Geodatabase

1.0   Introduction

Every tenth acre of wetland and linear foot of stream mitigation must be accounted for in order to comply with federal (404) and state (401) permits. If compliance is not met, construction on road projects can be suspended until corrective measures are performed and/or fines can be levied. With hundreds of both onsite and offsite mitigation projects, NCDOT has a vested interest in creating an effective method of inventorying these projects using GIS so permit violations do not occur.

1.1   Purpose and Need

A centralized location and standardized method of storing this information will help to protect the investments of the state of North Carolina. Accurate geographic records of these conservation areas will provide a record of these sites to ensure that they will be preserved into perpetuity. In addition, a detailed geodatabase of NCDOT's mitigation sites may lead to future spatial analyses to improve how NCDOT identifies mitigation needs and plans its mitigation efforts.

1.2   Goal

The three main goals of this project were to (1) design a geodatabase to store NCDOT mitigation sites with high positional accuracy and detailed attribute information which is easy to use and maintain, (2) document the procedures for editing and utilizing the data and (3) offer employee training for the use of the geodatabase.

1.3   Objectives

  -    Digitize the boundaries of mitigation sites as accurately as possible

- Create a ESRI geodatabase using ArcGIS 8.2 with which to store the mitigation site data and any other related geographic data

- Use Microsoft Access to enter, store, edit and query the attribute data which can be linked to ArcGIS

- Produce shapefile versions of the feature classes for use in ArcView 3.2

- Document the protocol in the NCDOT ICI Unit Procedure Manual

- Train NCDOT ONE staff on how to edit and use the database

1.4   Methodology

Before a geodatabase could be designed, any existing data for the mitigation sites was gathered and researched to create a "master" list of all the sites and their locations because one did not exist at the time. Mitigation information for road projects was found on multiple spreadsheets, site mitigation plans and 404 permits. Each site was named and given an ONE ID number. The data was then analyzed to determine what data needed to be tracked for each site and how it could be organized into one database. Thirty-six various types of sites were chosen to place in the pilot geodatabase to confirm the design was feasible to store all the different types of mitigation data.

The ArcGIS personal geodatabase model was chosen for the database for its flexibility and ability to meet the needs of ONE. Maps of the selected sites were digitized from Microstation files (.dgns), extracted from county parcel data, or mapped with Trimble ProXR GPS units. The site maps were then loaded into a geodatabase as a feature class, along with other relevant datasets that may help to locate the mitigation sites in. ArcGIS 8.2 was used for the entire process of digitizing and creating feature classes. Microsoft Access '97 provided several tools for an effective, yet uncomplicated

means of storing and managing the attributes of each site. Access allowed this data to be stored in tables, while an easy-to-use customized form was created to enter new information. Queries were created to help extract and summarize data while reports were designed to provide a systematic means of displaying the results of query, which can be printed in a standardized format.

2.0   Geodatabase Design

2.1   Data Organization

Before exploring the geodatabase itself, it is important to know how the files for the geodatabase and the ancillary data are organized on the server, illustrated below. The main folder, *Geodatabase,* contains the actual Mitigation Site geodatabase, called *Mit_v5* (the name of database may vary over time), and other folders, which are included to help organize the movement and storage of the data. These folders are described below:
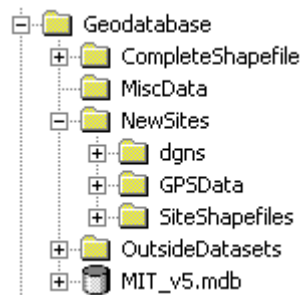
- *CompleteShapefile* – this folder contains the shapefile version of the spatial data for all the mitigation sites. The maps are exported from the feature class in the geodatabase as a shapefile and will be explained in detail in Section 5.

- *Misc. Data* – this folder contains any miscellaneous data which may help to find or identify the locations or attributes of a mitigation site.
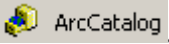
- *New Sites* – this folder is the location for storing the spatial data for new sites that will

be added to the database. Within this folder, there are three more folders:

- *dgns* – The location to store the .dgn's for new sites

- *GPSData* – The location to store GPS data for new sites

- *SiteShapefiles* – The location to store the new shapefiles once they have been converted

  from .dgn's or GPS files.

- *OutsideDatasets* – this folder contains spatial data that is not found in the geodatabase

but is used help locate and digitize the new shapefiles, such as parcel data, USGS "quad"

shapefiles, aerial photograph, hydrography shapefiles etc.

NOTE: The exact server location in which the database will reside has not yet been determined.

2.2   Introduction to the ESRI Geodatabase Model

The ArcGIS geodatabase is stored with the extension ".mdb", meaning it is basically a

Microsoft Access database with GIS functionality. It can be opened in either ESRI

software (ArcGIS 8.2) or Microsoft Access. Below illustrates how the geodatabase will

look in Microsoft Windows Explorer (top) and ArcCatalog (bottom).

MIT_v5   56,630 KB   Microsoft Access Database

MIT_v5.mdb   Personal Geodatabase
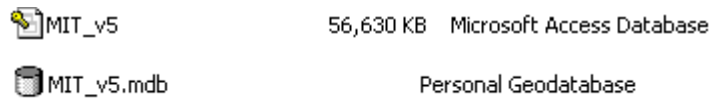
TIP: ArcCatalog is an ESRI program designed to browse data in ESRI format. It is similar to Microsoft Windows Explorer, however it helps to manage ESRI data, such as shapefiles and geodatabases, much more effectively. It will appear on the program menu with this icon: ArcCatalog **.**

The basic elements, or objects, of the ESRI geodatabase are feature classes, feature datasets, tables and relationship classes (which are not discussed is this text). The ESRI geodatabase objects in the Mitigation Site geodatabase are described in Section 4.

Warning: Though the Mitigation Site geodatabase can be opened in both ArcGIS and Microsoft Access, it is best NOT to open it in both programs at the same time. Editing the database while it is open in both programs will result in irreversible data corruption.

2.2.1 Feature Classes

Feature classes are conceptually similar to the more common shapfile format. They share the same geometry type (point, line or polygon), spatial reference (projection, etc.) and an attribute table. All of this data is stored in multiple tables in the geodatabase, though some may be hidden. Feature classes are either stand alone or stored inside a feature dataset (ESRI, 2000).

2.2.2 Feature Datasets

Feature datasets are containers for feature classes that have topological relationships or have the same spatial reference. They are conceptually similar to ESRI coverages, which are mainly used in ArcINFO. Feature classes that are stored in a feature dataset must have the same spatial reference, but do not have to share the same geometry (ESRI 2000). For example, a line feature class of streams can be stored in the same feature dataset with a polygon feature class of water bodies.
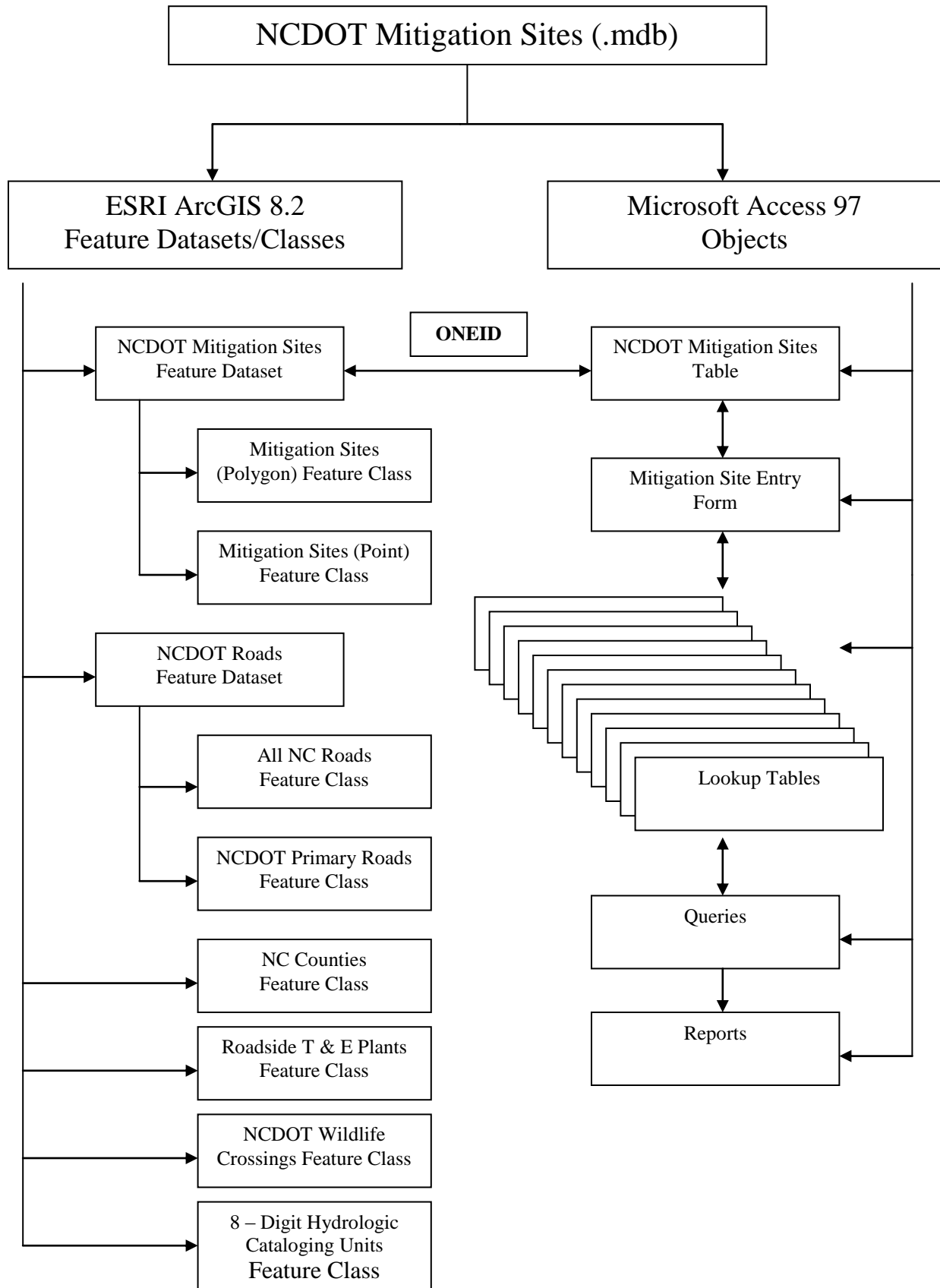
2.2.3 Tables

Table elements in the geodatabase refer to the attribute tables that store rows and columns of nonspatial tabular data and do not refer to the tables that store the geometry of the feature classes (ESRI, 2000). Each feature class possesses an attribute table that

stores attributes of each feature. Attribute columns, or fields, can be added and the value of each attribute can be edited in ArcGIS.

**2.3   Introduction to the Mitigation Site Geodatabase Design**

The spatial data for the mitigation sites is stored in two separate feature classes within the geodatabase. One of them is a polygon feature class, where the sites are polygons based on the site boundaries, and the other is a point feature class, where the sites are only represented with points. The attribute tables essentially store the same data for both feature classes. In addition to the ESRI geodatabase elements like feature classes and attribute tables, the Mitigation Site Geodatabase also contains Microsoft Access components, or objects, which are explained in detail in Section 3.0. Though the attribute tables of the feature classes contain some data, it was decided that the bulk of the attribute data would be stored in a separate table, capable of being joined to the attribute table in ArcGIS. By doing this, the attributes for the mitigation sites can be entered or edited in Microsoft Access without the need for ArcGIS software. This is helpful because ONE has only a limited number of ArcGIS licenses. However, ArcGIS is required when a site map is loaded or edited in the feature class. Figure 1 on the next page shows the basic layout of the entire geodatabase. The Access components are described in detail in Section 3 and ArcGIS elements are described in Section 4. The process for joining the tables is described in Section 5.

Figure 1: Basic Geodatabase Layout

NCDOT Mitigation Sites (.mdb)

ESRI ArcGIS 8.2 Feature Datasets/Classes	Microsoft Access 97 Objects

ONEID

NCDOT Mitigation Sites Feature Dataset

NCDOT Mitigation Sites Table

Mitigation Sites (Polygon) Feature Class

Mitigation Site Entry Form

Mitigation Sites (Point) Feature Class

NCDOT Roads Feature Dataset

All NC Roads Feature Class

NCDOT Primary Roads Feature Class

Lookup Tables

NC Counties Feature Class

Roadside T & E Plants Feature Class

Queries

NCDOT Wildlife Crossings Feature Class

Reports

8 – Digit Hydrologic Cataloging Units Feature Class

3.0 Microsoft Access Objects

The four main objects of Microsoft Access used in the geodatabase are tables, forms, queries and reports. When the *Mit_v5.mdb* is opened in Access, the "database window", shown below, displays all the current objects in the database. The tabs at the top of the window allow the user to select which type of object is displayed.
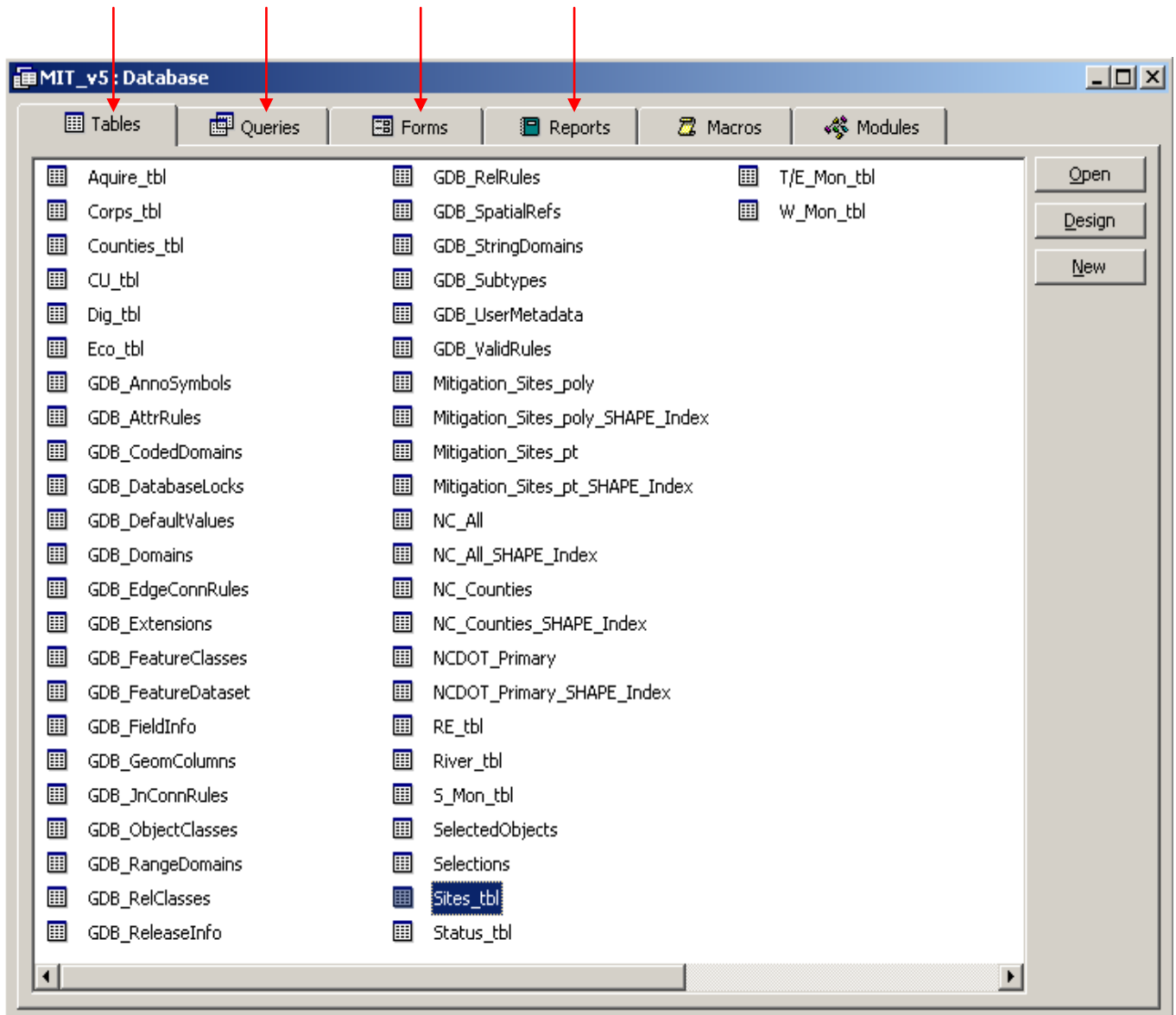
3.1   Tables

All of the information in the geodatabase, even spatial data, is stored in tables. However, additional tables were created in Access to store the large amounts of data associated with the mitigation sites. Notice in the previous figure, the table named *Sites_tbl* is highlighted. This is the main table for storing the attribute information for each site. All other tables are either the spatial data or lookup tables for the main table, *Sites_tbl* (these will be discussed later). To open the table, double click on it or single click on it to select it, then click on open. It will look like the figure below.

| SerialID	ONEID	Name	Alias	Alias2	TIP	Size	Oι
22	006-001	Hanging Rock Creek	n/a	n/a	R-2237WM	0	
18	009-002	Dowd Diary	n/a	n/a	R-2204WM	0	
14	016-001	Cedar Point	n/a	n/a	R-2105WM	0	
16	016-002	Deer Creek	n/a	n/a	R-2105WM	0	
26	025-001	Lengyel	n/a	n/a	B-2531	0	
37	025-002	Sawmill	n/a	n/a	B-2531	0	
15	025-003	Croatan	Croatan National Forest	n/a	R-1015WM	0	
13	027-002	Casey Tract	n/a	n/a	R-2228WM	0	
41	027-003	Tucker Tract	n/a	n/a	R-2228WM	0	
29	028-001	Mashoes Road	n/a	n/a	R-2551WM	0	
40	028-004	Stumpy Point	n/a	n/a	M-316	0	
35	028-006	Roanoke Visitor Center	Roanoke Island	n/a	K-4003WM	0	
30	033-001	Mildred Woods	n/a	n/a	R-2111WM	0	
20	034-001	Friedburg Marsh	n/a	n/a	R-2247WM	0	
17	037-001	Dismal Swamp	n/a	n/a	R-2208WM	0	
42	038-001	Tulula Creek	Tulula Bog	n/a	A-0009WM	0	
21	040-001	Gurley Swamp	n/a	n/a	R-1023WM	0	
32	045-002	Mud Creek	n/a	n/a	A-0010WM	0	
27	047-002	Long Swamp	n/a	n/a	R-0521WM	0	
11	051-003	Benson Grove	n/a	n/a	R-2547WM	0	
23	058-001	Huskanaw	n/a	n/a	R-2111WM	0	
12	063-001	Blue Tract	n/a	n/a	R-2417WM	0	
39	065-001	Spring Branch	n/a	n/a	U-0092WM	0	
43	067-002	USMC	US Marine Corps	n/a	U-2107	0	
36	076-019	Sandy Creek	n/a	n/a	I-2402	0	
24	078-006	Juniper Bay	n/a	n/a	R-0513WM	0	
45	085-002	Friends of Horseshoe	n/a	n/a	B-3045	0	
10	092-001	Abbot Stream	n/a	n/a	R-2541WM	0	
19	092-002	Dutchmans Creek	n/a	n/a	R-2000WM	0	
25	092-004	Lake Wheeler	n/a	n/a	R-2000WM	0	
34	092-005	Phillips Property	n/a	n/a	R-2000WM	0	

Record: 1 of 36

In all, there are 54 columns, or fields, which store the attributes of each site. Most of names of each field are coded or abbreviated in order to minimize the size of the database. The field names and descriptions are included in Appendix A. Some of the fields are numerical or text, meaning the information must be typed in as number or text. On the other hand, some of the fields were created as combo boxes, meaning the table will give all the possible values for the attribute in a list. These values are stored in another table, called a lookup table, and linked to the *Sites_tbl* table. Instead of typing in attributes, they are chosen from a defined list, thus the data entry process is simplified and the potential for errors in the database is minimized. Figure 2 on the next page shows how the main table, *Sites_tbl*, and all ten of the lookup tables are related. Lookup tables can be edited independently so the possible choices given in the combo box in the main table can be changed as needed. All of the lookup tables are described in Appendix B. An example of a combo box in the main table is shown below. When choosing the county the mitigation site is located in, a combo box with all of the county names appears. These county names are stored in a table called *Counties_tbl* which is linked to the main table.

Field name

"County" attribute for a mitigation site

Combo box
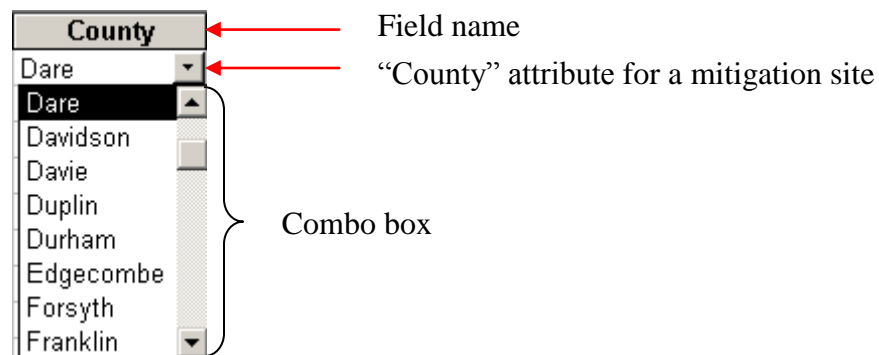
TIP: When an object is created in Access, a suffix is usually added to the end of name to help identify what type of object it is. For example, _tbl is placed at the end of the name of a table, _frm at the end of a form's name, _qry for query and _rep for report.

Figure 2: The relationship between the main table and the lookup tables
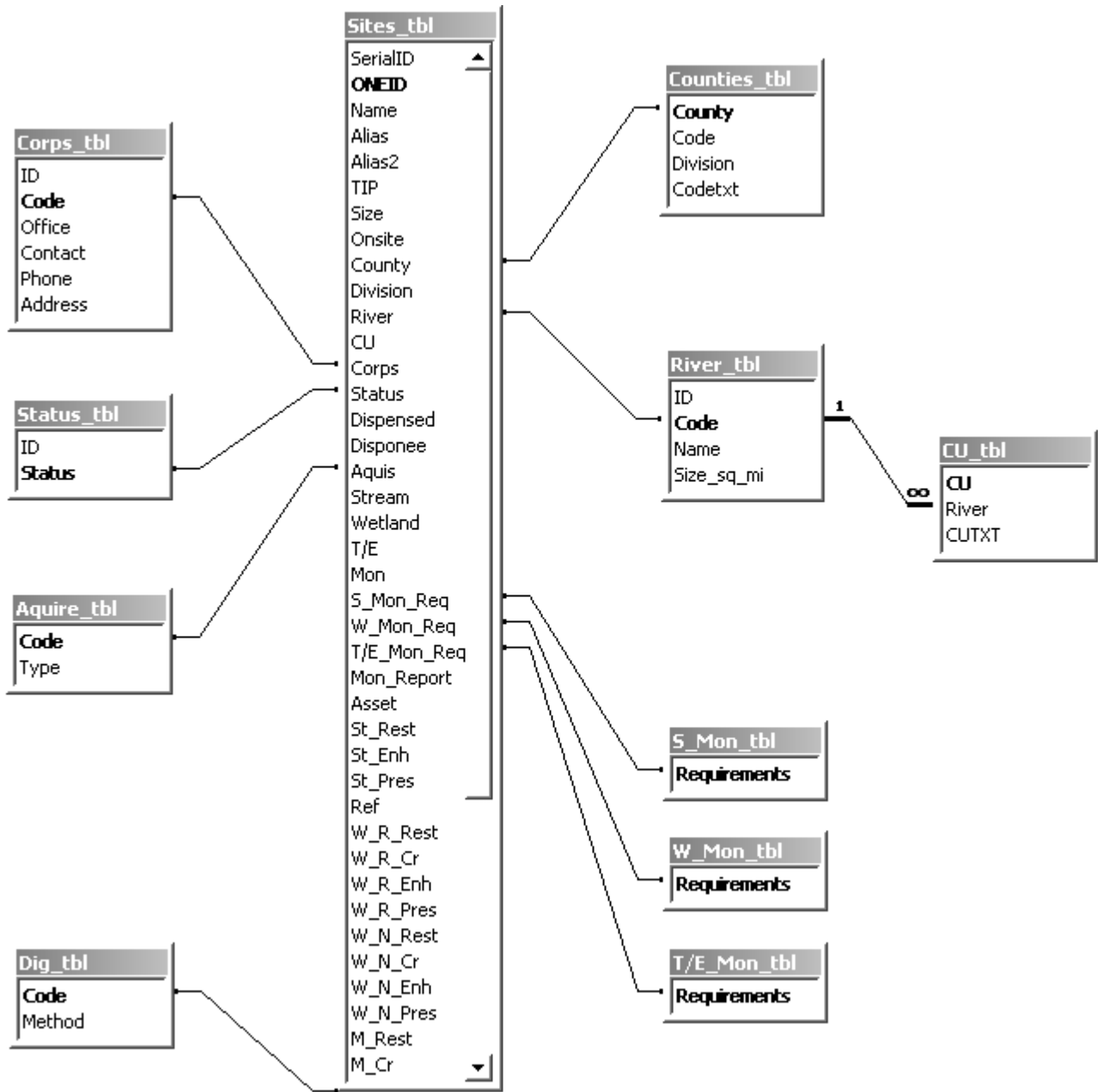
3.2   Forms

The tables are storage "containers" for data in the geodatabase and forms can be created to help enter the data into the table (Course Technology, 2000). A form can be designed in any way, but it usually contains the fields of the table so when they are entered in the form, they are also filled out in the table to which they are connected. Presently, there is only one form in Mitigation Site Geodatabase, *SiteEntry_frm*, and it is shown below. When the form is opened, notice the four tabs underneath the title named "General Info", "Internal Info" and two named "Mitigation Info". These are the four "pages" of the form for data entry. The mitigation site called Tucker Tract is used in the example.

The data entered into the form is the same data stored in the table. However, the form uses clearly worded labels instead of coded or abbreviated field names. The text boxes allow the information to be typed directly into the form next to these labels. Additionally, the combo boxes used in the table, will work for the form as well. The information for each mitigation site, or record, can be viewed by changing the record number at the bottom, shown below. To add a new record, or site, click on the button the red is pointing at, called the "New Record Button".

Record: I◄ ◄ 　　　9 ► ►I ►* of 36
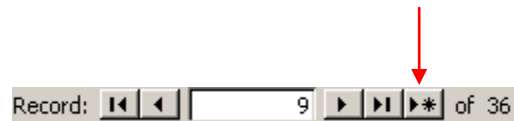
3.3 Queries

Queries are objects in Access design to answer "questions" about the database, meaning they usually summarize or calculate a value of an attribute or multiple attributes in one or more tables (Course Technology, 2000). They search the database for the answers to the question and display them in a separate datasheet. Datasheets are not objects and are only temporary. Queries can either be stand-alone, or they can be linked to a table or form to help provide attribute values. This text will describe the queries that were designed to be stand-alone. Additionally, queries can be linked to reports, which is described in Section 3.4. Currently, there are three of these queries in the database, *All_Sites_qry*, *ONEIDbyCounty_qry*, and *SitebyONEID_qry*. All of these appear under the "Queries" tab in the "Database Window", as shown in the next figure.
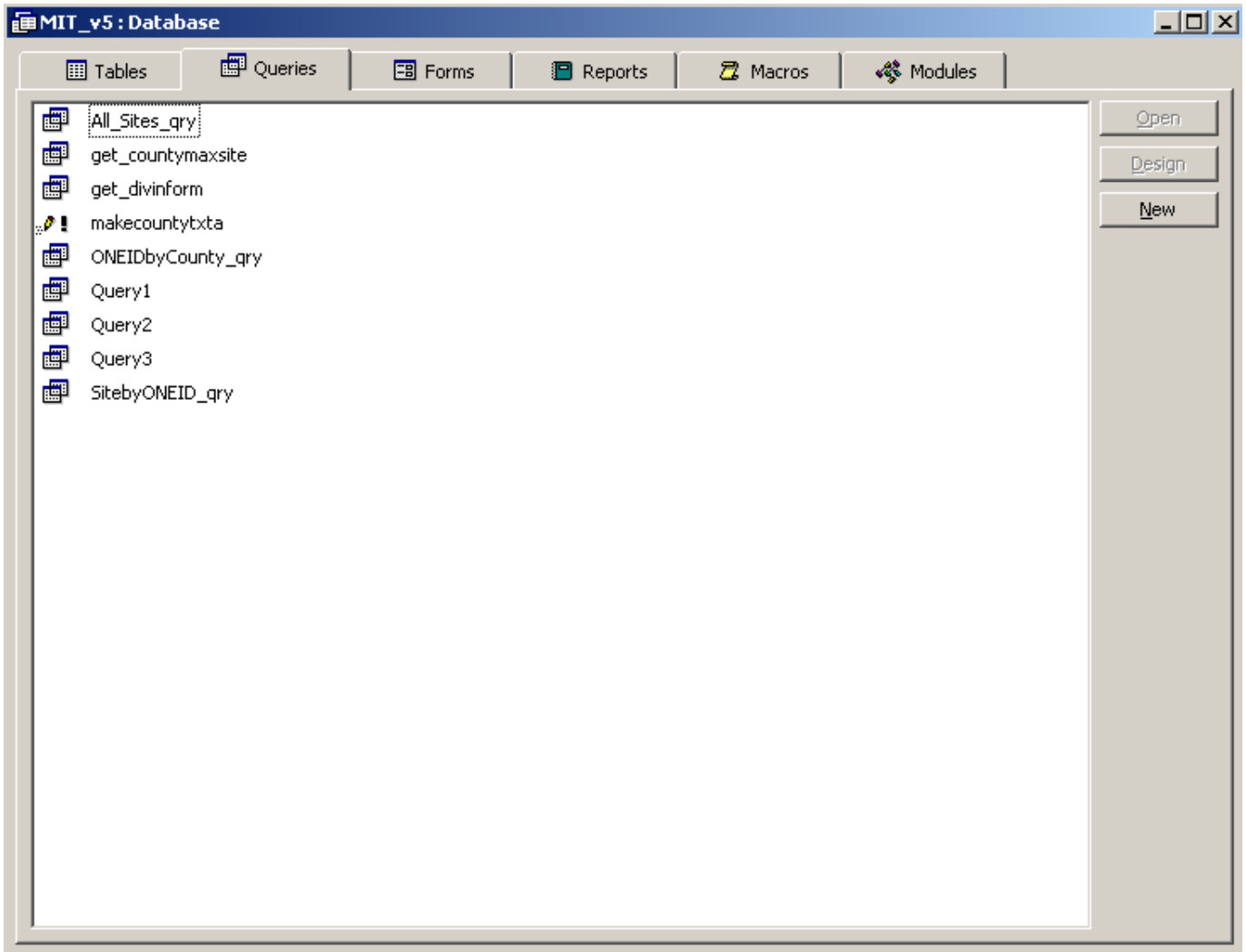
3.3.1 *All_Sites_qry* Query

The *All_Sites_qry* was designed to list all of the mitigation sites in the database. When the query is opened, a datasheet will appear listing all of the ONE ID's for each site, the site names, the name of the county in which they are located and the TIP number associated with it. The datasheet is shown on the next page. Again, this datasheet is only a subset of the main table *Sites_tbl* and is created temporarily. To print this information, refer to Section 3.4.

ONEID	Name	County	TIP
006-001	Hanging Rock Creek	Avery	R-2237WM
009-002	Dowd Diary	Bladen	R-2204WM
016-001	Cedar Point	Carteret	R-2105WM
016-002	Deer Creek	Carteret	R-2105WM
025-001	Lengyel	Craven	B-2531
025-002	Sawmill	Craven	B-2531
025-003	Croatan	Craven	R-1015WM
027-002	Casey Tract	Currituck	R-2228WM
027-003	Tucker Tract	Currituck	R-2228WM
028-001	Mashoes Road	Dare	R-2551WM
028-004	Stumpy Point	Dare	M-316
028-006	Roanoke Visitor Center	Dare	K-4003WM
033-001	Mildred Woods	Edgecombe	R-2111WM
034-001	Friedburg Marsh	Forsyth	R-2247WM
037-001	Dismal Swamp	Gates	R-2208WM
038-001	Tulula Creek	Graham	A-0009WM
040-001	Gurley Swamp	Greene	R-1023WM
045-002	Mud Creek	Henderson	A-0010WM
047-002	Long Swamp	Hoke	R-0521WM
051-003	Benson Grove	Johnston	R-2547WM
058-001	Huskanaw	Martin	R-2111WM
063-001	Blue Tract	Moore	R-2417WM
065-001	Spring Branch	New Hanover	U-0092WM
067-002	USMC	Onslow	U-2107
076-019	Sandy Creek	Randolph	I-2402
078-006	Juniper Bay	Robeson	R-0513WM
085-002	Friends of Horseshoe	Stokes	B-3045
092-001	Abbot Stream	Wake	R-2541WM
092-002	Dutchmans Creek	Wake	R-2000WM
092-004	Lake Wheeler	Wake	R-2000WM
092-005	Phillips Property	Wake	R-2000WM
092-007	New Light Creek	Wake	R-2000WM
092-009	Speight Branch	Wake	R-2541WM
092-010	Mingo Creek	Wake	R-2641WM

3.3.2 *ONEIDbyCounty_qry* Query

The *ONEIDbyCounty_qry* query was designed to list the ONE ID numbers that have already been assigned to the sites in a specific county. This query is useful when a new ONE ID needs to be assigned to a new site. The datasheet will show all the numbers assigned to sites in a county so the next number in order can be assigned to the new site. When this query is opened, a dialog box will ask what county needs to be viewed, as shown in the next figure.
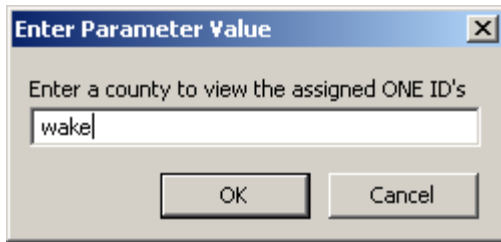
When the county name is entered, click "OK" and a datasheet will appear, listing the

ONE ID number, the county, and the site name, as shown below.

3.3.3 *SitebyONEID_qry* Query

The SitebyONEID_qry query was designed to list all of the attributes of a

specific mitigation site in the database. When the query is opened, a dialog box

will ask which site needs to queried, based on the site's ONEID. The next figure

shows the dialog box with the Tucker Tract as the example.
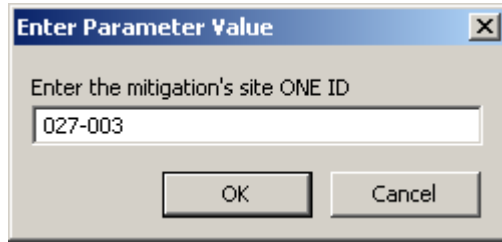
After the ONE ID is entered, click "OK" and the datasheet will display the main table with one record, which will be the site that was entered, as shown below.

SerialID	ONEID	Name	Alias	Alias2	TIP	Size	Onsite
1	027-003	Tucker Tract	n/a	n/a	R-2228WM	68.3	☐
(AutoNumber)			n/a	n/a		0	☐

3.4   Reports

Reports are Access objects used to create printouts of data from the database. They can either be based on fields or records from a table or query (Course Technology, 2000). Currently, there are three reports in the database, all of which are based on the three queries described in the previous sections. As shown in the next figure, these are all share the same name as the queries, with the exception of the _rep suffix used in place of _qry suffix.
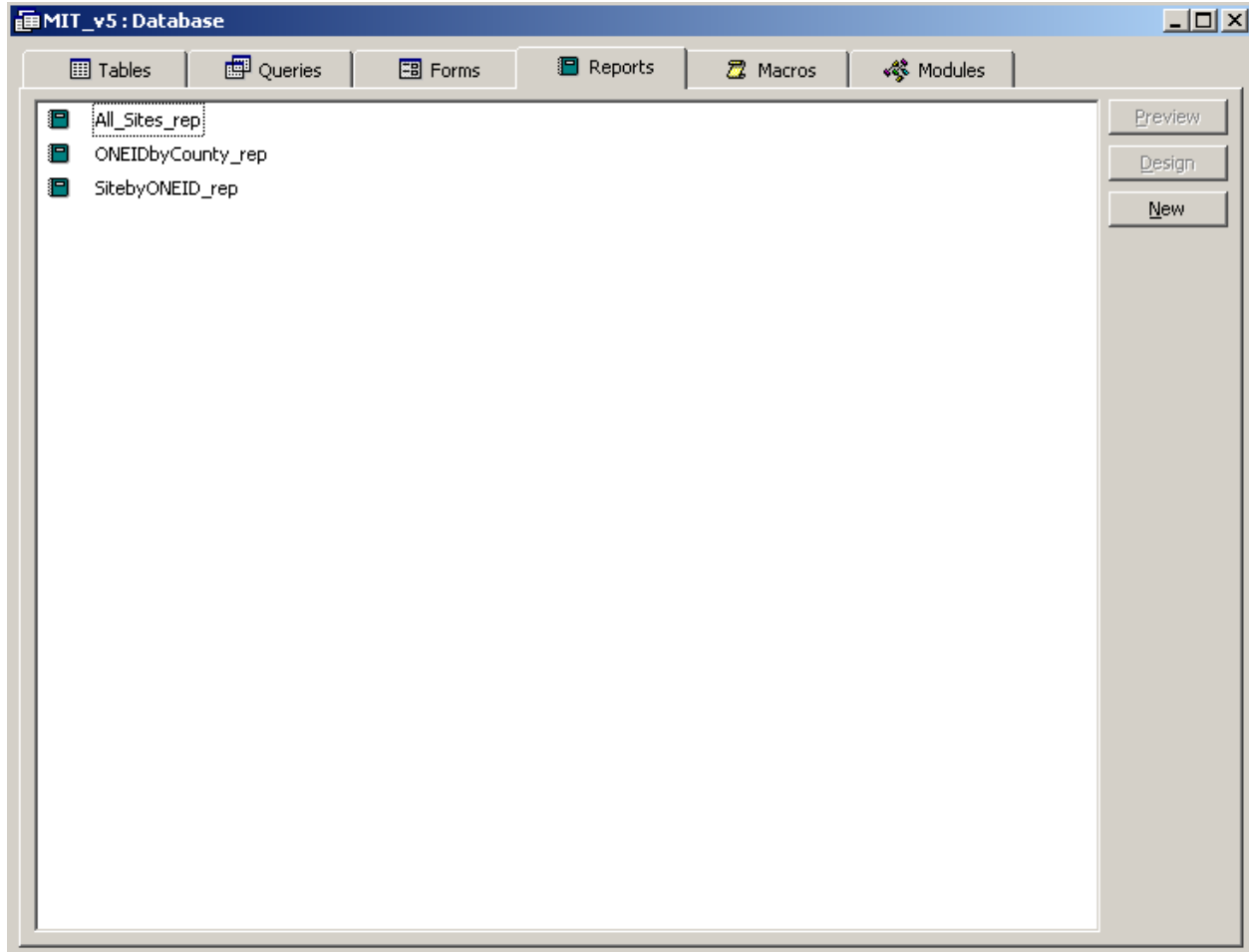
Data cannot be entered or stored with a report. They are used solely for creating customizable printouts of the data. As with the form, the reports use labels that clearly describe the field instead of the coded or abbreviated field names. When the *AllSites_rep* is opened it automatically creates a report of all the sites in the database, just like the query but a little more readable. When the *ONEIDbyCounty_rep* and *SitebyONEID_rep* reports are opened, the initial dialog box must be filled out exactly like the query. The report can then be exported as a Microsoft Word document or sent to the printer.

4.0   ESRI Geodatabase Objects

The figure below shows what the geodatabase and its objects look like in ArcCatalog.   Notice all of the tables shown are tables created in Microsoft Access, while the other objects are feature datasets and feature classes, which are described in the following sections.
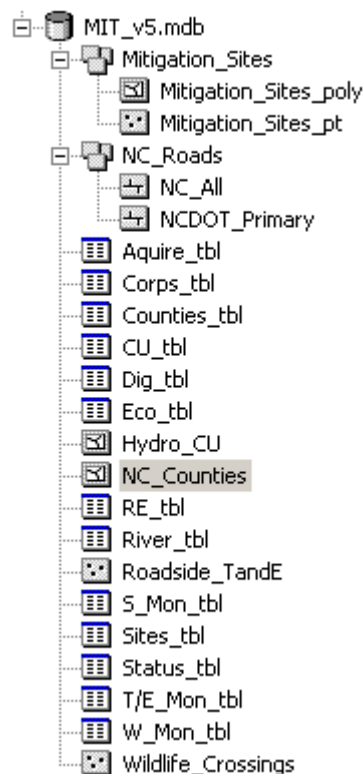
4.1   Feature Datasets

As stated in Section 2.2 feature datasets are containers that store feature classes with the same spatial reference and/or have topologic relationships. In the Mitigation Site geodatabase, there are two feature datasets, *Mitigation_Sites* and *NC_Roads*, and both contain two feature classes.

4.1.1 *Mitigation_Sites* **Feature Dataset**

The *Mitigation_Site* feature dataset contains the two feature classes of the mitigation sites, *Mitigation_Sites_poly* and *Mitigation_Sites_pt*, which are described in Section 4.2.1 and 4.2.2. The feature dataset can be added to ArcMap or each of the individual feature classes can be added separately.

4.1.2 *NC_Roads* **Feature Dataset**

The *NC_Roads* feature dataset also contains two feature classes, *NC_All* and *NCDOT_Primary*, which are described in Section 4.2.3 and 4.2.4. These feature datasets were created to simply help organize the data by keeping feature classes of similar theme together in one dataset.

4.2 **Feature Classes**

There feature classes *Mitigation_Sites_*poly, *Mitigation_Sites_pt*, *Roadside_TandE* and *Wildlife Crossings* were created to store the spatial data for the mitigation sites and other ONE information. The remaining feature classes were included in the geodatabase to aid the user in verifying the correct location of each site.

4.2.1 *Mitigation_Sites_poly* **Feature Class**

Mitigation_Sites_poly was created for storing all of the NCDOT mitigation sites as polygon features. The steps for editing and adding new sites to this feature class in described in Section 4.4.

4.2.2 *Mitigation_Sites_pt* **Feature Class**

Mitigation_Sites_pt was created for storing all of the NCDOT mitigation sites as point features. This feature class is similar to *Mitigation_Sites_poly*, except the sites are

represented as points. The steps for editng and adding new sites to this feature class is described in Section 4.4 as well.

4.2.3 *NC_All* Feature Class

NC_All is a feature class representing all the roads in North Carolina, both state-maintained and non state-maintained. It is derived from a shapefile, created and distriubted by the NCDOT GIS Unit. For more information and metadata, visit the GIS Unit at **www.ncdot.org/planning/tpb/gis** . This feature class will need to be regularly updated.

4.2.4 *NCDOT_Primary* Feature Class

NCDOT_Primary represents all of the primary roads in North Carolina and includes all interstate, US and NC highways. These roads are all features in the *NC_All* feature class, as well. However, *NCDOT_Primary* is much smaller and less cumbersome to use in ArcMap and may be more practical to use in some situations. This feature class is derived from a shapefile created and distributed by the NCDOT GIS Unit and should be regularly updated. For more information and metadata, visit the GIS Unit at **www.ncdot.org/planning/tpb/gis** .

4.2.5 *NC_Counties* Feature Class

NC_Counties represents the county boundaries of North Carolina as polygons, as distributed within NCDOT by the NCDOT GIS Unit. For more information and metadata, visit the GIS Unit at **www.ncdot.org/planning/tpb/gis** .

4.2.6 *Hydro_CU* Feature Class

Hydro_CU represents the 8-digit hydrologic cataloging units in North Carolina. This feature class is derived from the shapefile named "nchu83mp.shp", which is a

revision of the 1996 24K Hydrologic Unit shapefile. It originally stored the 10-digit

hydrologic units, but the 10-digit units were dissolved, or grouped together, into the 8-

digit cataloging units to create this feature class. The shapefile was distributed to ONE

by Sherman Biggerstaff of the USDA NRCS. He can be contacted at 919-873-2132 or

emailed at Sherman.Biggerstaff@nc.usda.gov.

4.2.7 *Roadside TandE* Feature Class

This feature class does not yet contain features. In the future, it will store

the locations of roadside threatened and endangered plant species as a point file.

4.2.8 *Wildlife_Crossings* Feature Class

This feature class does not yet contain features. In the future it will store

the locations of wildlife crossings designed to help the movement of animals

across roadways and reduce roadkill.

4.3 Attribute Tables

Each feature class includes an attribute table that contains nonspatial data about

each feature. These tables are viewed and edited in ArcGIS when the feature class is

added to ArcMap. Only the attribute tables for the *Mitigation_Sites_poly* and

Mitigation_Sites_pt feature classes will be described in this text. Attribute tables for the

Roadside_TandE and *Wildlife_Crossings* feature classes do not exist as of now, but will

be included in this text once they are created. The user is encouraged to explore the

tables for the other feature classes or visit the NCDOT GIS website at

www.ncdot.org/planning/tpb/gis for further details.

4.3.1   Attribute Table for the *Mitigation_Sites_poly* Feature Class

    To open the attitude table, add the feature class to ArcMap and right click on the feature class name and click "Open Attribute Table". The attribute table is shown in the next figure and contains seven attribute fields.

OBJECTID*	SHAPE*	Cnt_Id	Name	ONEID	SHAPE_Length	SHAPE_Area
2	Polygon	1	USMC	067-002	2655.313161	187087.385443
3	Polygon	2	Tulula Creek/Bog	038-001	22192.896091	10037979.069510
4	Polygon	1	Tucker Tract	027-003	10133.676970	2998207.115583
5	Polygon	2	Stumpy Point	028-004	3261.489145	184974.030750
6	Polygon	2	Spring Branch	065-001	5546.089919	622241.658169
7	Polygon	1	Speight Branch	092-009	5523.587739	1182382.102726
8	Polygon	1	Sawmill	025-002	2189.691539	177449.214328
9	Polygon	1	Sandy Creek	076-019	5297.975327	575013.465729
10	Polygon	2	Roanoke Island Visitor's Center	028-006	5064.331107	152138.364939
11	Polygon	1	Phillips Tract	092-005	9382.537986	2516055.794686
12	Polygon	1	New Light Creek	092-007	4959.327188	862591.371462
13	Polygon	1	Mud Creek	045-002	7119.056741	1704675.225692
14	Polygon	2	Mingo Creek	092-010	19588.449165	8923634.102797
15	Polygon	2	Mildred Woods	033-001	42568.017737	260062323.718400
16	Polygon	2	Mashoes Road	028-001	42266.853926	17371891.559478
17	Polygon	2	Marks Creek	092-011	10560.620838	2988891.508374
18	Polygon	4	Long Swamp	047-002	29630.273182	10437231.565425
19	Polygon	3	Lengyel	025-001	6141.830166	512442.387795
20	Polygon	1	Lake Wheeler	092-004	13984.137642	5051554.849668
21	Polygon	1	Juniper Bay	078-006	23349.062807	31734209.723948
22	Polygon	1	Huskanaw Swamp	058-001	10088.908244	5043118.057471
23	Polygon	1	Hanging Rock Creek	006-001	4355.784593	428274.115075
24	Polygon	3	Gurley Tract	040-001	23120.162667	7571702.943466
25	Polygon	1	Freidburg Marsh	034-001	7024.186833	2261779.942245
26	Polygon	1	Dutchmans Creek	092-002	10757.719153	3768172.909112
27	Polygon	1	Dowd Dairy	009-002	26454.806910	28743049.612343
28	Polygon	1	Dismal Swamp	037-001	20919.050596	26640033.205185
29	Polygon	1	Deer Creek	016-002	1838.293611	194698.027030
30	Polygon	2	Croatan	025-003	63153.560965	175714973.260264

Record: 14 ◄ [1] ► ►I   Show: All | Selected | Records (0 out of 36 Selected.)   Options ▼

    The names and descriptions of each attribute field are described below.

"ObjectID" – An internal ID number automatically generated by ArcGIS when a new feature is added.

"Shape" – The geometry of the features (point, line or polygon) automatically generated by ArcGIS when a new feature is added.

"Cnt_ID" – The number of polygons associated with each feature. For example, a site may be compose of two polygons, so the "Cnt_ID" would be "2". This situation is described in more detail in Section 4.4, Step 6. This attribute will need to be manually entered into the table, which is detailed in Section 4.4, Step 7.

"Name" – The name of the mitigation site. This attribute will need to be manually entered into the table, which is detailed in Section 4.4, Step 7.

"ONEID" – This is the ID of each site that is used throughout the database. It is used to link the attribute table to the Sites_tbl Access table that stores the rest of the attribute data. This attribute will need to be manually entered into the table, which is detailed in Section 4.4, Step 7.

"SHAPE_Length" – The length of the polygon(s) perimeter in feet. This attribute is automatically generated by ArcGIS when a new feature is added.

"SHAPE_Area" – The area of the polygon(s) in square feet. This attribute is automatically generated by ArcGIS when a new feature is added.

4.3.2   Attribute Table for the Mitigation_Sites_pt Feature Class

This table is opened the same way as described above when the feature class is added to ArcMap and is shown below.

OBJECTID*	SHAPE*	ONEID	Name
1	Point	038-001	Tulula Creek/Bog
2	Point	045-002	Mud Creek
3	Point	078-006	Juniper Bay
4	Point	047-002	Long Swamp
5	Point	009-002	Dowd Diary
6	Point	063-001	Blue Tract
7	Point	034-001	Friedburg Marsh
8	Point	076-019	Sandy Creek
9	Point	092-010	Mingo Creek
10	Point	092-011	Marks Creek
11	Point	092-001	Abbott Property
12	Point	092-009	Speight Branch
13	Point	092-002	Dutchmans Creek
14	Point	092-005	Phillips Tract
15	Point	092-004	Lake Wheeler
17	Point	051-003	Benson Grove
18	Point	098-001	Wiggins Mill
19	Point	040-001	Gurley Tract
20	Point	033-001	Mildred Woods
21	Point	058-001	Huskanaw Swamp
22	Point	016-001	Cedar Point
23	Point	016-002	Deer Creek
24	Point	025-003	Croatan
25	Point	025-001	Lengyel
26	Point	025-002	Sawmill
27	Point	037-001	Dismal Swamp
28	Point	027-003	Tucker Tract
29	Point	027-002	Casey Tract
30	Point	028-001	Mashoes Road

Record: 1   Show: All Selected   Records (0 out of 36 Selected.)

The attributes are the same as the *Mitigation_Sites_poly* except the attributes "Cnt_ID", "SHAPE_Length" and "Shape_Area" because these are only associated with polygon features.

4.4   Adding New Sites to the Mitigation Site Feature Classes

The following procedures describe how a new mitigation site is added to the *Mitigation_Sites_poly* and/or *Mitigation_Sites_pt* feature classes.

Step 1: Acquiring Data

Spatial data for the database may come from different forms, such as Microstation files (.dgn), GPS files (.cor), existing shapefiles and possibly aerial photographs. The likely source will be .dgn from the NCDOT Locations and Surveys Unit or ,occasionally, a .dwg from a contract surveyor or consultant. Fortunately, ArcGIS has the capabilities to read and import both .dgn's and .dwg's. This section will focus on drawing, or digitizing, a shapefile from a .dgn. The new shapefile will then be stored in the geodatabase as a feature in the *Mitigation_Site_poly* and *Mitigation_Site_pt* feature classes (both polygon and point variations). There are numerous ways of accomplishing this and the best method may be different depending on the data, the software, the operator user's experience, etc. The reader is encouraged to explore the data and the software and adjust the methodologies to best fit the situation.

The procedures for acquiring information using a GPS unit and, subsequently, exporting it as a shapefile are explained in Section 3.8 ONE GPS Protocol under Section 3 IT Strategy of the ONE Procedures Manual. The procedures for digitizing the site boundaries from an aerial photograph are briefly described in Step 3, as well as how to extract data from an existing shapefile in Step 4.

> **Important Note: The database and all other spatial data related to this database is projected using the NAD 83 North Carolina State Plane coordinates in FEET.**

Step 1.1

Once the .dgn of the boundaries has been acquired, Open ArcCatalog and create a new folder within the "dgn" folder, then name it after that mitigation site. For the purposes of these procedures, a new mitigation site, Tucker Tract, will be used as an example throughout the process.
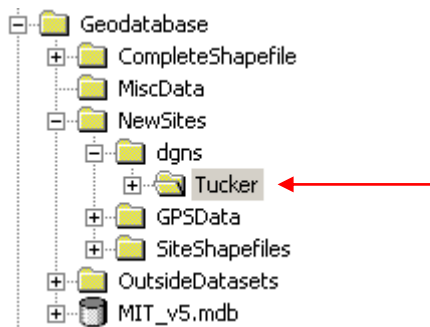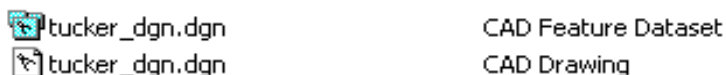

Step 1.2

Place a copy of the .dgn in the new folder. The .dgn file of the survey boundary for Tucker Tract appears in Windows Explorer as the following:
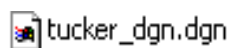
As stated before, ArcGIS can read the .dgn file extension and the same .dgn appears in ArcCatalog as two files, shown below:

Step 1.3

       The .dgn on top, the CAD Feature Dataset, resembles an ESRI and is composed

of several layers. When it is expanded, the four layers are a annotation layer, which

contains all the text in the .dgn and point, polygon, and polyline layers, which contain the

points, polygon and line features of the .dgn, respectively. They can be added separately

into ArcMap as well, or added all together as a single file.
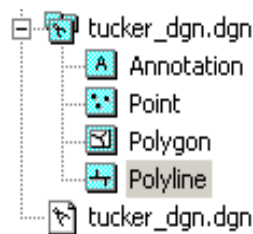
The bottom .dgn, the "CAD Drawing", contains all of these layers as well, though they

are kept together and can not be displayed separately.

Step 2: Adding the .dgn to ArcMap

Once you have gathered the .dgn and confirmed that ArcGIS can read it with

ArcCatalog, it can be loaded into ArcMap for futher analysis in preparation for creating a

shapefile.

Step 2.1

Open ArcMap by clicking on the "Launch ArcMap" button in ArcCatalog, as

shown below.
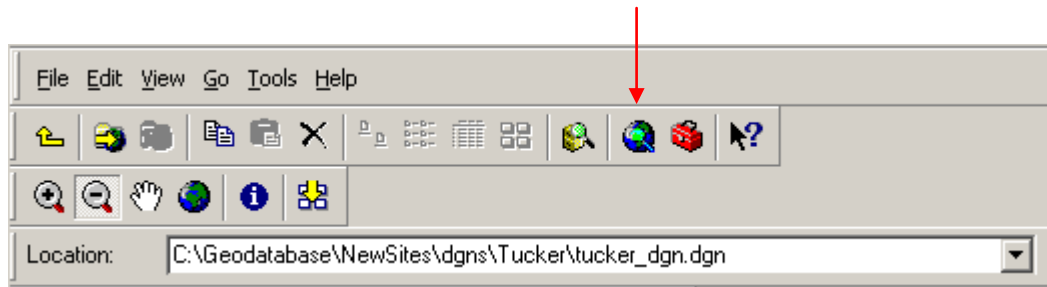
Step 2.2

Once ArcMap is launched, it will give the option of opening an empty map, a

template or an existing map. Click on "an empty map". Add data by clicking on the

"Add Data" button:

Step 2.3

Navigate to the *Tucker* folder and add the .dgn. As discussed in the previous

section, there are two versions of the .dgn. The file described as a "CAD Feature

Dataset", shown in the next figure, is used to digitize from, though sometimes the "CAD

Drawing" is better for viewing.

tucker_dgn.dgn   CAD Feature Dataset ←———————

tucker_dgn.dgn   CAD Drawing

When *Tucker_dgn.dgn* is added to the map, it will look like the figure below:
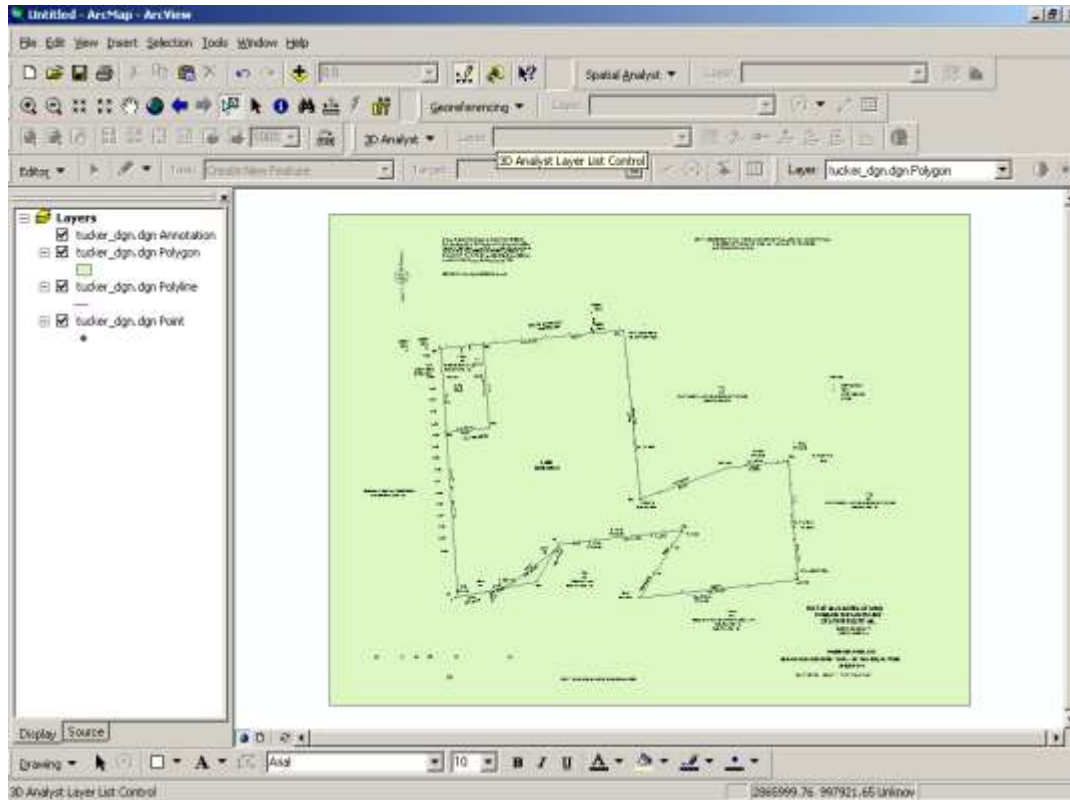
Step 2.4

        The .dgn has been added to the map and now the location of the site needs to checked to confirm the .dgn is georeferenced correctly. In other words, make sure the .dgn is correctly placing the site boundary on the ground in ArcMap. To do this, other datasets will need to be added, such as county boundaries, road centerlines, parcel data, or possibly aerial photographs, if available, and overlain with the .dgn. This data should be found in the *Outside Datasets* folder. As stated at the beginning of this section, the database and all outside datasets should be projected in NAD 83 NC State Plane Feet

coordinates. If the .dgn does not place the site in the correct location, it may be projected differently.   If the .dgn is projected differently, the original projection needs to be determined by asking the person or entity whom created the file. Most likely, if there is a positional inaccuracy, the .dgn was projected using meters instead of feet. Make note if this is the situation as it will be addressed in a later step.

<div style="border:1px solid black; padding:8px">

TIP: If the .dgn shows up to the south and east of its true position, usually completely out of the state of North Carolina, it is most likely projected in meters instead of feet.

</div>

Step 2.5

The .dgn will now need to be explored in ArcMap before the next step. Microstation allows different features, or elements, of a .dgn to be stored on different levels that can be turned on and off as needed (Full explanation of Microstation file stucture is beyond the scope of this manual). The different levels can be examined as properties of the .dgn in ArcMap. To do this, right click on the polyline layer of the .dgn in the Table of Contents and click on "Properties". The polyline layer is important because the site boundary lines will be stored in this layer. The annotation, polygon and points layers can be turned off as well.
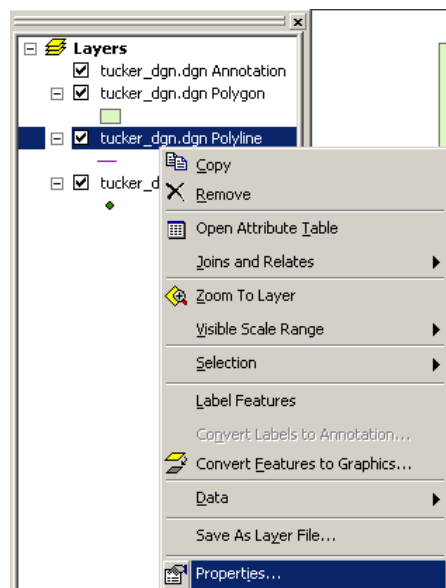
Step 2.6

Click on the "Drawing Layers" tab and ArcMap will list all 64 possible levels (0-63) Microstation offers for drawing .dgns. The levels can then be turned on and off in ArcMap. This is to determine which level the actual site boundary is stored in and may be helpful when the .dgn is digitized and will be explained in a later step. When the appropriate level is located, make note of this and continue to Step 5. The levels of *Tucker_dgn.dgn* is illustrated below:
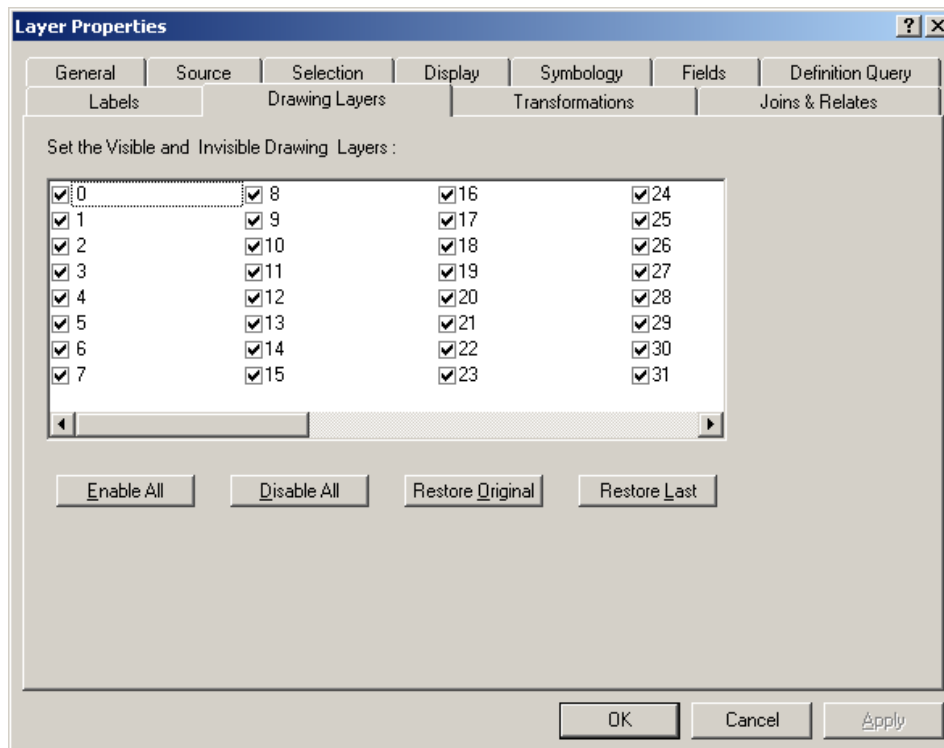

Step 3: Creating a new shapefile

The .dgn containing the site boundary is now in an ESRI format, however, it needs to be digitized as a shapefile with the correct geometry. In other words, the site needs to be converted from a line file to a polygon file. Again, this could be easily

accomplished with ArcINFO Command Line, however, ONE currently does not have this software and must find an alternative method. A new empty shapefile needs to be created and the site boundary will be drawn in as a polygon.

TIP: **This step and the following step can be used to digitize a shapefile from an aerial photograph. Once a new shapefile is created, load the photo to ArcMap and digitize the site boundaries from it instead of digitizing it from .dgn, which is described in the next step.**

Step 3.1

In ArcCatalog, navigate to the folder *NewSite*s and right click on the *SiteShapefiles* folder. Click on "New", then "Shapefile" as shown below:
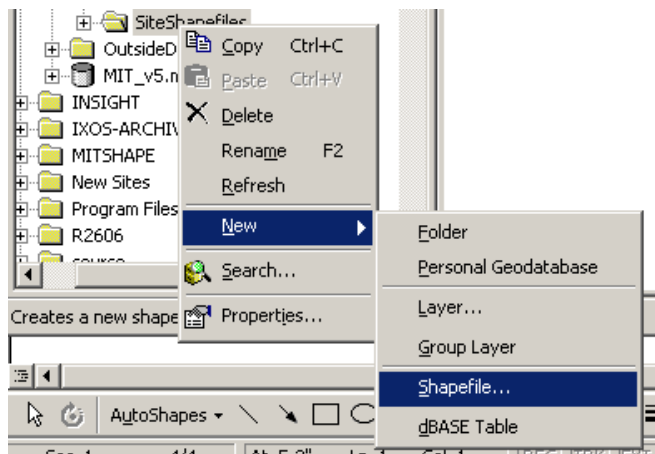
Step 3.2

A dialog box, shown in the next figure, will then asks for several requirements to complete the process. Type the name of the site as the name of the new shapefile, in this case, "Tucker". Next, be sure to choose "Polygon" as the feature type. The

"Description" box under "Spatial Reference" allows the user to define the projection of the new shapefile, as it will be undefined as this point.
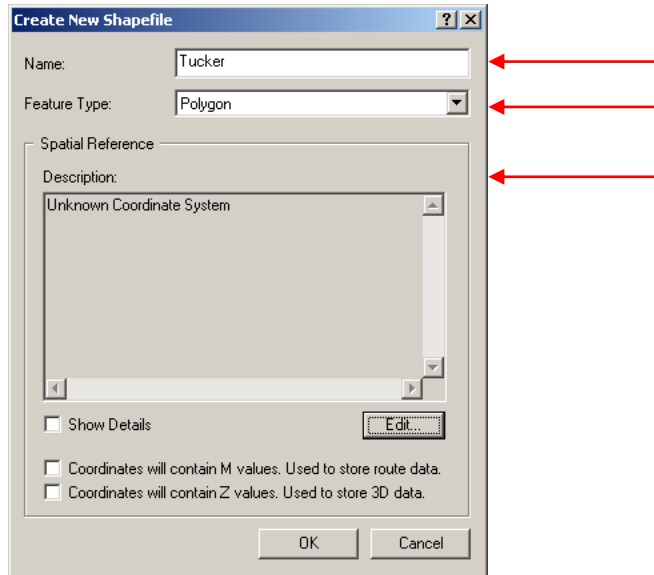
Step 3.3

The coordinate system of the .dgn should have been determined in Step 2.4 and the same coordinate system should be used for this shapefile. Choose the coordinate system by clicking on the "Edit…" button, which the opens another dialog box, shown below.
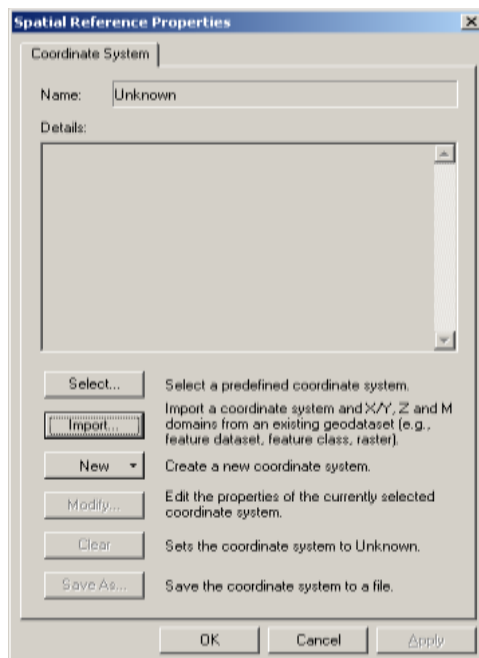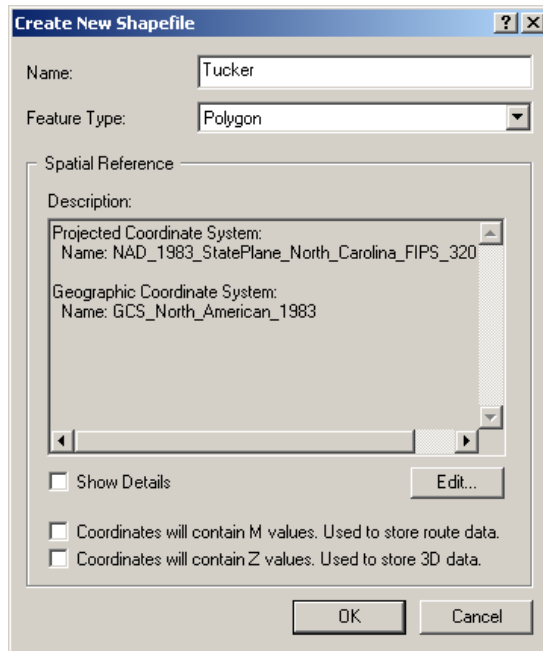
Step 3.4

From here, the coordinate system can then be selected from a collection of systems or it can be imported from another shapefile if it has already been projected. Importing a coordinate system is the easiest method and can be used if NAD 83 NC State Plane Feet is being used because the entire geodatabase is projected using this coordinate system. If this is not the case, proceed to Step 3.6. If this is the situation, click on the "Import…" button and navigate to the geodatabase and click on one of the feature classes within the geodatabase. Then click "Add", then "OK" to import this coordinate system.
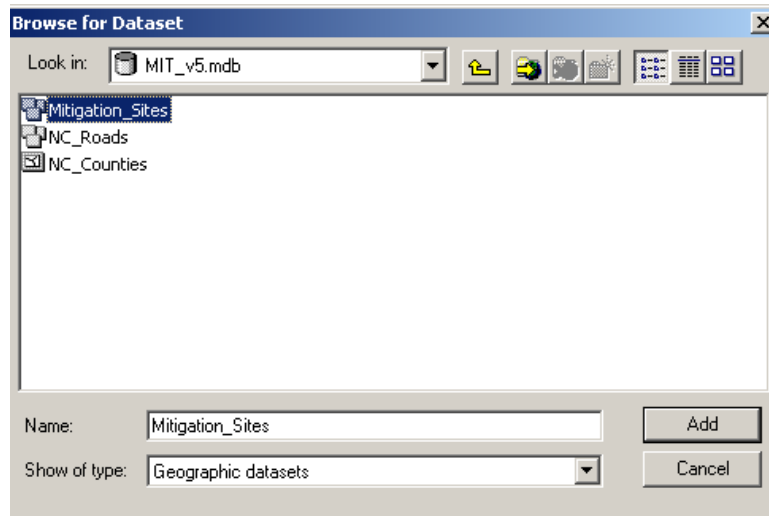
All of the coordinate system's details will then be listed in the "Description" box described earlier, shown in the next figure.

Step 3.5

Click "OK" in this box and the shapefile is projected and the process is complete. The shapefile should now show up in ArcCatalog.

Step 3.6

If the original .dgn was projected in meters instead of feet, the new shapefile will also need to be projected in meters, even though the geodatabase is projected in feet. This conflict will be addressed later. In order to project the new shapefile in a coordinate system other than NAD 83 NC State Plane Feet, such as NAD 83 NC State Plane Meters, it will have to be selected instead of imported. Click on the "Select…" button, then click on the folder "Projected Coordinate Systems", then "State Plane" to select among various state plane systems. "NAD 83 (feet)" can be chosen here and is an alternative to importing the NAD 83 NC State Plane Feet coordinate system as described in the previous step. Instead, click on the folder "NAD 83" for meters (Meters is implied here

and not shown). The state plane coordinate system in meters for every state is contained

in this folder, so find North Carolina's. Click on it, then click on "Add".
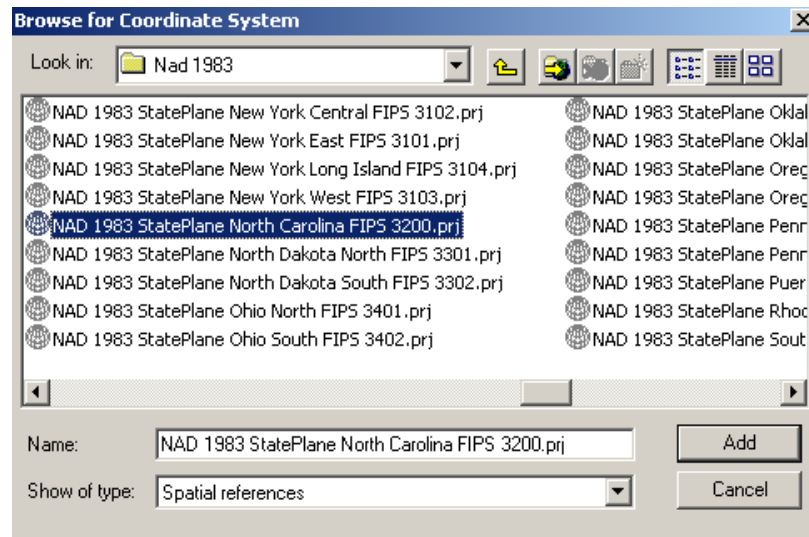
Step 3.7

Click "OK" in the next box and the shapefile is projected and the process is

complete. The new shapefile should now show up in ArcCatalog.

Step 3.8

If the shapefile is projected in something other that NAD 83 NC State Plane Feet,

meters for example, it will then need to be reprojected in feet using the Projection Wizard

in ArcToolbox so it will be compatible with the rest of the geodatabase.

Step 4: Preparing the .dgn

The boundary line can be digitized directly from the polyline layer on the .dgn as

is. But before digitizing, the boundaries of the site need to be clearly visible and not

confused with other lines that are common in these files. Because .dgns have many

levels and can store a large amount of data, they can appear cluttered at times. To reduce the clutter, you can extract the only the data you need. There are several ways of accomplishing this.

Step 4.1

Step 2.5 recommended making a note of the level in the .dgn file on which the actual site boundary was located. Turn all the levels off except the level on which the site boundaries are stored. This may not help if a lot of other features are stored on the same level as well.
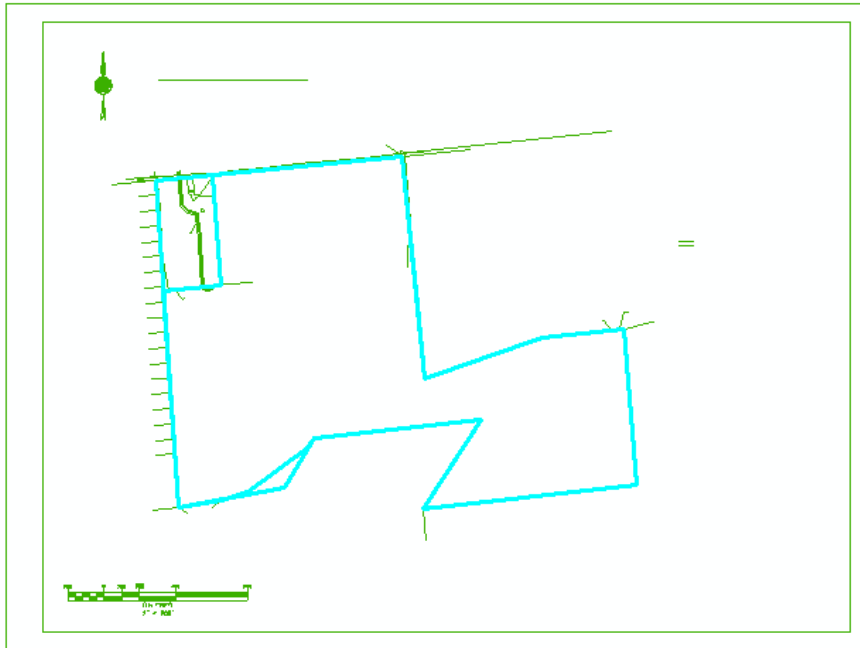
Step 4.2

Another way to extract data from an imported .dgn is to directly select lines using the "Select Features" tool on the Tools Toolbar, shown below:

This tool allows the user to point at features, such as lines, on the drawing with the cursor and selecting them by clicking on them. The selected feature will be highlighted in blue. Below, the boundary of Tucker Tract was selected and is highlighted.

Step 4.3

The selections now need to be isolated from the rest of the file. The easiest way to accomplish this is to right click on the .dgn from which you just made the selection, then click on "Create Layer From Selected Features", shown below.
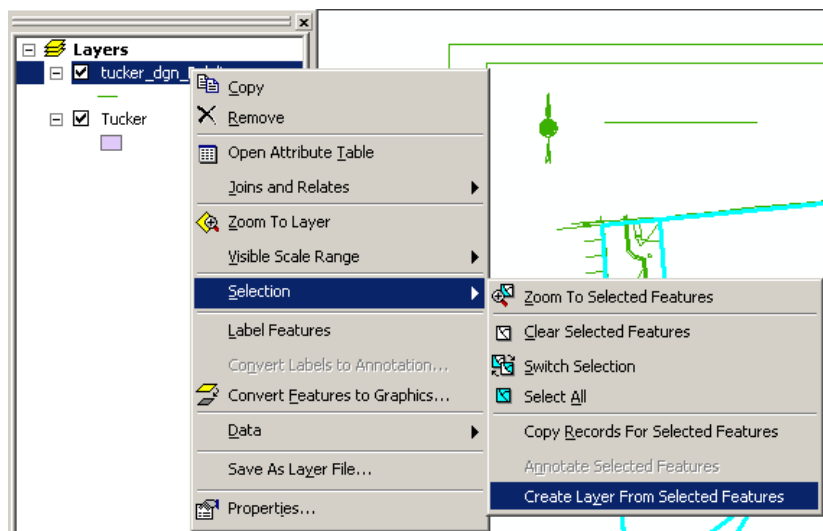
The features that were selected are now a separate layer. The new layer is not a new

shapefile, just a portion of the original layer copied and stored temporarily. In the

example it is named *Tucker_dgn.dgn Polyline Selection* by default.

TIP: The Select Features tool **can also be used to extract features from existing shapefiles. For example, if parcel data is used to create a shapefile of a site, use the Select Feature tool to select the parcel. A shapefile can then be created of the selected parcel. To do this, right click on the original parcel shapefile, then click on "Data", then on "Export Data". ArcGIS will then ask the path and name of the new shapefile. This can then be added into the geodatabase as described in Step 8.**

Step 5: Digitizing the new shapefile

The new shapefile that was created is empty and now data is ready to be placed in

it. This will be performed by using the Editing tools in ArcGIS.

Step 5.1

Add the new shapefile into ArcMap where the .dgn has already been added. Be

sure the Editor toolbar is visible in ArcMap, shown below:

If not, at the top of ArcMap, click "View", then "Toolbars" and check "Editor". On the

Editor Toolbar, click on "Editor", then "Start Editing":

Step 5.2

A dialog box will ask for the location of the data that will be edited. Choose the

folder in which the new shapefile is stored, which should be "SiteShapefile" folder in the

"NewSites" folder, which is all contained in the "Geodatabase" folder. The new

shapefile name should be visible in the in the box in the bottom half of the dialog box, as
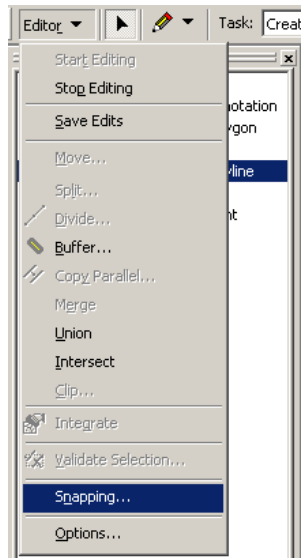
shown below.
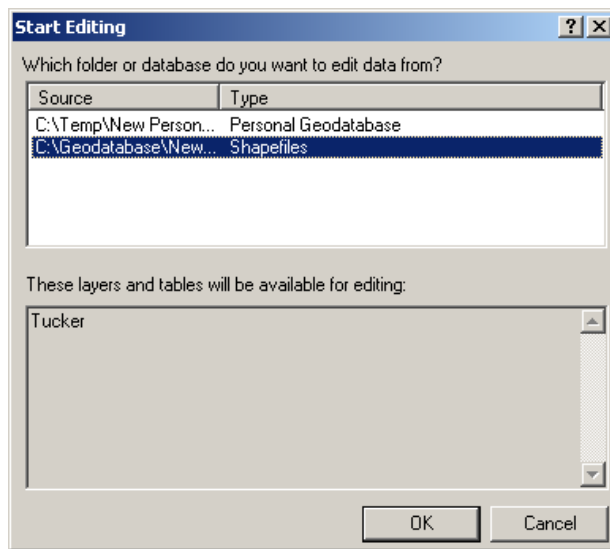
Step 5.3

Click "OK". In the "Task" box on the Editor Toolbar, choose "Create New

Feature" and in the "Target" box, choose the shapefile, "Tucker" in this case:

Step 5.4

The Editor Toolbar allows the user to set and/or modify the snapping options for easier drawing. Click on "Editor" on the Editor Toolbar and click on "Snapping…":


The "Snapping Environment" dialog box allows the user to choose what to snap to. In this case, snapping to the vertices, ends, and edges of the "Tucker_dgn.dgn Polyline Selection" layer is chosen. In other words, when digitizing, when the cursor is placed near a vertex, edge or end of the layer, ArcMap will automatically place the cursor directly on top of that feature.
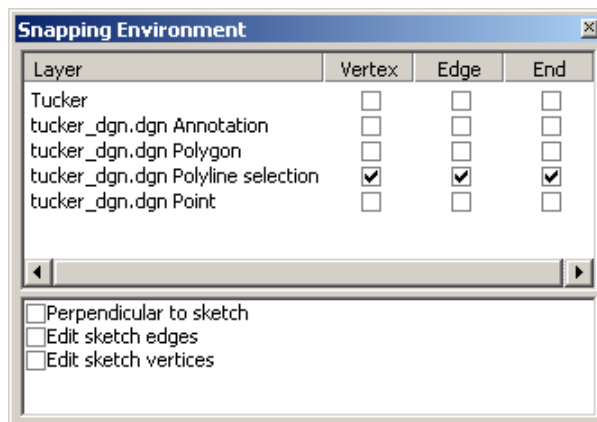
The user is encouraged to explore the snapping options before digitizing, as some options

may be useful in some cases and not in other cases.

> **TIP: The snapping tolerance can be modified by clicking on "Editor" on the Editor Toolbar, then clicking on "Options". The default tolerance is 10 pixels, as shown below. This means if the cursor is placed within 10 pixels of a vertex, for example, the cursor will be placed directly on top of that vertex.   This may need to be adjusted depending on the situation.**
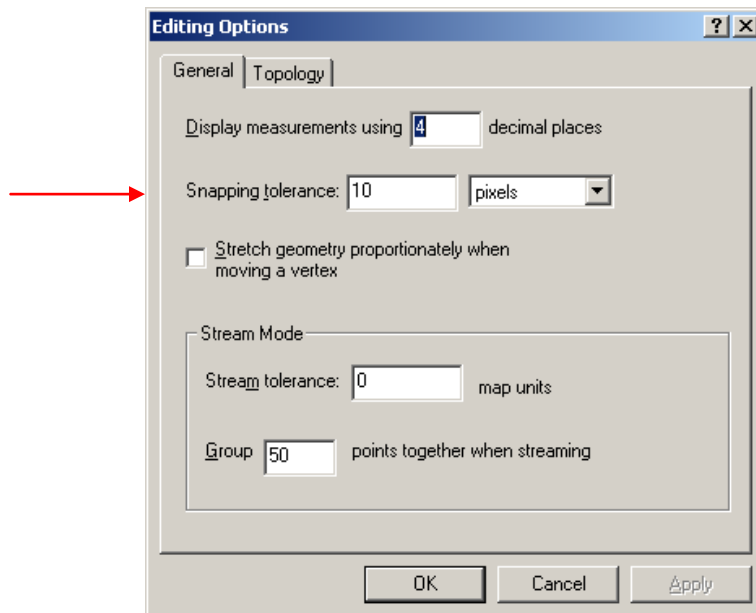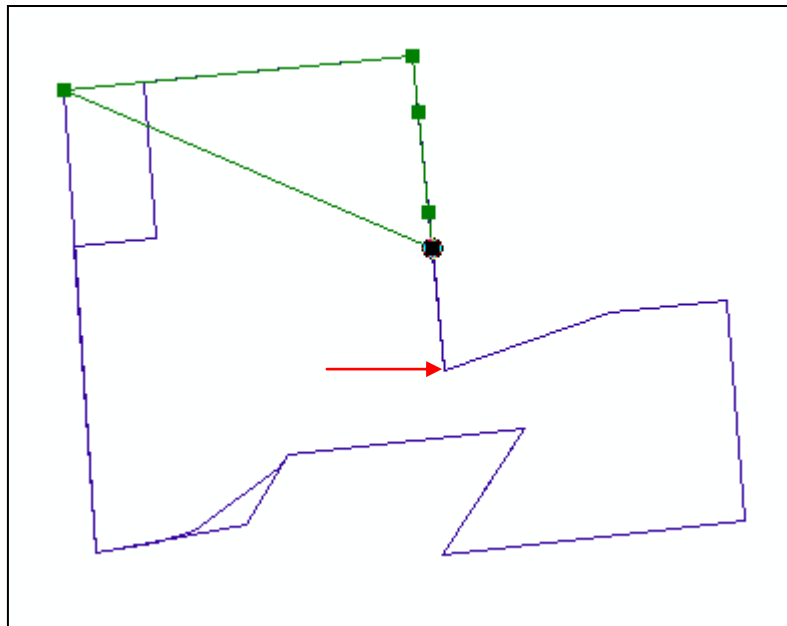

Step 5.5

The actual digitizing is ready to begin. Click on the "Create New Feature" tool on

the Editor Toolbar:

With the cursor, go around the site boundary, clicking on the exact places a vertex should

be located. This is where snapping is beneficial. In Step 3, the new shapefile "Tucker"

was created as a polygon shapefile. Therefore, ArcGIS will only allow polygons to be drawn when creating new features. The figure below illustrates the boundaries of Tucker Tract being digitized. The polygon being drawn started in the upper left-hand corner and the red arrow is pointing where the next vertex should be placed:

TIP: If a vertex is incorrectly located while digitizing, use the "Undo" button **and ArcMap will erase the last vertex that was added**.

Step 5.6

Double clicking the last vertex when it is placed will close out the polygon. Go back to check the accuracy of the new polygon. If it is satisfactory, go to "Editor" on the Editor Toolbar and click on "Save Edits" then "Stop Editing".

Step 6: Dissolving (if necessary)

       This step is only required if there are multiple polygons for one site. For example, a road or a waterway may divide a site and two separate polygons represent the same site. If this is the case, the two polygon features need to be dissolved into one to avoid creating multiple records for one site in the geodatabase. For example, Mingo Creek in Wake County is made of two separate polygons divided by a road:
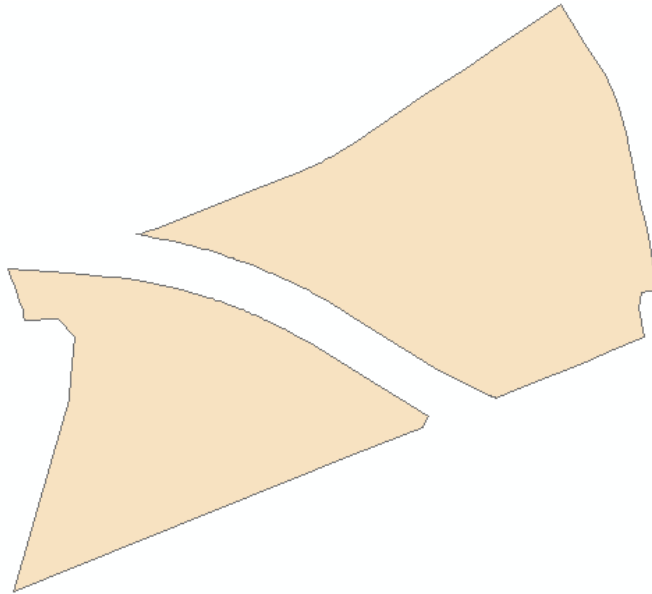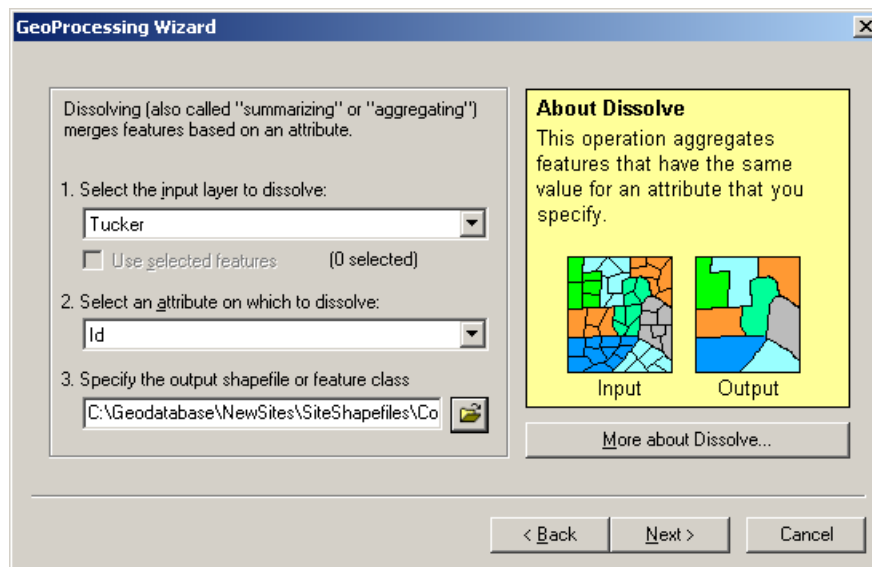

Step 6.1

       On the Main Toolbar, click on "Tools", then click on "Geoprocessing Wizard". The Geoprocessing wizard will then offer several operations from which to choose. Click the radial button beside "Dissolve features based on an attribute" and click "Next" as shown in the next figure.
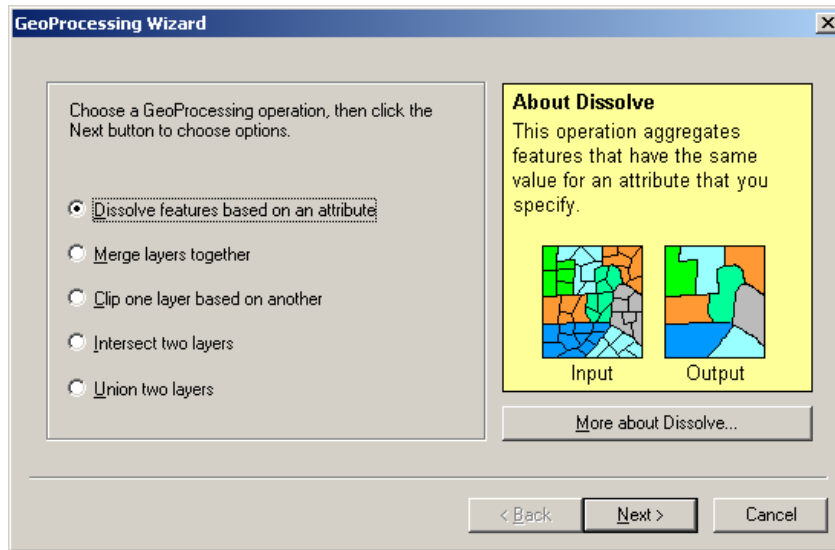
Step 6.2

The wizard will then show three steps required to complete the operation. In the first box, enter the name of the shapefile that will be dissolved. The second box will ask for an attribute that the dissolve will be based on. ArcGIS will automatically dissolve the features that share the same record for that attribute. Be sure the attribute chosen in this step has the same value for both features that need to be dissolved. A new shapefile will be created from this operation so the last step asks for the name and path of the new shapefile. A folder called "Corrected_shapefiles" in the "SiteShapefiles" folder was created to store these new shapefiles. Name it the same name. These steps are shown below using Tucker Tract as an example though it does not need to be dissolved.

Step 6.3

Finally, click "Next" and then "Finish". A new shapefile is then created in the "Corrected_shapefile" folder.

Step 7: Creating point shapefile of site

The geodatabase not only stores polygon files of the mitigation sites, but point files of the sites as well. A point shapefile will need to be digitized on top of the polygon to approximate the site's location.
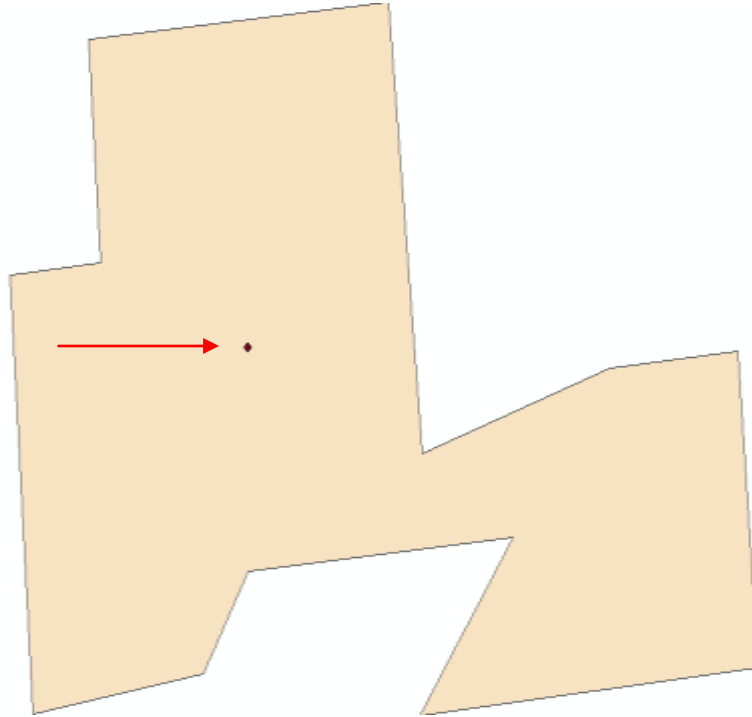
Step 7.1

A new shapefile will need to be created just as before. Repeat Step 3, however, this time "Point" should be chosen as the feature type and _pt should be placed at the end of the site name so it can be distinguished from the polygon file. The red arrows in the figure below illustrate this.
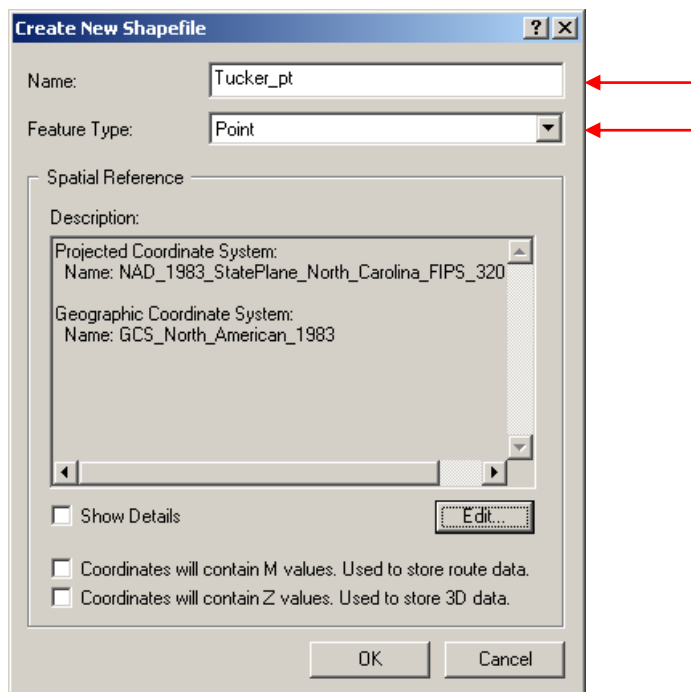
Step 7.2

Add the new empty shapefile to ArcMap and start editing as before. Using the Create New Feature Tool, place a point near the middle of the polygon(s) that were just digitized for the same site, as shown below:

Step 7.3

Click on "Save Edits", then "Stop Editing" on the Editor Toolbar and the new point shapefile is complete

Step 8: Loading the new shapefiles into the geodatabase

The new shapefiles of the site need to be loaded into the geodatabase with the other mitigation sites. There is a polygon feature class, *Mitigation_Sites_poly*, where the

polygon shapefile will be stored and point feature class, *Mitigation_Sites_pt,* for the point

shapefile. There are several ways of doing this, however, the methods described below

were found to be the easiest.

Step 8.1

In ArcCatalog, navigate to the geodatabase, *Mit_v5.mdb* (though this name may

change), then click on the feature dataset *Mitigation Sites* to open it. Inside this dataset

are two feature classes, *Mitigation_Sites_poly* and *Mitigation_Sites_pt.*
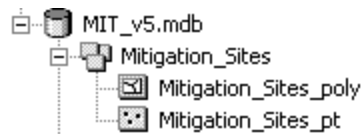
Step 8.2

To add the polygon shapefile to the polygon feature class, right click on
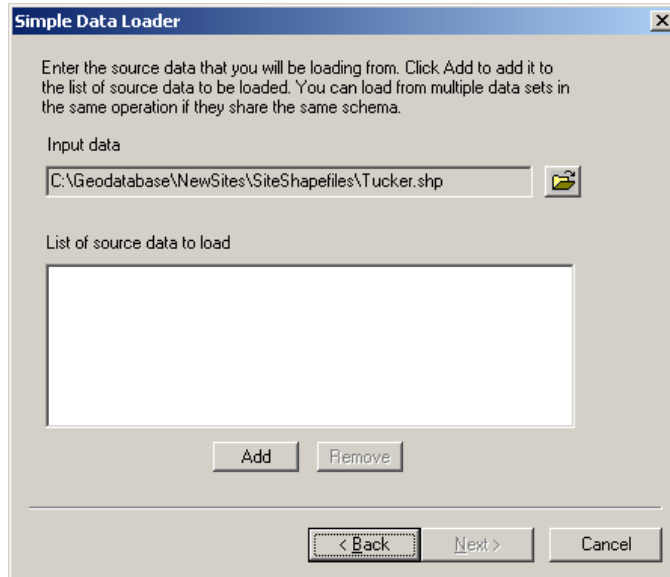
Mitigation_Sites_poly and click on "Load Data".
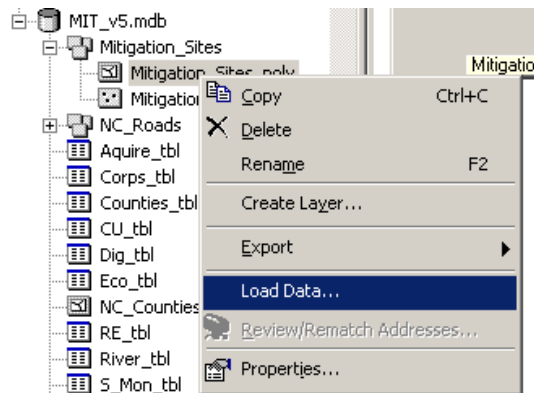
Step 8.3

The Simple Data Loader will appear. Click on the first "Next" and Data Loader

will ask for the input data. Click on the open folder icon to navigate to the *SiteShapefile*

folder that contains the shapefile that will be loaded. Then click on the shapefile and click "Open":

Step 8.4

Then click the "Add" button and the shapefile will appear in the box under "List of source data to load". Multiple shapefiles from multiple locations can then be added to this list. Click "Next" when all the shapefiles that need to be loaded are listed. Accept all the defaults from here and click on the next three "Next" buttons and then the "Finish" button as nothing else will need to be changed.

Step 8.5

Repeat this process to add the point shapefile to the *Mitigation_Sites_pt* feature class.

Step 9: Entering the attribute data

The shapefiles for the new mitigation sites have now been loaded into the geodatabase with the rest of the sites, however, the attribute data has not been added. When the new shapefiles were loaded into the geodatabase, they inherited all the fields the other sites possessed, though they are now empty and must be populated with data.

Step 9.1

Add the two feature classes, *Mitigation_Sites_poly* and *Mitigation_Sites_pt* to ArcMap if necessary. Open their attribute tables by right clicking on them in the Table of Contents, then clicking on "Open Attribute Table". The attribute table will look similar to the figure below. It contains seven attributes for each mitigation site. Notice the feature at the bottom of the table contains the value <Null> for three of the fields.

OBJECTID*	SHAPE*	Cnt_Id	Name	ONEID	SHAPE_Length	SHAPE_Area
14	Polygon	2	Mingo Creek	092-010	19588.449165	8923634.102797
15	Polygon	2	Mildred Woods	033-001	42568.017737	26062323.718400
16	Polygon	2	Mashoes Road	028-001	42266.853926	17371891.559478
17	Polygon	2	Marks Creek	092-011	10560.620838	2988891.508374
18	Polygon	4	Long Swamp	047-002	29630.273182	10437231.565425
19	Polygon	3	Lengyel	025-001	6141.830166	512442.387795
20	Polygon	1	Lake Wheeler	092-004	13984.137642	5051554.849668
21	Polygon	1	Juniper Bay	078-006	23349.062807	31734209.723948
22	Polygon	1	Huskanaw Swamp	058-001	10088.908244	5043118.057471
23	Polygon	1	Hanging Rock Creek	006-001	4355.784593	428274.115075
24	Polygon	3	Gurley Tract	040-001	23120.162667	7571702.943466
25	Polygon	1	Freidburg Marsh	034-001	7024.186833	2261779.942245
26	Polygon	1	Dutchmans Creek	092-002	10757.719153	3768172.909112
27	Polygon	1	Dowd Dairy	009-002	28454.806910	28743049.612343
28	Polygon	1	Dismal Swamp	037-001	20919.850596	26640033.205185
29	Polygon	1	Deer Creek	016-002	1838.293611	194698.027030
30	Polygon	2	Croatan	025-003	63153.560965	175714973.260264
31	Polygon	2	Cedar Point	016-001	2229.019533	35636.630089
32	Polygon	1	Casey Tract	027-002	5488.527800	1286802.495810
33	Polygon	2	Blue Tract	063-001	13130.367670	7700300.740764
34	Polygon	1	Benson Grove	051-003	9288.466770	3624268.075021
35	Polygon	1	Wiggins Mill	098-001	8614.198775	3873079.058544
36	Polygon	1	Abbott Property	092-001	2210.655873	249882.262051
37	Polygon	<Null>	<Null>	<Null>	92.176098	524.591929

Record: ◄◄ ◄ 1 ► ►◄   Show: All Selected   Records (0 out of 37 Selected.)   Options ▼

Step 9.2

To fill in the fields, click on "Editor" on the Editor toolbar, then click on "Start Editing". Be sure to choose the Mitigation_Site_poly feature class as the data source for editing, just as before. Click on the field that needs to be filled out and type the correct data in the cell.

OBJECTID*	SHAPE*	Cnt_Id	Name	ONEID	SHAPE_Length	SHAPE_Area
16	Polygon	2	Mashoes Road	028-001	42266.853926	17371891
17	Polygon	2	Marks Creek	092-011	10560.620838	2988891
18	Polygon	4	Long Swamp	047-002	29630.273182	10437231
19	Polygon	3	Lengyel	025-001	6141.830166	512442
20	Polygon	1	Lake Wheeler	092-004	13984.137642	5051554
21	Polygon	1	Juniper Bay	078-006	23349.062807	31734209
22	Polygon	1	Huskanaw Swamp	058-001	10088.908244	5043118
23	Polygon	1	Hanging Rock Creek	006-001	4355.784593	428274
24	Polygon	3	Gurley Tract	040-001	23120.162667	7571702
25	Polygon	1	Freidburg Marsh	034-001	7024.186833	2261779
26	Polygon	1	Dutchmans Creek	092-002	10757.719153	3768172
27	Polygon	1	Dowd Dairy	009-002	28454.806910	28743049
28	Polygon	1	Dismal Swamp	037-001	20919.850596	26640033
29	Polygon	1	Deer Creek	016-002	1838.293611	194698
30	Polygon	2	Croatan	025-003	63153.560965	175714973
31	Polygon	2	Cedar Point	016-001	2229.019533	35636
32	Polygon	1	Casey Tract	027-002	5488.527800	1286802
33	Polygon	2	Blue Tract	063-001	13130.367670	7700300
34	Polygon	1	Benson Grove	051-003	9288.466770	3624268
35	Polygon	1	Wiggins Mill	098-001	8614.198775	3873079
36	Polygon	1	Abbott Property	092-001	2210.655873	243882
37	Polygon	1	Tucker Tract		92.176098	524

Record: 37   Show: All Selected   Records (0 out of 37 Selected)   Options

When everything is complete, click on "Save Edits, then "Stop Editing" on the Editor toolbar.

Step 9.3

Repeat this process for the Mitigation_Sites_pts feature class in order to add the attributes to the point representing the new site. Now the new mitigation site has been digitized, added to the geodatabase feature classes and the attribute table has been updated.

5.0   Using the Geodatabase

5.1   Joining Tables

The *Mitigation_Sites_poly* and *Mitigation_Sites_pt* feature class attribute tables can now be joined with the Access table, *Sites_tbl*, which stores the rest of the attributes. *Sites_tbl* can be linked to the feature classes directly from the geodatabase, unless the geodatabase is not accessible to the user. If the geodatabase is not accessible, refer to Section 5.2 and 5.3.

5.1.1   Joining Tables in ArcGIS 8.2

Step 1

Load the feature class into ArcMap. In the Table of Contents, right click on the feature class to be linked, in this case *Mitigation_Sites_poly*, then click on "Joins and Relates", then click on "Join", as shown below:
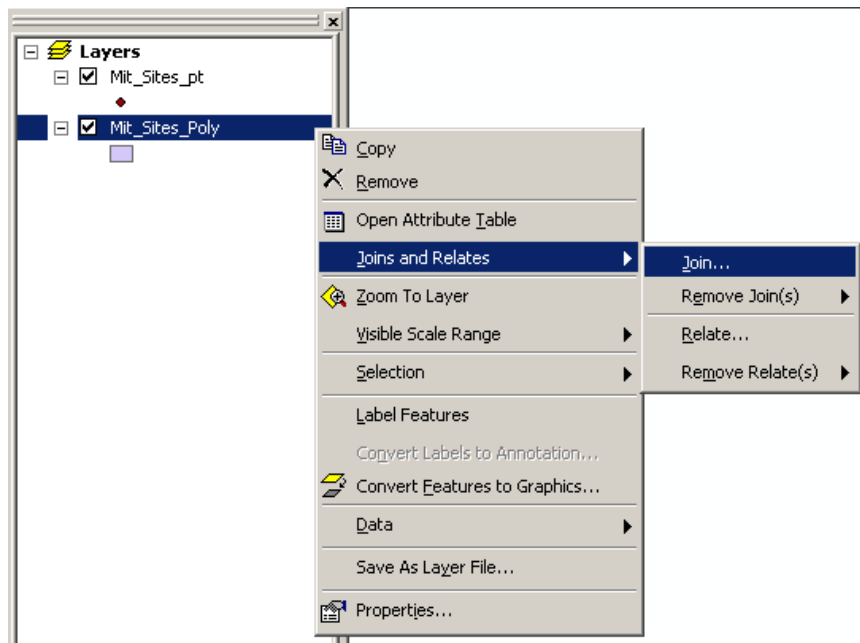
Step 2

A dialog box will open to select the options of the join operation, which is shown below.   In the first box, be sure "Join attributes from a table" is selected. For step 1, in the box labeled "Choose the field in this layer that the join will be based on", select the "ONEID" field. For step 2, choose the *Sites_tbl* Access table stored in the geodatabase as the table to join to the layer. To select this table, click on the open folder icon and navigate to it, then click "Add". For step 3, choose the ONEID field in the *Sites_tbl* table to join to the ONEID field in *Mitigation_Sites_poly's* attribute table.
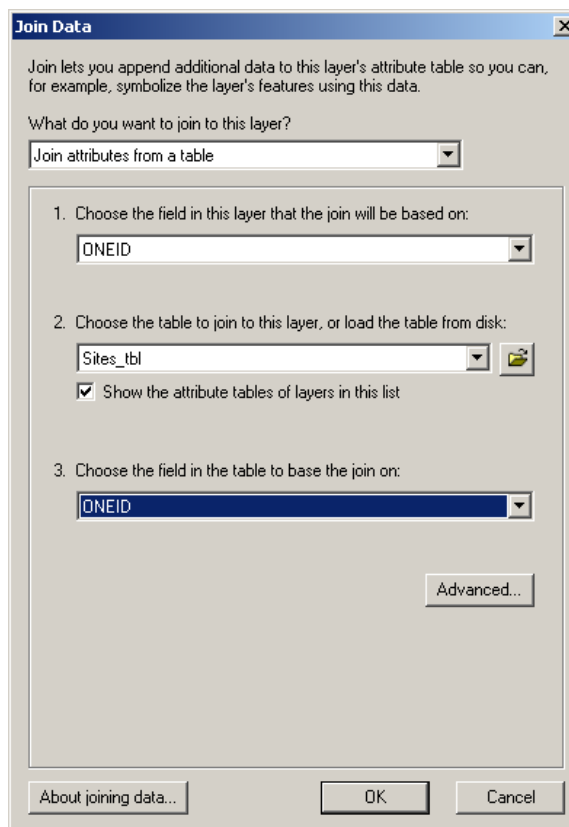
Step 3

Click "OK" and the two tables will be joined, but will appear as one large table when the *Mitigation_Sites_poly* attribute table is opened.

Step 4

The same join can be performed with the *Mitigation_Sites_pts* feature class because it contains the ONEID field as well.
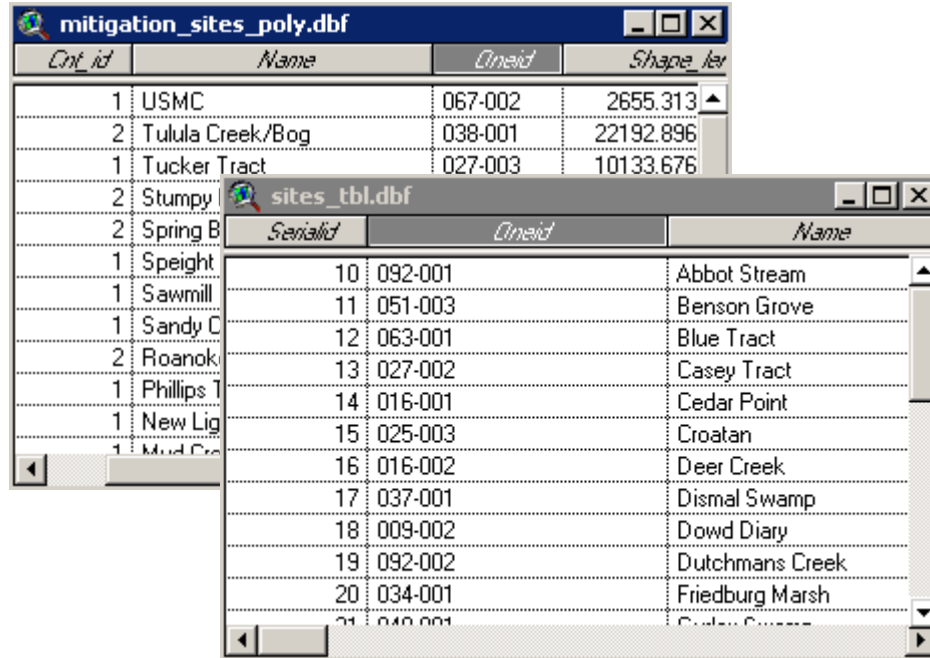
5.1.2   Joining Tables in ArcView 3.2

Step 1

In the project window, add the shapefile of the mitigation sites into ArcView (creating a shapefile of the mitigation sites from a feature class is described in the next section). Then , click on the "Tables" icon and add the *Sites_tbl* to the project, as shown below. The attribute table for the shapefile should be there as well.

Step 2

Open both tables and click on the the field name that will be used to link the two
tables together, in this case, it will be "ONEID" in both tables.

Be sure that the attribute table, *mitigation_sites_poly.dbf*, is highlighted, making it
the active window. By doing this, ArcView will know to add the fields of the *Sites_tbl*
table to the *mitigation_sites_poly* table, instead of the other way around.

Step 3

Click on the "Join" button on the main toolbar and the fields in the *Sites_tbl* table
will appear in the *mitigation_sites_poly* table.

5.2   Exporting Feature Classes as Shapefiles

ArcGIS 8.X or 9.x is required to use a geodatabase, whereas ArcView 3.x does not support this data model. If an individual wishes to access the information from the geodatabase, but does not have ArcGIS, the feature classes needs to be converted to a shapefile. ArcGIS 3.x, 8.x or 9.x can all read shapefiles.

Step 1

In ArcCatalog, right click on the feature class that is to be converted to a shapefile, then click on "Export" and then "Geodatabase to Shapefile".
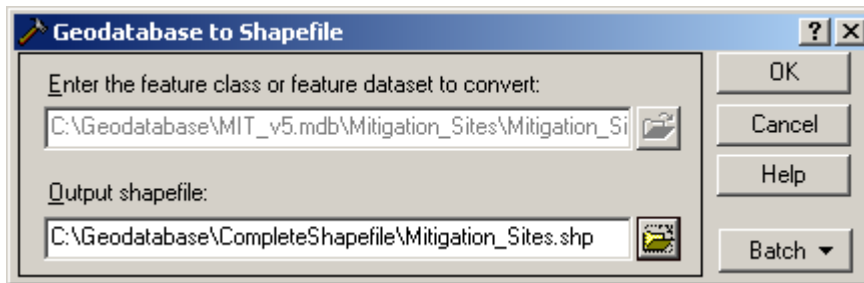*Mitigation_Sites_poly* is used in example below:
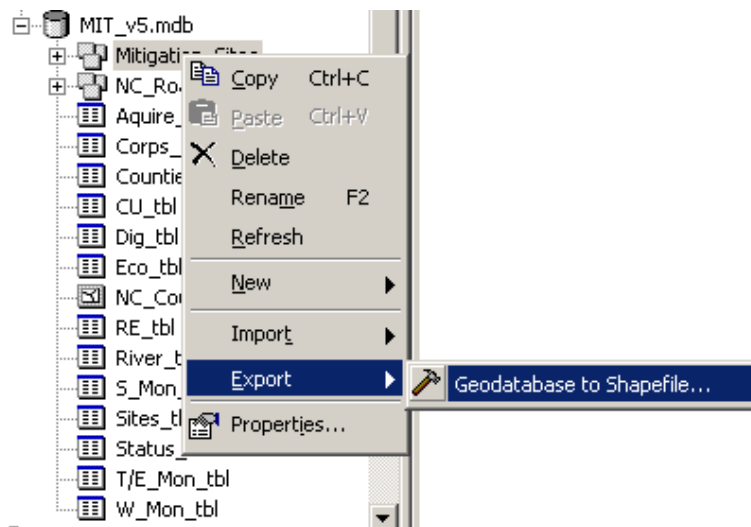
Step 2

A dialog box will then appear, shown below, which will ask for the input feature class or feature dataset, which is already done, and the output shapefile path and name. Store this new shapefile in the folder *CompleteShapefile* in the main folder *Geodatabase*. The name should be something recognizable.

Click "OK" and the feature class will be converted to a polygon shapefile that can be used in ArcView 3.2.
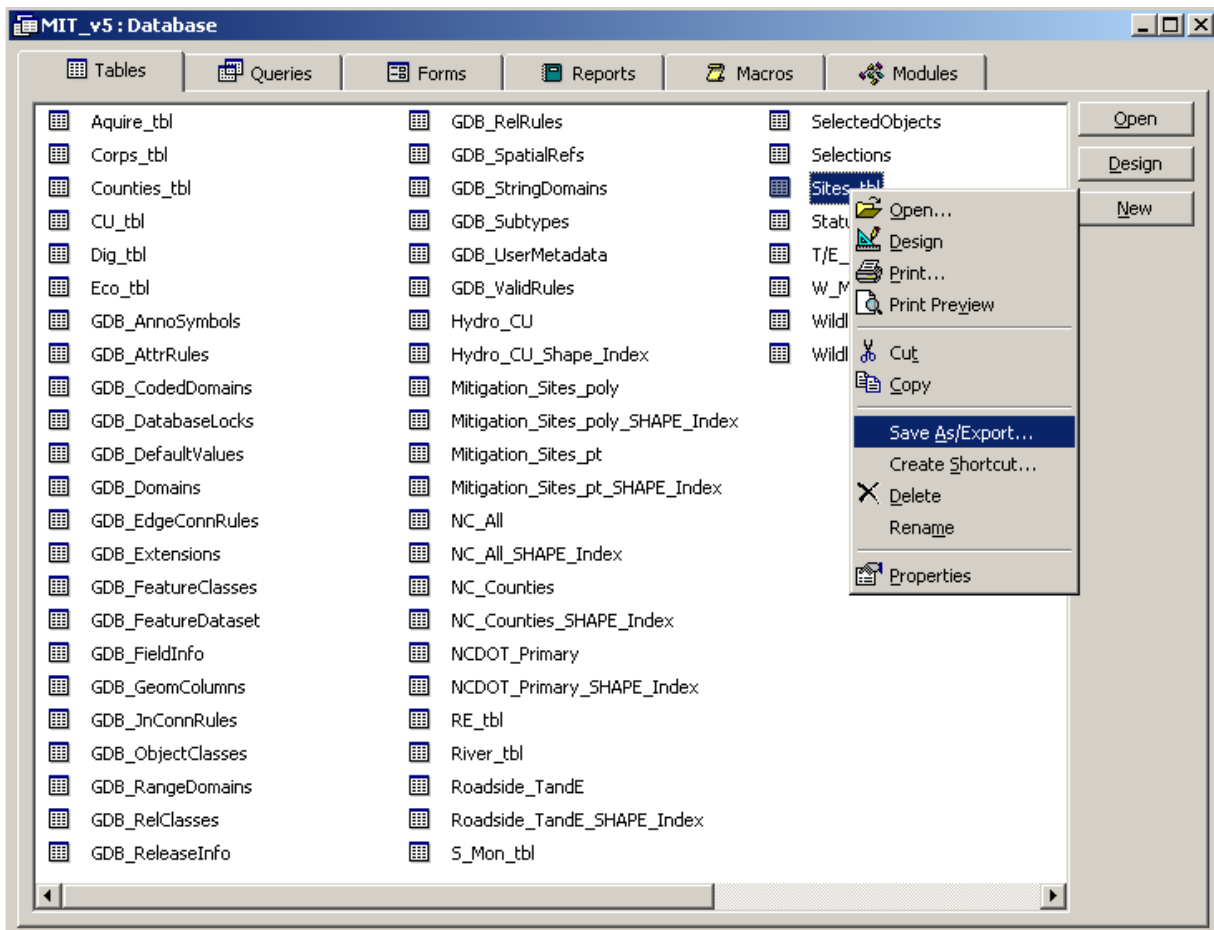
Step 3

The same process can be performed to convert the *Mitigation_Sites_pt* feature class to a point shapefile of the mitigation sites.

5.3   Exporting Access Tables as dBASE tables

If a shapefile is created and is being used by someone that does not have ArcGIS 8.x or does not have access to the geodatabase itself, they may need the *Sites_tbl* as well. In this is this case, the table will need to be exported as dBASE table (.dbf), that can be joined to the shapefile in either ArcGIS 8.x or ArcView 3.x.
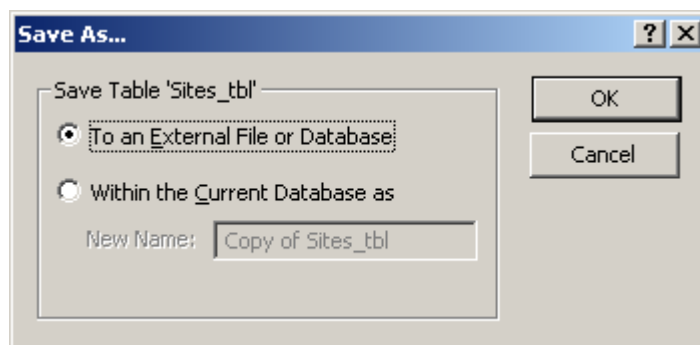
Step 1

In Microsoft, right click on the Sites_tbl table, then click on "Save As/Export..", as shown in the next figure.

Step 2

A dialog box will then appear asking what the table should be saved as. Be sure the radial button beside "To an External File or Database" is checked, then click "OK", as shown below.

Step 3

Another dialog box, shown below, will appear asking where the new dBASE table should be saved, its name and file type. It is best to save the new table in the *CompleteShapefile* folder and the name can remain the same, *Sites_tbl*. The file type, chosen in the box named "Save as type", should be changed to dBase III. Click "Export" and the new table will be created.
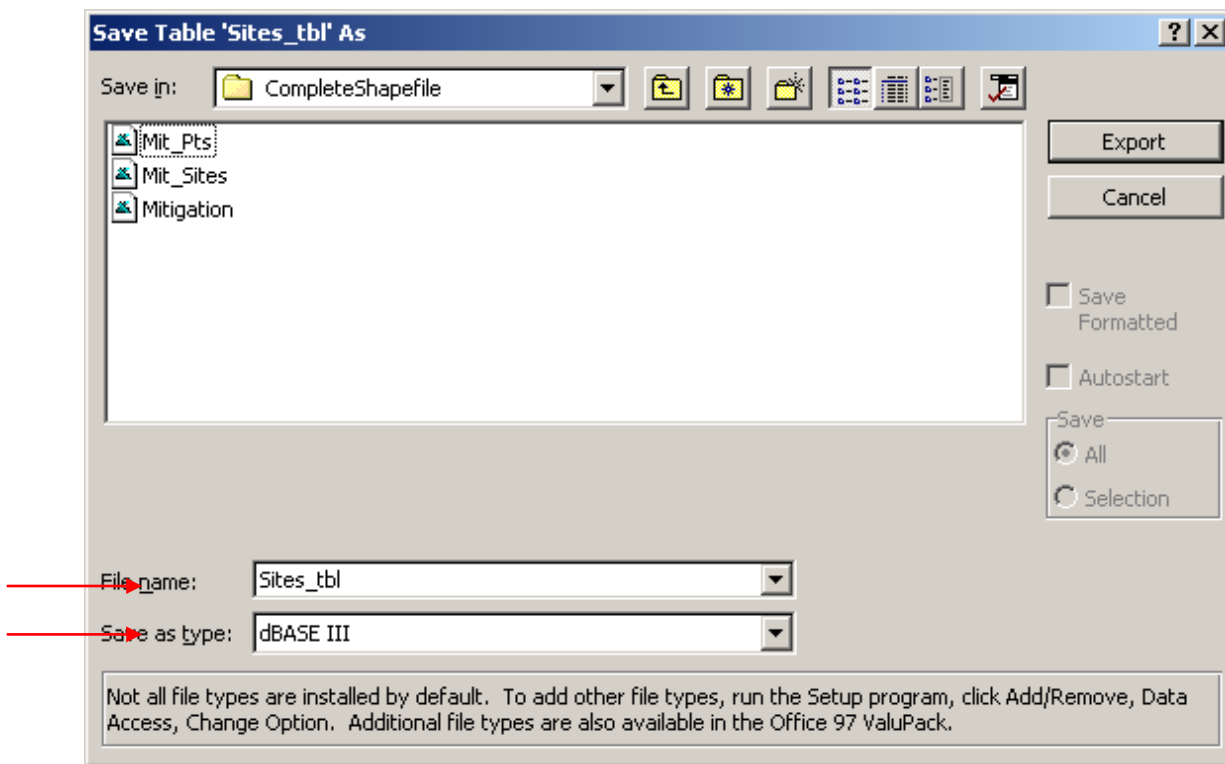
This new .dbf table can now be added to ArcGIS or ArcView and joined to the shapefile or feature class of the mitigation sites.

6.0   Conclusion

The Mitigation Site geodatabase was designed as a tool to help NCDOT ONE track its mitigation efforts across the state.   The ESRI geodatabase model has provided a simple and versatile means of storing an extensive amount of data that can be used by a multitude of people. Shapefiles generated from the geodatabase can be distributed among both NCDOT and other interested parties, regardless of whether they are using ArcGIS or ArcView. By storing the site information in Microsoft Access, anyone can have access to the data without needing a ArcGIS license. The main Access table and the lookup tables can easily be edited and manipulated as needed. The inclusion of other Microsoft Objects, such as queries and reports, allows the data to be easily analyzed or summarized in unlimited ways. Though most ONE personnel still rely on ArcView, procedural documentation will allow anyone to manage the database regardless of their experience in ArcGIS. Furthermore, a simplistic design utilizing lookup tables while relying on a very limited amount of programming code, will help to minimize the maintenance needed for the geodatabase. The Mitigation Site geodatabase will not only help NCDOT staff manage their mitigation program, but will also help to protect the wetlands, streams and threatened and endangered species of North Carolina into the future.

7.0   Future Work

In the future it will be necessary to enter the rest of the data for the remaining mitigation sites, some 380+ sites, into the geodatabase and adding new ones as they are

built. Attributes may need to be added or edited as the mitigation process changes over time. Data for NCDOT's roadside threatened and endangered species populations will also need to be loaded into the *Roadside_TandE* feature class and attributed with the help of the National Heritage program and ONE's Biological Survey's Unit, who monitor these sites. NCDOT's wildlife crossings will also need to GPS'ed and attributed in the *Wildlife_Crossings* feature class. Furthermore, it is likely new queries and reports will need to be created to help extract data from the geodatabase and analyze NCDOT's mitigation efforts.

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