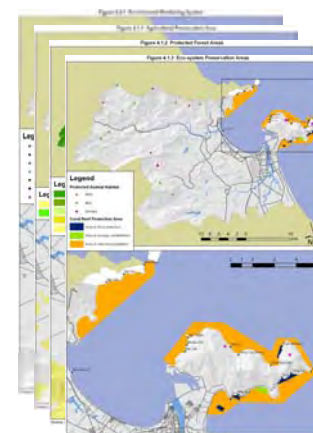
- 8.2.1 Education Facilities
- 8.2.2 Healthcare Facilities
- 8.2.3 Commercial Facilities

8.3 Cultural and Recreational Facilities

- 8.3.1 Parks
- 8.3.2 Cultural Facilities
- 8.3.3 Sports Facilities
- 8.3.4 Tourism Facilities
- 8.3.5 Religious Facilities

Thematic Maps

9. Environmental Management



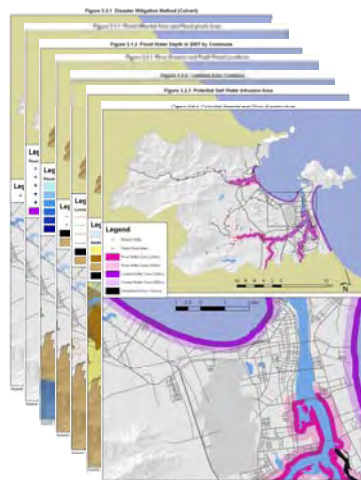
9.1 Preservation Suitability Area

- 9.1.1 Agricultural Preservation Area
- 9.1.2 Forest Area
- 9.1.3 Eco-system Preservation Area

9.2 Monitoring System

Thematic Maps

10. Natural Disaster Potential



10.1 Hazard/Risk Records

- 10.1.1 Flood Affected Area and Flood-prone Area in Urban Area
- 10.1.2 Flood Water Depth in 2007 by Commune
- 10.1.3 Flood Affected Area by Typhoon Ketsana in 2009
- 10.1.4 Flood Duration Period in Typhoon Ketsana in 2009

10.2 Development Constraints

- 10.2.1 River Erosion and Flash Flood Locations
- 10.2.2 Lowland Area Contours
- 10.2.3 Potential Coastal & River Erosion Area

Natural Disaster Potential

Flood Depth In 2007 by Commune



FSCC provided flood depth data on November 2007 flood which is showing only commune name and flood depth in the report. Flood area map is not attached to this report and also flood prone area map cannot be collected. Study team plotted flood water depth on the map based on FSCC report above:

Natural Disaster Potential

River Erosion & Flash Flood

River bank erosion is observed along the main river channel. Especially in flood plain area, river channel erodes river bank laterally. Big bamboo forest and trees growing along the river channel severely eroded and a block of river bank is swept away at Yen river. Through this lateral erosion accompanied by severe flood, river channel changed and silt gradually. This will eventually cause a big damage to houses, road and agricultural land located close to river channel.



Natural Disaster Potential

Flood by Typhoon Ketsana

- Ketsana landed in Danang September 28th, 29th, 30th of 2009, bringing strong wind and heavy rainfall.
- Severe flood was caused by this typhoon.
- Study team prepared survey plan for this flood, to clarify inundation area, flood water depth and damages.
- Flood depth from paddy level, road level, and house floor level were surveyed by field survey.
- Possible past highest flood level is also checked by interview survey.
- Totally 300 survey points were set.

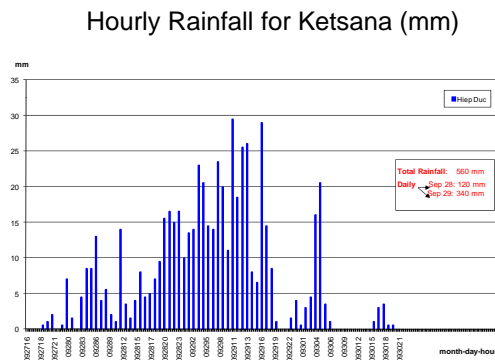


Maximum extent of inundated area together with flood water depth from paddy level.

Natural Disaster Potential

Flood by Typhoon Ketsana

- Figure on the right shows hourly rainfall data collected at Hiep Duc
- rainfall began on the evening of 27th of September and cleared in the morning of 30th of September.
- Total rainfall amount in four days recorded at 560mm. Out of this amount, 340mm is recorded on 29th of September.
- Most intensive hourly rainfall is 30mm



Natural Disaster Potential

Flood by Typhoon Ketsana

Flood Depth in Typhoon Ketsana in 2009

Flood water depth in deltaic area at lower reach of Cam Le river and Vinh Dien river, and Co Co river is showing almost 200cm depth in general.

Flooding in Cu De river is showing rather deeper inundation along the river channel. At the lowest reach of the river, lagoon lowland is developed where the flooding occurs frequently according to the rise of river water level. Inundation depth is also deeper from 100cm up to 200cm

Flood by Typhoon Ketsana

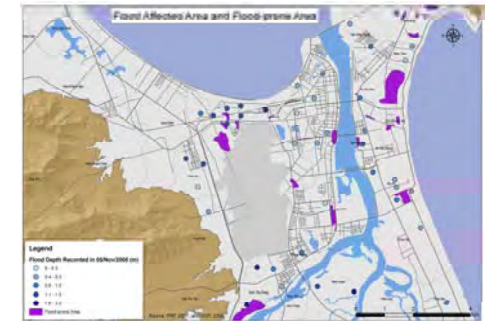
Flood Duration Period in Typhoon Ketsana in 2009

Flood duration is changing from one day to five days according to topographical condition. Lowland area of paddy field is mainly flooding for several days in general



Flood Protection in Urban Areas

- Flooding in urban area is mainly inundation of inner water due to ineffective drainage system.
- According to DOT, one of the reasons causing inner water inundation in urban area is related to no drainage connection to existing network at big construction site.
- Large bare land or under construction site generate a significant volume of draining water without proper networking of existing drainage system.
- Water at construction site flowing freely to surrounding area causing inner water inundation at the time of strong rainfall.



Frequent inundation locations in urban area

Disaster Mitigation Method

Implementation of flood mitigation measures is not taken enough yet. Mitigation measures for flood disaster protection should be implemented such as :

- river dyke construction for main river channel,
- promotion of integrated watershed management to control runoff including tree plantation and erosion control in upper reach of the river basin,
- implementation of early warning system for flood disaster management, and
- promotion of community based flood disaster management.



Potential Salt Water Intrusion

The excess usage of the groundwater will easily cause the degradation of groundwater quality by salinization in coastal area. The potential areas of the salinization of groundwater is indicated by the existence of alluvium and diluvium in general and distribution of these geology overlaying with the potential salty underground water area as shown in Figure 3.3.7. This map is also showing potential land subsidence area by groundwater exploitation. For long term urban land use plan-ning, these environmental aspects should be considered as one of the constraints in this area..



11.Current Master Plan



- Ongoing Construction Project
- Current Master Plan - DOC

Land Use Analyses

- Urban land-use analysis and mapping
- Development Suitability
 - Identification of areas suitable for development
 - Identification of areas for preservation

Land Use Analyses :

Urban land-use analysis and mapping

Urban land-use analysis and thematic mapping are conducted mainly for urban districts based on large-scale topographical maps. Detailed urban land-use conditions in Danang City are analyzed by commune. Population density, builtup ratio, urban road ratio, open space ratio, park ratio, and related urban facilities are calculated using topographical maps through GIS. Results of calculation are compiled into table format by commune unit in a Databook. These data are compiled into an urban karte and can be used as urban planning indicators for Danang City when compared with the basic data of another city

Land Use Analyses :

Urban land-use analysis and mapping

Example of Calculation: Number of Public Facilities per 1,000 Population

Commune Name	PC	DN City Department	Police	Postal Service Facility	Park	Sport Facility	School	Hospital	Tourism Spot	Market	Cultural Facility	Religious Facility
P. Binh Hien	0.08		0.08	0.31	-	-	0.39	0.31	-	0.08	0.16	0.63
P. Binh Thuan	0.07	0.07	0.07	0.13	-	0.07	0.54	0.07	-	0.07	-	0.27
Hoa Thuan Tay	0.08		0.08	0.30	-	0.08	0.23	0.15	-	-	-	0.15
Hoa Thuan Dong	0.07		0.07	0.26	-	0.20	0.39	0.07	-	0.07	-	0.33
P. Hai Chau I	0.14	0.41	0.14	2.46	0.07	-	1.16	0.41	0.07	0.07	0.55	0.27
P. Hai Chau II	0.07		0.07	0.14	-	0.07	0.21	-	-	0.07	-	0.07
Hoa Cuong Bac	0.05		0.05	0.40	0.15	0.05	0.35	0.15	0.10	0.10	0.15	0.15
Hoa Cuong Nam	0.08		0.08	0.59	-	-	0.59	0.08	0.08	0.08	-	0.08
P. Nam Duong	0.09		0.09	0.18	-	-	0.27	0.09	-	0.09	0.09	0.44
P. Phuoc Ninh	0.22	0.15	-	1.42	-	0.07	0.37	0.15	-	0.07	0.07	0.07
P. Thanh Binh	0.05		0.05	0.15	-	-	0.41	0.10	0.05	-	-	0.15
P. Thuan Phuoc	0.06		-	0.76	-	-	0.13	0.06	-	0.19	-	0.25
P. Thach Thang	0.06	0.39	0.11	1.27	0.06	0.06	0.39	0.39	-	-	0.17	0.11
Sub-Total	0.08	0.08	0.07	0.65	0.03	0.05	0.42	0.16	0.03	0.07	0.09	0.22

Land Use Analyses :

Development Suitability

- Data of the following were compiled to have an understanding of constraints to development in Danang City:
 - flood potential areas,
 - coastal and river buffer zones,
 - forest areas,
 - ecological preservation areas,
 - agricultural areas,
 - saltwater intrusion areas,
 - erosion potential areas

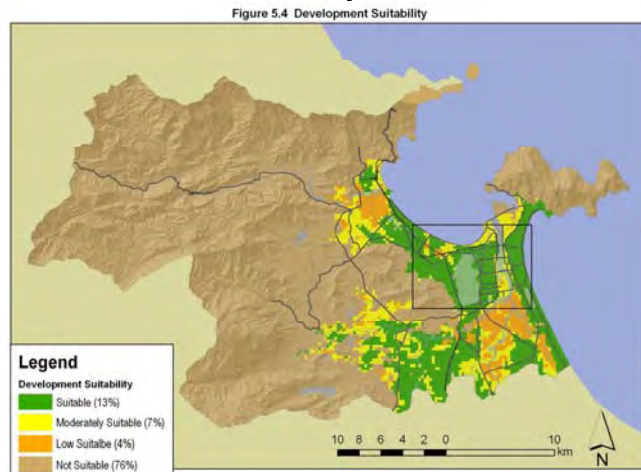
Land Use Analyses :

Development Suitability

- Based on the above constraints, two suitability analyses were conducted:
 - Identification of areas suitable for development
 - Identification of areas for preservation

Land Use Analyses :
Development Suitability

Identification of areas suitable for development



Land Use Analyses :

Development Suitability

- As a result of Suitability analyses, planners generated general policy guidelines for possible land-use patterns in the study area, i.e., where to develop or what to preserve. After the completion of the draft map on general land use, it was overlaid on the development suitability map or preservation suitability map to check necessary modifications to the general land-use pattern. Detailed discussions were then made on specific areas based on more accurate information

Planning Tools produced based on the DaCRISS GIS Database

- City Atlas
- Map Viewer

Planning Tools: City Atlas

The City Atlas is a categorized compilation of GIS outputs of DaCRISS in a convenient PDF and hardcopy format.

Planning Tools: Map Viewer

In order to facilitate dissemination of information and encourage maximum use of the DaCRISS GIS database, Map Viewing System was developed. The map viewer is a categorized compilation of GIS outputs of DaCRISS. The map viewer allows technical and non-technical users to view and manipulate map data without the need of expensive GIS nor CAD software. The map viewer provides functions to view the mapping outputs in several ways including the ability to manipulate actual GIS data developed for the study. The map viewer uses a menu based system to easily navigate through the numerous mapping outputs of DaCRISS.

Planning Tools: Map Viewer

