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While printing map in "Data View" window, it will print data display in "Data View" only. Similarly, while printing map in "Layout View" window, it will print full map.

5.3 GIS Database Application Manual for Samut Songkhram Province (for GIS Database Manager)

In the technological world, a digital system is becoming as the supporting tool for decision making system and mapping. At present, the Geographic Information System (GIS) is an effective tool for production, rectification, improvement, gathering, exploration, analysis, and demonstration. It has been applied to various projects because its convenience and fast-and-easy to develop or manage complicated spatial data. The natural resources and environmental problems, in particular, can identify the impact to quality of life both direct and indirect. Consequently, it is properly to use a GIS system for an effective environmental quality management in provincial level.

a. Introduction to ArcGIS

ArcGIS, one of GIS programs developed by ESRI, is high capability to demonstrate, analyze, and manage geographic information. It can apply to a variety of field works and manage a large file with attractive Graphic User Interface (GUI).

ArcGIS 9.2 is latest version which operating under Windows (98/NT2000/XP2002) or higher. ArcGIS's components are ArcView, ArcEditor, and ArcInfo. In case of using any software operation is depended on propose and requirement of each organization. ArcView can view any data running by ArcSDE. In contrast, ArcEditer and ArcInfo can rectify data running under ArcSDE which is Client/Server software for spatial data management in term of DBMS (Database Management Systems). The above three components of ArcGIS are comprises of;

ArcView has ArcCatalog, ArcMap, and ArcToolbox programs which can explore, manage, analyze, and rectify data and create a map.

ArcEditor has all ArcView's functions. It also has additional tool for rectify data as Coverage and Geodatabase.

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ArcInfo has all ArcEditor's functions. It also has Geoprocessing and ArcWorkstation (ARC, ArcEdit, ArcPlot, INFO, ARC Macro Language or AML) as an additional tool.

Details of each component are described below.

a.1   ArcView

ArcView has a capability of Data Visualization, Query, Analysis, and Map Creation under Windows operation with a tool for Exploring, Selecting, Displaying, Editing, Analyzing, Symbolizing, Classifying Data, and Metadata.

ArcView's structure is composed of ArcCatalog, ArcMap, and ArcToolbox. It can view data directly to a file or network and web-enabled. ArcView was created from COM (Component Object Model) technology; therefore, the customization and Macros program (Visual Basic for Applications (VBA) or Visual Basic, C++, and Delphi extensions can be applied. Main capabilities of ArcView are;

- Explore, Display, and Query spatial data

- Access and edit Shapefile and Personal geodatabase

- Spatial analysis with Geoprocessing

- Mapping with various tools and Wizards program

- 2D and 3D reporting and graph

- Co-ordinates system projection

- Data annotation

- Map display with the Internet system

- Import/ Export compatible with various data file types

Furthermore, it also have Extensions Program to increase capability of ArcView comprises of Spatial Analyst, ArcView 3D Analyst, ArcPress, Geostatistical Analyst, and StreetMap for instance.

a.2   ArcEditor

ArcEditor is a medium size of ArcGIS composed of all ArcView's function components. It is designed for Enterprise GIS Organization as their name with a capability for data edition in Enterprise GIS. For example, under the core system of ArcInfo and ArcSDE with a Relational Database Management System (RDBMS), one of user can editing data by use ArcEditor and another user can viewing or searching data by use ArcView in the same time.

ArcEditor is comprises of all ArcView's function components and additional component of data editing tools for Shapefile, Coverage, Personal geodatabase, and Enterprise geodatabase.

a.3   ArcInfo

ArcInfo is the most capability of ArcGIS with all function components of Arcview and ArcEditor. It also has completed ArcToolbox and ArcInfo Workstation (ARC, ArcEdit, ArcPlot, AML and all extensions). Hence, ArcInfo is a completed GIS program with various functions such as data creating, editing, querying, mapping, and analyzing.

ArcInfo is usable for data analysis function completely and comply with other application program. Because ArcInfo was created from COM (Component Object Model) technology, it

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can distribute Objects by define their principal and behavior. The main capabilities of ArcInfo are;

- Graphical User Interface (GUI) in Windows system

- Client/Server architecture

- High efficiency data processing tools such as creating, managing, querying, overlaying, analyzing, and display.

- Ability to edit one database by various users

- Other high effectiveness tools such as auto change co-ordinates system (On-the-fly projection), data type changing, and data import or export.

a.4   ArcMap, ArcCatalog, and ArcToolbox

All ArcGIS (ArcView, ArcEditor, and ArcInfo) are have 3 mains programs separated by function as ArcCatalog (data management), ArcMap (mapping management), and ArcToolbox (analysis management). Those 3 programs are working simultaneously.

ArcCatalog is usable for source selection, data creation, and metadata.

ArcMap is usable for display, query, edit, and create map document.

ArcToolbox is useable for spatial data analysis, database analysis, and convert and import-export data.

a.5   ArcMap

ArcMap is usable for display, edit spatial data, and create map, graph, and report. ArcMap can provide data viewing as "appear on the map like what seeing on screen" and able to drag-and-drop data from ArcCatalog by open map documents in ArcMap then drag data from ArcCatalog to display area of ArcMap directly.

GIS database that show on the map in ArcMap is called as Layer. Each layer separated each data type and source with Table of Content (TOC) display of ArcMap. The TOC default position at left side but it is able to move to other position.

Layer order in TOC means data showing order in map section. The top order will show on top, thus the background should be located lowest layer in order to not cover an important data.

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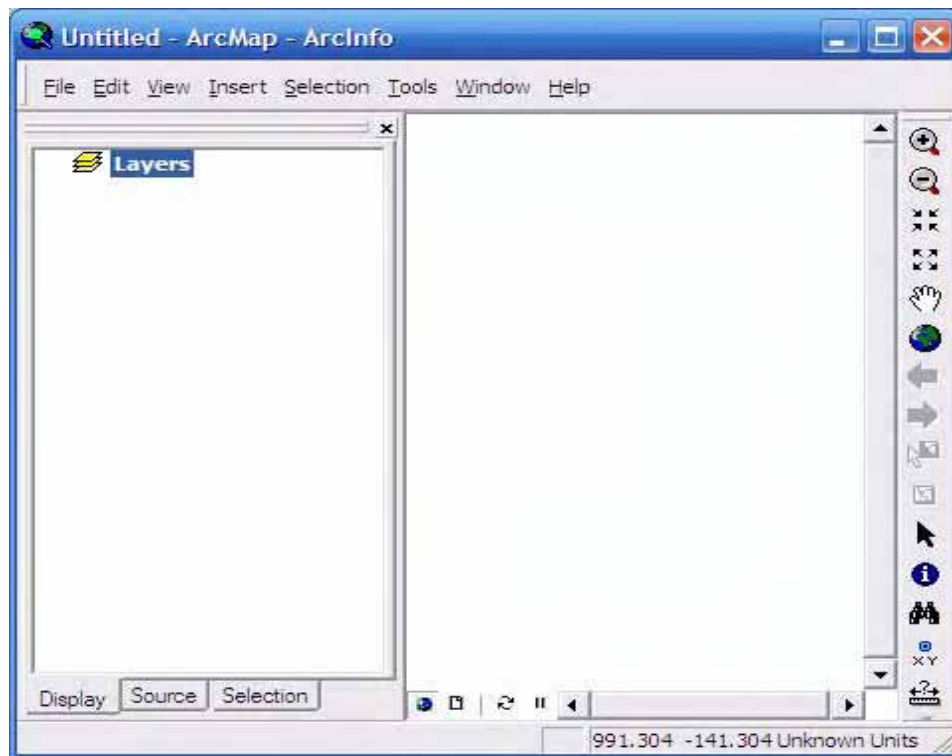
Figure 98 : ArcMap Program

While map is showing, user can find other interested data by click at their Feature then access to ArcMap database. There is easy to design the map annotation of electronics document and publishing. For some data which appropriate to present as graph or report, ArcMap is also manageable.

a.6　　　　ArcCatalog

ArcCatalog is application program for database connection. The main effectiveness is an applicable to browse and organize data source, spread map document or data. Graphic interface of ArcCatalog is look like the Windows Explorer, but different on that it can browse data, map, and metadata.

The data on disk drive or network system can access by click the button of "Connect to Folder" and select the pathway of data. ArcCatalog is able to connect with various database includes SDE and OLE DB databases.

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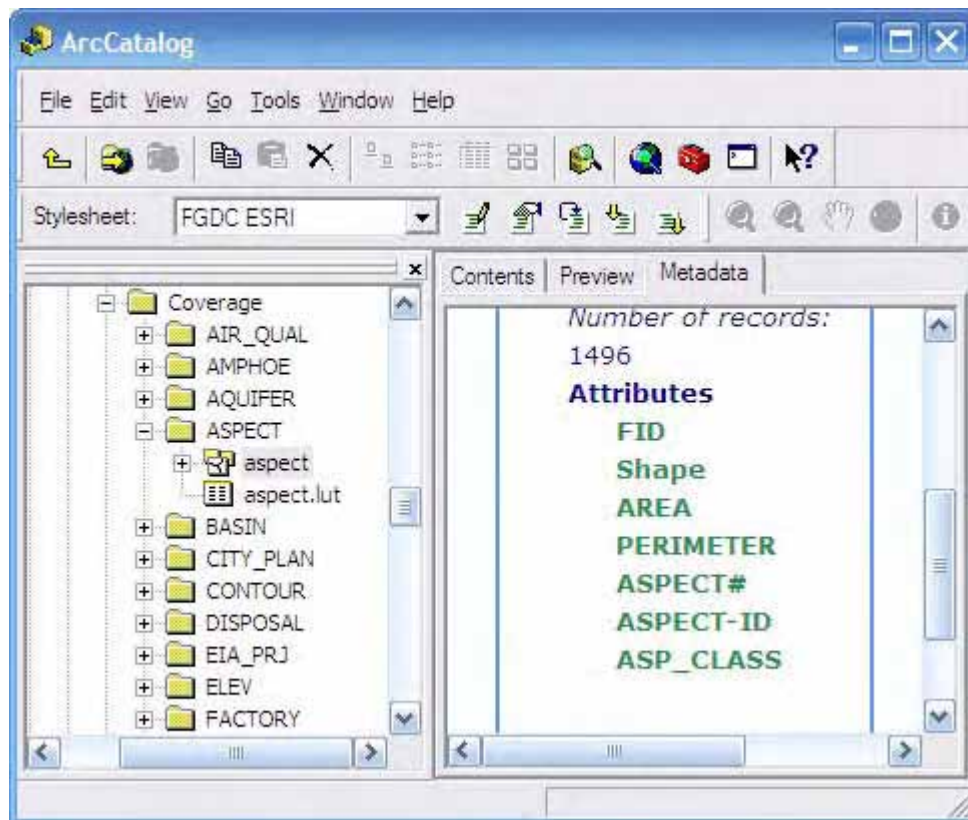
Figure 99 : ArcCatalog Program

The selected group of data is called "Catalog". The "Catalog Tree" is located on left side, while the right side is "Catalog Contents". The right side of ArcCatalog program is composed of 3 components; Content (data lists), Preview (figure or table), and Metadata.

a.7   ArcToolbox

ArcToolbox is a tool for advance analysis GIS data such as co-ordinates system conversion or data type conversion (for example, convert Shapefile to Geodatabase). User can import data with "drag-and-drop" working from ArcCatalog to ArcToolbox.

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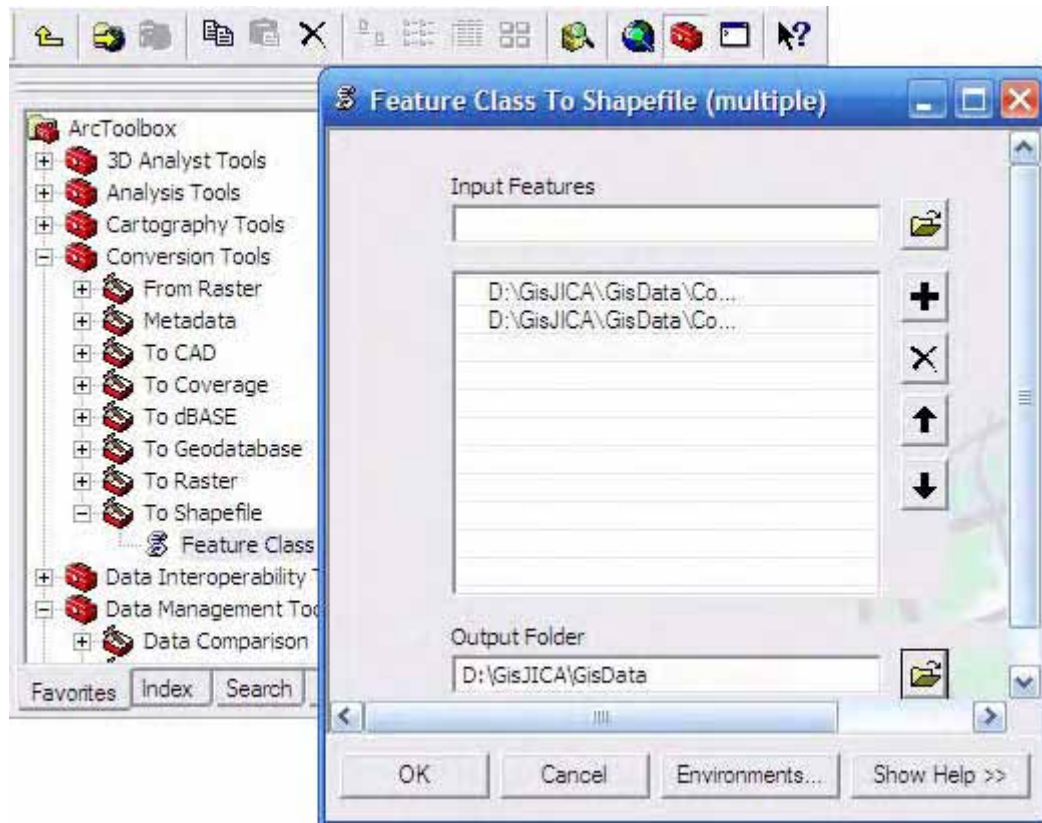
Figure 100 : Arc Toolbox Program

In addition, user can create own tool as ".exe" or ".dll" file types.

There are more than 140 tools of ArcToolbox in ArcInfo such as Conversion Tools, Map Analysis Tools (Union, Clip, Split, Buffer etc.).

ArcToolbox in ArcInfo also has linkage to ArcInfo Workstation by Open Development Environment (ODE) which allow ArcInfo user to use AML and DLL.

b.   Data Handling

b.1   Data Composition and Import

Layer can create by use ArcCatalog program. Normally, when installed ArcGIS program, it will located on Start/All Progams/ArcGIS/ArcCatalog

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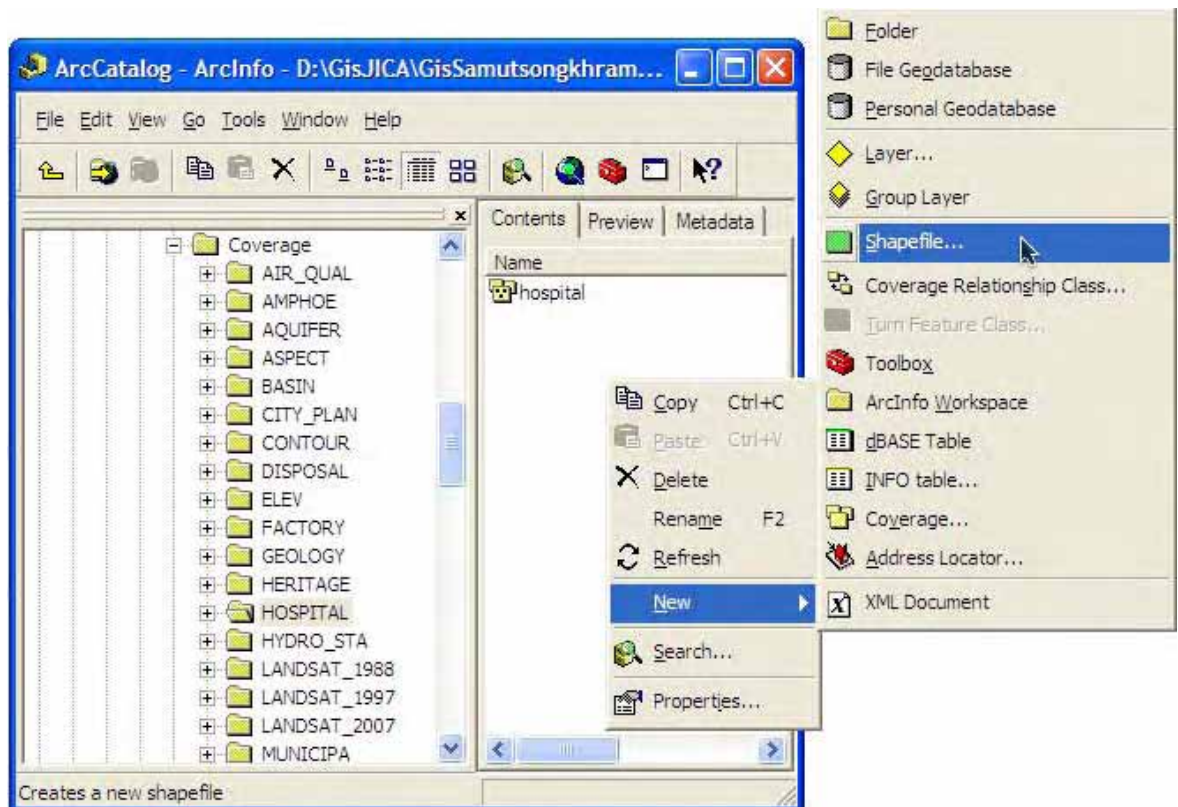
Figure 101 : Arc Catalog Program

Starting by right click at the "Directory" which need to keep layer and select "New" to create layer such as Shapefile, Coverage, Personal Geodatabase etc. Then the box will appear to fill in the name, type (such as Point, Polyline ,and Polygon ,(and spatial reference edition) click "Edit" button).
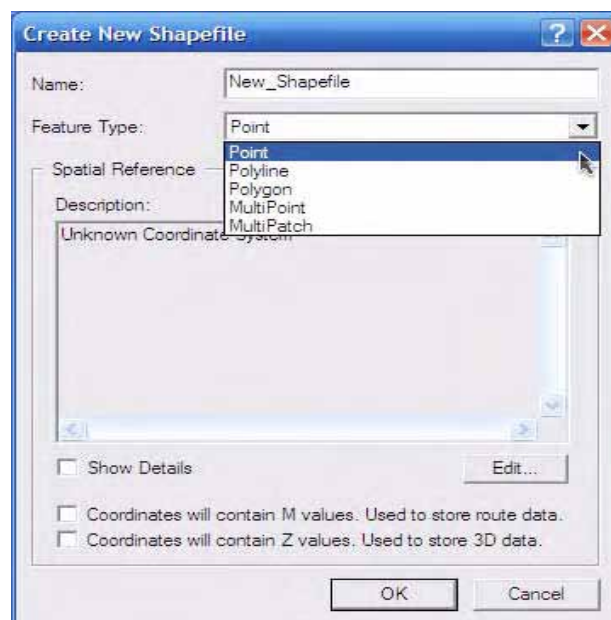
Figure 102 : Layer Creation

Right click and select Properties to create Field as Attribute of layer by type the name in "Field Name" and select data type in "Data Type" (display as Dropdown Menu).

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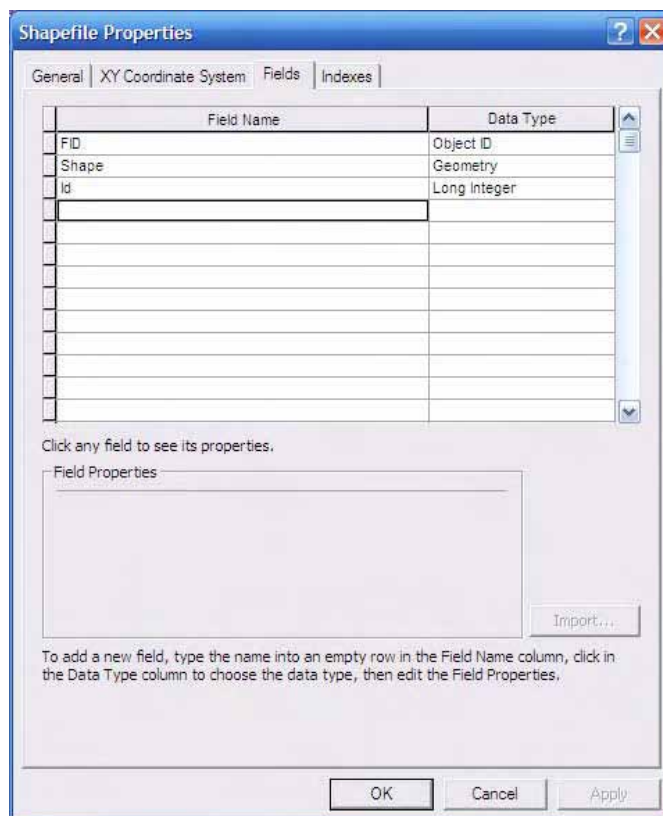
Figure 103 : Define Field to Layer

This layer will use for graphic data composition in section of spatial data editing and attribute data editing of ArcMap.

Data import by click "Add Data" button at File > ⬇ Add Data in Main Menu
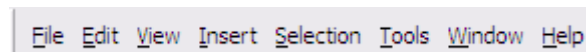
Figure 104 : Main Menu

Otherwise click ⬇ at Data button on standard menu or open ArcCatalog Program and drag data from ⬇ ArcCatalog to ArcMap.

Figure 105 : Standard Menu

b.2   Data Editing

Data can be edited with ArcMap, a part of ArcGIS program, by Graphic Data Editing and Attribute Data Editing

b.2.1.   Graphic Data Editing

It is necessary to open "Editor Toolbar" in ArcMap before start to data editing. If Editor Tool is not show, when right click at Menu Bars or Toolbars it will be appear hidden function and click Editor.

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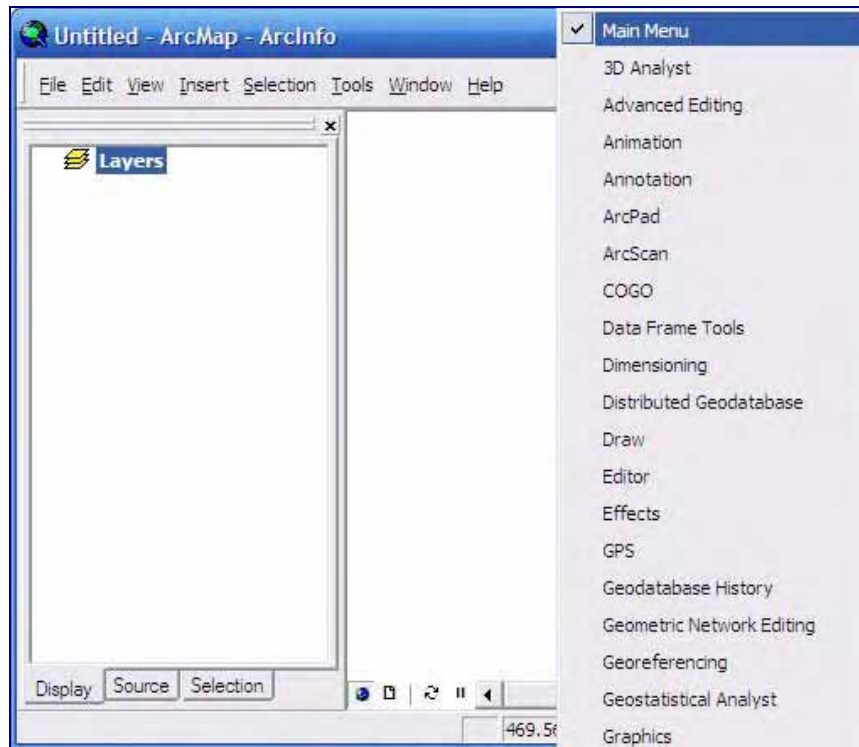
Figure 106 : Open Editor

If currently use Standard Tool, the Editing ![icon] button will appear on toolbar and click to add Editor Tool. The position of Editor Tool can move as user defined.

Also select the task of Start Editing ,Save Editing, or Stop Editing on Editor Toolbar.
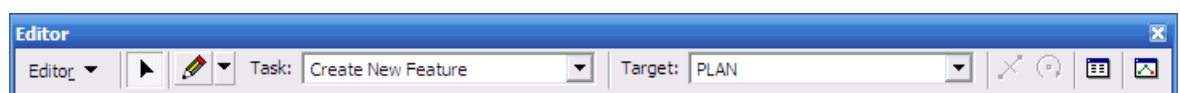
Figure 107 : Editor Toolbar

In case of Coverage data type, it has to convert by right click and select "Export" in ArcCatalog program to Shapefile or Personal Geodatabase before editing.

Data editing in ArcMap will begin on Start editing. The editing data will temporary store in Edit session until finish or save, then record editing data in original file.

The history of editing data in Edit session will show on map display but still not record in original file until save editing data.

A variety of button such as Dropdown Menu on Editor Toolbar is gray, means "Disabled", because it is still not order to edit. Then click "Start Editing" from Editor Toolbar.

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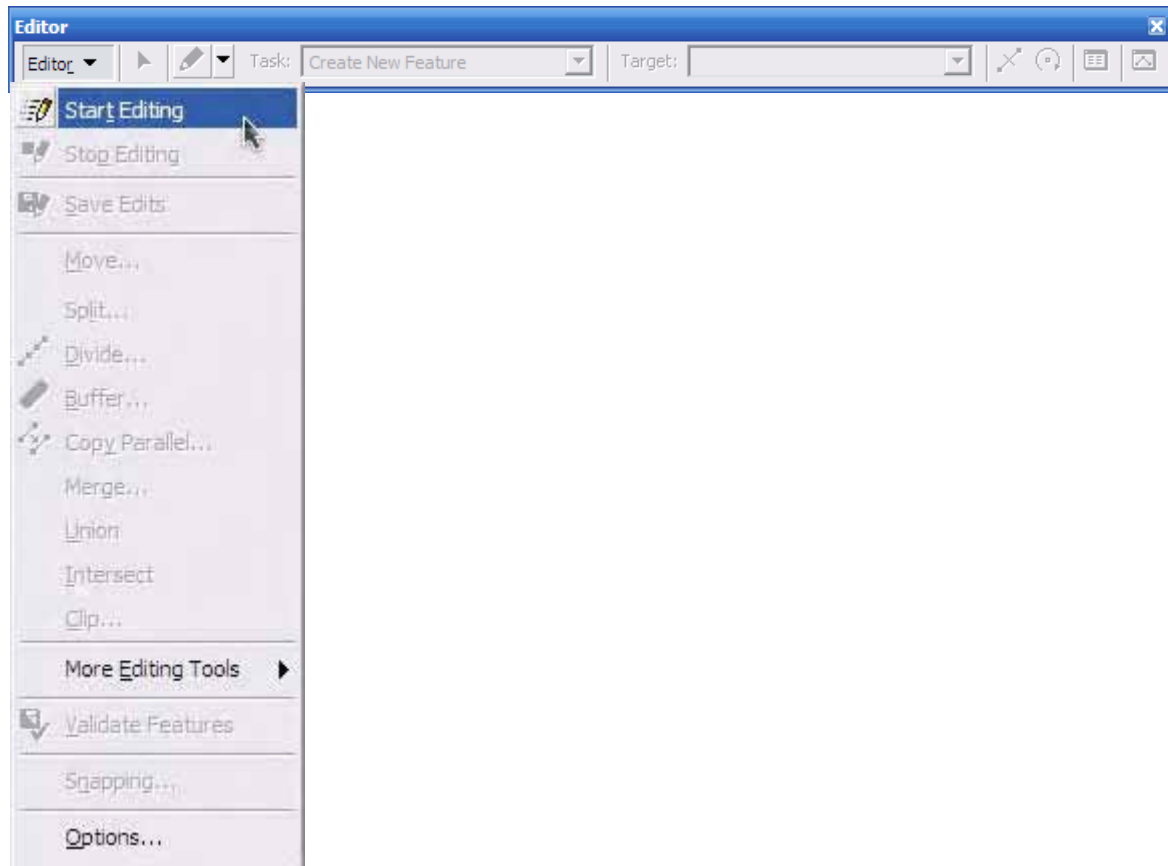
Figure 108 : Start Editing

Object movement; click "Start Editing" buttons will Enabled, the "Edit" is main tool for select and move object. Click at Edit ▶ (this tool may activated (on object, it will be Highlighted.
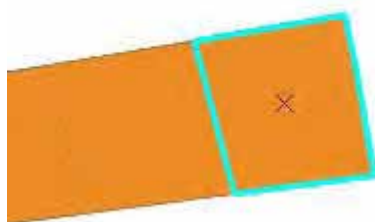
Figure 109 : Object Selection

When point the mouse at object, pointer will be change as 4 directions arrow symbol means ability to move object position. It should be noted that buttons on Editor Toolbar are enabled.

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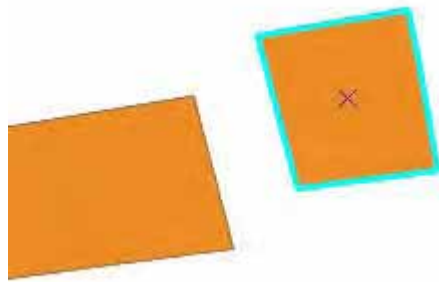
Figure 110 : Object Movement

Object Rotation; click Rotate button and move object around Selection Anchor. The Anchor moving will be effect to object rotation.
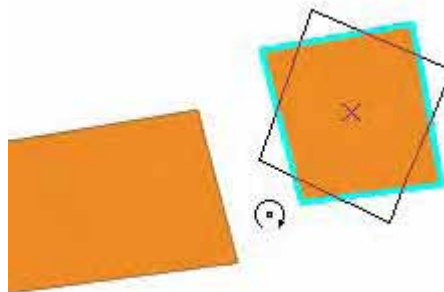
Figure 111 : Object Rotation

It can specify the degree of rotation; positive degree means rotate clockwise and negative degree means anticlockwise.

Sketch is an outline drawing tool. The sketch is a group of all spots composed to be object)Vertices) and lines) Edge(composed to be object) Segments). The movement of one spot within object called Vertex, Edit tool is usable for move this Vertex position. When click

at Edit and double click at object, their Sketch will be appeared with Vertices and Segments. And when point mouse above the Vertex and drag Vertex in the new position, the figure of Sketch will be changed.
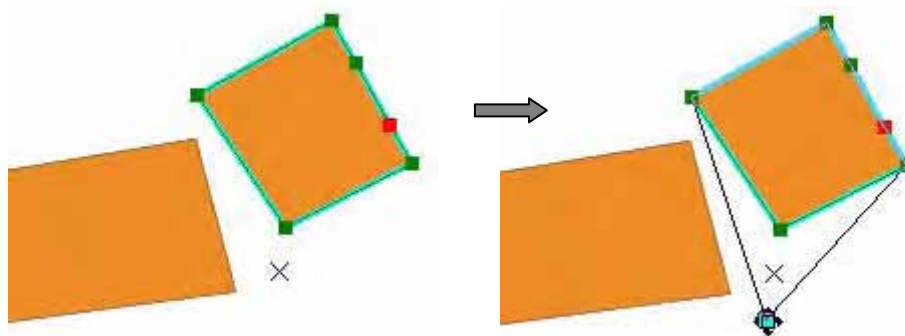
Figure 112 : Vertex Movement

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Delete Vertex; use Context menu help to edit object. Right click at Sketch by point mouse above the left below Vertex and right click to show Sketch then select Delete Vertex
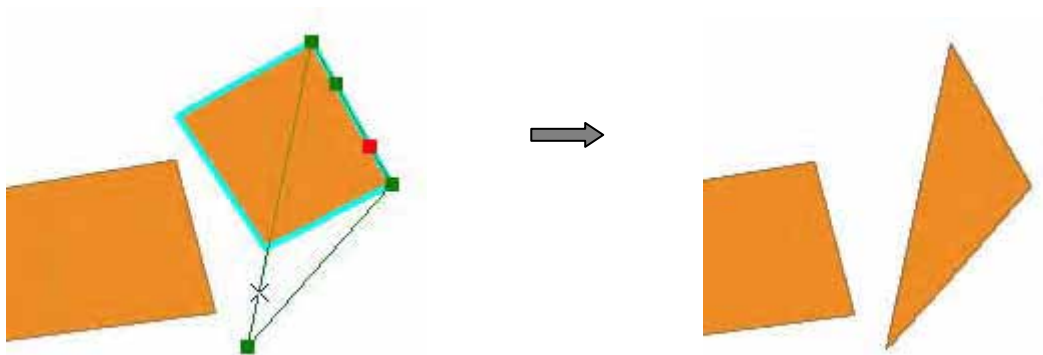
Figure 113 : Delete Vertex

Insert Vertex; as same as delete vertices, add the vertices by point mouse above the Sketch line and right click to open Context menu then select Insert Vertex
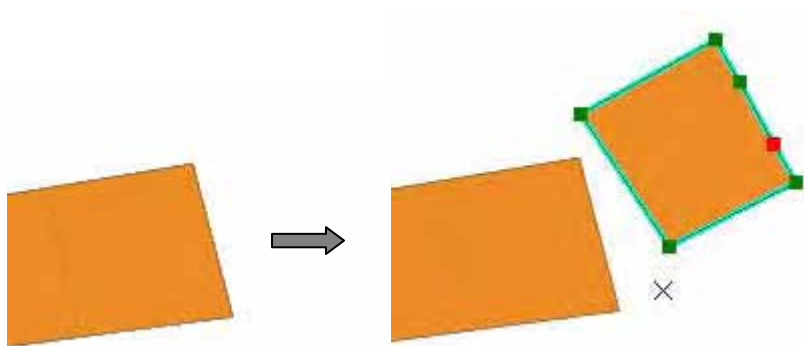
Figure 114 : Insert Vertex

Split Tool use to split one line into two lines. Start by select the line and use Split tool at the position that want to split. It is default as copy an attribute data of original line to the new one.

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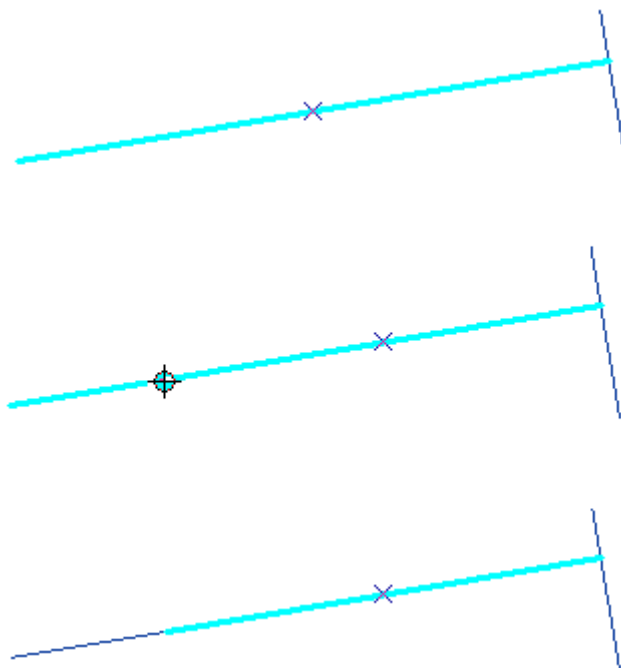
Figure 115 : Split

Delete object; select object or data from Table of Content and click Delete ✕ at Standard toolbar or click Delete at Keyboard.
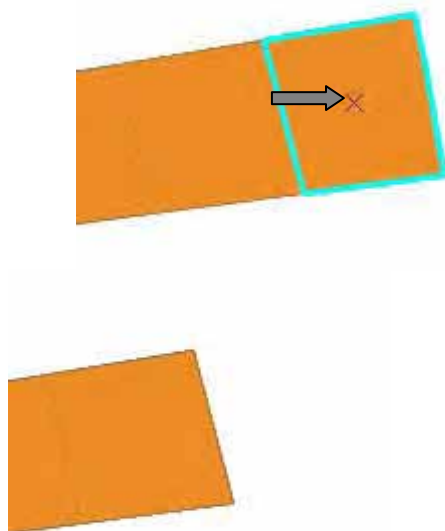
Figure 116 : Delete Object

The editing session as described above is show a variety of tools useful for editing, besides user can use various tool on Standard toolbar such as Cut, Copy, and Paste object between layers and Delete object. User can also use Undo and Redo command, for instance, use Undo to reuse latest working.

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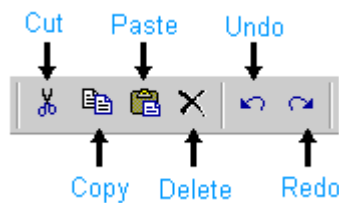
Figure 117 : Standard Toolbar

Save change and leave ArcMap program; Click Stop Editing from Editor Menu and click Yes when dialog box appear to ask save change or not. Or select File from Main Menu and click Exit and click No when dialog box appear to ask save document or not.

b.2.2.   Attribute Data Editing

If user wants to edit an attribute data, use editing option by perform Start Editing and view attributes by click attributes button then the attributes window will be appeared.

Figure 118 : Attribute Button

The attributes window is divided into 2 parts; 1) Data view located on left side is object lists and 1) Right side is details of selected object from left side.
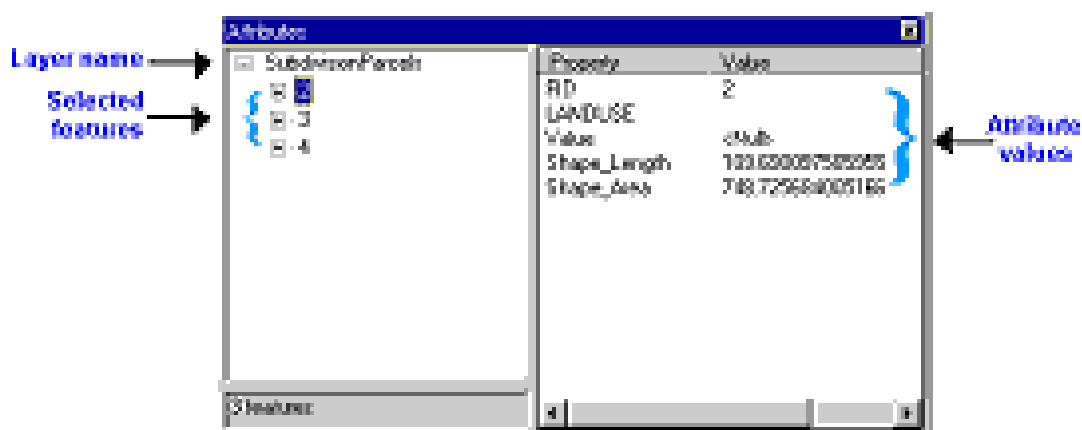
Figure 119 : Attributes Window

If select object more than one layer, each layer composed of selected object in list of data viewing. User can access interested object by click (+)symbol to expand the list.
User can edit attribute data by click Field of each data appeared in right side and edit in Value to change the new one.

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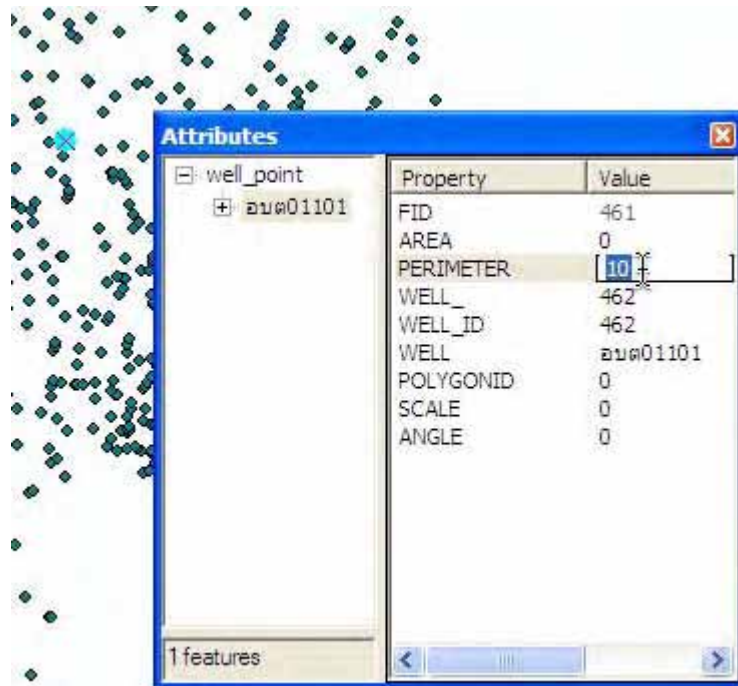
Figure 120 : Data Editing in Attributes Window

If user wants to change value of all objects, it can do by click at the name of layer and type a new value in data field as same. Then below of all selected data field will change to the new one.
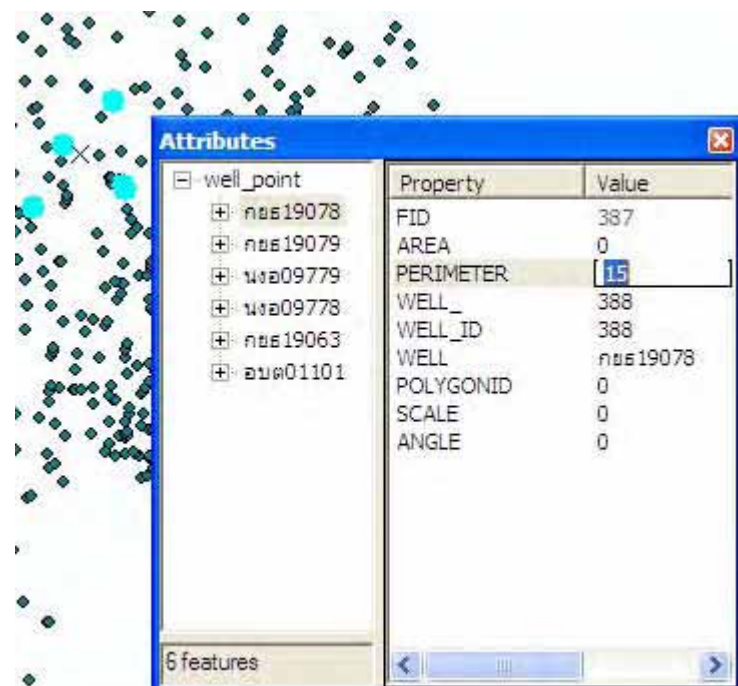
Figure 121 : Data Editing in Layer

Value in all PERIMETER field of WELL_POINT layer will change to be 15.

User can copy or cut to each value or all value of attribute data and paste as each object or all selected objects.

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Additionally, for calculated option in ArcMap, user can edit attribute data of an object by create a simple calculation of define condition in Field Calculator. The Field Calculator will activate to selected object, if no one it will activate to all object.

To use Field Calculator, start with editing session first and open the table of each layer by right click at their name in Table of Contents and select "Open Attribute Table". When the table appeared, right click at the heading of data which want to edit, select Calculate Values from menu to show Field Calculator Window.
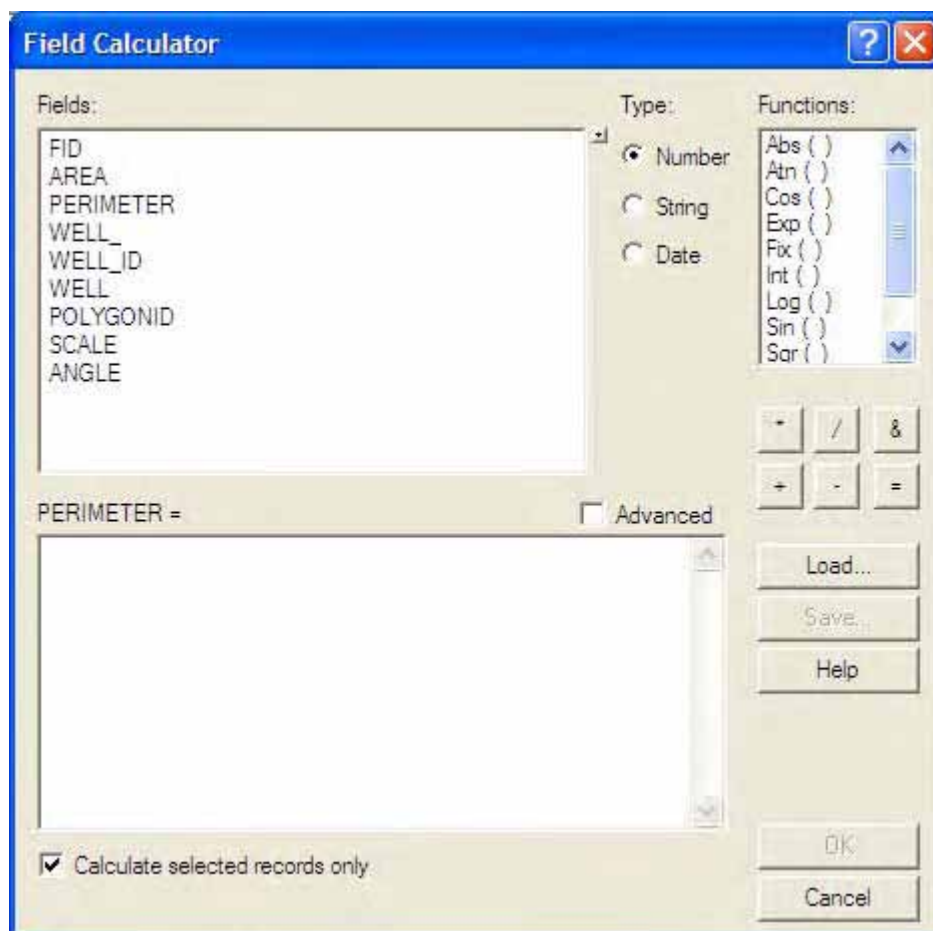
Figure 122 : Field Calculator Windows

To define a condition in Field Calculator, it has a field, function, and operation options support to user. User can click in area of field, the list of field will be appeared in Expression box for define condition. Otherwise user can type a condition directly as below example; the PERIMETER field is edited to be sum with 10 to each perimeter.

Using Field Calculator is useful for advance calculation and can be edit only selected data or edit all data in table.

When user defined a condition in Field Calculator already and click OK, the value in field will change as defined condition or calculation.

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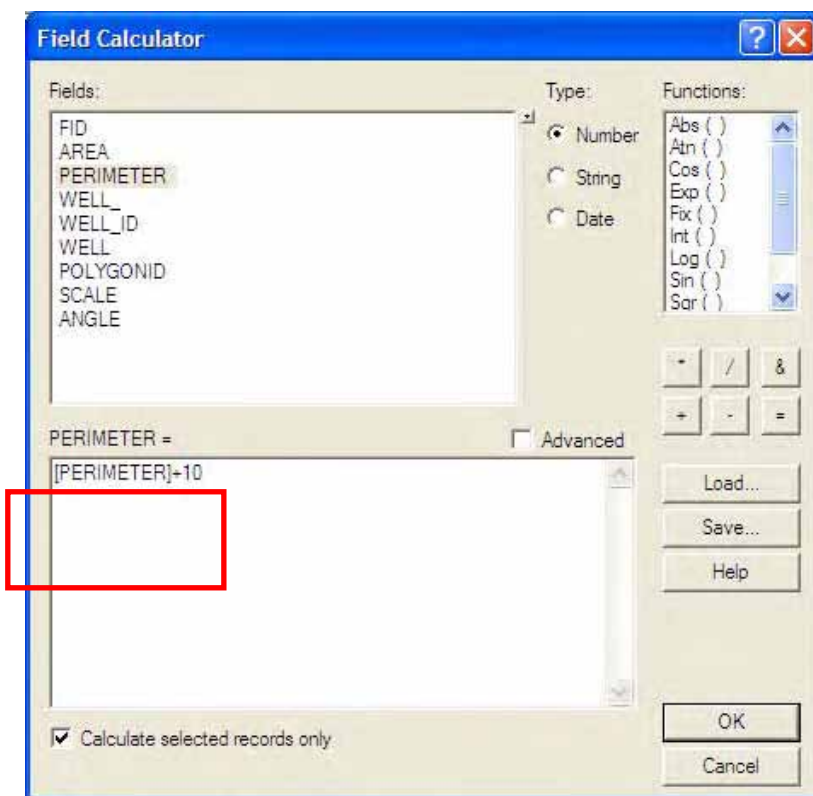
Figure 123 : Field Calculator Windows

c.   Map Printing

The provided file is comprise of Layout or map printing format, just move the map to the wanted position, specify scale, edit heading and other then able to print out.
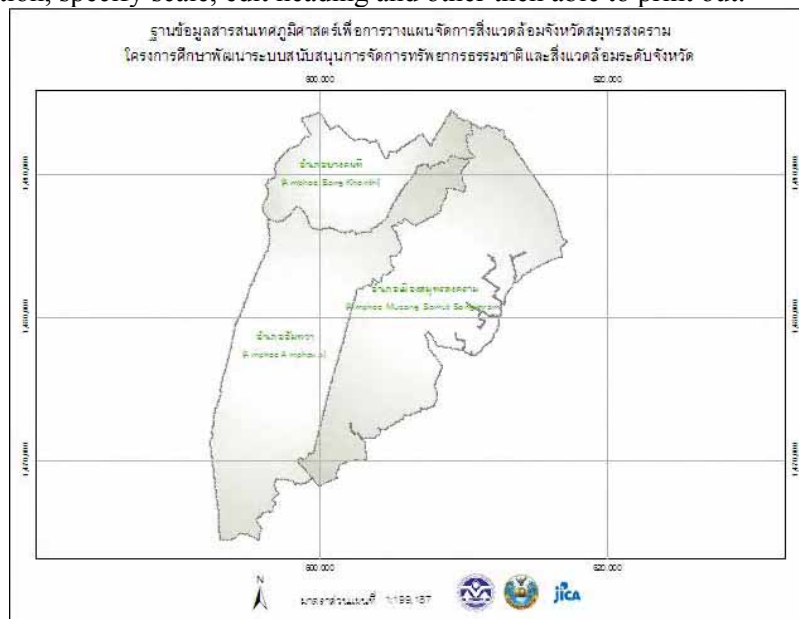
Figure 124 : Mode Layout View

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Anyway, it has to change as Mode Layout View (usually working in Map Display) by click Layout View at the left below window or select View > Layout View on Main Menu
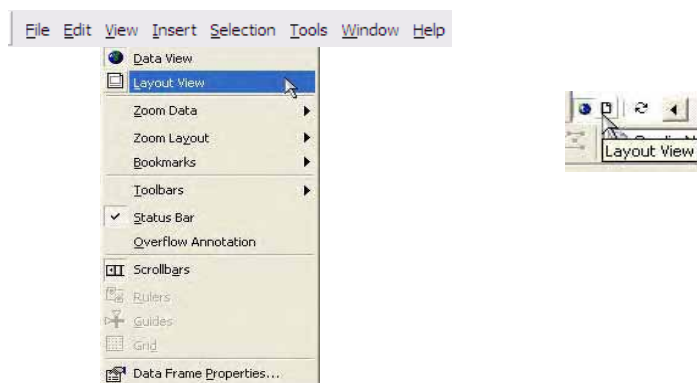
Figure 125 : Layout View Display

To create Map Layout, it is necessary to define size and printing property first; because ArcGIS will change Layout as paper size (default paper size is set as A4). If user wants to print other sizes, they should specify paper size by right click at outer Layout frame.
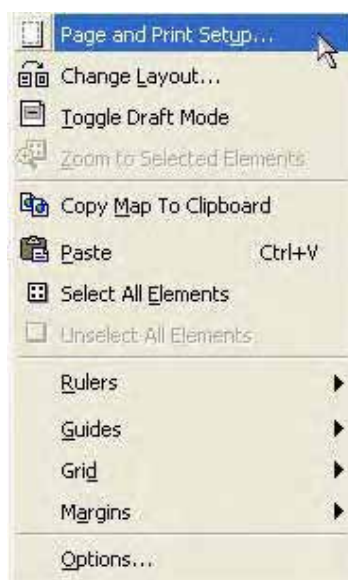
Figure 126 : Printing Preference

If user wants to change other details, they can double click to edit default map composition or add new element by click Insert at Main Menu.

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c.1   Adding the Direction) North Arrow)
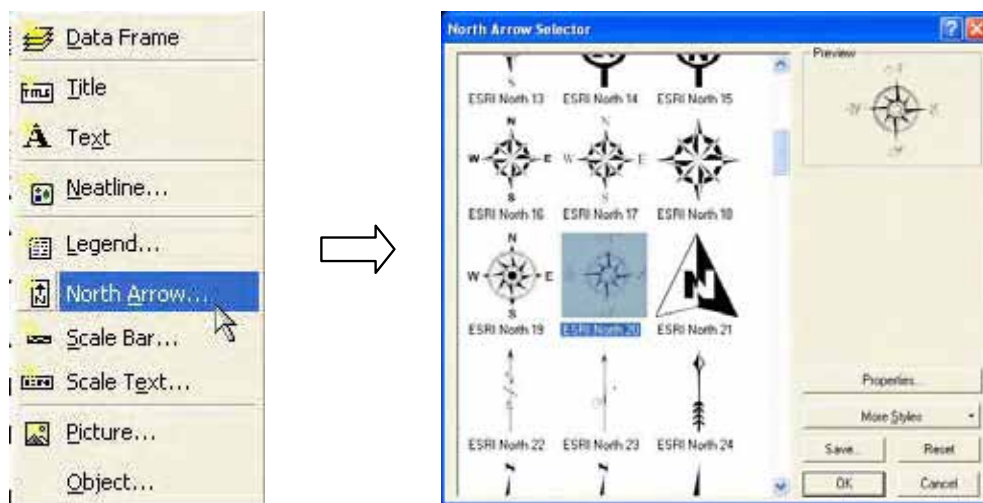
Figure 127 : North Arrow Addition

c.2   Adding the Scale) Scale bar & Scale Unit)
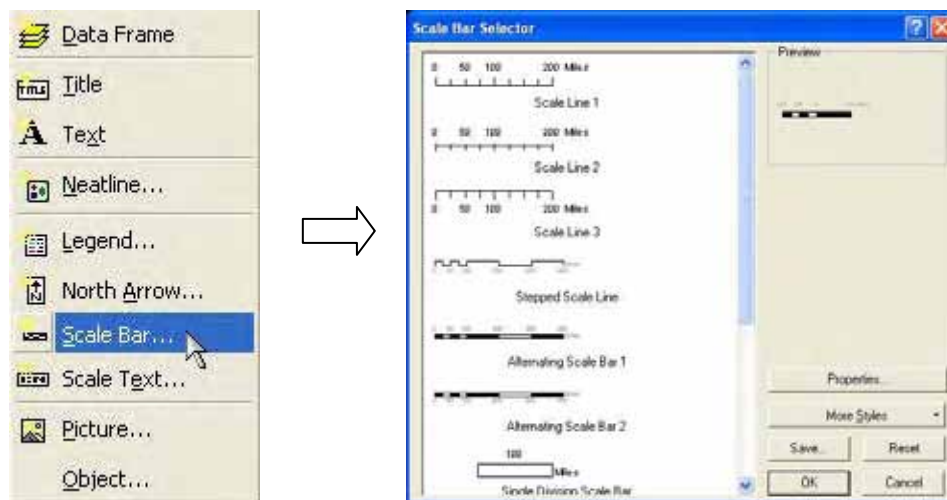
Figure 128 : Scale Addition

Other than to select scale format to display, user has to specify map unit too. When completed Insert Scale Bar, change the unit of measurement by right click at Scale bar and select Properties. Then the alternating Scale bar properties window will be appeared, select "Scale and Unit Tab" to change unit.

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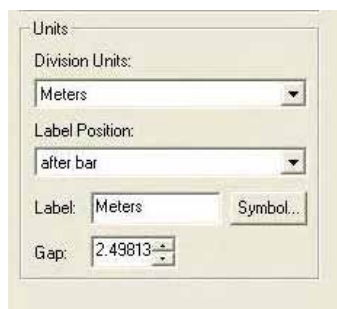
Figure 129 : Change the Unit of Measurement

c.3   Adding the Legend

As figure below, the name of layer will be appeared for user to define symbol of layer. The left frame is all names of layer and the right side is layer need to added symbol.
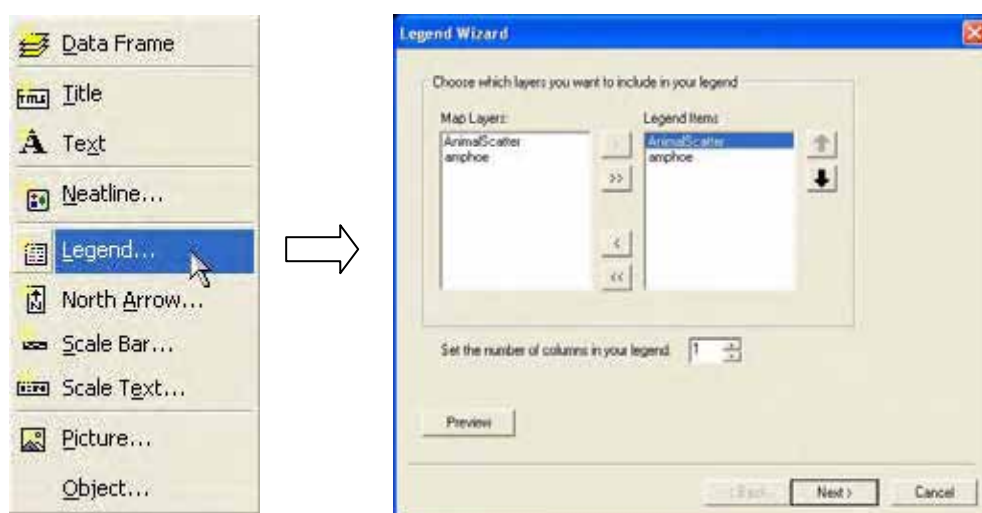
Figure 130 :Adding the Legend

To edit symbol, Legend has to convert as Graphic by right click at Legend Frame select Convert To Graphic and right click Ungroup again. Then Legend will be separated to single Graphic which can rename, delete, change color, and regroup.

c.4   Adding Map Title

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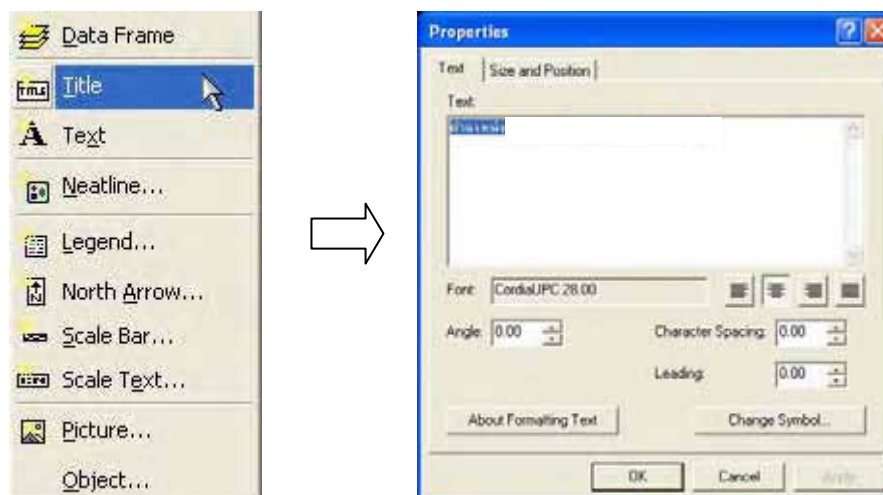
Figure 131 : Adding Map Title

After completed map editing, click Menu File and select Print Preview to verify before printing that map is outside paper margin or not and select Print.
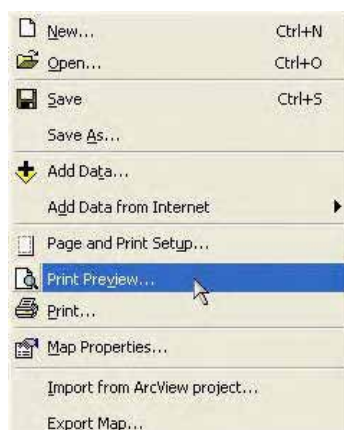
Figure 132 : Map Printing

In case of color map printing is not available or want to use as annotation in other programs such as Microsoft Word, PowerPoint, or HTML format, ArcGIS is compatible to convert map file in other file format as follows;

- PDF (Portable Document Format) is an Electronic Paper which can display on web in document format both text and picture.

- SVG (Scaleable Vector Graphic) support to Graphicpresentation which can reduce or expand or move picture without lost details. It can present through WebB rrowseandin SVG Vi-Plug ewer.

- Picture file group such as

  - BMP (Windows Bitmap)
  - JPEG (Joint Photographic Experts Group)
  - TIFF (Tag Image File Format)
  - EMF (Enhanced Windows Metafiles)
  - EPS (Encapsulated Postscript)

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c.5   **Export Map by click File Menu and select <u>E</u>xport Map**
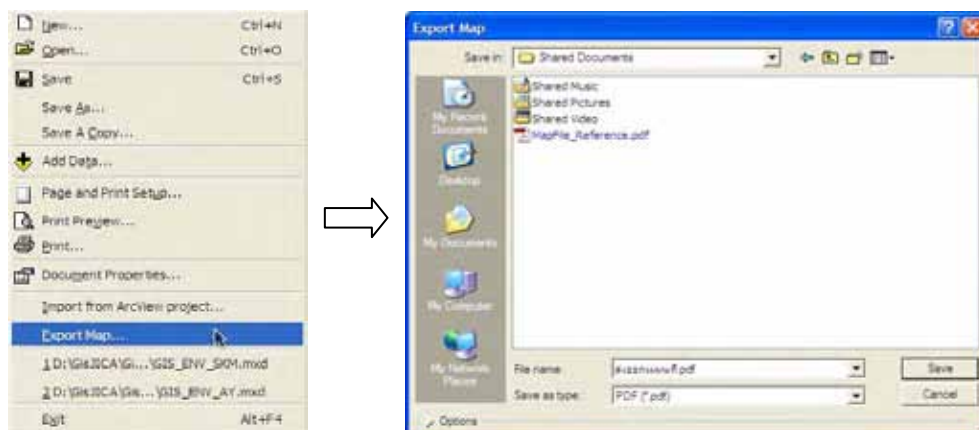
Figure 133 : Export Map

d.   **Geographic Information Database Program for Environmental Quality Management**

The Geographical Information Database for Environmental Quality Management is a development of application program for support to GIS usability and convenient access to database. User who does not have deeply knowledge can use this database with a Graphic User Interface (GUI) that helpful to decrease complexion of procedures and confusing of data access.

This program was developed by Visual Basic for Applications (VBA) based on ArcMap 9.2 in order to benefit of specific work for environmental quality management of Samut Songkhram Province.

Geographic Information System for Environmental Quality Management Installation

Install program by copy folder in CD-ROM to disk drive as required. The folder is GisSamutsongkhram as details described below.

Table 22 : Description of Data Storage Folder

Folder Name	Description
GisSamutsongkhram	Folder of Samut Songkhram Province
Configdata	Folder of configuration program storage
GisData	Folder of data storage
Coverage	Folder of coverage data storage
Satellite	Folder of satellite photo storage
Topo	Folder of topographic map storage
GIS_ENV_SKM.mxd	Program file (ArcMap Document)

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d.1   Open Project File

After completed program installation, open ArcMap program which generally located in Start/All Progams/ArcGIS/ArcMap
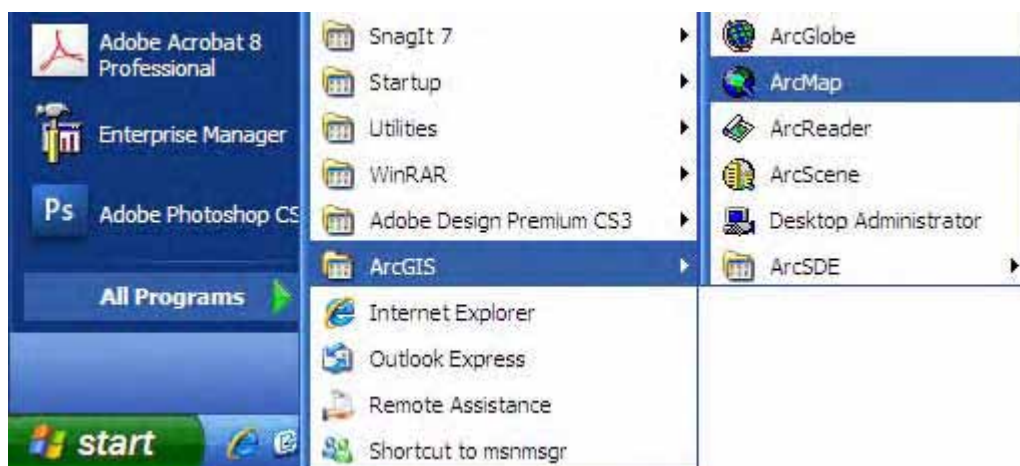
Figure 134 : ArcMap Program

Program file can open by two ways, the first way open with ArcMap program and select project file (An Existing Map) and select file GIS_ENV_SKM.mxd
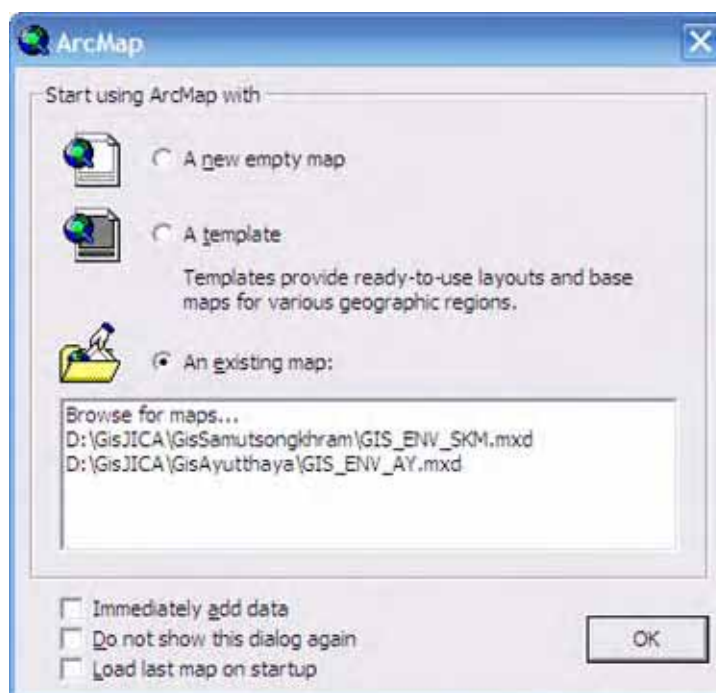
Figure 135 : Open Project File

The second way is select menu File > Open at Main Menu and select file

GIS_ENV _SKM.mxd from folder (Browse for maps)

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Otherwise double-click file   GIS_ENV_SKM.mxd which copy to disk drive.

When open project file, welcome window will be appeared.

Figure 136 : Program Welcome Window

Then, click Login to the page of Geographic Information Database for Environmental Quality Management of Samut Songkhram Province, the Study and Development of Provincial Natural and Environmental Resources Management System Project.
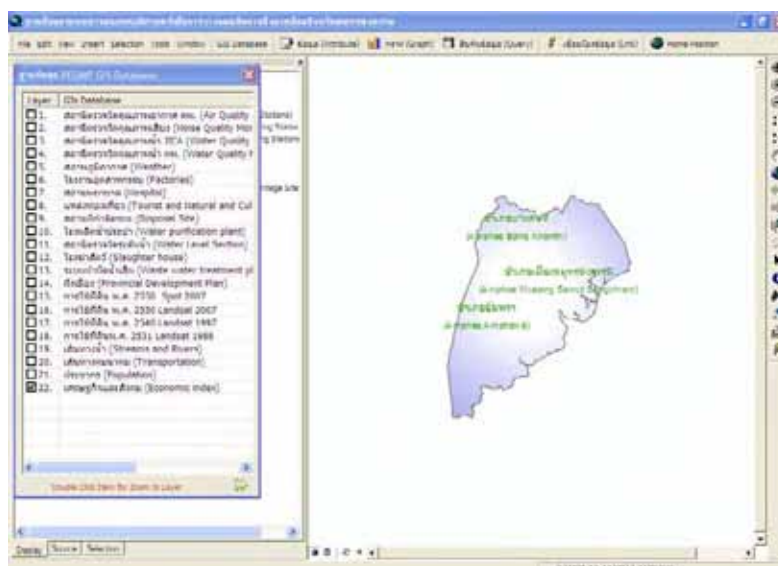
Figure 137 : Geographic Information Database Program

If user edits the default position of GUI and save change in original file, the position of GUI will change as user edited while open it next time.

The GUI of Geographic Information Database for Environmental Quality Management Planning of Samut Songkhram Province is divided as usability as follows;

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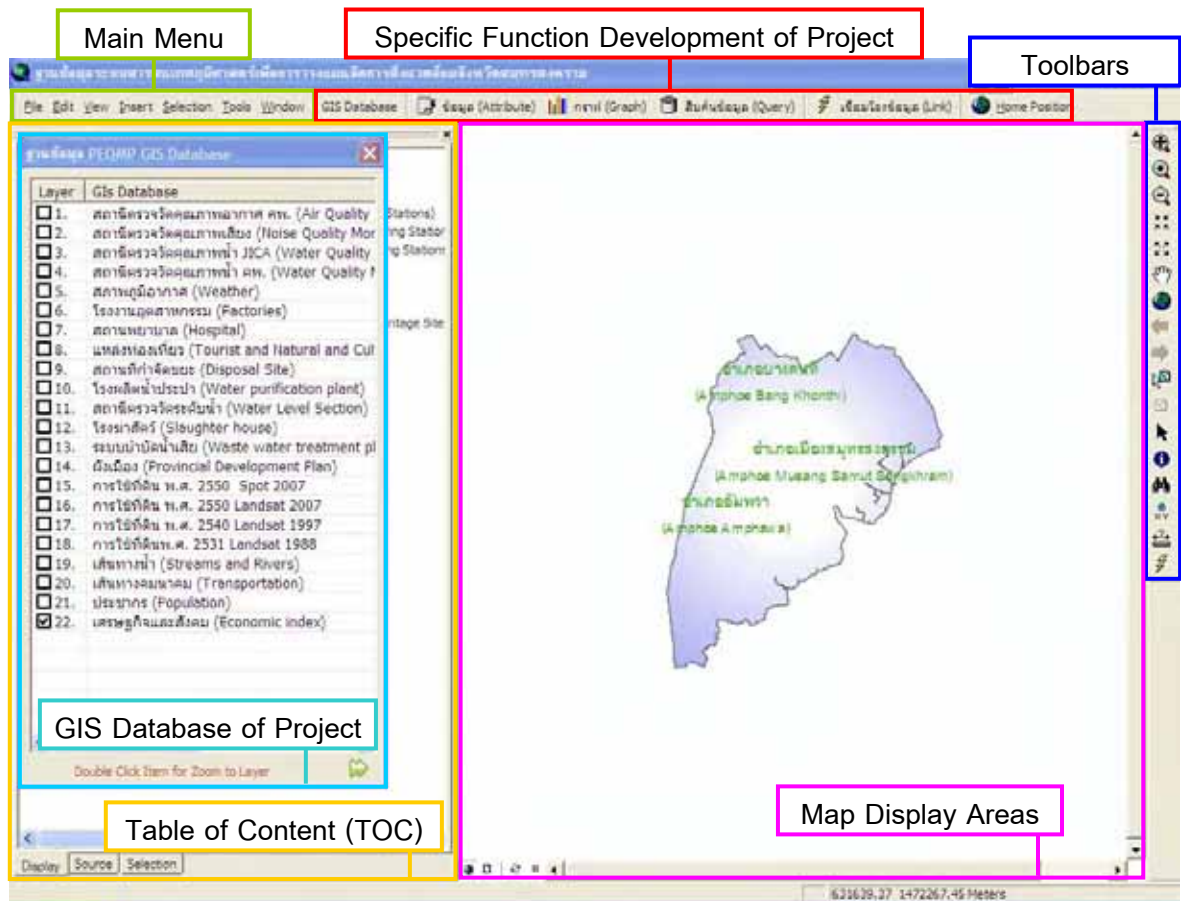
Figure 138 : Graphic User Interface

d.2   **Main Menu**

This part is defined as default of ArcGIS program and auto run when ArcGIS program is opened always. This main menu is cannot be removed.
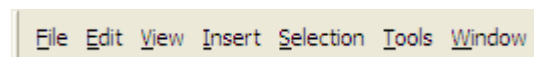
Figure 139 : Main Menu

The important commands orders are 1) File has orders to Add Data, Save, Print etc. 2) Edit has orders to Cut, Copy, Paste etc. 3) View has orders to Zoom, Toolbars etc. 4) Insert has orders to input map compositions 5) Selection has orders to Zoom to Selection, Clear Selected Features etc. 6) Tools has orders to Editor, Graph, Report etc. and 7) Window has orders to Magnifier, Table Of Content (TOC) etc.

d.3   **Specific Function Development of Project**

This function is specific develop to the Geographic Information Database for Environmental Quality Management Planning of Samut Songkhram Province Project only for convenient to user in order to database access. It is help to reduce complex procedures and confuse data access with function components of GIS Database, Attribute, Graph, Query, Link, and Home Position **"Functions Created within Program"** .

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| GIS Database | ข้อมูล (Attribute) | กราฟ (Graph) | สืบค้นข้อมูล (Query) | เชื่อมโยงข้อมูล (Link) | Home Position |
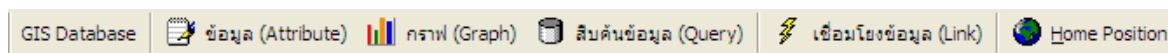
Figure 140 : Specific Function Development of Project

d.4 Toolbars

A group of tools prepared by ArcGIS for manage to graphic data. The tool sorts from the top to bottom are described as follows;

- Continuous zoom/move
- Zoom in
- Zoom out
- Fix zoom in
- Fix zoom out
- Move
- Show all boundaries
- Previous boundary
- Next boundary
- Select object
- Cancel select object
- Select composition
- Specify details
- Find
- Go to   x,y
- Measure
- Hyperlink
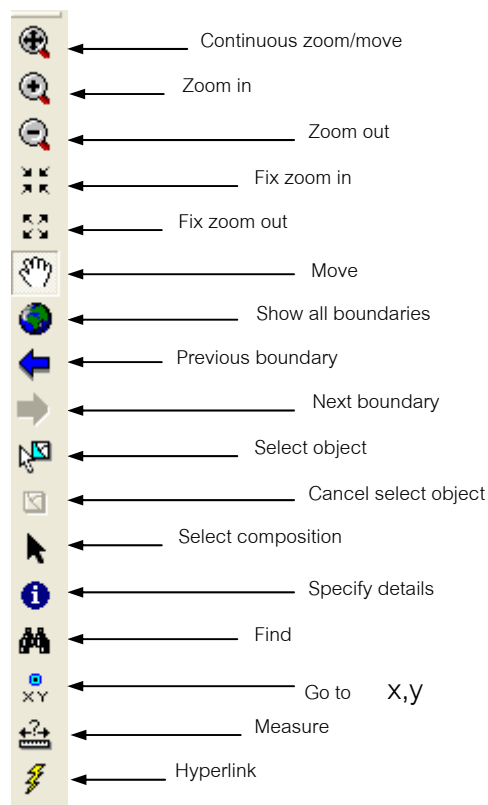
Figure 141 : Toolbars

d.5 GIS Database of Project

The database lists will appear when click GIS Database button on the bar of specific function development of project. It has two databases, which user can select one by one, such as PEQMP GIS Database and DEQP GIS Database. For more details, please see sub-section "GIS Database Windows" in section **"Functions Created within Program"**.

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Figure 142 : GIS Database of Project

d.6 Table of Content (TOC)

A list of all data in program which can open/close layer as requires from Check Box in front of the name of layer. Besides, it is able to click to the + symbol at the front to show hidden details or click to the - symbol to hide details.

In addition, it is able to select view format as Display, Source, or Selection by click the bar in the left of below TOC window.

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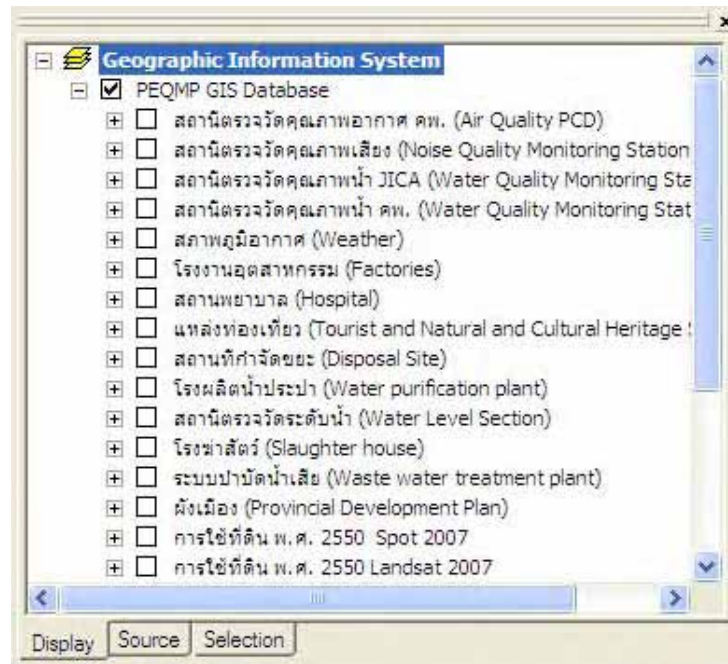
Figure 143 : Table of Content

d.7 Map Display Areas

The area to show Graphic Data and Attribute Data.

The order at left of below window will allow user to select Data View (show data), Layout View (show map printing layout), Refresh (may display adjustment), and Pause Drawing.

Figure 144 : Map Display Areas

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e. **Specific Function Development of Project**

This program has divided into 6 parts; database window, attribute, graph, query, link, and home position. The functions of each part are the following expressed.

e.1 **GIS Database Window**

The project database is consists of two parts; PEQMP GIS Database and DEQP GIS Database.

To open-close layer in window by click to mark a check symbol in front of the layer (Check Box)

Besides, when double click to checking layer in window, program will expand to display in those layer field.

Figure 145 : GIS Database Windows

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e.2   Attribute

Attribute is a tool for show details of selected object corresponding with database window.

When click attribute button, check box in front of layer, and select object on the map, program will show their attribute.

However, the attribute display format will different as program set up to access data in each layer.
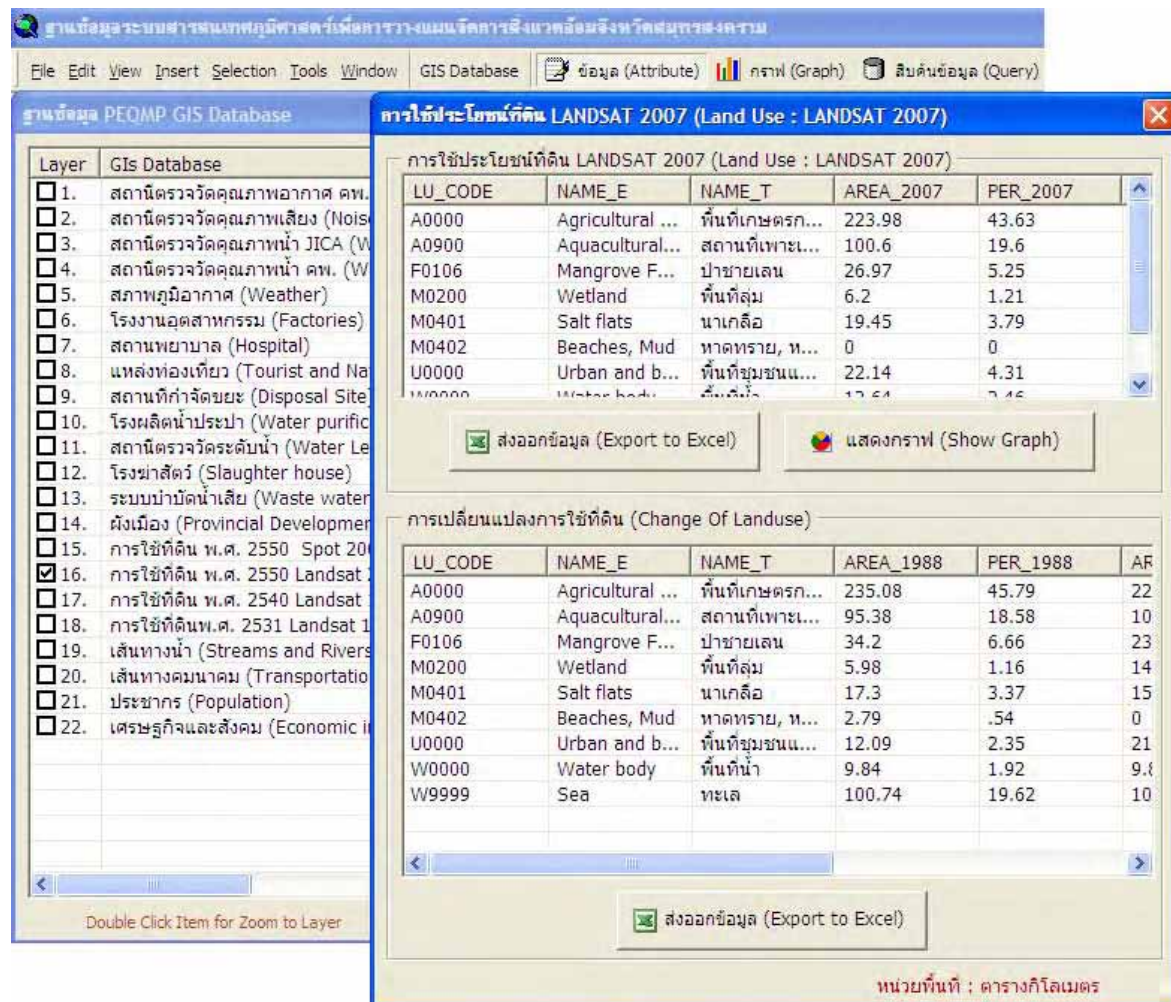
Figure 146 : Attribute Data Display

The attribute data can export to Excel Spreadsheet (Microsoft Excel Worksheet) by click export button.
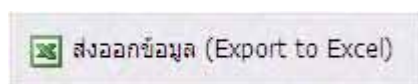
Figure 147 : Export Button (Export to Excel)

When click at export button, the window of Export to Excel will be appeared.

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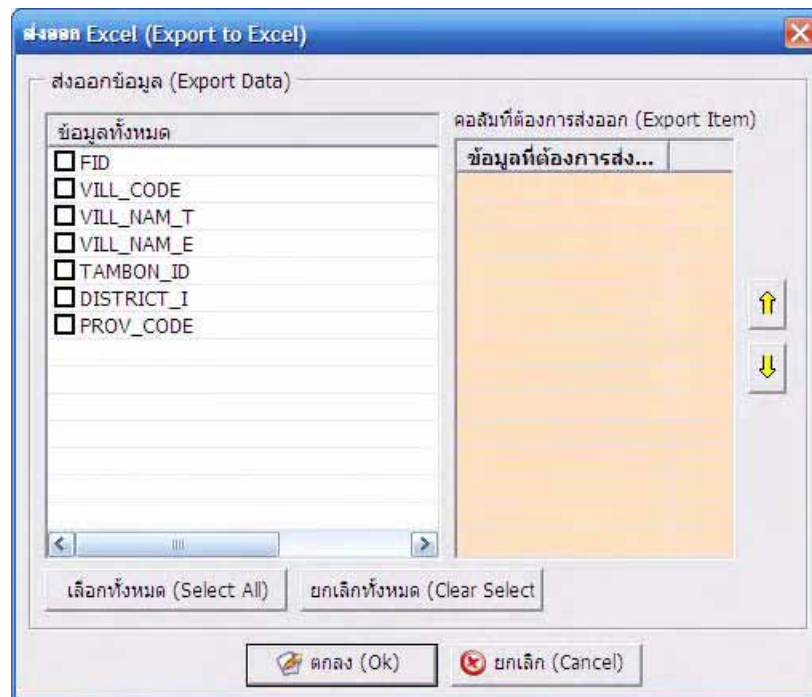
Figure 148 : Exports to Excel Window

The frame "All Fields" at left side will show the name of all fields. User can check box in each field to select an export field, then the selected field will be appeared in the right frame "Export Fields".
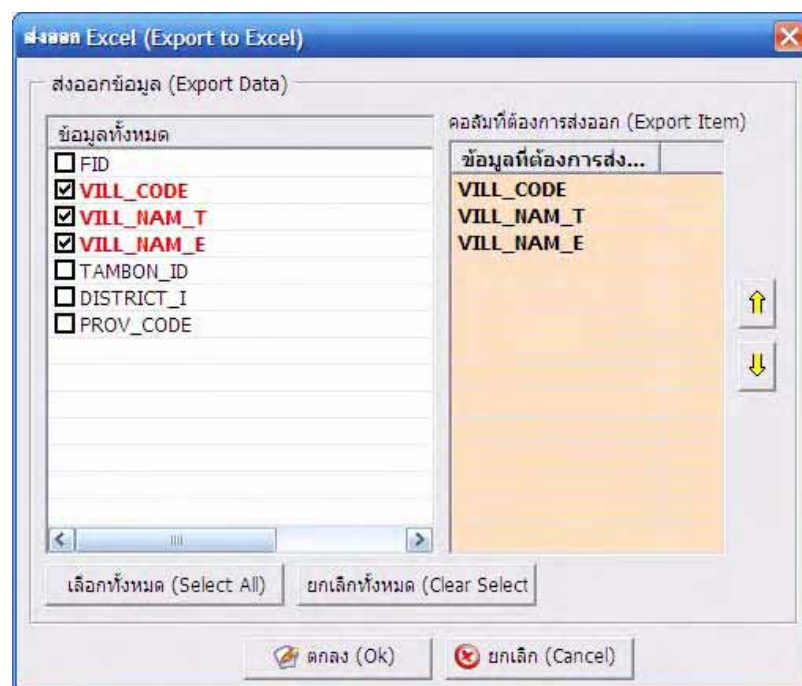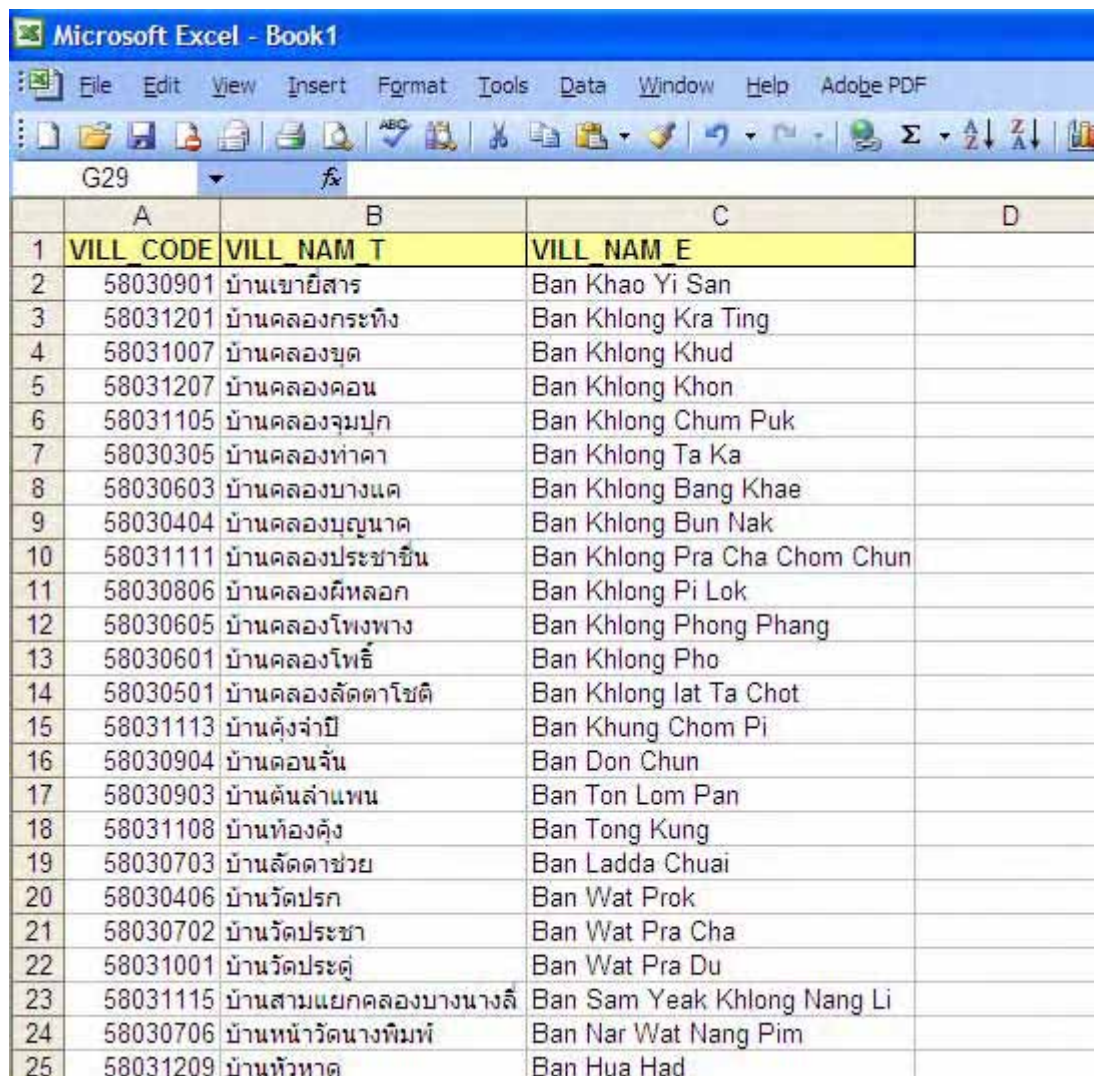
Figure 149 : Field Selections for Export to Excel

If user wants to export all fields, click Select All button. Otherwise if user wants to cancel all fields, click Clear Select button.

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In the frame "Export Fields", user can arrange the order of field export by select the field and click arrow to lift field up or down as requires.

Click OK button when finished for export fields to Excel, then the system will run Excel program for user to save data in Excel file.

Figure 150 : Export to Excel

Besides, in order to show attribute details, it can present with a graph by click Show Graph button, then result will show the graph as program set up. For more details, please see in Graph section.
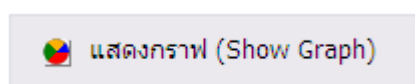
Figure 151 : Show Graph Button

e.3   Graph

Use for display data in graph pattern. The usability characterization as same as Attribute buttons that it will show graph of selected object related to database window.

When check box in front of the field, click Graph button and select object on the map, program will show graph data. Graph types of each field will show column, bar, or pie as appropriate with each field.

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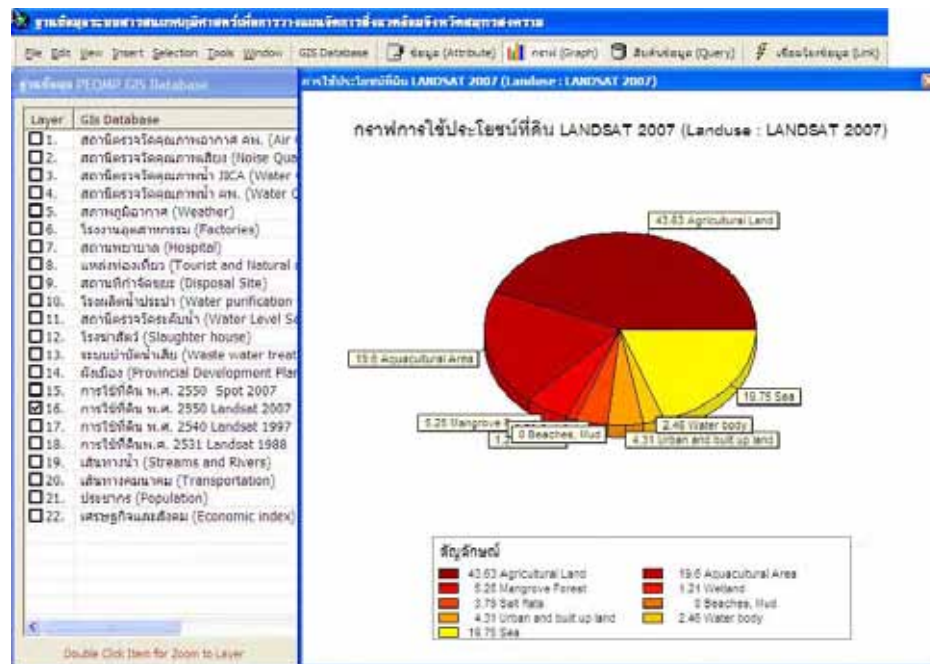
Figure 152 : Graph Display

Some field has to choose parameter, beginning time, and ending time of graph display.

Figure 153 : Graph Condition Windows

If any field is does not have graph display result, dialog box will appear to notice user.
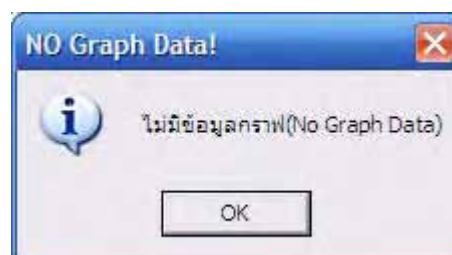
Figure 154 : Dialog box "No Graph Data Available"

e.4   Query

Query button is use for search data in Amphoe or all Amphoes in Province. User can define and select field of query from the database.

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Click Query button; select one or all Amphoe and field data then click search, details of selected data will be appeared.

Besides, user can export result to Microsoft Excel.
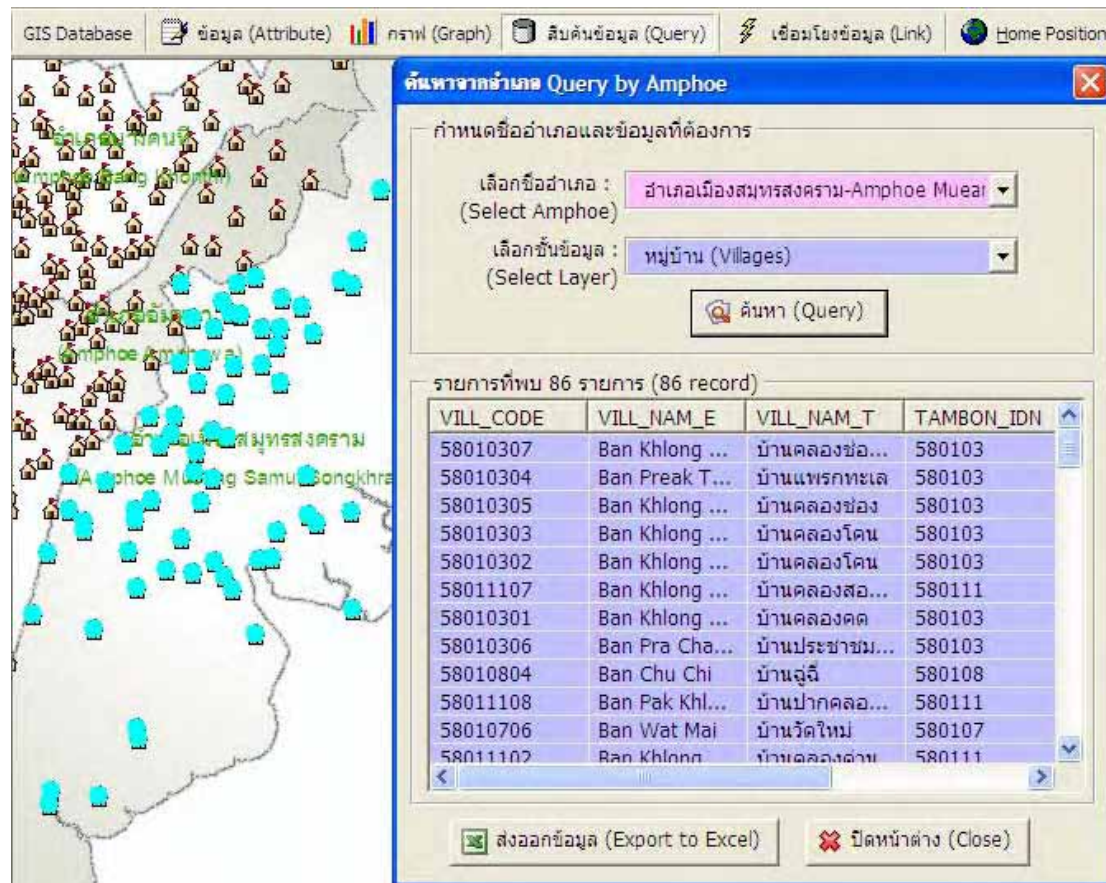
Figure 155 : Query

e.5   Link

The fields of town plan, tourism location, wastewater treatment plant, solid waste disposal site, and water supply plant are able to use Link button.

When click Link button and select object, the window will appear to show linkage data. For example, town plan data will link to Adobe Acrobat program to open town plan data file in ".pdf" format.

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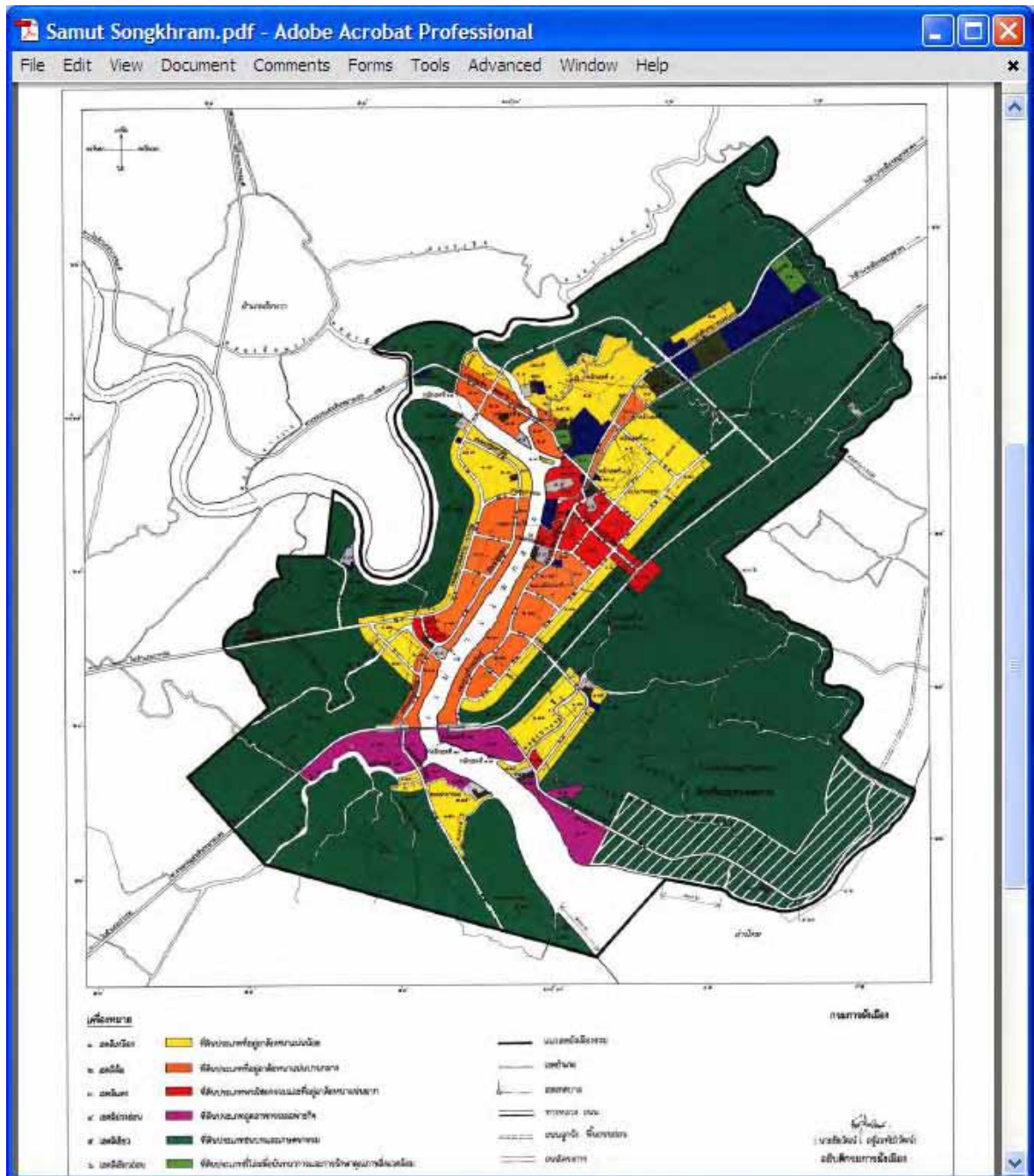
Figure 156 : Link Button Display

e.6   Home Position

Home Position is usable for set the screen back to the original setting at the beginning (show the map cover all area of Samut Songkhram Province).

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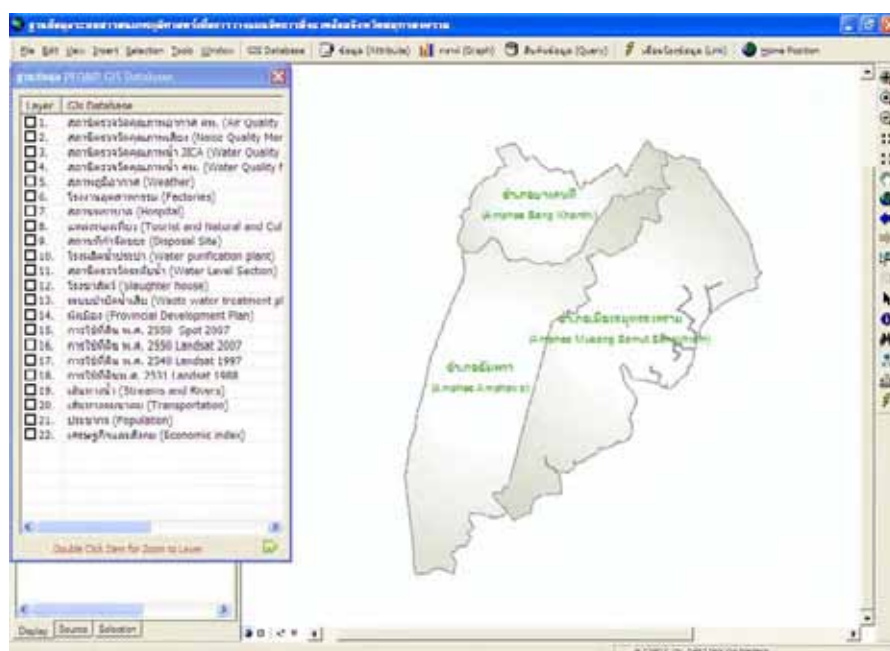
Figure 157 : Home Position Display

Besides, it has many tools and functions without showing in window, but can open and use by right click on area of Menu Bars or Toolbars then hidden functions will be appeared.
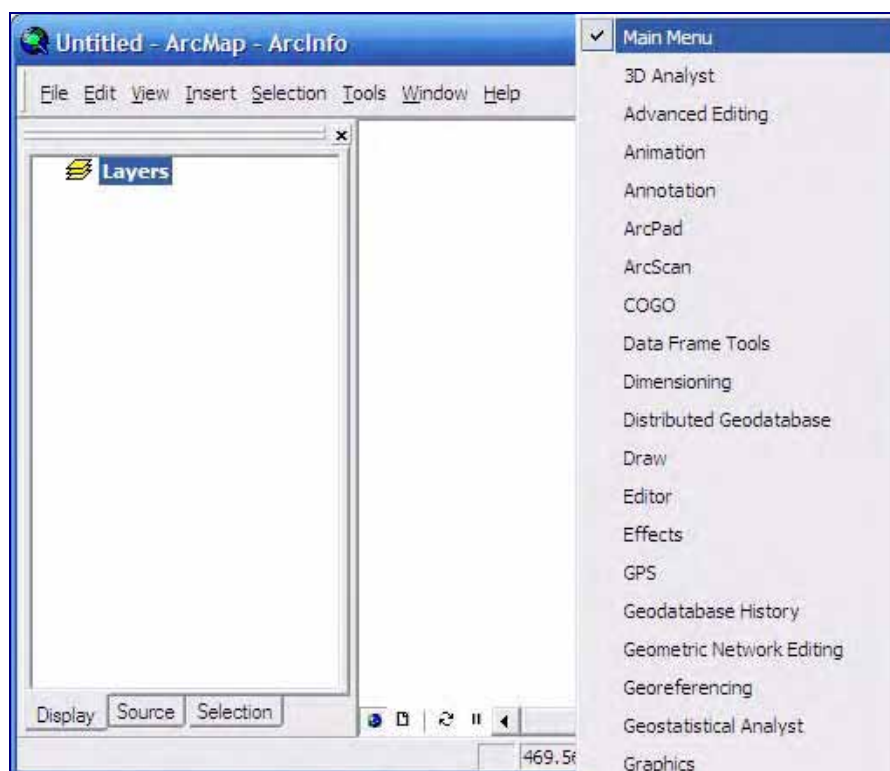
Figure 158 : On-off Tools and Functions Display

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f. **Usability Description of Each Field**

The field is divided into three main parts; PEQMP GIS Database, DEQP GIS Database, and Base Map.


```
☐ 🗐 Geographic Information System
    ☐ ☑ PEQMP GIS Database
        ⊞ ☐ สถานีตรวจวัดคุณภาพอากาศ คพ. (Air Quality PCD)
        ⊞ ☐ สถานีตรวจวัดคุณภาพเสียง (Noise Quality Monitoring Stations)
        ⊞ ☐ สถานีตรวจวัดคุณภาพน้ำ JICA (Water Quality Monitoring Stations JICA)
        ⊞ ☐ สถานีตรวจวัดคุณภาพน้ำ คพ. (Water Quality Monitoring Stations PCD)
        ⊞ ☐ สภาพภูมิอากาศ (Weather)
        ⊞ ☐ โรงงานอุตสาหกรรม (Factories)
        ⊞ ☐ สถานพยาบาล (Hospital)
        ⊞ ☐ แหล่งท่องเที่ยว (Tourist and Natural and Cultural Heritage Sites)
        ⊞ ☐ สถานที่กำจัดขยะ (Disposal Site)
        ⊞ ☐ โรงผลิตน้ำประปา (Water purification plant)
        ⊞ ☐ สถานีตรวจวัดระดับน้ำ (Water Level Section)
        ⊞ ☐ โรงฆ่าสัตว์ (Slaughter house)
        ⊞ ☐ ระบบบำบัดน้ำเสีย (Waste water treatment plant)
        ⊞ ☐ ผังเมือง (Provincial Development Plan)
        ⊞ ☐ การใช้ที่ดิน พ.ศ. 2550  Spot 2007
        ⊞ ☐ การใช้ที่ดิน พ.ศ. 2550 Landsat 2007
        ⊞ ☐ การใช้ที่ดิน พ.ศ. 2540 Landsat 1997
        ⊞ ☐ การใช้ที่ดินพ.ศ. 2531 Landsat 1988
        ⊞ ☐ เส้นทางน้ำ (Streams and Rivers)
        ⊞ ☐ เส้นทางคมนาคม (Transportation)
        ⊞ ☐ ประชากร (Population)
        ⊞ ☐ เศรษฐกิจและสังคม (Economic index)
    ☐ ☑ DEQP GIS Database
        ⊞ ☐ ท่าเรือ (Ports)
        ⊞ ☐ ธรณีวิทยา (Geology)
        ⊞ ☐ สถานที่สำคัญ (Places)
        ⊞ ☐ โรงเรียน (Schools)
        ⊞ ☐ จุดเกิดอุบัติเหตุ (Accidental Point)
        ⊞ ☐ บ่อบาดาล (Well)
        ⊞ ☐ ชุดดิน (Soil Series)
        ⊞ ☐ ความลาดชัน (Slope)
        ⊞ ☐ จุดระดับความสูง (Spot Height)
        ⊞ ☐ ระดับความสูง (Elevation)
        ⊞ ☐ ทิศทางความลาดชัน (Aspect)
        ⊞ ☐ ชั้นน้ำบาดาล (Aquifer)
        ⊞ ☐ แหล่งน้ำ (Water Body)
        ⊞ ☐ ลุ่มน้ำ (Basin)
        ⊞ ☐ ชั้นคุณภาพลุ่มน้ำ (Watershade)
        ⊞ ☐ พื้นที่ชุ่มน้ำตามอนุสัญญาแรมซาร์ (Ramsar Wetland Site)
    ☐ ☑ แผนที่พื้นฐาน (Base Map)
        ⊞ ☐ หมู่บ้าน (Villages)
        ⊞ ☑ อำเภอ (Amphoe)
        ⊞ ☐ ตำบล (Tambon)
        ☐ ☐ เทศบาล (Municipalities)
```

Figure 159 : List of all GIS Fields of Project

Details of each layer and described below.

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f.1   PEQMP GIS Database

f.1.1.   Air Quality Monitoring Station of PCD) Air Quality PCD)

When click Attribute and select station, program will show window of air quality monitoring station of PCD) Air Quality PCD). If click Export to Excel, program will show window as addressed in page 39.

Figure 160 : Details of Air Quality Monitoring Station of PCD

When click Graph and select station, program will show graph window.

Figure 161 : Graph of Air Quality Monitoring Station of PCD

User can select parameters and data collecting period by select the beginning time and check the box to select ending time of air quality monitoring of PCD) Air Quality PCD).

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Figure 162 : Specify Graph Condition of Air Quality Monitoring Station of PCD

Then click show graph.

Figure 163 : Example Graph of Air Quality Monitoring Station of PCD

f.1.2.   Noise Quality Monitoring Stations

When click Attribute and select station, program will show window of Noise Quality Monitoring Stations.

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Figure 164 : Noise Quality Monitoring Stations

When click Graph and select station, program will show graph window.

Figure 165 : Graph of Noise Quality Monitoring Stations

User can select parameters and data collecting period by select the beginning time and check the box to select ending time of Noise Quality Monitoring Stations.

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Figure 166 : Define Condition of Noise Quality Monitoring Stations Graph

Then click show graph.
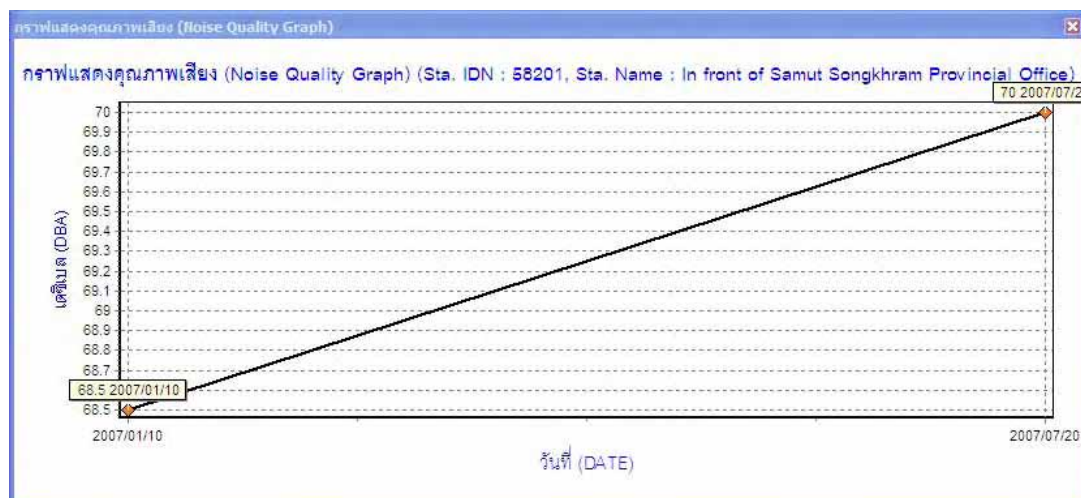
Figure 167 : Example Graph of Noise Quality Monitoring Stations

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f.2 **Water Quality Monitoring Stations of JICA**

When click Attribute and select station, program will show window of Water Quality Monitoring Stations of JICA.

Figure 168 : Details of Water Quality Monitoring Stations of JICA

When click Graph and select station, program will show graph window.

Figure 169 : Graph of Water Quality Monitoring Stations of JICA

User can select parameters and data collecting period by select the beginning time and check the box to select ending time of Water Quality Monitoring Stations of JICA

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Figure 170 : Define Condition of Water Quality Monitoring Stations of JICA

Then click show graph.
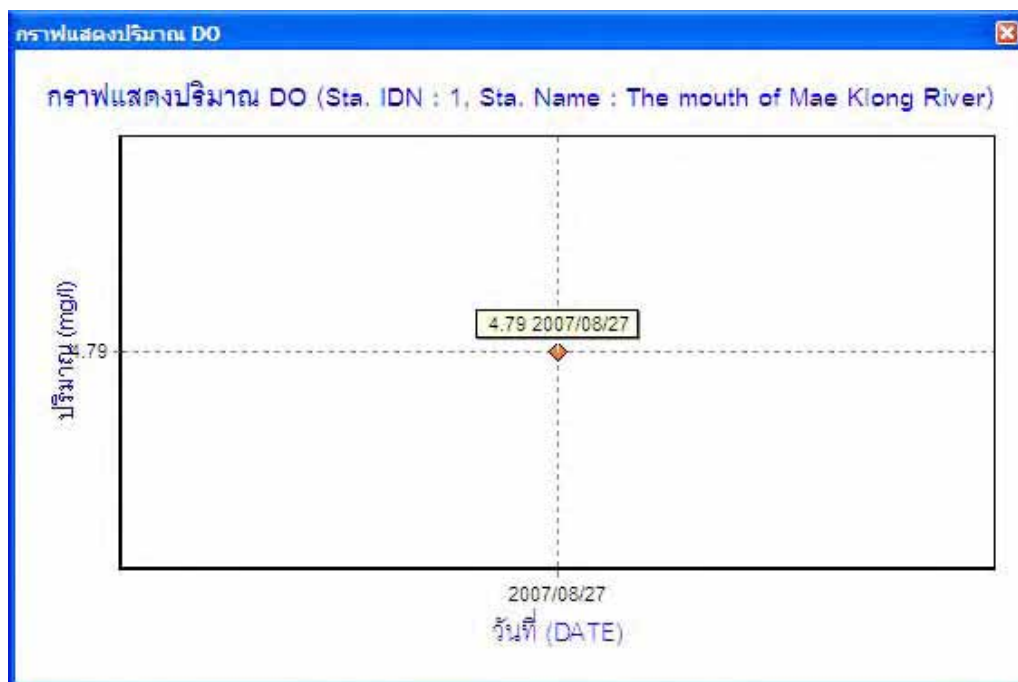
Figure 171 : Example Graph of Water Quality Monitoring Stations of JICA

f.2.1.　　　　Water Quality Monitoring Stations of PCD

When click Attribute and select station, program will show window of Water Quality Monitoring Stations of PCD. User can choose to view Raw Data or Summary Data by click selection bar at the top.

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Figure 172 : Raw Data of Water Quality Monitoring Stations of PCD

Figure 173 : Summary Data of Water Quality Monitoring Stations of PCD

When click Graph and select station, program will show graph window.

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Figure 174 : Graph of Water Quality Monitoring Stations of PCD

User can select parameters and data collecting period by select the beginning time and check the box to select ending time of Water Quality Monitoring Stations of PCD

Figure 175 : Define Condition of Water Quality Monitoring Stations of PCD

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Then click show graph.
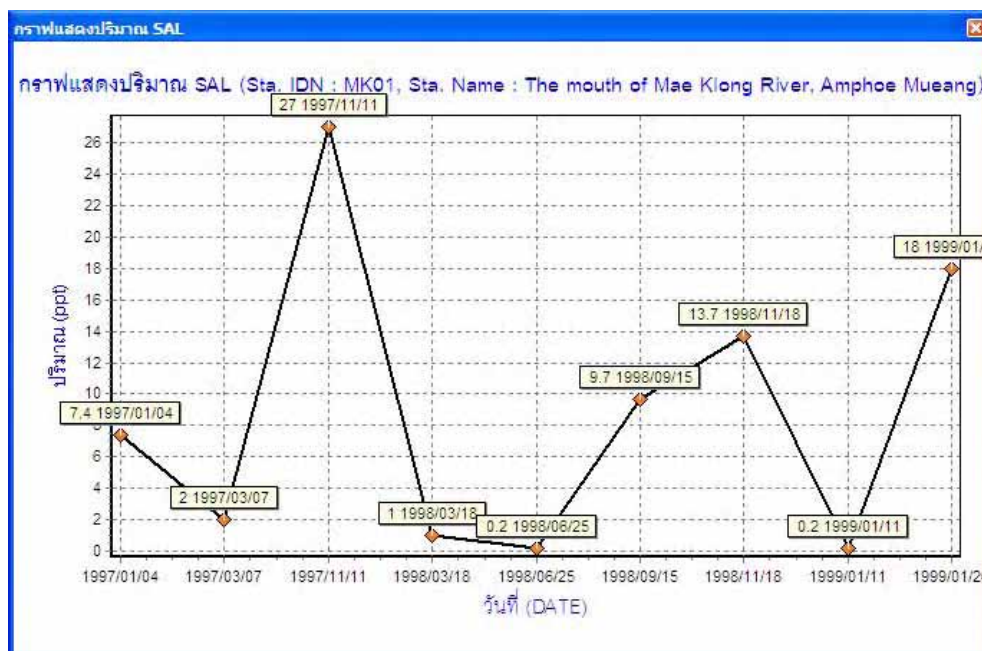
Figure 176 : Example Graph of Water Quality Monitoring Stations of PCD

f.3   Weather

When click Attribute and select station, program will show window of Weather. The data is consists of steam, cloud, humidity, precipitation, wind speed, sunlight, and temperature. User can select data type at left bar.

Figure 177 : Weather Data

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When click Graph and select station, program will show Weather Graph window. User can select to view data of cloud graph, steam graph, humidity graph, precipitation graph, wind speed graph, sunlight graph, and temperature graph.

Figure 178 : Window Selection of Weather Graph

When select graph, window will be appeared to show selected graph as example below.
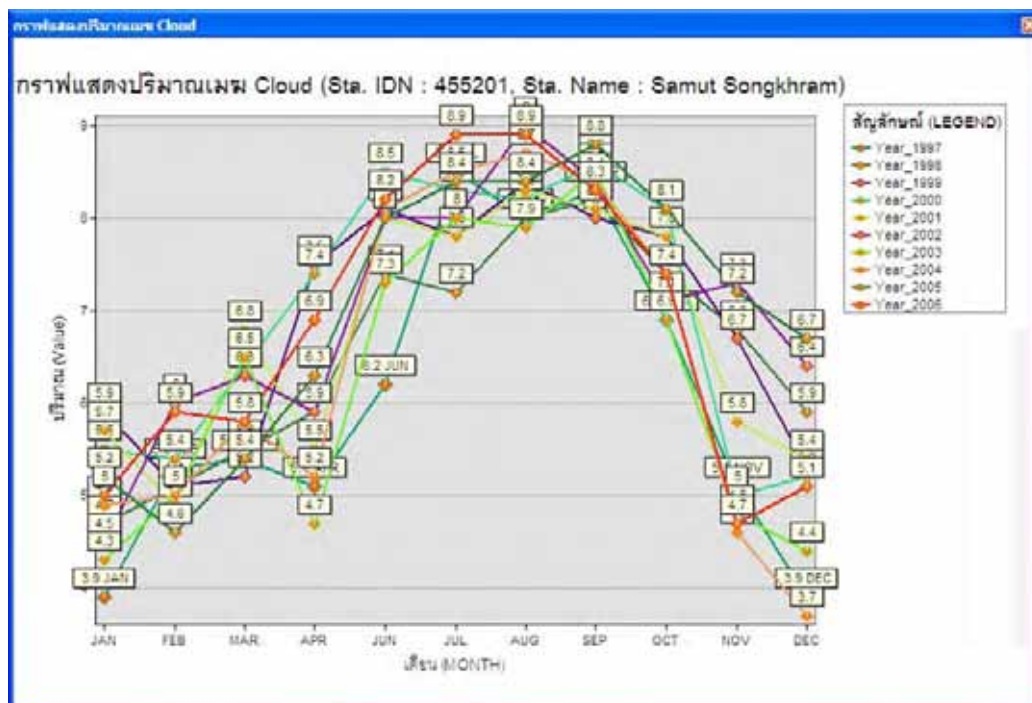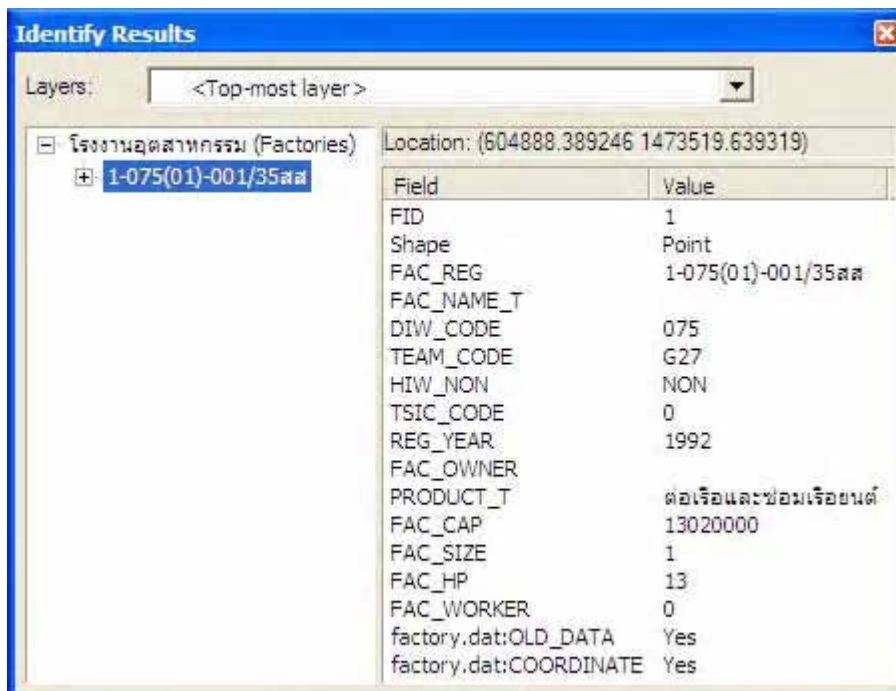
Figure 179 : Windows of Cloud Graph

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f.4 **Factories**

When click Attribute and select factory, program will show window of factory details.

Figure 180 : Window of Factory Details

f.5 **Hospital**

When click Attribute and select hospital, program will show window of hospital details.

f.6 **Tourist and Natural and Cultural Heritage Sites**

When click Attribute and select tourism location, program will show window of tourism location details.

When click Link and select tourism location, program will show window of tourism location pictures

f.7 **Solid Waste Disposal Site**

When click Attribute and select solid waste disposal site, program will show window of solid waste disposal site details.

When click Link and select solid waste disposal site, program will show window of solid waste disposal site pictures.

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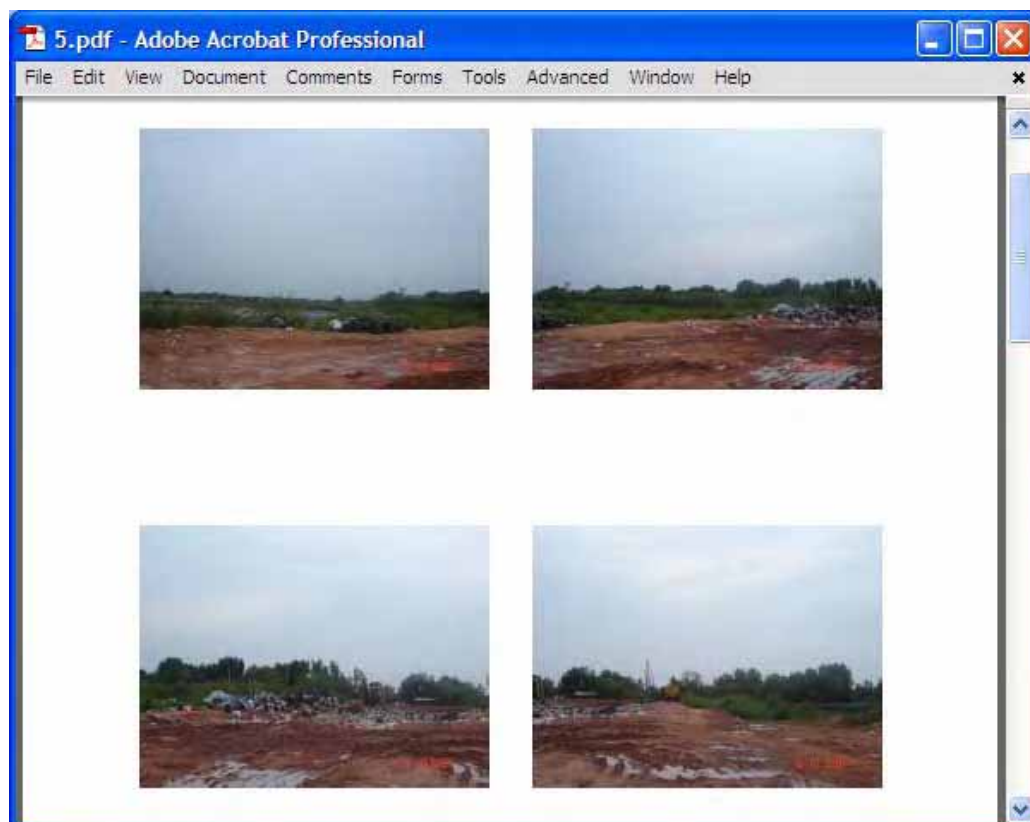
Figure 181 : Link of Solid Waste Disposal Site

f.8 Water Purification Plant

When click Attribute and select water purification plant, program will show window of water purification plant details.

When click Link and select water purification plant, program will show window of water purification plant pictures.

f.9 Water Level Section

When click Attribute and select water level section, program will show window of water level section details.

f.10 Slaughter House)

When click Attribute and select slaughter house, program will show window of slaughter house details.

f.11 Wastewater Treatment Plant

When click Attribute and select wastewater treatment plant, program will show window of wastewater treatment plant details.

When click Link and select wastewater treatment plant, program will show window of wastewater treatment plant pictures.

f.12 Provincial Development Plan

When click Attribute and select provincial development plan, program will show window of provincial development plan details.

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When click Link and select provincial development plan, program will open Adobe Acrobat to show provincial development plan file (.pdf).

f.13   Land Use in 2007 (B.E. 2550) Spot 2007

When click Attribute and select any position on the map of land use in 2007 (B.E. 2550) Spot 2007, program will show details.

Figure 182 : Land Use Data in 2007 (B.E. 2550) Spot 2007

When click Graph and select any position on the map of land use in 2007 (B.E. 2550) Spot 2007, program will show graph.
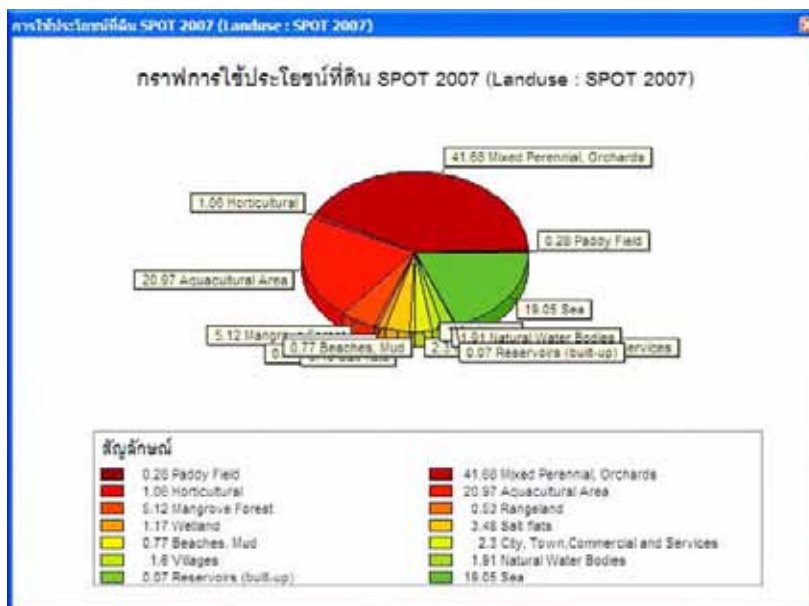
Figure 183 : Land Use Graph in 2007 (B.E. 2550) Spot 2007

f.14   Land Use in 2007 (B.E. 2550) Landsat 2007

When click Attribute and select any position on the map of land use in 2007 (B.E. 2550) Landsat 2007, program will show details.

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Figure 184 : Land Use Data in 2007 (B.E. 2550) Landsat 2007

When click Graph and select any position on the map of land use in 2007 (B.E. 2550) Landsat 2007, program will show graph.
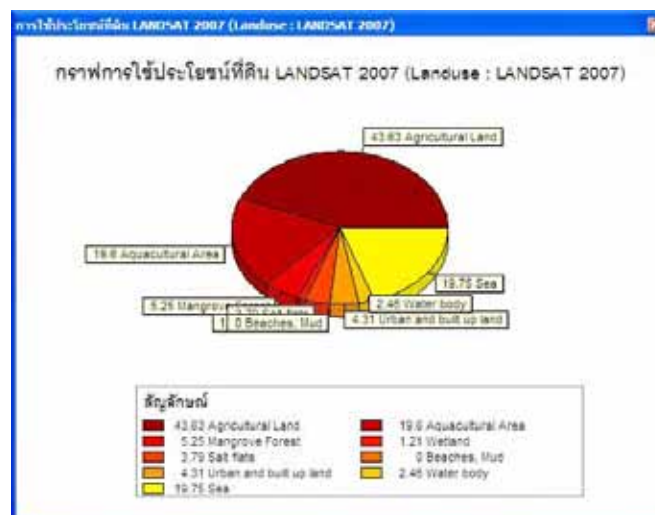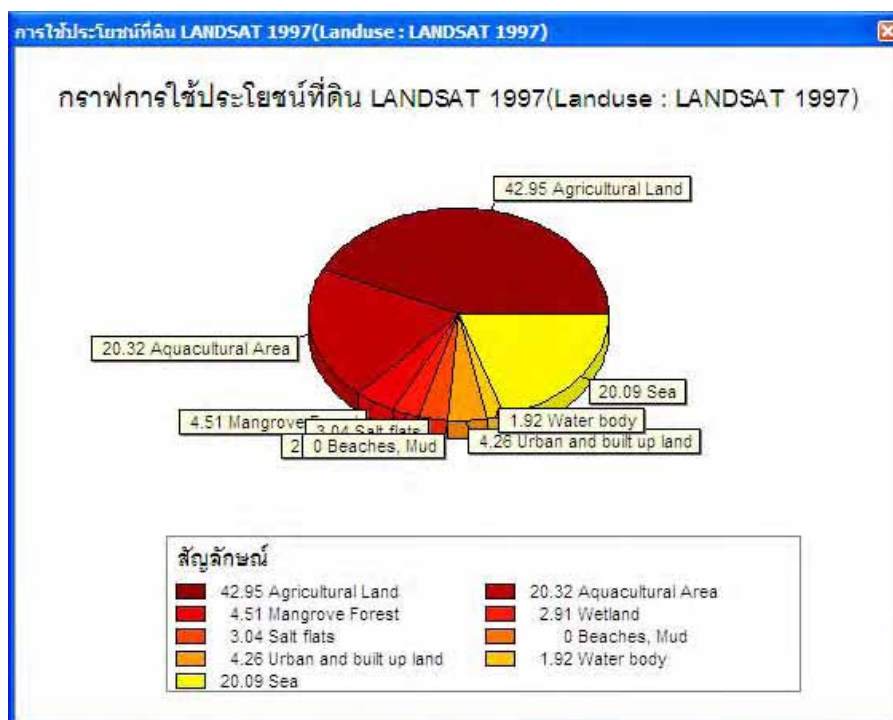

Figure 185 : Land Use Graph in 2007 (B.E.2550) Landsat 2007

f.15   Land Use in 1997 (B.E. 2540) Landsat 1997

When click Attribute and select any position on the map of land use in 1997 (B.E. 2540) Landsat 1997, program will show details.

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Figure 186 : Land Use Data in 1997 (B.E. 2540) Landsat 1997

When click Graph and select any position on the map of land use in 1997 (B.E. 2540) Landsat 1997, program will show graph.

Figure 187 : Land Use Graph in 1997 (B.E. 2540) Landsat 1997

f.16   Land Use in 1988 (B.E. 2531) Landsat 1988

When click Attribute and select any position on the map of land use in 1988 (B.E. 2531) Landsat 1988, program will show details.

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Figure 188 : Land Use Data in 1998 (B.E. 2531) Landsat 1988

When click Graph and select any position on the map of land use in 1988 (B.E. 2531) Landsat 1988, program will show graph.
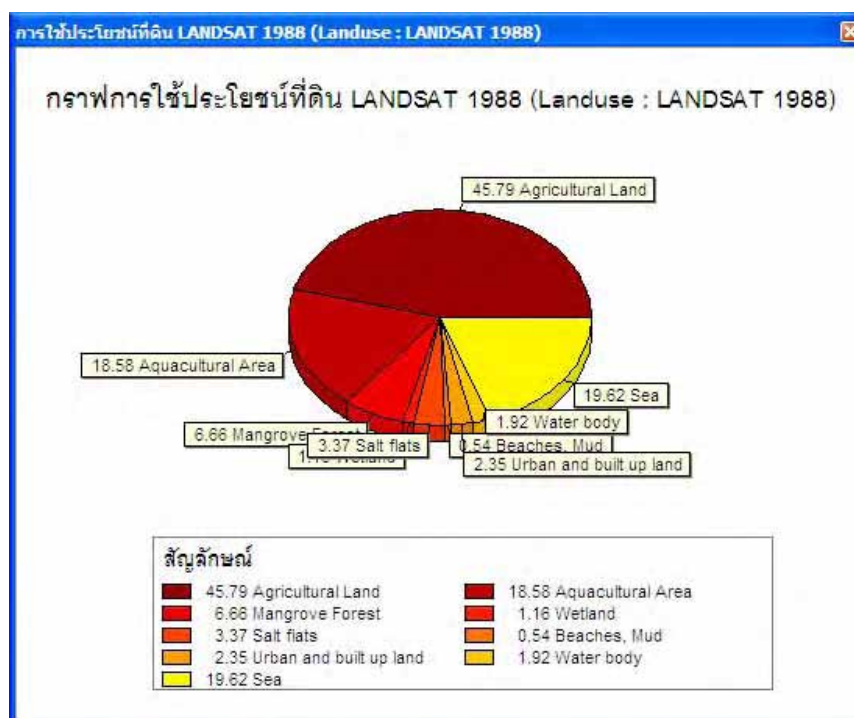
Figure 189 : Land Use Graph in 1988 (B.E. 2531) Landsat 1988

f.17   Streams and Rivers

When click Attribute and select stream and river, program will show window of stream and river details.

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f.18   Transportation Route

When click Attribute and select transportation route, program will show window of transportation route details.

f.19   Population

When click Attribute and select population, program will show window of population details.

When click Graph and select the position of population data, program will show graph of population numbers of Samut Songkhram Province.
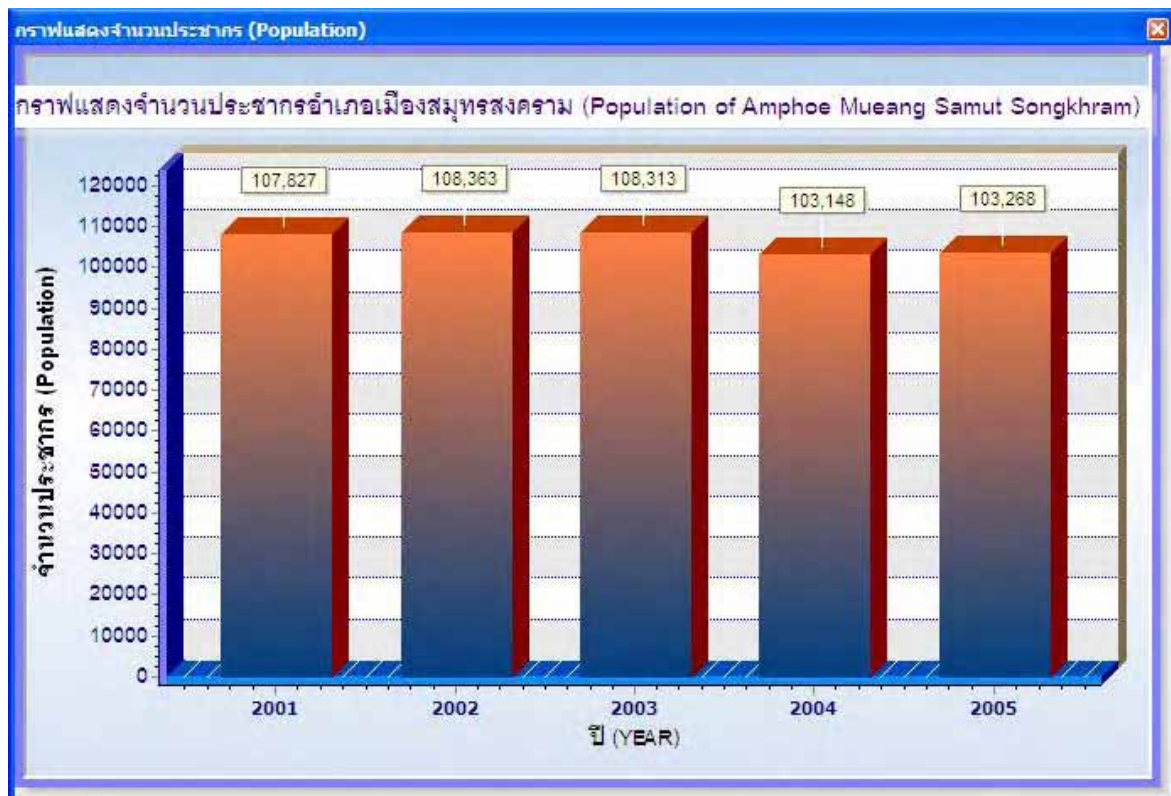
Figure 190 : Population Graph

f.20   Socio-economic) **Economic Index)**

When click Attribute and select any position of socio-economic data, program will show window of socio-economic details of the province.

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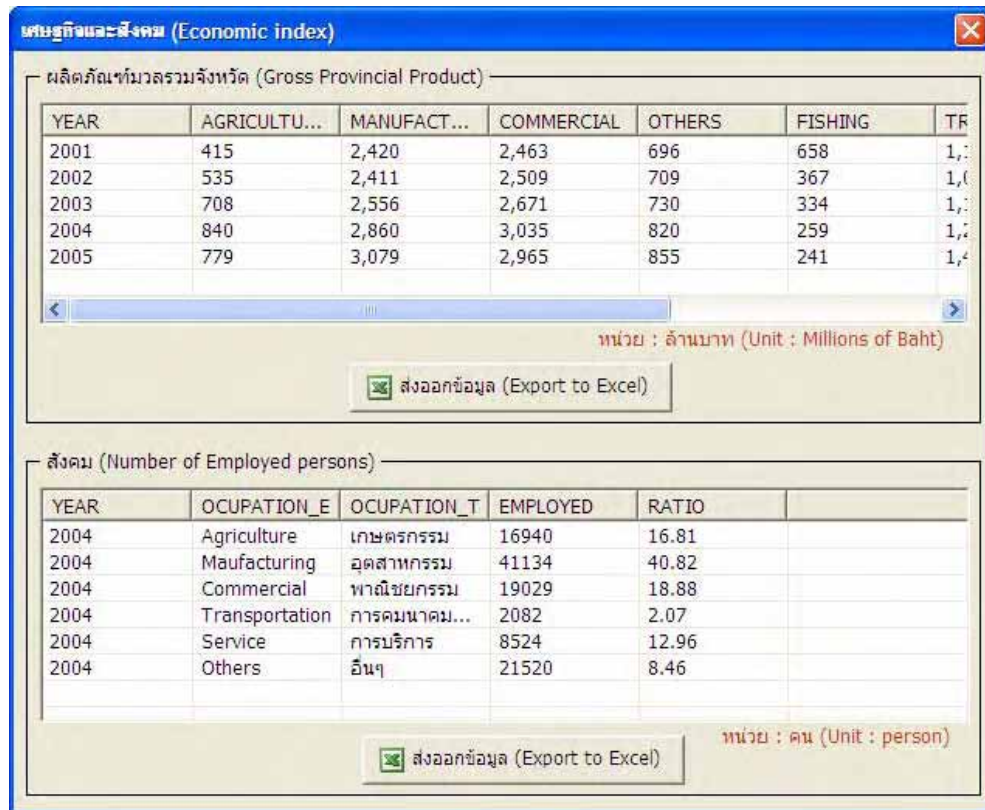
Figure 191 : Socio-economic Data

When click Graph and select any position, program will show graph of socio-economic data.
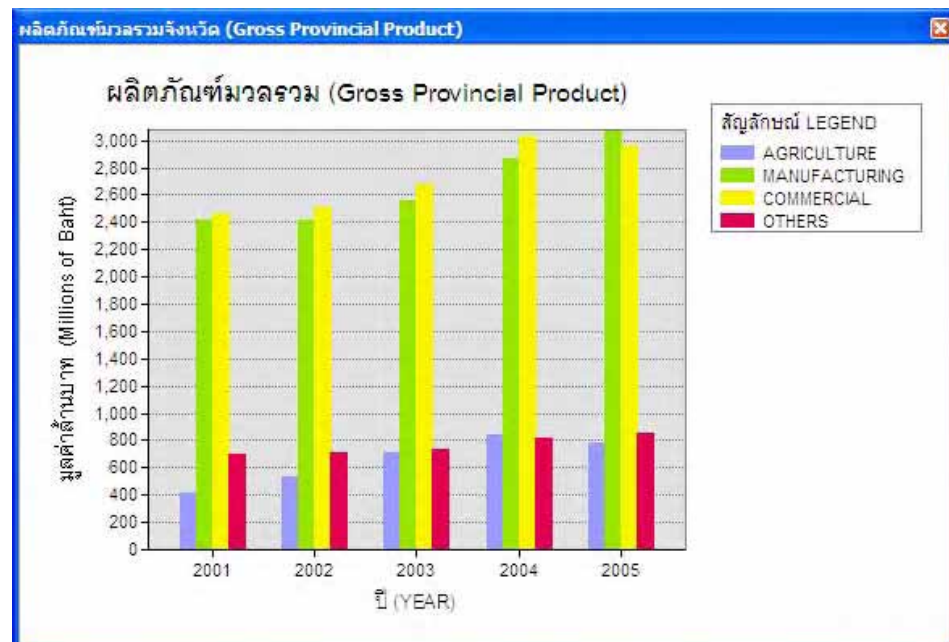
Figure 192 : Socio-economic Graph

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f.21   DEQP GIS Database

When click Attribute and select the position in each field under DEQP GIS Database, program will show details window to explain the selected object as below example.
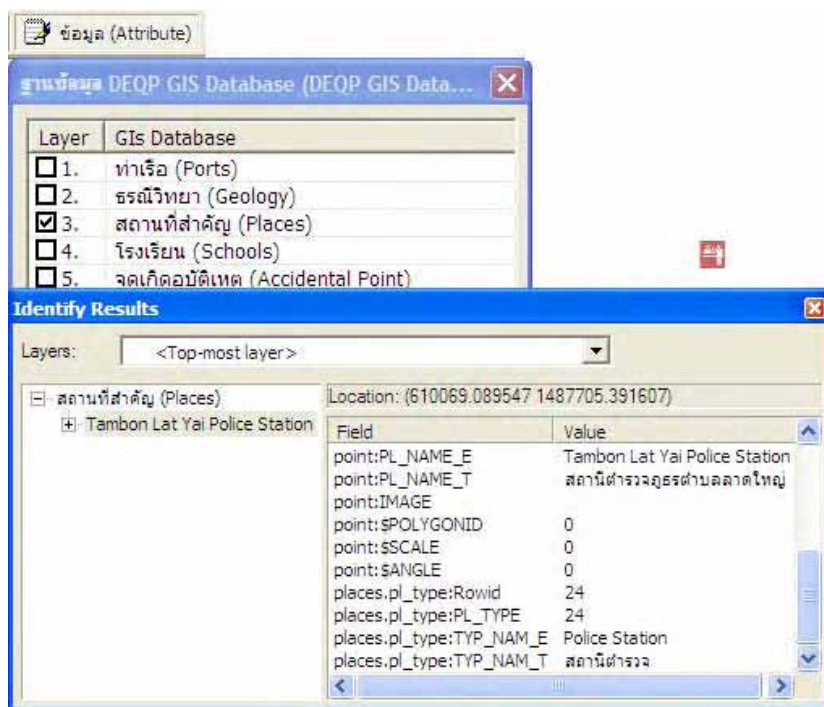
Figure 193 : Data Example

- Ports
- Geology
- Places
- Schools
- Accidental Point
- Well
- Soil Series
- Slope
- Spot Height
- Elevation
- Aspect
- Aquifer
- Water Body
- Basin
- Watershade
- Ramsar Wetland Site

f.22   Base Map

Base Map is usable to specify object position by administration boundary area divided into 4 levels as follows;

- Villages
- Amphoe
- Tambon
- Municipalities

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Appendix

Related Table for Program Function with Samut Songkhram Province GIS Database

	PEQMP GIS Database	Attribute	Graph	Link
1.	Air Quality PCD	✔	✔	
2.	Noise Quality Monitoring Stations	✔	✔	
3.	Water Quality Monitoring Stations JICA	✔	✔	
4.	Water Quality Monitoring Stations PCD	✔	✔	
5.	Weather	✔	✔	
6.	Factories	✔		
7.	Ports	✔		
8.	Hospital	✔		
9.	Tourist and Natural and Cultural Heritage Sites	✔		✔
10.	Disposal Site	✔		✔
11.	Water purification plant	✔		✔
12.	Water Level Section	✔		
13.	Slaughter house	✔		
14.	Waste water treatment plant	✔		✔
15.	Provincial Development Plan	✔		✔
16.	Landuse year 2007 (Spot-5)	✔	✔	
17.	Landuse year 2007 (Landsat-5)	✔	✔	
18.	Landuse year 1997 (Landsat-5)	✔	✔	
19.	Landuse year 1988 (Landsat-5)	✔	✔	
20.	Streams and Rivers	✔		
21.	Transportation	✔		
22.	Population	✔	✔	
23.	Economic index	✔	✔	

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Related Table for Program Function with Samut Songkhram Province GIS Database (Cont.)

DEQP GIS Database		Attribute	Graph	Link
1.	Geology	✓		
2.	Places	✓		
3.	Schools	✓		
4.	Accidental Point	✓		
5.	Well	✓		
6.	Soil Series	✓		
7.	Slope	✓		
8.	Spot Height	✓		
9.	Elevation	✓		
10.	Aspect	✓		
11.	Aquifer	✓		
12.	Water Body	✓		
13.	Basin	✓		
14.	Watershade	✓		
15.	Ramsar Wetland Site	✓		
Base Map				
1.	Villages	✓		
2.	Amphoe	✓		
3.	Tambon	✓		
4.	Municipalities	✓		

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5.4 ArcReader Manual for Samut Songkhram Province (for GIS Database User)

ArcReader is an application program for map display, attribute data viewing, and published map document (*.pmf) printing. This program is based on ArcGIS with ArcPublisher using, and is also available for free to download.

a. Open ArcReader

Click "Start" at Windows taskbar and go to ArcGIS > ArcReader, then click to open program

b. ArcReader Components

1) Menu
2) Toolbars
3) Table of Contents
4) Data View
5) Layout View
6) Status Bar

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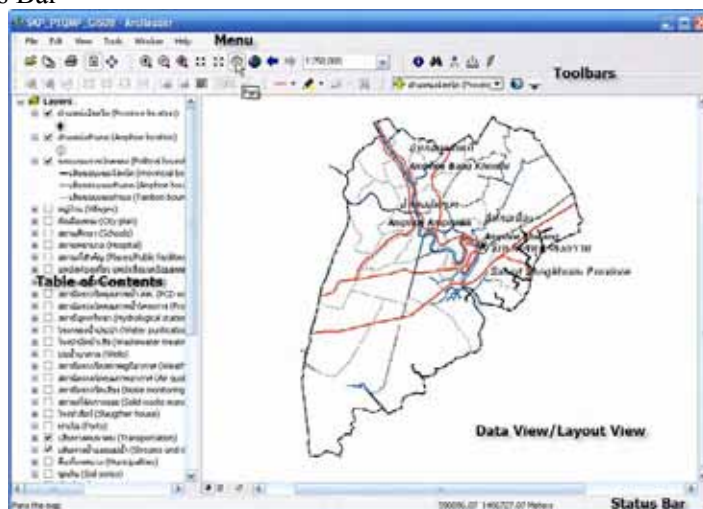
c.   ArcReader Instructions

ArcReader instructions can access from "Menu" or "Toolbars". The Menu options are provided below.

File   Edit   View   Tools   Window   Help
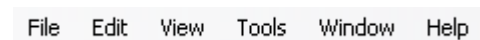
Frequently used instruction in Menu can access from Toolbars. When point the mouse to each tool, it will have balloon pop-up to show their name and explanation at "Status Bar". All features are described below.

c.1   File Toolbars
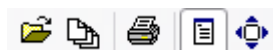
Tool	Name	Function
	Open	Open "Published Map Documents" file (*.pmf)
	Recent Files	Open used file
	Print	Map printing
	Toggle Table of Contents	Show/hide "Table of Contents"
	Toggle Application Into Full Screen Mode	Switch to normal and full screen

c.2   Navigation Toolbars

Tool	Name	Function
	Zoom In	Expand the map by click desired area or drag mouse as square area
	Zoom Out	Compress the map by click desired area or drag mouse as square area
	Continuous Zoom/Pan	Continuous expand/compress the map by hanging mouse then move down to expand or move up to compress
	Fixed Zoom In	Expand the map in center area
	Fixed Zoom Out	Compress the map in center area
	Pan	Move the map by hanging mouse then move to desired direction
	Full Extent	Show the coverage map
	Go Back To Previous Extent	Back to previous screen before expand/compress or move the map
	Go Back To Next Extent	Back to next screen before expand/compress or move the map
1:100,000	Zoom To Scale	Show the map in specified scale

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c.3   Data Toolbars
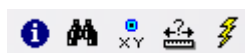
Tool	Name	Function
ⓘ	Identify	Look up attribute data by click to the tool of desired data
🔍	Find	Explore data by click to fill in the term condition
XY	Go To XY	Go to XY position by click to fill in the co-ordinates
📏	Measure	Distance measure by click to estimate distance of the map
⚡	Hyperlinks	Linkage to hyperlinks data

c.4   Layout Toolbars
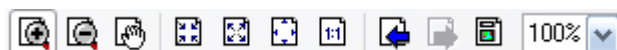
Tool	Name	Function
🔍	Zoom In	Expand the map in "Layout View" by click desired area or drag mouse as square area
🔍	Zoom Out	Compress the map in "Layout View" by click desired area or drag mouse as square area
✋	Pan	Move the map in "Layout View" by hanging mouse then move to desired direction
▣	Fixed Zoom In	Expanding center area of the map in "Layout View"
▣	Fixed Zoom Out	Compressing center area of the map in "Layout View"
▣	Zoom Whole Page	Show the coverage "Layout View"
1:1	Zoom To 100%	Show 100% scale of "Layout View"
⬅	Go Back To Previous Extent	Back to previous screen before expand/compress or move the map in "Layout View"
➡	Go Back To Next Extent	Back to next screen before expand/compress or move the map in "Layout View"
▣	Change Title	Rename map in "Layout View"
100% ▾	Zoom To Percent	Show "Layout View" in specified scale

c.5   Layer Effects Toolbars
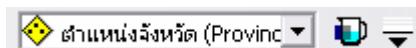
Tool	Name	Function
◆ ตำแหน่งจังหวัด (Provinc ▾	Layer List	Select desired layer
🗐	Transparency	Modify transparency of the selected layer
▽	Swipe Layer	Modify hidden layer

c.6   Markup Toolbars

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Tool	Name	Function
— ▾	Pen	Graphic drawing on the map
✎ ▾	Highlighter	Graphic highlighting on the map
⌀ ▾	Eraser	Delete graphic on the map

d.   Open Published Map Documents

Click   to   📂   "Open" or click to menu "File > Open" then select "Published Map

Documents" file (*.pmf) and click to "Open"
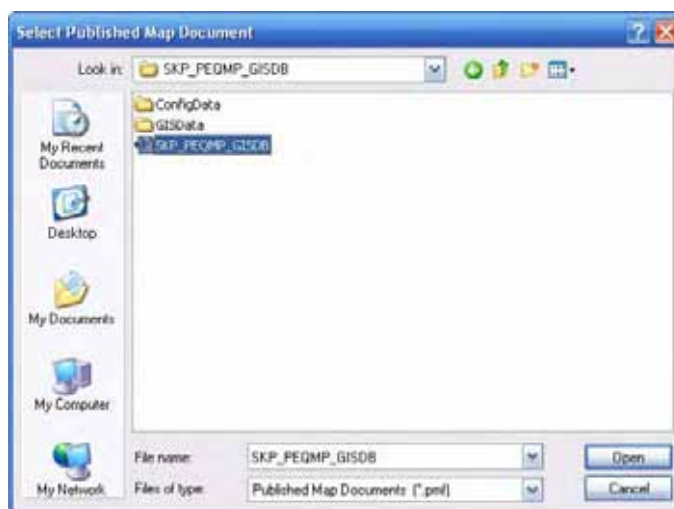
In addition, user can open used files by click to "Recent Files" 📑 or go to "Windows Explorer" then double-click at "Published Map Documents" file (*.pmf) to open and access program directly.

e.   Table of Contents Usage

"Table of Contents" is a space to show data list and symbol. User can access step-by-step as shown below.

e.1   Open/close data layer

User can open/close layers to display in "Data View" and "Layout View" from "Table of Contents" by select ☑ in front of wanted layer to display or select ☐ in front of wanted layer to not display. The open/close selected layer is comprised of data label and layer.

e.2   View hidden layer

User can view hidden layer and their symbol by click ⊞ to show details of layer or click ⊟ to hide details of layer.

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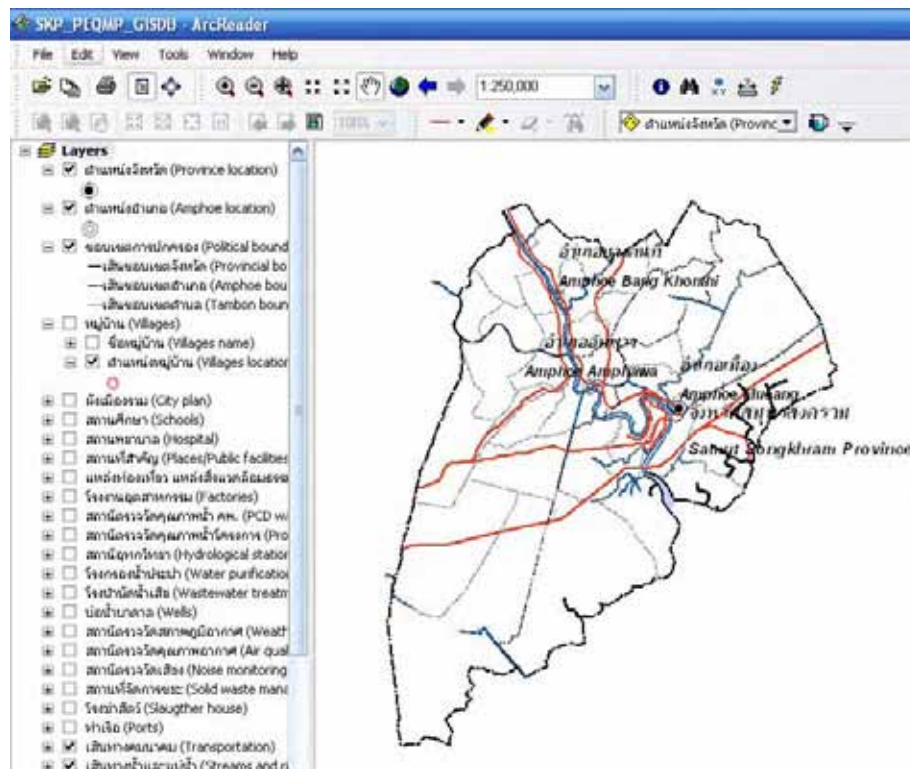
e.3 View layer properties

User can view layer properties such as general data and data source by right-click to layer and choose "Properties".

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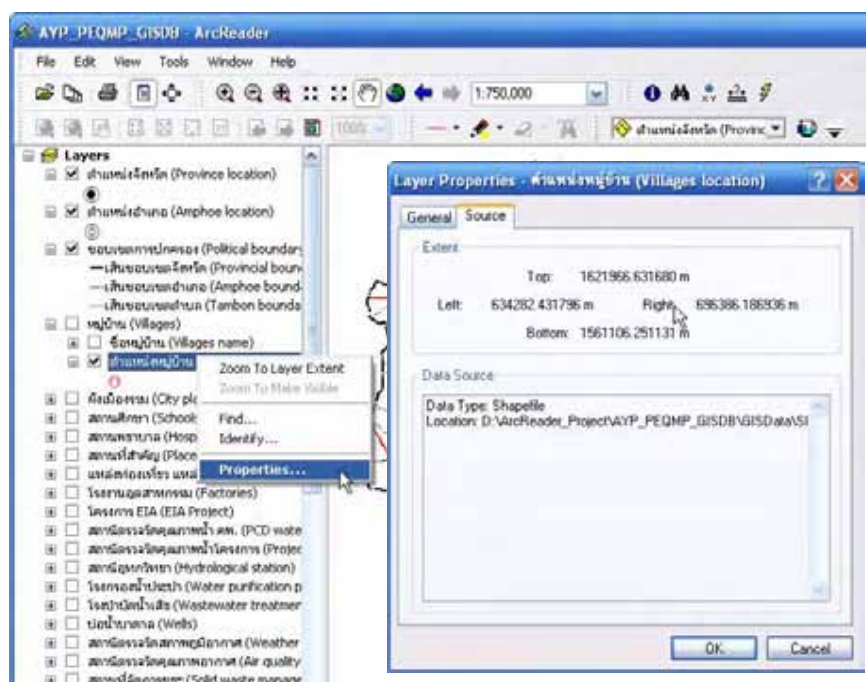
f.   Data View Usage

"Data View" is a map display window which user can display selected layer of the map from "Table of Contents". User allowed applying various tools for mapping from "Navigation Toolbars". When point the mouse at "Data View", the geographical co-ordinates will appear in status bar also.

If current status is "Layout View", it can back to "Data View" by click to menu "View > Data View".
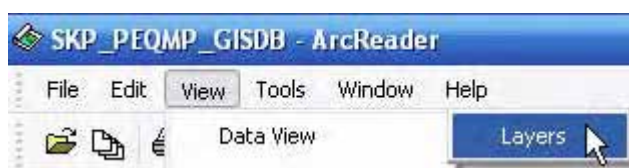
g.   Layout View Usage

"Layout View" is a map printing window which user can display selected layer of the map from "Table of Contents". User allowed applying various tools for mapping from "Navigation Toolbars" to defined scale and boundary for display mapping in "Layout View". For display a printing map, user can apply various tools in "Layout Toolbars". When point the mouse at "Data View", the geographical co-ordinates will appear in status bar also.
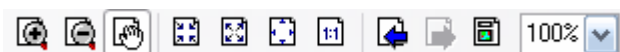
User can go to "Layout View" by click to menu "View > Layout View".

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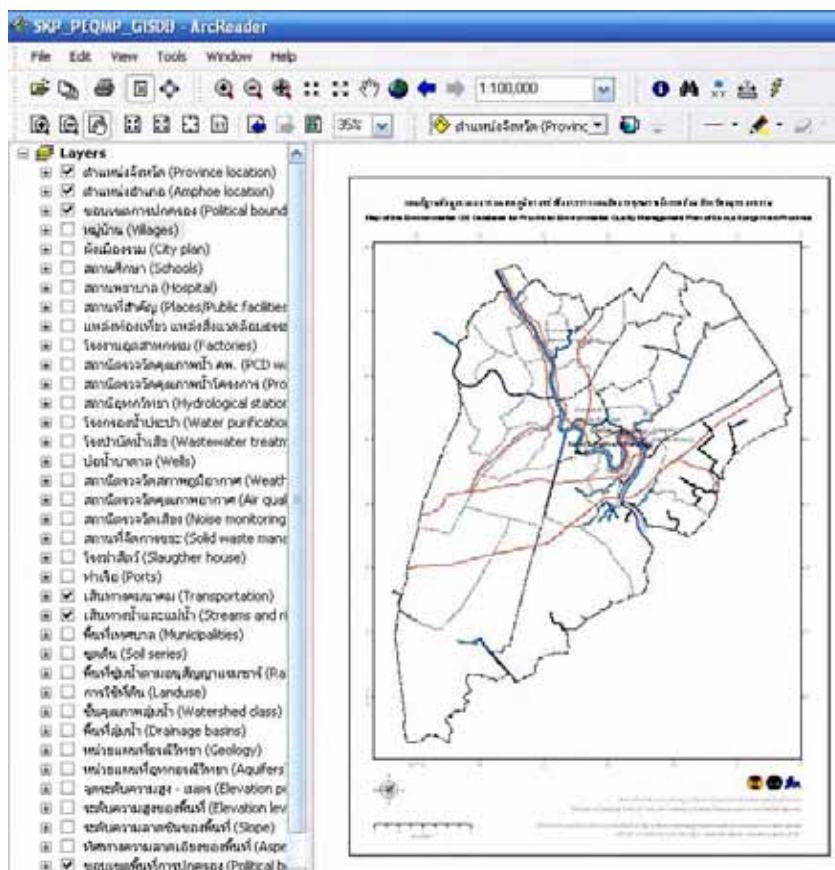
h.   Magnifier Window Usage

"Magnifier Window" is a tool for details map showing without mapping adjustment in "Data View". User can access to this function by click to menu "Window > Magnifier".

In this regard, user can move "Magnifier Window" to the position that wants to expand. Then choose the wanted size to be enlarged by right-click at "Magnifier Window" and select "Magnifier Factor".

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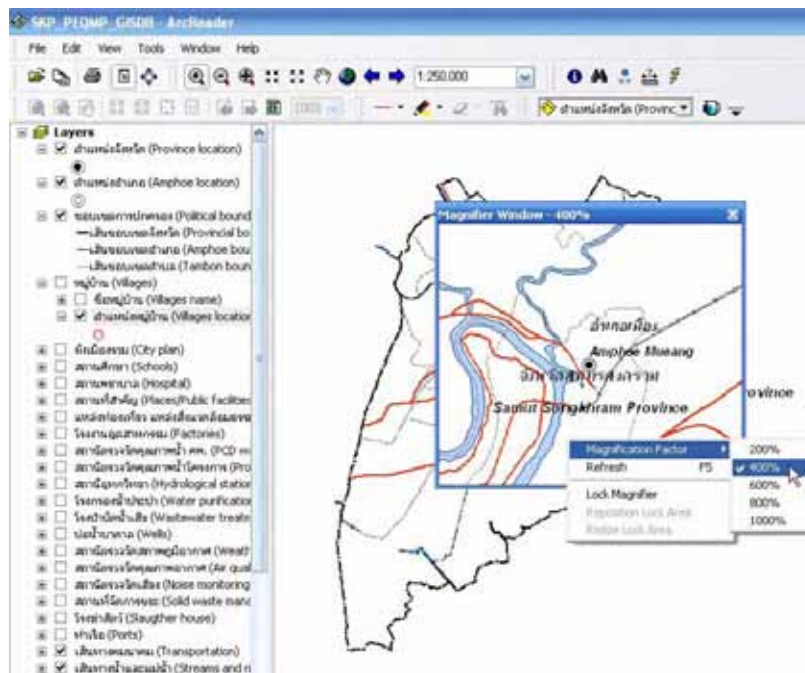
i.   Attribute Data Viewing

User can use "Identify" tool to view an attribute data by click to "Identify" at the position that want to view their attribute data in "Data View" or "Layout View".
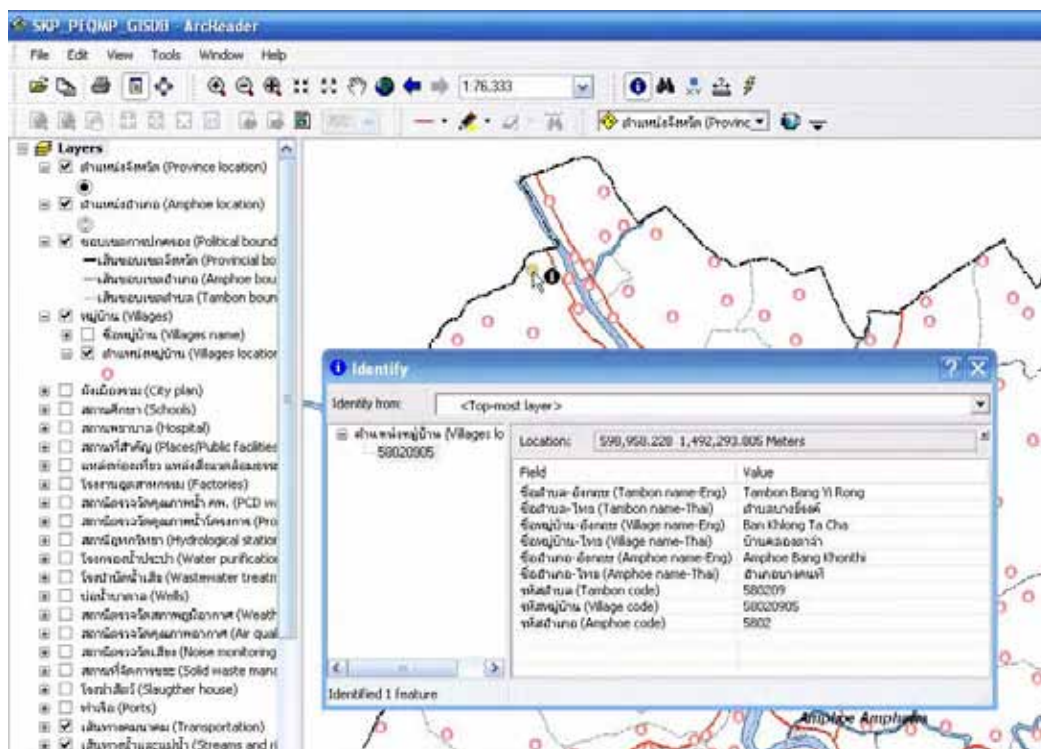
User can also use "Identify" tool to drag frame in "Data View" or "Layout View" for display a group of selected data.

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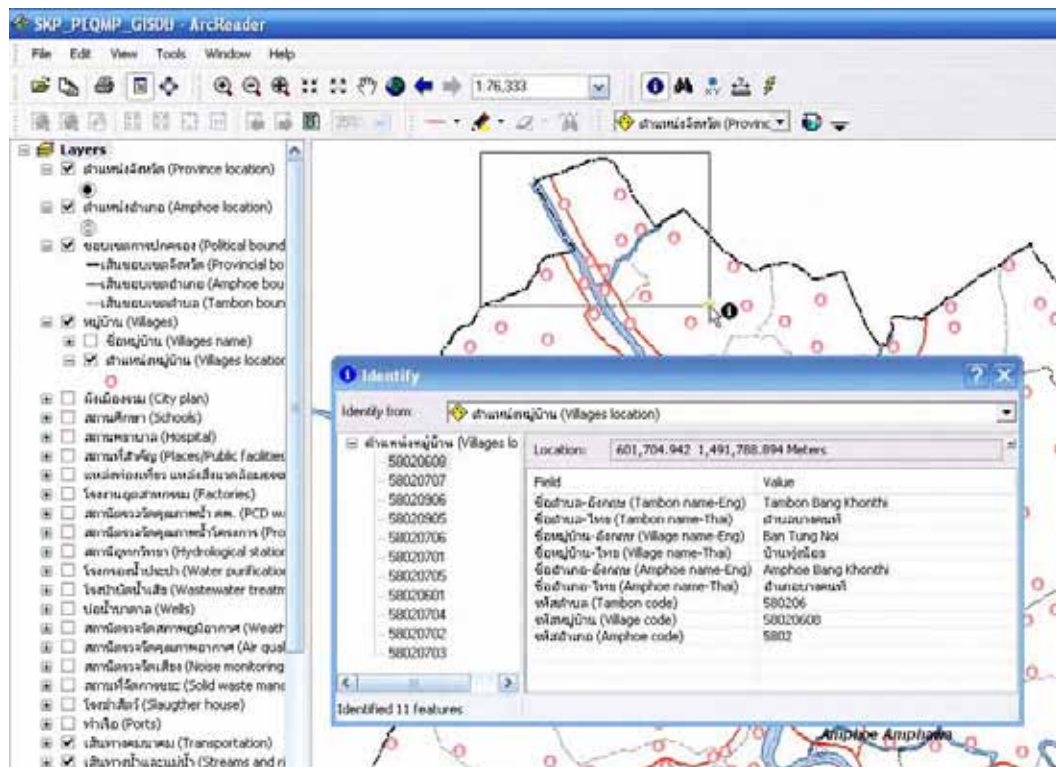
The "Identify" command will use the top layer as default; therefore, it can not select wanted layer in sometime. User can specify a condition to "Identify" by using "Identify from".
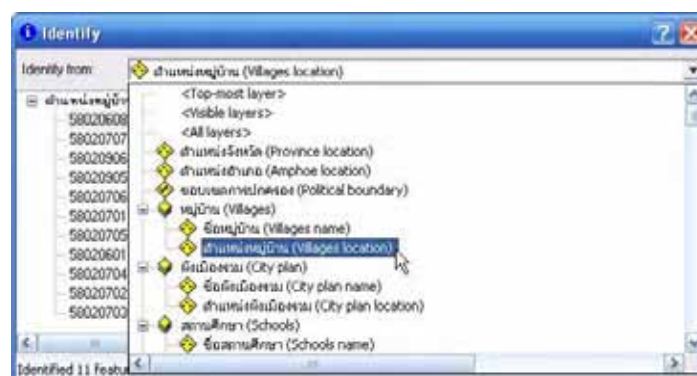
Furthermore, the "Identify" view is allowed user to apply other commands by right-click to activate selected layer as follows.

Flash – Flash to layer

Zoom To – Expand to layer

Pan To – Move to layer

Sort Ascending – Data sort from less to more

Remove from Tree – Delete layer from "Identify" window

Copy Record – Copy attribute data

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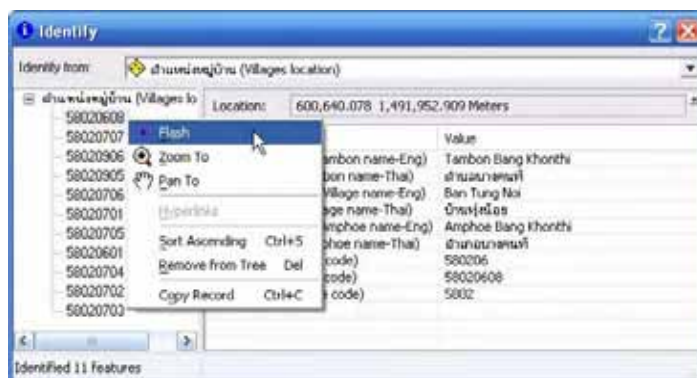
The "Identify" window also shows geographical co-ordinates of active layer in "Location". User can change the co-ordinates system to display by click to "Choose Units" ☒ .
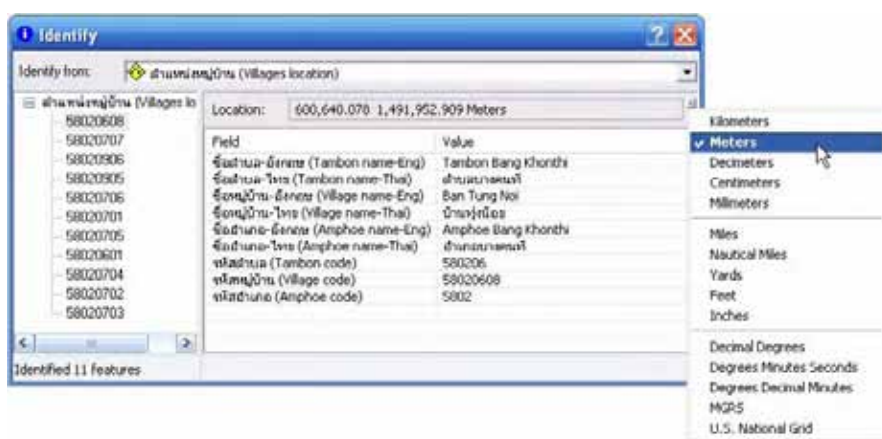
j.   Data Searching

"Find" 🔍 is a tool for data searching. User can explore by click to "Find" 🔍 and fill the condition in "Find" window, then click to [Find] button. Finding results will appear at below window.
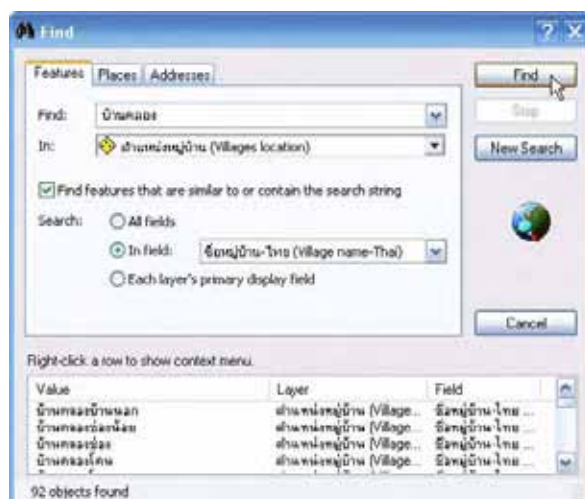
From "Find" window in search results, user can apply other commands by right-click to activate a search results as follows.

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* Flash – Flash to layer

* Zoom To – Expand to layer

* Pan To – Move to layer

* Identify – View attribute data of layer

* Add to My Places – Create "My Places" position

* Manage My Places – Manage "My Places" position

k.   My Place Usage

"My Places" is a data making to identify the position or place which user want to use again without searching. From "Find" window in search results, user can bookmark any results in "My Places" by right-click to wanted data and select "Add to My Places".

User can manage "My Places" by click to menu "Tools > My Places".

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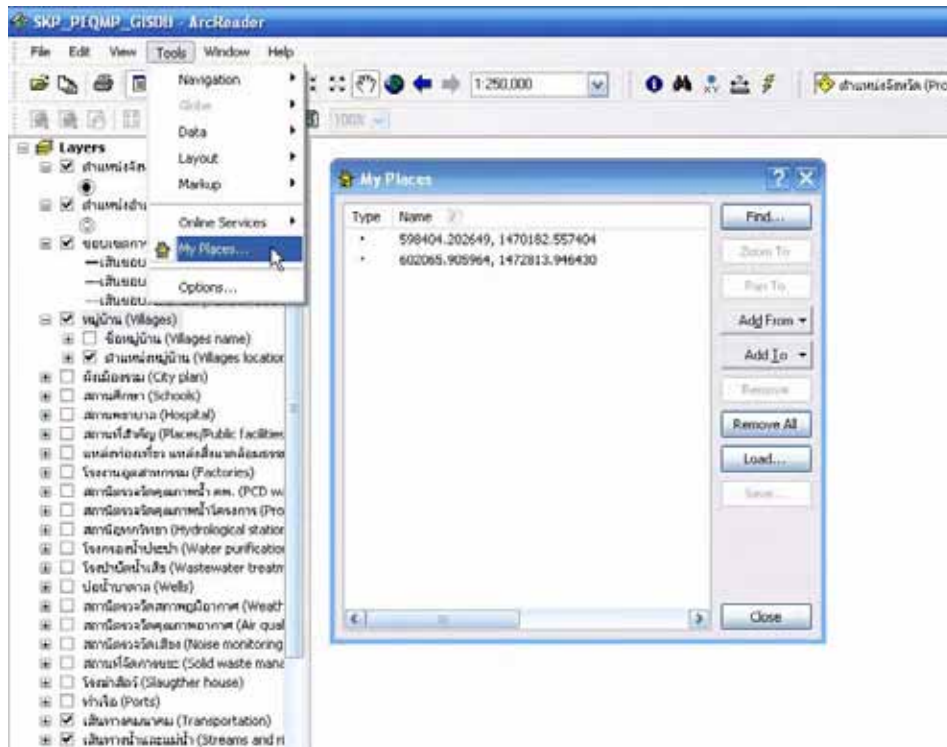
l.   Go to XY Position

User can use "Go To XY" tool to go to XY position by fill co-ordinates in "XY" gap and apply below commands.

- Pan To – Move to co-ordinates position
- Zoom To – Expand to co-ordinates position
- Flash To – Flash to co-ordinates position
- Mark XY – Show co-ordinates point on the map
- Text XY – Show co-ordinates value on the map
- Label XY – Show co-ordinates label on the map
- Undo – Select previous co-ordinates
- Choose Units – Change co-ordinates input system

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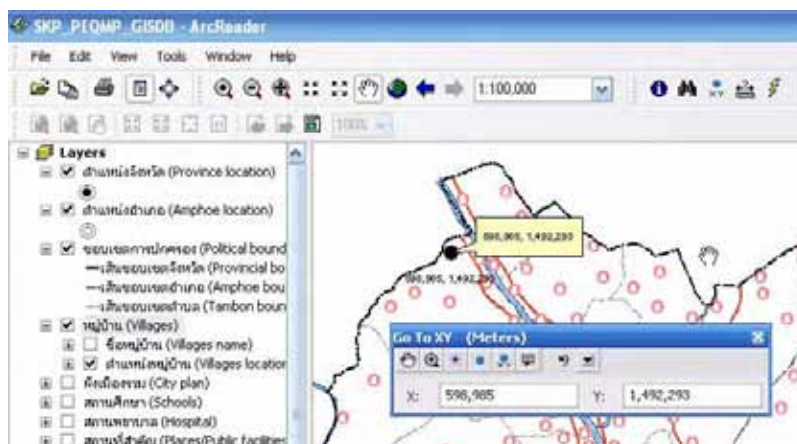
m.   Distance Measurement

User can use "Measure" ⬚ tool to measure a distance by click "Measure" ⬚, then "Measure" window will appear to show below commands.

- ∿ Measure Line – Length measurement
- ▱ Measure An Area – Area measurement
- ＋ Measure A Feature – Position measurement
- ● Snap to Features (on/off) – On/off move the measured position to data
- Σ Show Total (on/off) – On/off show total distance measurement
- ▰ Choose Units – Change unit of measurement
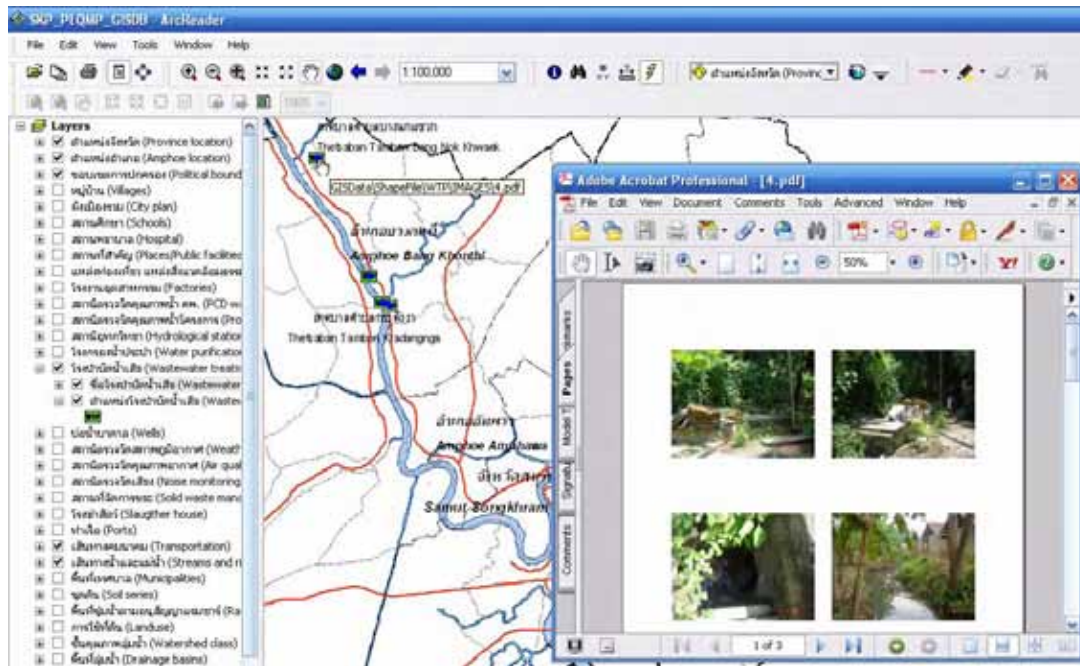- ✕ Clear and Reset Results – Clear "Measure" window

In order to measure, user can click to the beginning position and click to the next position until to the last position for distance or area measurement. Results will show in "Measure" window.
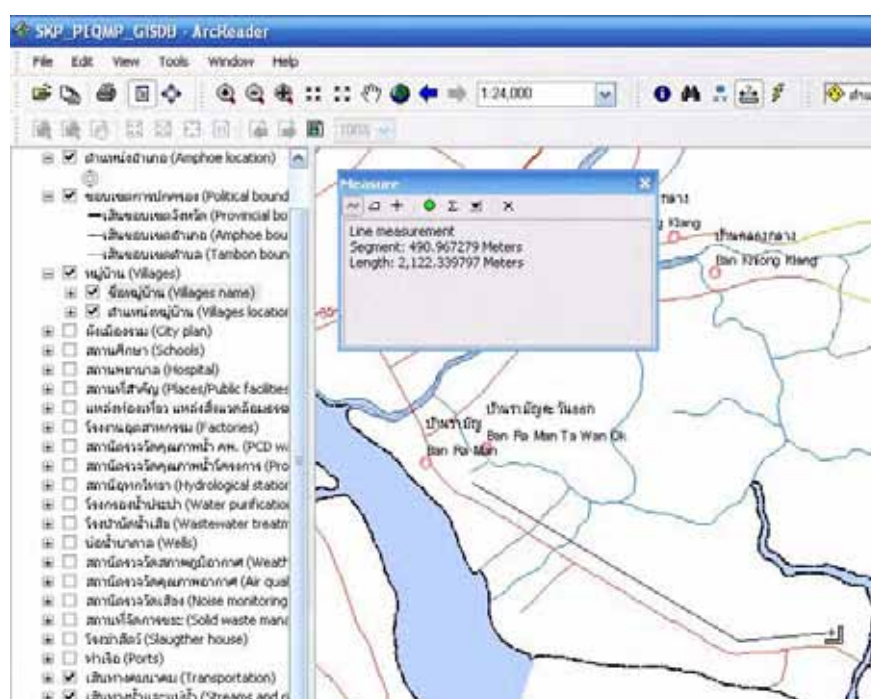
n.   Linkage to External Data

Some layer of "Published Map Documents" is link to external data such as picture, document, website etc. User can view those linkages in "Table of Contents" and click to "Hyperlinks"

⚡ tool. The linkage data will show ● symbol, user can click to view details.

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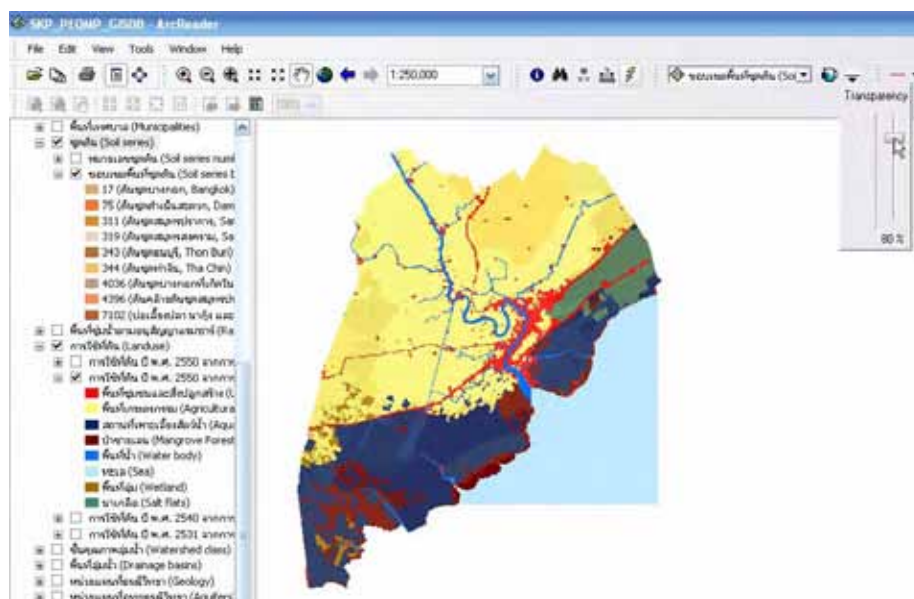Kokusai Kogyo Co., Ltd.
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o. Display Layer Modification

Display layer can modify by 2 methods of "Layer Effects Toolbars" as follows.

o.1 Layer List – Layer transparency adjustment

Select layer by click to "Layer List" from "Layer Effects Toolbars", then click

"Transparency" tool to adjust by hanging mouse at transparency bar and move up to
increase or move down to decrease layer transparency.

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o.2   Swipe Layer – Manage hidden layer

Select layer by click to "Layer List" from "Layer Effects Toolbars", then click "Swipe

Layer" ▼ tool to move a selected layer by hanging mouse and move up/down or left/right.
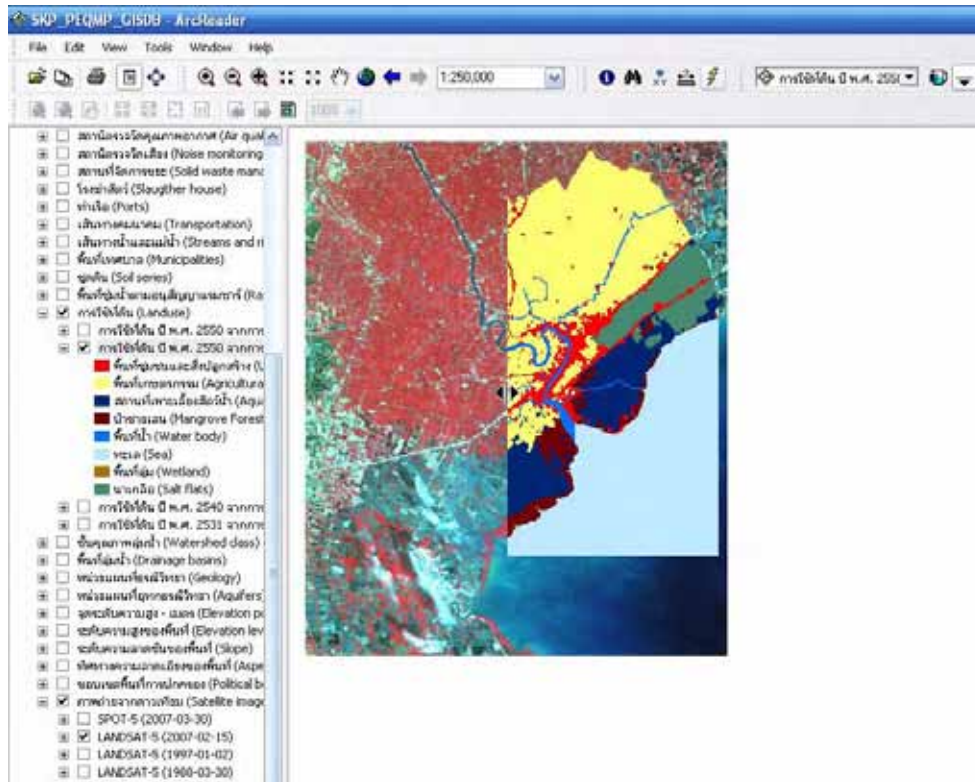
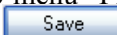**p.   Graphic Drawing on the Map**

User can draw a graphic to highlight an interested data on the map to use for another propose such as report or presentation. In order to labeling on the map, click "Markup Toolbars" to mark any figure by following tools.

— ▼ Pen – Graphic drawing on the map

✎ ▼ Highlighter – Graphic highlighting on the map

✐ ▼ Eraser – Delete graphic on the map

After used "Markup Toolbars", a pmfink file will be created to keep the created graphic file. It has a same file name with "Published Map Documents". Next time to open "Published Map Documents", program will run dialog box to ask user that want to use "Markup" with "Published Map Documents" or not? User can determine on this option.
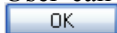
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q.   **Map Exportation**

User can export mapping data to picture as Bitmap Files (***.bmp**) to use for report or presentation by click to menu "File > Export Map". Then browse and save file location, put the file name, and click [Save] to save data.
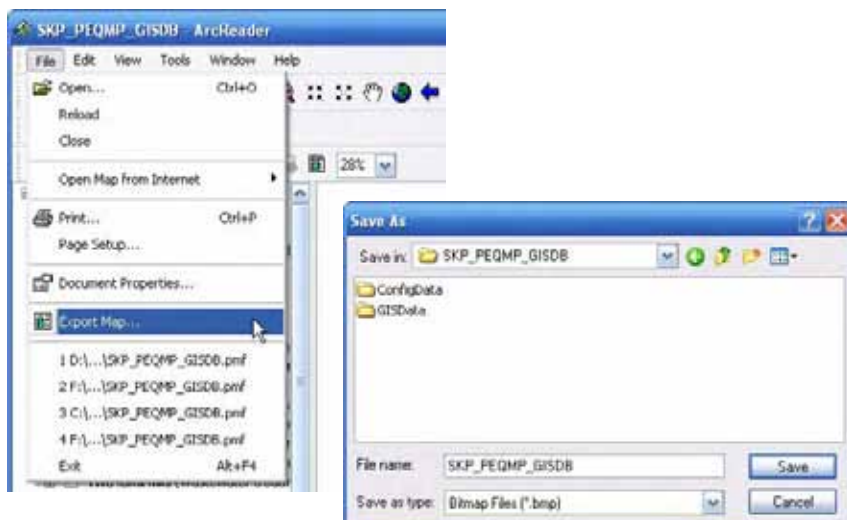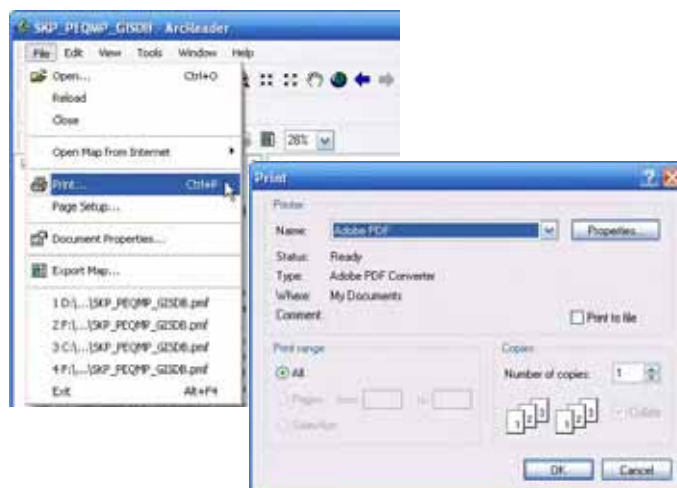
While exporting map in "Data View" window, it will export data display in "Data View" only. Similarly, while exporting map in "Layout View" window, it will export full map.

r.   **Map Printing**

User can print out map by click menu "File > Page Setup" to define paper size and click [OK].

After that, click menu "File > Print" to define printer properties and click [OK].

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While printing map in "Data View" window, it will print data display in "Data View" only. Similarly, while printing map in "Layout View" window, it will print full map.