

U.S. Department of the Interior

U.S. Geological Survey

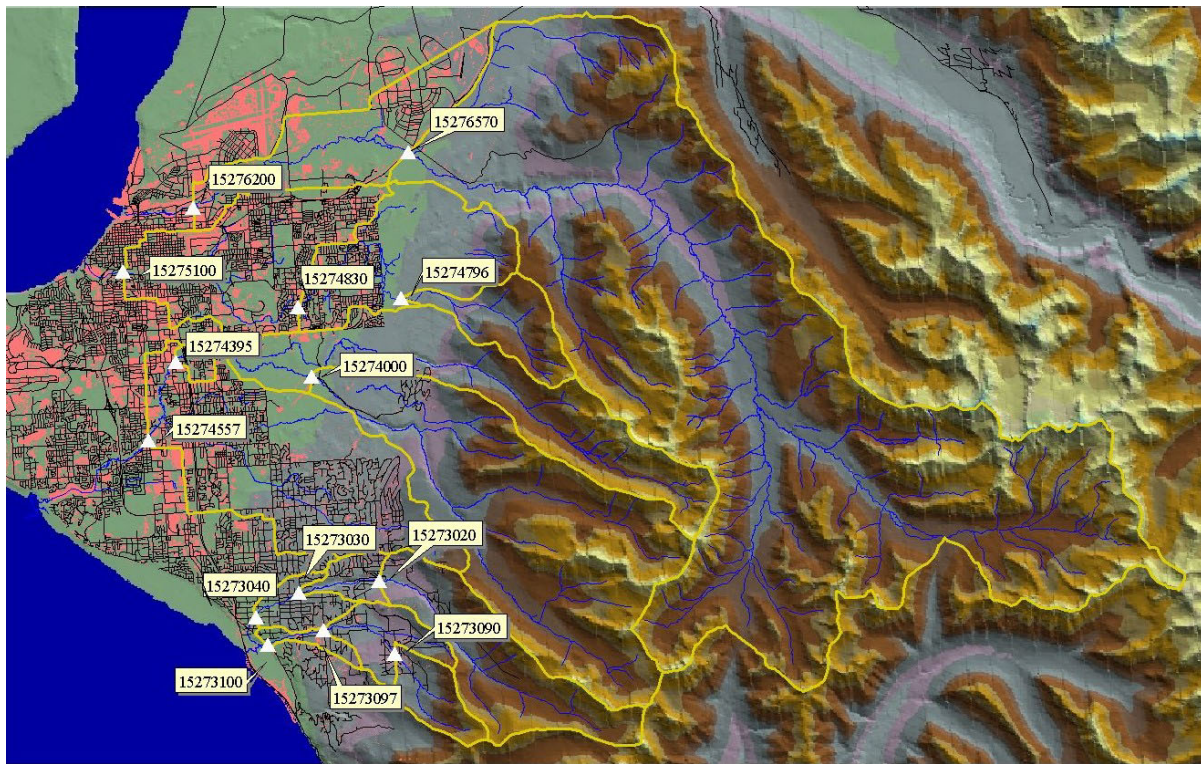
Open-File Report 02-334

# Characteristics of Urbanization in Five Watersheds of Anchorage, Alaska: Geographic Information System Data

Prepared as part of the

National Water-Quality Assessment Program

By Edward H. Moran



Cover Image: This image of Anchorage, Alaska was created in ESRI ArcView® 3.2 using the CD-ROM data sets dem.jpg, impervious\_cover.shp (peach color), watersheds.shp (yellow lines), streams.shp (blue lines), and station.shp (white triangles). The text boxes and triangles indicate station ID and location, respectively.



## **Forward**

### **National Water-Quality Assessment Program**

The U.S. Geological Survey (USGS) is committed to serve the Nation with accurate and timely scientific information that helps enhance and protect the overall quality of life, and facilitates effective management of water, biological, energy, and mineral resources. Information on the quality of the Nation's water resources is of critical interest to the USGS because it is so integrally linked to the long-term availability of water that is clean and safe for drinking and recreation and that is suitable for industry, irrigation, and habitat for fish and wildlife. Escalating population growth and increasing demands for the multiple water uses make water availability, now measured in terms of quantity and quality, even more critical to the long-term sustainability of our communities and ecosystems.

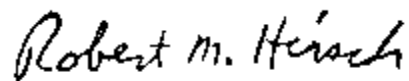
The USGS implemented the National Water-Quality Assessment (NAWQA) Program to support national, regional, and local information needs and decisions related to water-quality management and policy. Shaped by and coordinated with ongoing efforts of other Federal, State, and local agencies, the NAWQA Program is designed to answer: What is the condition of our Nation's streams and ground water? How are the conditions changing over time? How do natural features and human activities affect the quality of streams and ground water, and where are those effects most pronounced? By combining information on water chemistry, physical characteristics, stream habitat, and aquatic life, the NAWQA Program aims to provide science-based insights for current and emerging water issues. NAWQA results can contribute to informed decisions that result in practical and effective water-resource management and strategies that protect and restore water quality.

Since 1991, the NAWQA Program has implemented interdisciplinary assessments in more than 50 of the Nation's most important river basins and aquifers, referred to as Study Units. Collectively, these Study Units account for more than 60 percent of the overall water use and population served by public water supply, and are representative of the Nation's major hydrologic landscapes, priority ecological resources, and agricultural, urban, and natural sources of contamination.

Each assessment is guided by a nationally consistent study design and methods of sampling and analysis. The assessments thereby build local knowledge about water-quality issues and trends in a particular stream or aquifer while providing an understanding of how and why water quality varies regionally and nationally. The consistent, multi-scale approach helps to determine if certain types of water-quality issues are isolated or pervasive, and allows direct comparisons of how human activities and natural processes affect water quality and ecological health in the Nation's diverse geographic and environmental settings. Comprehensive assessments on pesticides, nutrients, volatile organic compounds, trace metals, and aquatic ecology are developed at the national scale through comparative analysis of the Study-Unit findings.

The USGS places high value on the communication and dissemination of credible, timely, and relevant science so that the most recent and available knowledge about water resources can be applied in management and policy decisions. We hope this NAWQA publication will provide you the needed insights and information to meet your needs, and thereby foster increased awareness and involvement in the protection and restoration of our Nation's waters.

The NAWQA Program recognizes that a national assessment by a single program cannot address all water-resource issues of interest. External coordination at all levels is critical for a fully integrated understanding of watersheds and for cost-effective management, regulation, and conservation of our Nation's water resources. The Program, therefore, depends extensively on the advice, cooperation, and information from other Federal, State, interstate, Tribal, and local agencies, non-government organizations, industry, academia, and other stakeholder groups. The assistance and suggestions of all are greatly appreciated.

A handwritten signature in black ink that reads "Robert M. Hirsch". The signature is written in a cursive, slightly slanted style.

Robert M. Hirsch  
Associate Director for Water

## Table of Contents

Table of Contents	4
Abstract	5
Introduction	5
Acknowledgments	6
Data Set Format and Presentation	7
Data Set Organization	9
Map Projections	11
Metadata: Data Set Information	11
Source Data	12
Prepared Projects	12
ArcExplorer2 projects	12
ArcView 3.2 project	13
ArcMap project	14
ArcExplorer2 GIS Software: Download and installation	15
ArcExplorer2 GIS Example: Viewing data	15
Opening a demonstration project from this CD-ROM	15
Exploring data on your own	16
Disclaimer	20
References	21

## **Abstract**

The CD-ROMs NAWQA\_CD1 and NAWQA\_CD2 contain environmental and urban geographic information system data for 14 sites in 5 watersheds in Anchorage, Alaska. These sites were examined during summer in 1999 and 2000 to determine effects of urbanization on water quality. The CD-ROM data sets are Environmental Systems Research Institute, Inc., shapefiles, coverages, and images. Also included are an elevation grid and a triangulated irregular network. Although the data are intended for users with advanced geographic information system capabilities, simple images of the data also are available. For user convenience, CD-ROM NAWQA\_CD1 includes an ArcView® 3.2 project, an ArcGIS® project, and 16 ArcExplorer2® projects.

## **Introduction**

In 1997, the U.S. Geological Survey (USGS) began a National-Water Quality Assessment (NAWQA) Program study of the Cook Inlet Basin, Alaska. The NAWQA Program is a nationwide water-quality assessment program designed to address an array of water-quality properties at various spatial and temporal scales. NAWQA scientists analyze and relate these specific water-quality properties to influencing natural and human factors.

One aspect of the Cook Inlet Basin, Alaska, study was to examine water quality at several stream sites that represent a gradient of urbanization in Anchorage. A stratified random sampling technique was used to select sampling sites (table 1) in five Anchorage area basins: Ship Creek, Chester Creek, Campbell Creek, Rabbit Creek, and Little Rabbit Creek. However, road density and accessibility influenced sample site selection.

During the summers of 1999 and 2000, USGS-WRD scientists collected water-quality data using NAWQA protocols at 14 sites in the 5 Anchorage area basins: 2 sites in the Ship Creek basin and 3 sites each in the Chester Creek, Campbell Creek, Rabbit Creek, and Little Rabbit Creek basins. NAWQA protocols include sampling for chemical, biological, and physical water-quality properties.

## **Acknowledgments**

I would like to thank Emily Binnian, Raytheon ITSS, USGS EROS Alaska Field Office, and Curtis Price, Physical Scientist, USGS for their review of this product. Their advice significantly improved its quality. I would like to extend a special thanks to Robert T. Ourso, Biologist, USGS Alaska District for his input and advice concerning this product. Lawrence E. Roberts, Computer Specialist, USGS, produced the executable splash screen included on CD-ROM NAWQA\_CD1.

## Data Set Format and Presentation

The data on the CD-ROM set will be most useful to advanced geographic information system (GIS) users. However, for users without GIS software, a GIS data viewer, Environmental Systems Research Institute, Inc (ESRI) ArcExplorer2® (ESRI, 1998), is available, free of charge, from the [ESRI ArcExplorer2 download](#) Web site. Additionally, NAWQA\_CD1 includes images of selected data layers that have been provided for users to view without the use of GIS software.

The CD-ROMs contain the environmental and urban spatial data applied in the analysis of the urban gradient sites. The spatial data are in ESRI shapefile, coverage, grid, and/or triangulated irregular network (TIN) formats. JPEG images of selected data sets are included also. This information was obtained from several sources: the Municipality of Anchorage (MOAMISD, 2000; MOATP, 1998), Space Imaging (2000), the Western Regional Climate Center (WRCC, no date), and the Natural Resources Conservation Service (NRCS, 1979). Many of the data sets used may be accessed through the Internet at the [Alaska Geospatial Data Clearinghouse](#) (AGDC, no date) Web site.

The ESRI shapefiles and coverages on the CD-ROMs represent three scales for data analysis and viewing: (1) the entire Cook Inlet Basin, (2) all urban gradient sites in the Anchorage area, and (3) individual urban gradient sites. Shapefiles and coverages for the Cook Inlet Basin include the basin boundary, soil types, precipitation, Thiessen polygons representing average annual temperature and snowfall, and the climate stations used to construct the Thiessen polygons. Anchorage area data sets include boundaries for all watersheds, urban gradient site stations, impervious area, streams, land use, and a data set for identifying each stream by name. Each urban gradient site watershed data set includes clipped versions of the Cook Inlet Basin and Anchorage area shapefiles and coverages. Some of the watersheds, however, contain no roads or

sewers; therefore, those shapefiles and coverages are not present. When applicable, Thiessen polygons indicating climate variables (average annual temperature and snowfall), and population estimates for 1998 are included.

Sampling locations are identified by map ID, station and watershed name, and/or station ID. Table 1 lists the Map ID, station and watershed name, and station ID for the 14 NAWQA Anchorage area watersheds studied by the Cook Inlet Basin NAWQA team.

**Table 1:** USGS Cook Inlet Basin NAWQA urban gradient station list. Map IDs are from a master list of all sites discussed in reports of the Cook Inlet Basin NAWQA study. Thus, the same map ID in all USGS publications for the Cook Inlet Basin NAWQA study refers to a particular site.

Click on the station and watershed name to go directly to the Cook Inlet NAWQA Web page for further information on that watershed.

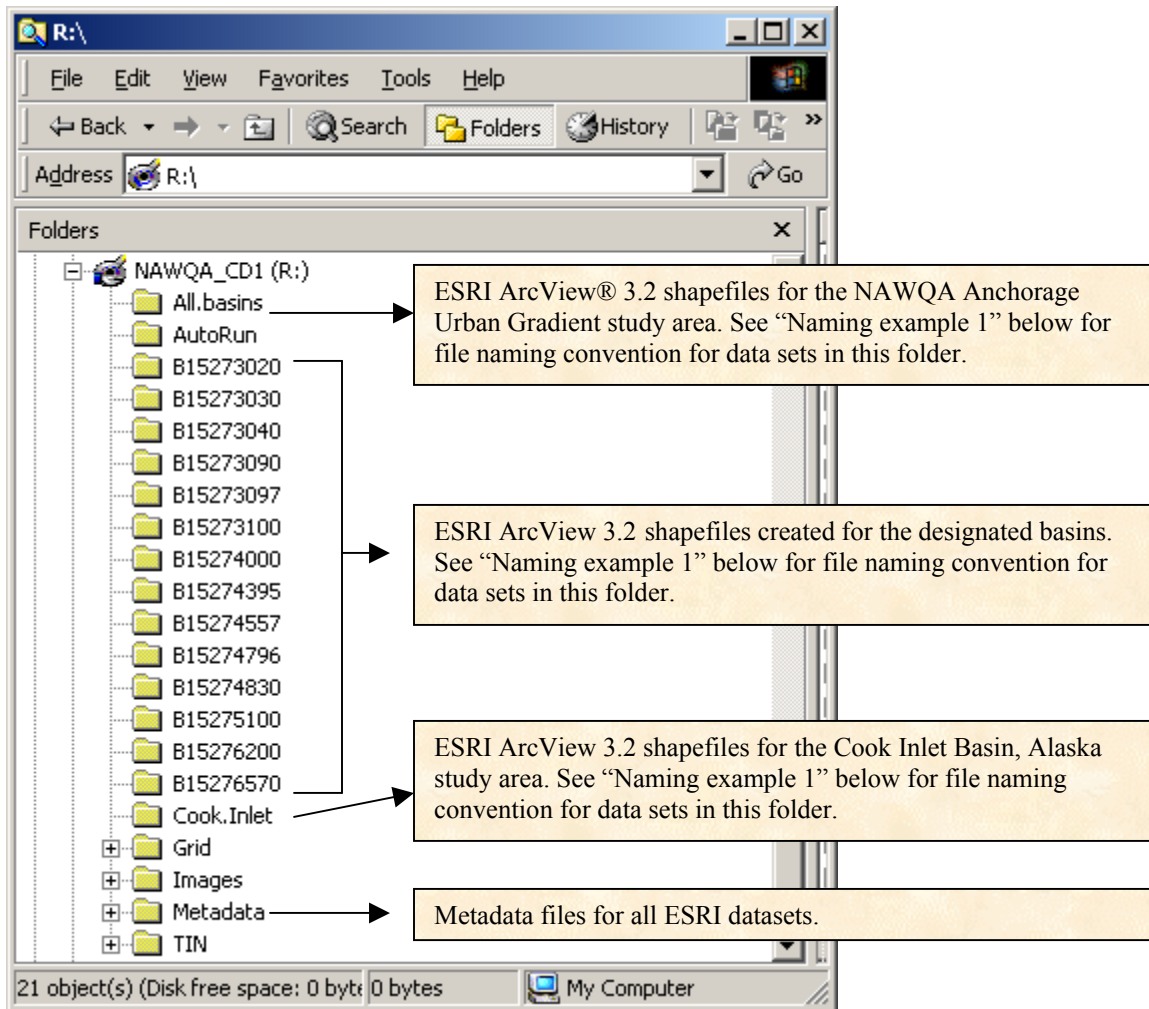
Click on the station ID to view the list of data sets on this CD-ROM that pertain to that watershed.

Map ID	Station and Watershed Name (Description)	Station ID
59	<a href="#">Rabbit Creek at Hillside Dr near Anchorage</a>	<a href="#">15273020</a>
60	<a href="#">Rabbit Creek at East 140 Ave near Anchorage</a>	<a href="#">15273030</a>
61	<a href="#">Rabbit Creek at Porcupine Trail near Anchorage</a>	<a href="#">15273040</a>
62	<a href="#">Little Rabbit Creek at Nickleen Street near Anchorage</a>	<a href="#">15273090</a>
63	<a href="#">Little Rabbit Creek at Goldenview Drive near Anchorage</a>	<a href="#">15273097</a>
69	<a href="#">Little Rabbit Creek near Anchorage</a>	<a href="#">15273100</a>
23	<a href="#">South Fork Campbell Creek near Anchorage</a>	<a href="#">15274000</a>
64	<a href="#">Campbell Creek at New Seward Highway near Anchorage</a>	<a href="#">15274395</a>
65	<a href="#">Campbell Creek at C St near Anchorage</a>	<a href="#">15274557</a>
66	<a href="#">South Branch of South Fork Chester Creek at Tank Trail near Anchorage</a>	<a href="#">15274796</a>
67	<a href="#">South Branch of South Fork Chester Creek at Boniface Parkway near Anchorage</a>	<a href="#">15274830</a>
27	<a href="#">Chester Creek at Arctic Blvd at Anchorage</a>	<a href="#">15275100</a>
68	<a href="#">Ship Creek at Glenn Highway near Anchorage</a>	<a href="#">15276200</a>
29	<a href="#">Ship Creek below Power Plant at Elmendorf Air Force Base</a>	<a href="#">15276570</a>



## Data Set Organization

The data reside on two CD-ROMs: NAWQA\_CD1 and NAWQA\_CD2. NAWQA\_CD1 contains documentation pertaining to the CD-ROMs and all data, a portable ArcView® project, a portable ArcMap® project, projected shapefiles, and 16 ArcExplorer2 projects. The data on NAWQA\_CD1 are partitioned into several folders by data file type and content (fig. 1).



**Figure 1:** Explanation of CD-ROM folder structure.

Naming example 1: An explanation for folder b15276570 and the shapefile named “b15276570\_basin\_boundary” follows: “b” means basin, “15276570” (table 1) is the station ID for the “Ship Creek below Power Plant at Elmendorf Air Force Base” watershed, “basin\_boundary” represents the type of attributes contained in the ESRI ArcView 3.2 (ESRI,

2000a) shapefiles and ArcInfo® (ESRI, 2000b) coverages; i.e., the b15276570\_basin\_boundary data set represents a polygon feature showing the digitized boundary of the watershed.

Naming example 2: An explanation for folder b23 and the ESRI ArcView 3.2 (ESRI 2000a) shapefile and ArcInfo (ESRI 2000b) coverage named “b23bb” follows: “b” means basin, “23” (table 1) is the map ID for the “Ship Creek below Power Plant at Elmendorf Air Force Base” watershed, “bb” (table 2) represents the type of attributes contained in the shapefile and coverage; i.e., the b23bb data set represents a polygon feature showing the digitized boundary of the watershed.

**Table 2:** File name abbreviations and meanings used for data sets contained on these CD-ROMs.

Abbr	Definition	Abbr.	Definition	Abbr.	Definition
bb	Basin Boundary	lus	Land use summation	sew	Sewers
ci	Cook Inlet	pop98	1998 Population	soil	Soil types
imp	Impervious Area	prec	Precipitation	strm	Streams
lu	Land use	rds	Roads	thies	Thiessen polygons

The Grid and TIN folders on NAWQA\_CD1 contain Digital Elevation Model (DEM) derived information [Note: For ESRI ArcView 3.2 (ESRI, 2000a) users, the ESRI Spatial Analyst® (ESRI, 1997a) extension is required to view the grid data, although grids may be viewed using ESRI ArcExplorer2 (ESRI, 1998). ESRI ArcView 3D Analyst® (ESRI 1997b) is required to view the TIN data]. The Images folder contains a georeferenced and nongeoreferenced folder containing JPEG images of selected files. Only the image files in the georeferenced folder are viewable with GIS data sets of the same projection. The georeferenced images are projected in Albers Conical Equal Area (Alaska), North American Datum of 1927.

NAWQA\_CD2 contains zipped folders of nonprojected (geographic, NAD27) shapefiles (folder ISO9660, shapefiles named by using the ISO 9660 Level 1 naming convention) and ArcInfo export coverages (folder containing ESRI export files; i.e., \*.e00). The ISO9660 folder contains ESRI data sets named by using the ISO 9660 Level 1 naming convention.

## **Map Projections**

All ESRI shapefiles in NAWQA\_CD1 are projected in Albers Conical Equal Area (Alaska), North American Datum of 1927, with distance in meters. Following are the projection parameters:

Standard\_Parallel: 55.000000  
Standard\_Parallel: 65.000000  
Longitude\_of\_Central\_Meridian: -154.000000  
Latitude\_of\_Projection\_Origin: 50.000000  
False\_Easting: 0.000000  
False\_Northing: 0.000000

The ISO9660 and the ArcInfo folders (NAWQA\_CD2) contain ESRI data sets projected in Geographic Coordinates, Decimal Degrees, North American Datum of 1927, which is an unprojected coordinate system.

## **Metadata: Data Set Information**

Information about each data set can be viewed in the Metadata folder. The files with the .met suffix are in ASCII format and can be read with a simple text reading program. The metadata files report construction technique, external data sources, map projection, table attributes, and other pertinent information concerning the data set. All data sets, except for the two Anchorage relief JPEG images (NAWQA\_CD1), have a corresponding metadata file. The data sets' metadata were created using FGDC (FGDC, 1998) standards. For metadata format information, go to the [Federal Geographic Data Committee](#) metadata Web page (FGDC, 2002).

## Source Data

Several sources contributed to the data on this CD-ROM set. If a data set on the CD-ROMs was generated from another source, that specific source was cited in the data set metadata file.

## Prepared Projects

For user convenience, there are three types of projects included on CD-ROM NAWQA\_CD1: ESRI ArcExplorer2, ArcView 3.2, and ArcMap projects. If your computer has the necessary software installed (ESRI ArcExplorer2, ArcView 3.2, or ArcMap), you may access these projects by clicking [here](#) or on the button titled “Projects” on the initial splash screen.

### *ArcExplorer2 projects*

(ESRI ArcExplorer2 software must be installed to view these projects).

Anch.aep: all Anchorage area NAWQA study units.

B23.aep: B15274000--South Fork Campbell Creek near Anchorage, Alaska.

B27.aep: B15275100--Chester Creek at Arctic Blvd. at Anchorage, Alaska.

B29.aep: B15276570--Ship Creek below Power Plant at Elmendorf Air Force Base, Anchorage, Alaska.

B59.aep: B15273020--Rabbit Creek at Hillside Drive near Anchorage, Alaska.

B60.aep: B15273030--Rabbit Creek at East 140th near Anchorage, Alaska.

B61.aep: B15273040--Rabbit Creek at Porcupine Trail near Anchorage, Alaska.

B62.aep: B15273090--Little Rabbit Creek at Nickleen Street near Anchorage, Alaska.

B63.aep: B15273097--Little Rabbit Creek at Goldenview Drive near Anchorage, Alaska.

B64.aep: B15274395--Campbell Creek at New Seward Highway near Anchorage, Alaska.

B65.aep: B15274557--Campbell Creek at "C" Street near Anchorage, Alaska.

B66.aep: B15274796--South Branch of South Fork Chester Creek at Tank Trail near Anchorage, Alaska.

B67.aep: B15274830--South Branch of South Fork Chester Creek at Boniface Parkway near Anchorage, Alaska.

B68.aep: B15276200--Ship Creek at Glenn Highway near Anchorage, Alaska.

B69.aep: B15273100--Little Rabbit Creek (at Old Seward Highway) near Anchorage, Alaska.

Ci\_basin.aep: NAWQA Cook Inlet Basin, Alaska, study area.

These are ArcExplorer2 projects containing all shapefiles for the designated viewing extent; for example, b23.aep contains all shapefiles for the B15273020, Rabbit Creek at Hillside Drive near Anchorage, Alaska, watershed (see table 1 for the map number for each watershed). These projects are in Albers Conical Equal Area, Alaska, North American Datum of 1927, with distance in meters.

### ***ArcView 3.2 project***

(ESRI ArcView 3.2 software must be installed to view this project).

nawqa.apr

This is an ESRI ArcView 3.2 project containing all shapefiles. The project contains different document “Views” that contain shapefiles organized by spatial relationship; for example, the “Cook Inlet” Basin, Alaska, View contains all shapefiles viewable at the Cook Inlet Basin, Alaska, extent, the “Anchorage Study Area” View contains all shapefiles viewable at the

extent of all the studied watersheds in the Anchorage area, the “B15273020: Rabbit Creek at Hillside Drive near Anchorage, Alaska,” View contains all shapefiles viewable at the extent of B15273020 Rabbit Creek at Hillside Drive near Anchorage, Alaska, watershed. Nawqa.apr is projected in Albers Conical Equal Area, Alaska, North American Datum of 1927, with distance in meters. This project includes a menu on the View that enables metadata viewing.

### ***ArcMap project***

(ESRI ArcMap software must be installed to view this project).

Nawqa.mxd

This project is an ArcMap project containing all the ArcInfo coverages on NAWQA\_CD1. This project is projected in Geographic Coordinates, North American Datum of 1927, in decimal degrees. Some functional knowledge of ArcMap may be required to view this project.

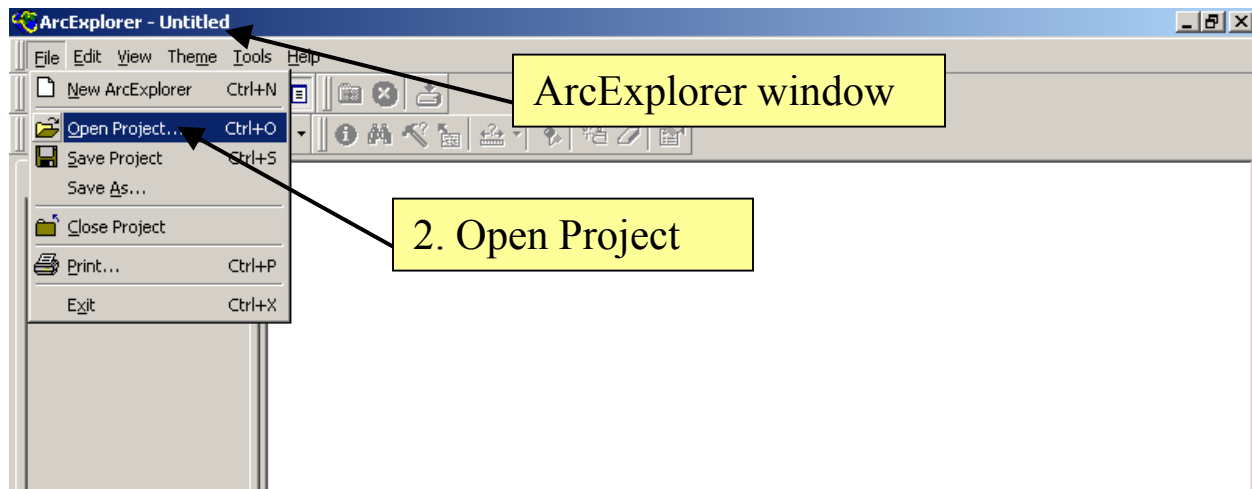
## ArcExplorer2 GIS Software: Download and installation

1. [Download ArcExplorer2](#) from the ESRI Web site into a folder of your choice. This Web site includes documentation for installing and running ArcExplorer2.
2. Go to the folder containing the file you just downloaded.
3. Run or open this executable file (ae2setup.exe) by double-clicking on it. Follow the instructions in the windows that appear on your desktop.

## ArcExplorer2 GIS Example: Viewing data

### *Opening a demonstration project from this CD-ROM*

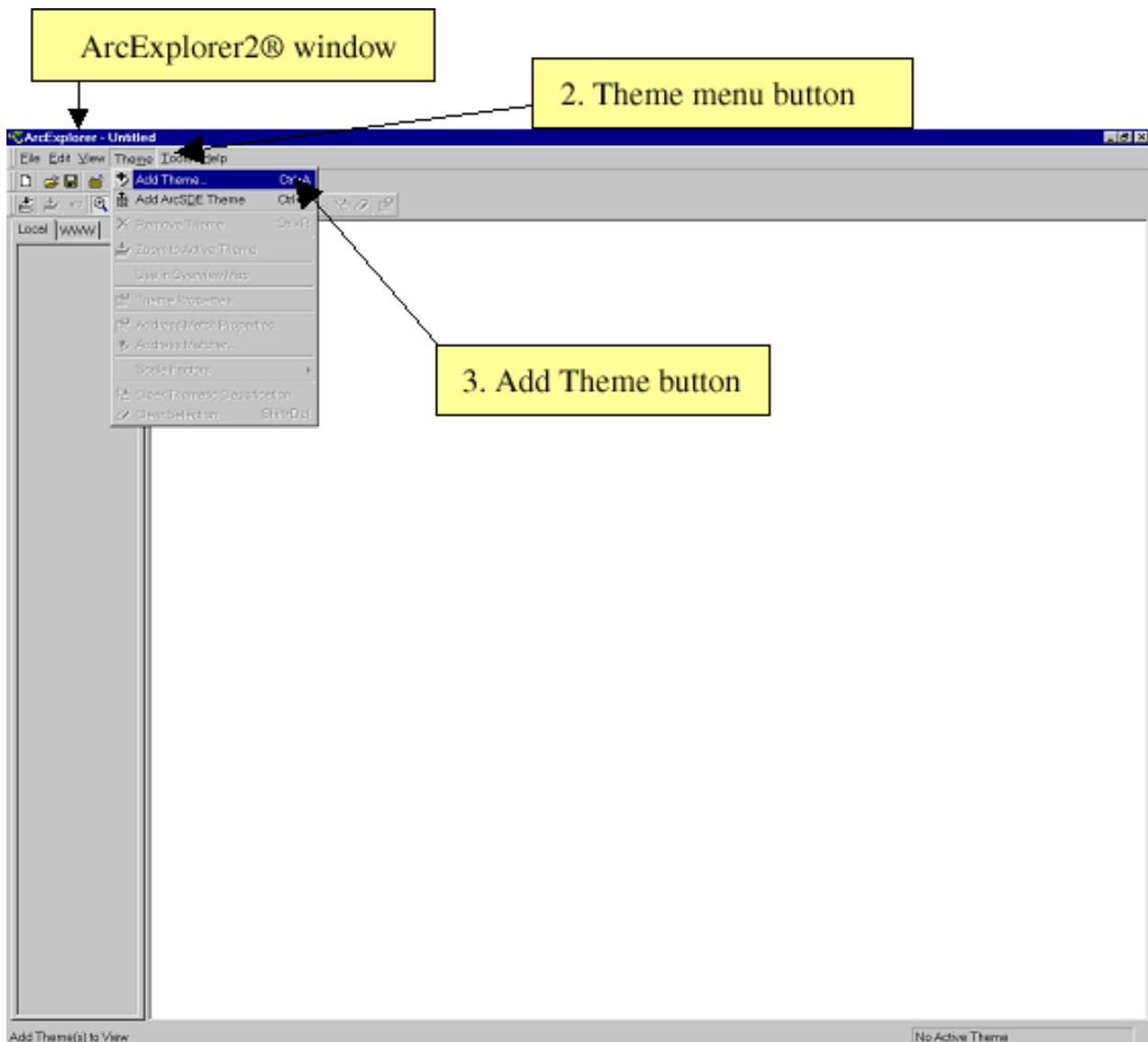
1. Go to ArcExplorer2 Icon that has been placed on your desktop. If the icon is missing, find ArcExplorer2.0 under Start>Programs. Click on the icon to open the software.
2. When the ArcExplorer2 window appears (fig. 2), move your cursor-pointer to the File menu tab. Click Open Project. Check to see that the “Look in” window is set to My Computer>(your CDROM drive) then select the project that you want to see.



**Figure 2:** ArcExplorer window displayed when the program is first opened.

## ***Exploring data on your own***

1. Go to ArcExplorer2 Icon that has been placed on your desktop. If the icon is missing, find ArcExplorer2.0 under Start>Programs. Click on the icon to open the software.
2. When the ArcExplorer2 window appears (fig. 3), move your cursor-pointer to the Theme menu button as shown.
3. Move cursor-pointer down to Add Theme and click on it. Another window appears inside the main ArcExplorer2 window (fig. 3).



**Figure 3:** ESRI ArcExplorer2 window showing steps 2 and 3.



4. Within the Add Theme window (fig. 4), click on the arrow at the right of the box Data Types. Choose the appropriate data type; i.e., shapefile, supported images, grid images, etc.
5. Go to the left window titled Selected Folder (fig. 4). Locate and open NAWQA\_CD1. Find the data folder that contains the data for the watershed that you wish to view.
6. Open the folder and select the data set you wish to review (fig. 4).
7. Within the Add Theme window, move cursor-pointer up to the Add Theme button and click on it (fig. 4). This will load the selected data set into window. Click the small white box in front of the data set's name to make it visible.

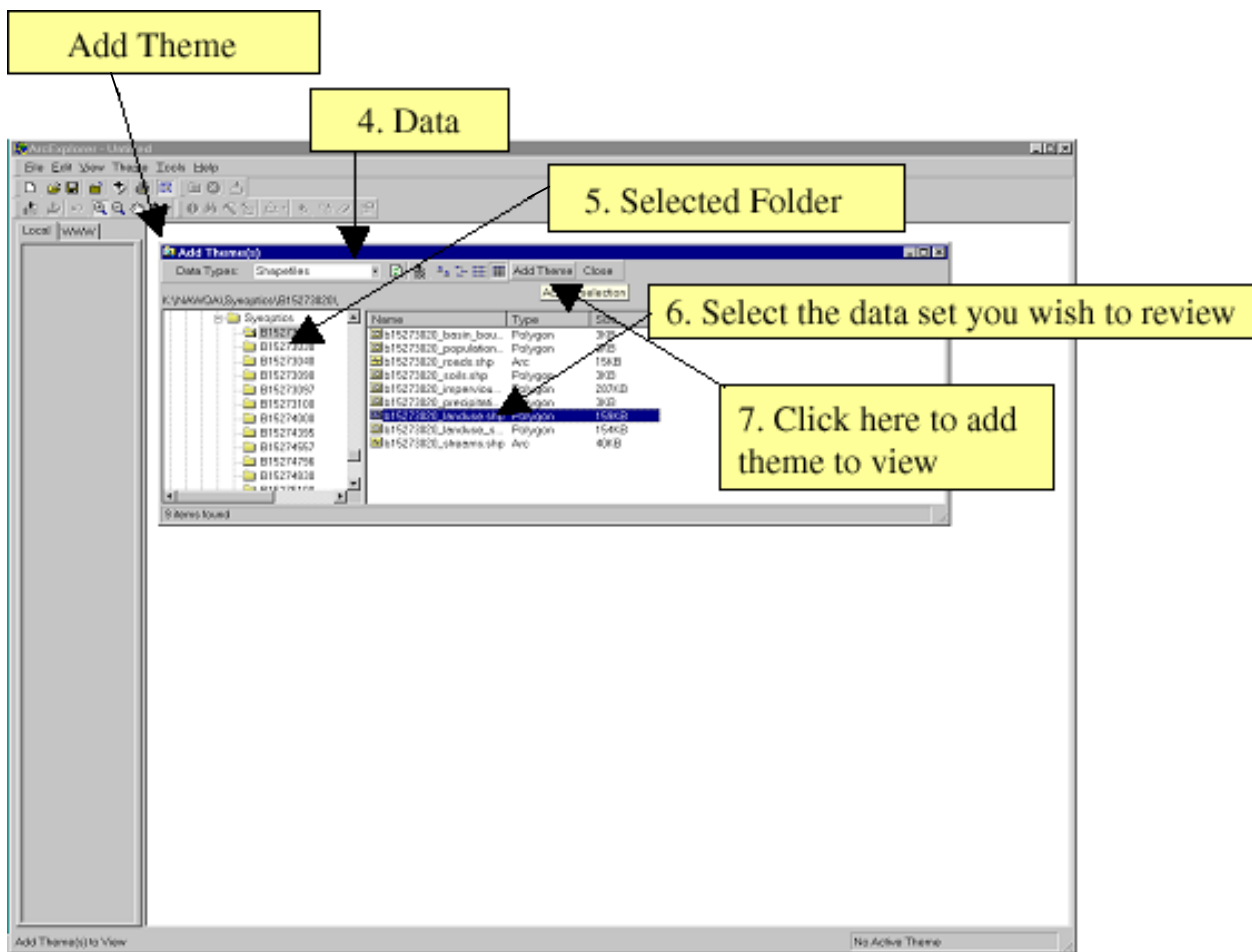


Figure 4: ESRI ArcExplorer2 window showing steps 4 through 7.

8. To view the different attributes in the data set, place the cursor-pointer over the data set name that has just been loaded into the main ArcExplorer2 window and click on it. A raised box now appears around the data set name (fig. 5).
9. There are two methods to view the data set attributes (fig. 5).
  - A. Double click within the area of the raised box, or
  - B. Move cursor-pointer to the Theme menu bar. Click on the menu tab and move down to Theme Properties. A new window named Theme Properties appears in the main ArcExplorer2 window.

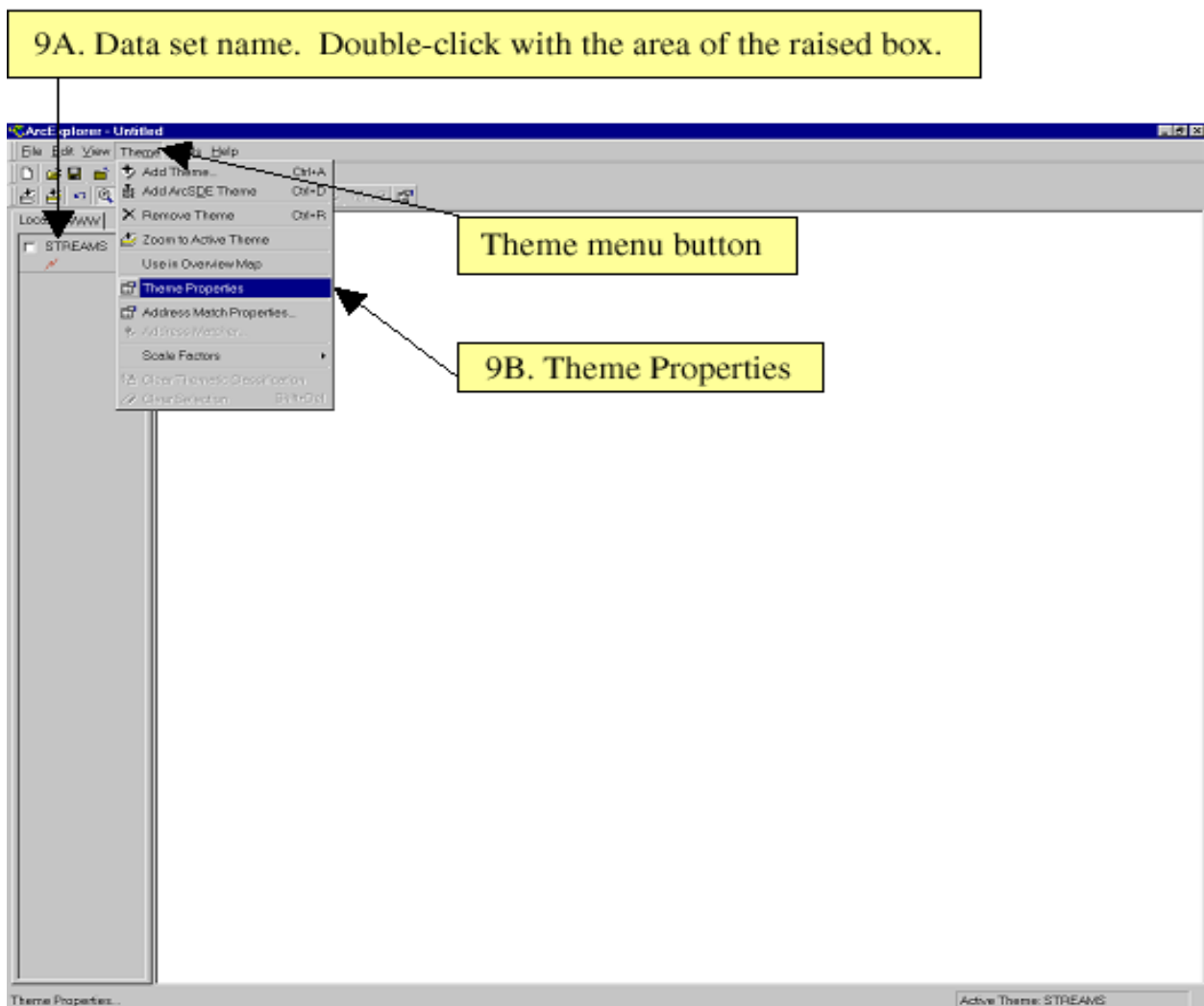
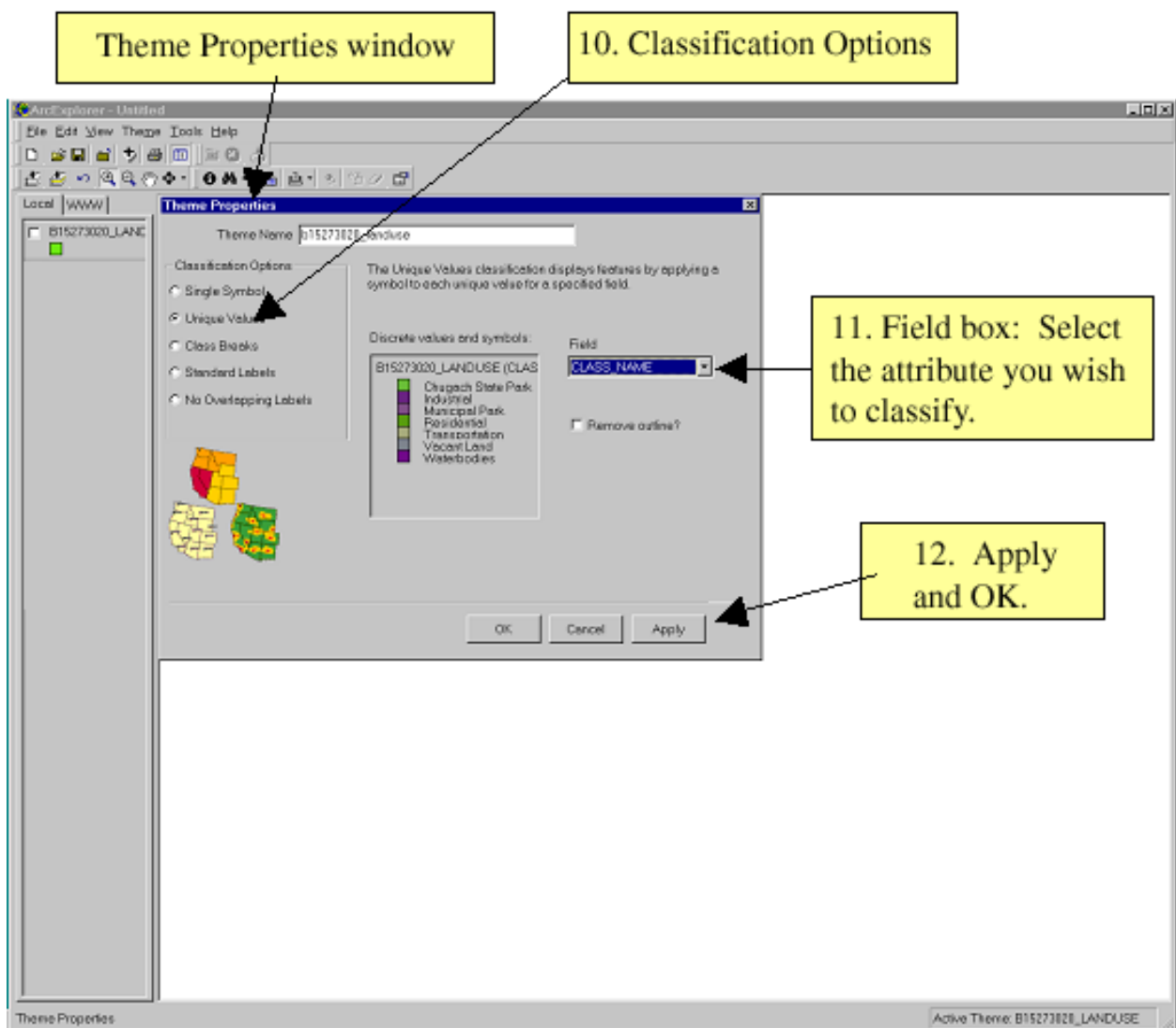
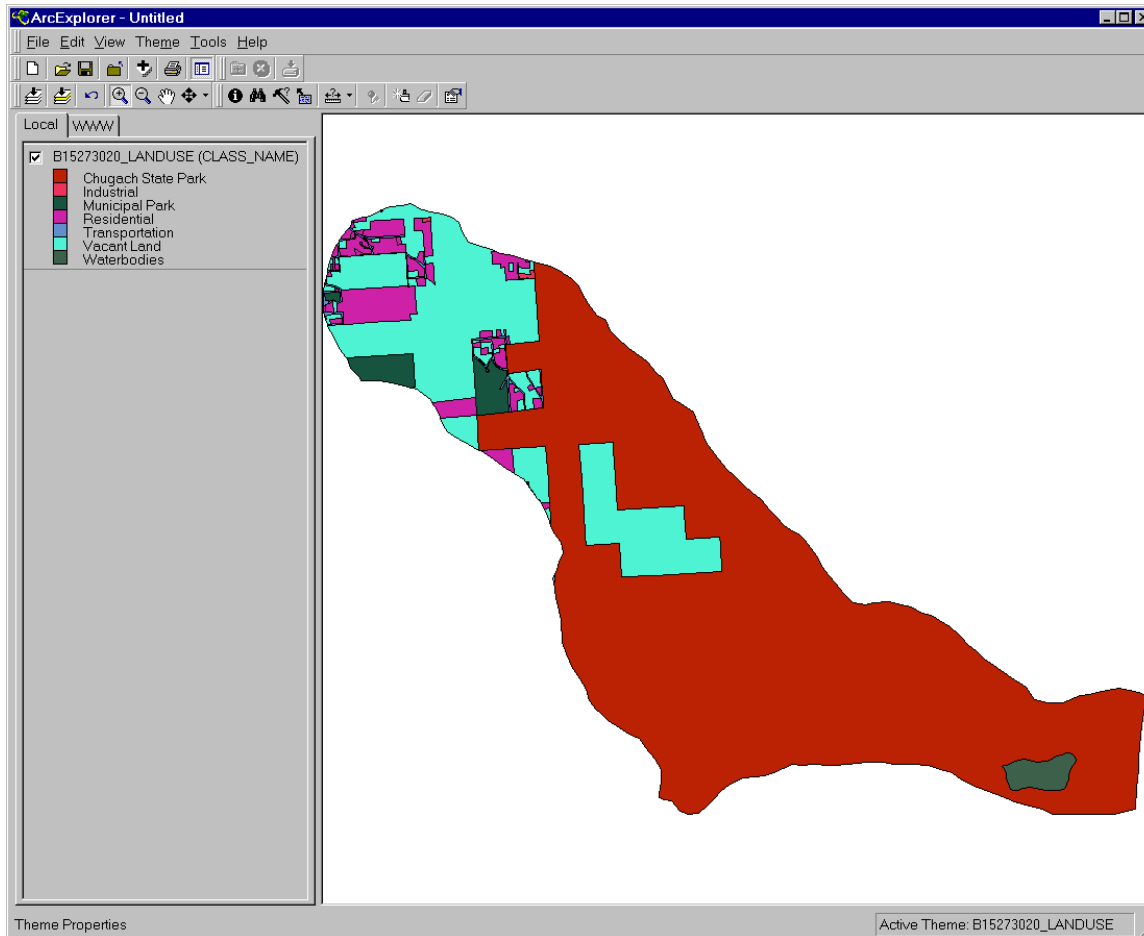


Figure 5: ESRI ArcExplorer2 window showing step 9.

10. Within the Theme Properties window, shown below, select a Classification Option (fig. 6).
11. Move the cursor-pointer to the arrow next to the Field box and click on it. Select the attribute about which you wish to view more detailed information.
12. Move the cursor-pointer to the Apply button located at the bottom of the Theme Properties window and click on it. View the classification scheme shown in the “Discrete values and symbols” box in the Theme Properties window. Go to the OK button and click on it. The window disappears, bringing you back to the main ArcExplorer2 window (fig. 7) where the results of your data choices will be displayed.



**Figure 6:** ESRI ArcExplorer2 window showing steps 10 through 12.



**Figure 7:** ESRI ArcExplorer2 window results from following steps 1 through 12.

For more information about the [Cook Inlet Basin, Alaska NAWQA Study Unit](#), visit our [Web site](#).

## **Disclaimer**

Although the U.S. Department of the Interior, Geological Survey uses the data on this CD-ROM, no warranty expressed or implied is made by the U.S. Geological Survey as to the accuracy of the data. The act of distribution shall not constitute any such warranty, and the U.S. Geological Survey in the use of this data, software, or related materials assumes no responsibility. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

## References

- [AGDC] Alaska Geospatial Data Clearinghouse, [no date], Data sets: <http://agdc.usgs.gov> last accessed August 9, 2002.
- [ESRI] Environmental Systems Research Institute, Inc, 1997a, ArcView Spatial Analyst Version 1.1: Redlands, California.
- [ESRI] Environmental Systems Research Institute, Inc, 1997b, ArcView 3D Analyst 1.0: Redlands, California
- [ESRI] Environmental Systems Research Institute, Inc, 1998, ArcExplorer Version 2.0.800: <http://www.esri.com/software/arcexplorer/index.html>, last accessed August 9, 2002.
- [ESRI] Environmental Systems Research Institute, Inc, 2000a, ArcView 3.2: Redlands, California.
- [ESRI] Environmental Systems Research Institute, Inc, 2000b, Arc Version 8.0.2: Redlands, California.
- [ESRI] Environmental Systems Research Institute, Inc, 2001, ArcMap 8.0.2: Redlands, California.
- [FGDC] Federal Geographic Data Committee, 1998, FGDC-STD-001-1998, Content standard for digital geospatial metadata): <http://www.fgdc.gov/metadata/constan.html>, revised June 26, 2001, last accessed August 9, 2002.
- [FGDC] Federal Geographic Data Committee, (2002), Metadata: <http://www.fgdc.gov/metadata/metadata.html>, revised June 18, 2002, last accessed August 9, 2002,.
- [MOAMISD] Municipality of Anchorage Management Information Systems Department, 2000, GIS Data—Q1 2000, CD-ROM: Anchorage, Alaska.
- [MOATP] Municipality of Anchorage Transportation Planning, 1999, Anchorage Population by Census Tract 1980-1998: Anchorage, Alaska.
- [NRCS] Natural Resource Conservation Service, 1979, Exploratory soil survey of Alaska: <http://agdc.usgs.gov/data/projects/fhm/#Q> , last accessed August 9, 2002.
- Space Imaging, 2000, IKONOS sensor satellite imagery: Thornton, Colorado, acquisition date August 2000.
- [WRCC] Western Regional Climate Center, no date, Alaska Climate Summaries: <http://www.wrcc.dri.edu/summary/climsmak.html>, last accessed August 9, 2002.