UNIT 34: OVERLAY OPERATORS

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Context

Overlay operations are powerful spatial analysis tools used to combine layers of data. They are generally used to determine which features in one coverage lay within polygon features of another coverage. Different operators allow the user to add (or subtract) all or part of a coverage's features to (or from) another coverage.

Example Application

The Slow The Spread Gypsy Moth Project generates grids of moth trap sites across eight states (Indiana, Illinois, Ohio, Michigan, North Carolina, Virginia, West Virginia, Wisconsin). The project is a cooperative effort between Federal (Forest Service) agencies and state agricultural agencies. Each agency is responsible for placing, checking, and removing traps located in its area of responsibility. The STS GIS manager must determine how many of which kind of trap fall within each agency's boundaries. Trap sites that fall into water bodies must be removed from the grid. Statistics related to acreage counts can be generated on a project, agency, or county level.

Example Operations:

- **Determine U.S. Forests that fall within the project area**
- **Add county boundaries**
- **Add trap sites (point data layer) to project area (polygon data layer) Eliminate traps that fall in water bodies**

Learning Outcomes

Awareness:

To gain a general understanding of the implementation and potential applications of overlay operators and to gain a working knowledge of overlay operation terminology.

Competency:

To determine the appropriate application of different overlay operations and be able to manipulate the command parameters to control overlay operation results.

Mastery:

To integrate knowledge of overlay operations into the decision making/analysis functions of a GIS.

Preparatory Units

Recommended:

Unit 10 - Projecting Data

Unit 28 - Editing polygon data

Unit 33 - Using Buffers

Unit 39 - Performing Statistical Analyses

Unit 41 - Using Boolean Search Techniques

Awareness

Learning Objectives

- Student can define a basic vocabulary of overlay operator terms.
- Student can differentiate between overlay operators.
- Student can describe an application of an overlay operator.

Vocabulary

- Attribute
- Layer
- Overlay
- Projection
- Registration
- Topology

Unit concepts

- Adding/subtracting all or part of a coverage to another coverage

Figure 1

- Restricting the addition/subtraction spatially
- Limits of overlay operators with different data models
- Knowledge of specific software commands related to overlay operations, their proper use and parameters
- Pre-overlay processes
- Projection (equal area)
- Registration
- Topology requirements

Competency

Learning Objectives:

Student can use overlay operations to perform:

- Addition of features from one coverage to another
- Determination of which features in one cover lay within the area of another cover
- Subtraction of features within an area of one cover from another cover

Mastery

- Student will be able to use post-overlay statistical analyses to determine:
- Acreage of a land use type within a greater boundary
- Number and attributes of features which are in specified territories

Comptency Tasks

4.2.1 Pre-Overlay Tasks

This example, based on the Gypsy Moth Slow The Spread Project, uses three polygon and one point coverage:

- VA_CNTY = a coverage of ten Virginia counties in the example area
- PROJ_QUADS = USGS 7 1/2 minute quads covering the example area

- USFSLAND = a coverage of Federal Forest land in the example area
- PROJ_SITES = a generated grid of trap site locations

These coverages will be referred to throughout this unit.

Generic List of Pre-Overlay Tasks

Section 1. Check each layer to be used for topology errors, proper registration, and accuracy of contents. Graphically display the layers individually to check for topology errors; display them together to check registration.

ARC **Section 1**

Section 2. Verify that each data layer has the expected and correct attributes. Use the data base query commands of your software package to list the items (fields) associated with each layer.

ARC **Section 2**

Section 3. View the descriptions of each data layer to be used in the overlay: all layers to be combined must have the same projection and projection parameters.

! TIP: If post overlay manipulations include area calculations/comparisons, the layers must be in an equal area projection (such as Albers Equal Area).

ARC **Section 3**

Section 4. Compare attribute names between the coverages. The names of the items which you wish to retain must be unique. When performing an overlay, items with the same name are dropped from one or the other coverage; this can result in data loss. Again use the software's data base query commands to check the items between coverages.

ARC **Section 4**

A Summary of Pre-Overlay Tasks:

- Check data layers for topology errors, proper registration, and accuracy of contents
- Be sure all layers are in the same projection; use an equal area projection if area data will be generated.
- Compare attribute names between coverages. Change attribute names, if necessary, to maintain data items during overlay operations.

4.2.2 Overlay Tasks

EXAMPLE: The purpose of this example is to combine several data layers to create a coverage containing Gypsy moth trap sites, county and USGS quad boundaries, and U.S. Forest Service boundaries. The example area is a portion of the actual STS Project area. Below is a list and a short description of each data layer:

- trap_sites98 - a point coverage of generated nodes (trap sites) across the example area
- proj_quads - a polygon coverage of USGS 7 1/2 min. quads across the example area

- va_cnty - a polygon coverage of ten Virginia counties: this defines the example area
- sm_mtn_lake - a polygon coverage of an inland water body
- usfs_lands - a polygon coverage of some USFS lands in Virginia & West Virginia

All of parts of the above data layers will be combined, using different overlay operators, to create a composite coverage containing multiple attributes. From that composite coverage information will be derived for pretend project funding requests, and a county administration data base.

Generic List of Overlay Tasks

Section 1. Add the total contents of one polygon layer to another polygon layer.

EXAMPLE: Using your software's commands, combine the data layers "va_cnty" and "proj_quads" so that all polygons and the non-duplicated attributes are retained.

Section 5

Figure 1

2. Add the partial contents of one layer to another

EXAMPLE: For the Gypsy Moth Slow-The-Spread project, knowledge of which agency (state or Federal) is in charge of an area is of utmost importance, as the responsible agency must oversee trap placement and trap checking.

Some of the land within the ten county example area is owned by the U.S. Forest Service. This example uses an overlay operator which adds only those features within an area of interest: here we wish to retain only that Forest land which is inside the project area. Using your software's commands, combine the data layers so that only those polygons of the "usfsland" data layer which fall inside of the "proj_coqds" are retained in the output data layer.

Section 6

Figure 2

Section 3. Subtract features falling within an area of one layer from another layer.

EXAMPLE: Trap Sites for the Gypsy Moth Slow-The-Spread Project are generated across the entire STS area (which covers parts of eight states). For this section, we need a coverage containing only those traps which are in the example area (the ten counties in Virginia). Using your software's commands, and using the example area as a "cookie cutter", extract those needed sites from the "sites98" data layer.

Section 7

Figure 3

Section 4: Subtract the area of one layer from another layer.

EXAMPLE: A recreational lake, Smith Mountain Lake, is within the example area. Any trap sites that fall within that water boundary should be eliminated from our sites coverage. Use your software's commands to remove features in one coverage, which are encompassed by polygons of another coverage.

Section 8

Figure 4

Summary of Overlay Tasks

- Add the total contents of one polygon layer to another polygon layer
- Add the partial contents of one layer to a polygon layer
- Subtract features falling within an area of one polygon layer from another layer
- Subtract the area of one polygon layer from another layer

Mastery

Learning Objectives:

Student will be able to use overlay operators to perform the following tasks:

- Combine data layers to achieve predicted results
- Given verbal instructions, determine the methods and commands to use to derive needed data from various layers
- Create data base ready files from attribute tables
- Generate descriptive statistics from combined data layer
- Perform spatial analysis on combined data layers
- Prepare combined data layers for further manipulations

EXAMPLE: Create database ready files from attribute tables

The composite polygon data layer "proj_coqdsfed" contains county, USGS quad, and USFS land information. The data points layer "sites_final" contains UTM coordinates and site numbers for the trap sites within the example area.

PROBLEM: A Craig County, Virginia administrator has contacted the GIS technician. She wants a list of traps sites within her county, so that any citizen inquiries can be knowledgeably answered. She has asked that the list include the coordinates, the name of the responsible agency, and the USGS quad name for each trap.

SOLUTION: Using your software's commands, generate a data base ready file of trap sites within one county. Suggested steps:

Step A. Combine the trap site layer with the composite layer

Step B. Choose only those trap sites within the given county

Step C. Output, from the layer's attribute table, a file of trap site UTM coordinates, site number, agency, and grid

Section 9

EXAMPLE: Budget estimates are due, and for the sake of this example we'll say that participating agencies are funded in proportion to the number of acres for which they are responsible. The agencies contact the GIS technician, each wanting to know how many acres in the example area are within their agency boundaries. Using your software's commands, calculate the number of acres in each agency's area. Suggested steps:

Step A. Be sure the polygon data layer is in an equal area projection

Step B. Output area values from the data layer's attribute table

Step C. Convert the area values from map units to acres

Section 10

Using your computer's file editor and a hand calculator, the area in square meters can easily be converted into square acres by multiplying the square meter values by 0.0002441054:

AGENCY AREA SQUARE ACRES SQUARE METERS

George Washington Nat'l Forest 100,544.73 406,890,068.387467

Jefferson Nat'l Forest:Blacksburg 115,312.39 466,652,662.325159

Jefferson Nat'l Forest:JNF_GL 74,363.79 300,939,578.135164

Jefferson Nat'l Forest:New Castle 139,976.45 566,464,549.283207

Jefferson Nat'l Forest:Wytheville 2,493.66 10,091,498.234800

Virginia Dept. of Ag. & Cons. Serv. 172,282.82 16,884,628,275.990430

Alternatively, the values can be exported to a spreadsheet software package and converted there. From the above values, VDACS should receive the majority of the available funding.

EXAMPLE: The EPA in the Hardy quadrangle is conducting some biological monitoring. Franklin County is working closely with the EPA on this monitoring project and is concerned that the weekly trap inspections will disrupt the delicate monitoring equipment. Franklin County's EPA project liaison person has contacted the GIS technician to request a list of sites and the coordinates that are in both Franklin County and the Hardy quad. Use your software's commands to extract the sites that fall in the area overlapped by both Franklin County and the Hardy quadrangle. Suggested steps are:

Step A. Extract the Hardy quad polygon from the quads data layer

Step B. Using the appropriate overlay operator, create a coverage of sites common to both areas

Step C. Output a file to send to the County EPA liaison

Section 11

Figure 5

For a look at the entire Gypsy Moth Slow-The-Spread Project, including current trap placements and moth catches plus historical data, click here:

Slow The Spread Project

Follow-Up Units

Suggested:

Unit 30 - Validating Data Bases

Unit 31 - Managing Data Base files

Unit 33 - Using Buffering Operations

Unit 35 - Line in Polygon Operations

Unit 37 - Data Expansion - Deriving New Attributes/Files/Layers

Unit 38 - Performing Statistical Analyses

GIS Resources

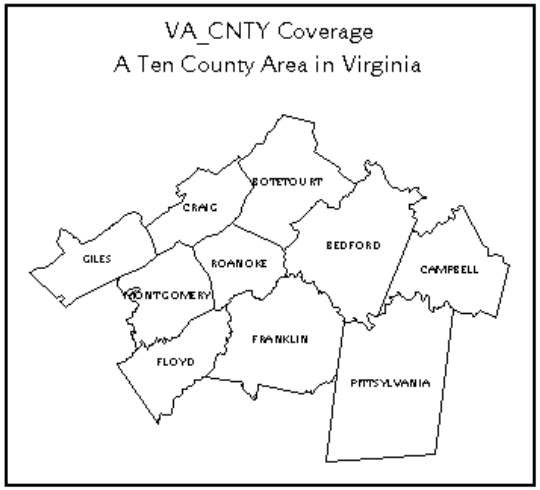
[Outdated links have been removed.]

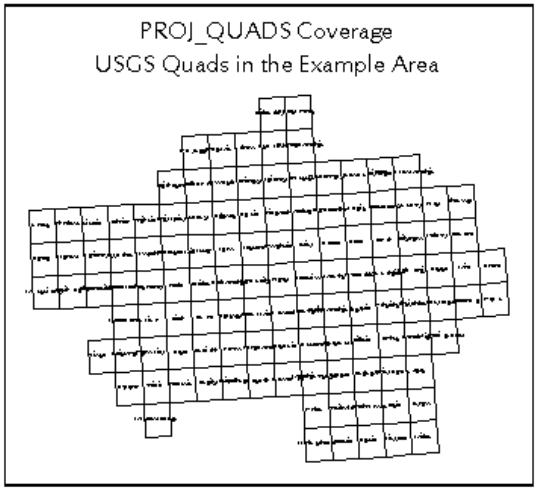
Clark University Geography and GIS Resources

GIS Resources Over The Net

GIS Links

Created: May 14, 1997. Last updated: February 27, 1999.


VA_CNTY Coverage
A Ten County Area in Virginia
BOTETOURT
CRAIG
GILES
ROANOKE
BEDFORD
CAMPBELL
MONTGOMERY
FRANKLIN
FLOYD
PITTSYLVANIA


PROJ_QUADS Coverage
USGS Quads in the Example Area

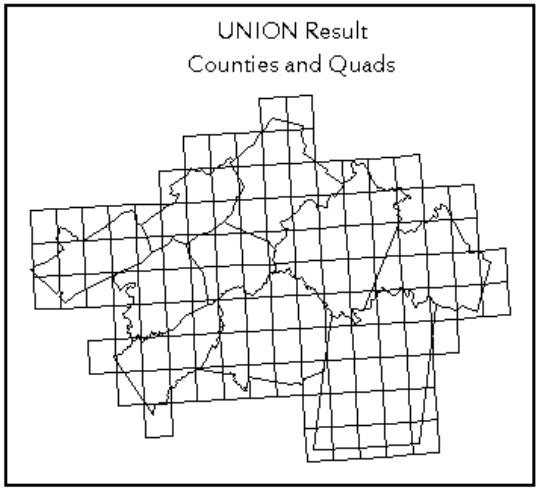

UNION Result
Counties and Quads

Figure 1

Section 1

For Arc/Info users, display the coverage in arcedit:

```
Arc: ae

Copyright (C) 1982-1997 Environmental Systems Research Institute, Inc. All
 rights reserved. ARCEDIT (COGO) Version 7.1.1 (Thu Feb 6 23:26:50 PST 1997)

Arcedit: ec va_cnty

The edit coverage is now /HOME/TAPITTS/CCTP/VA_CNTY

WARNING the Map extent is not defined

Defaulting the map extent to the BND of /HOME/TAPITTS/CCTP/VA_CNTY

Arcedit: de arcs labels node errors

Arcedit: nodecolor dangle 2

Arcedit: draw

Arcedit:
```

Look for any small red square outlines: these may indicate an open polygon. Correct all topology errors, exit arcedit and "build" or "clean" the coverage. Repeat this step for all polygon coverages; next display them together (in arcplot or arcedit) to check their registration.

For more information on these processes please refer to:

Unit 28 - Editing Polygon Data

Unit 11 - Registration and Conflation

Section 2

For Arc/Info Users, list the items in a coverage's .PAT file:

```
Arc: items va_cnty.pat
COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME INDEXED?
1 AREA 4 12 F 3 -
5 PERIMETER 4 12 F 3 -
9 VA_CNTY# 4 5 B - -
13 VA_CNTY-ID 4 5 B - -
17 VAFIPS 5 5 I - -
22 COUNTY 20 20 C - -
Arc:
```

To list the values of any item, use "list":

```
Arc: list va_cnty.pat county
Record county
1
2 BOTETOURT
3 CRAIG
4 BEDFORD
5 GILES
6 CAMPBELL
7 ROANOKE
8 MONTGOMERY
9 FRANKLIN
10 PITTSYLVANIA
11 FLOYD
Arc:
```

These are reasonable and expected values for this coverage. Repeat these steps for the other coverages.

Section 3

For Arc/Info Users, "describe" the coverages:

```
Arc: describe va_cnty
Description of SINGLE precision coverage va_cnty
FEATURE CLASSES
Number of Attribute Spatial
Feature Class Subclass Features data (bytes) Index? Topology?
------------- -------- --------- ------------ ------- ---------
ARCS 42 28
POLYGONS 11 72 Yes
NODES 33
SECONDARY FEATURES
Tics 4
Arc Segments 1087
Polygon Labels 10
TOLERANCES
Fuzzy = 19.406 V Dangle = 0.000 N
COVERAGE BOUNDARY
Xmin = 498966.906 Xmax = 693031.875
Ymin = 4044608.000 Ymax = 4184009.000
STATUS
The coverage has not been Edited since the last BUILD or CLEAN.
COORDINATE SYSTEM DESCRIPTION
Projection UTM
Zone 17
Units METERS Spheroid CLARKE1866
Parameters:
Arc:
```

Repeat this step for all coverages; be sure they all have the same projection.

NOTE: For this example, all of the coverages are in UTM Zone 17 projection. Because we will perform area calculations on the final results, we must reproject these covers into an equal-area projection:

```
Arc: project
Usage: PROJECT <COVER | GRID | FILE> <input> <output> {projection_file}
{NEAREST | BILINEAR | CUBIC} {out_cellsize}
Arc: project cover va_cnty cnty_alb $ARC/files/prjs/utm172albers.prj
```

```
Arc: build cnty_alb
Building polygons...
Re-building AAT...
Arc: describe cnty_alb
Description of SINGLE precision coverage cnty_alb
FEATURE CLASSES
Number of Attribute Spatial
Feature Class Subclass Features data (bytes) Index? Topology?
------------- -------- --------- ------------ ------- ---------
ARCS 42 28
POLYGONS 11 42 Preliminary
NODES 33
SECONDARY FEATURES
Tics 4
Arc Segments 1087
Polygon Labels 10
TOLERANCES
Fuzzy = 19.410 N Dangle = 0.000 N
COVERAGE BOUNDARY
Continue?
Xmin = 113280.984 Xmax = 865646.875
Ymin = 3802816.750 Ymax = 4173794.500
STATUS
The coverage has not been Edited since the last BUILD or CLEAN.
COORDINATE SYSTEM DESCRIPTION
Projection ALBERS
Units METERS Spheroid CLARKE1866
Parameters:
1st standard parallel 34 0 0.000
2nd standard parallel 47 0 0.000
central meridian -85 0 0.000
latitude of projection's origin 0 0 0.000
false easting (meters) 0.00000
false northing (meters) 0.00000
Arc:
```

Repeat for all of the coverages. For the convenience of this example the reprojected coverages will keep their original names.

For more information on this process please refer to:

Unit 10 - Projecting Data

Section 4

```
************************ ARC BLOCK 104 TEXT
 *********************************

For Arc/fo users, use the "items" command:

Arc: items va_cnty.pat

COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME INDEXED?

 1 AREA 4 12 F 3 -

 5 PERIMETER 4 12 F 3 -

 9 VA_CNTY# 4 5 B - -

 13 VA_CNTY-ID 4 5 B - -

 17 VAFIPS 5 5 I - -

 22 COUNTY 20 20 C - -

 42 SOURCE 10 10 C - -

Arc: items proj_quads.pat

COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME INDEXED?

 1 AREA 4 12 F 3 -

 5 PERIMETER 4 12 F 3 -

 9 PROJ_QUADS# 4 5 B - -

 13 PROJ_QUADS-ID 4 5 B - -

 17 USGSNAME 40 40 C - -

 57 USGSCODE 8 8 C - -

 65 SOURCE 10 10 C - -

Arc: items usfsland.pat

COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME INDEXED?

 1 AREA 8 18 F 5 -

 9 PERIMETER 8 18 F 5 -

 17 USFSLAND# 4 5 B - -

 21 USFSLAND-ID 4 5 B - -

 25 FOREST_AGENCY 15 15 C - -

 40 SOURCE 10 10 C - -

Arc:

Each coverage has the item "SOURCE" (in this example, it indicates the source
 of

the coverage's graphic data). Because it might be useful to retain this
 infor-

mation throughout the overlay operation, rename that item in all of the
 coverages.
```

```
Use the "ALTER" command in Info:
Arc: info
 INFO EXCHANGE CALL
28/05/1998 19:31:08
 INFO 9.42 11/11/86 52.74.63*
 Copyright (C) 1994 Doric Computer Systems International Ltd.
 All rights reserved.
 Proprietary to Doric Computer Systems International Ltd.
 US Govt Agencies see usage restrictions in Help files (Help Restrictions)
 ENTER USER NAME>ARC
 ENTER COMMAND >SEL PROJ_QUADS.PAT
 122 RECORD(S) SELECTED
ENTER COMMAND >ALTER
 ITEM NAME>SOURCE
 82 SOURCE 10 10 C - 4 - - - - - - -
 ITEM NAME>QDSOURCE
 ITEM OUTPUT WIDTH>
 ITEM TYPE>
 ITEM PROT. LEVEL>
 ALTERNATE ITEM NAME >
 ENTER KEY LEVEL>
 ENTER INDEX NUMBER>
 82 QDSOURCE 10 10 C - 4 - - - - - - -
 ENTER COMMAND >Q STOP
Arc:
Repeat for the other coverages. For more information on this topic please
refer to:
Unit 31 - Managing Data Base Files
*******************************************************************************
```

Section 5

For Arc/Info users, use the UNION command:

```
Arc: union
Usage: UNION <in_cover> <union_cover> <out_cover> {fuzzy_tolerance}
{JOIN | NOJOIN}
NOTE: With the UNION command, both coverages must be polygon coverages.
```

The JOIN option is the default; it specifies that all non-duplicate items in both coverages will be kept. Duplicate items are dropped from the <union_cover>.

The NOJOIN option keeps only the internal number (#) from both the input and union coverages

```
Arc: union proj_quads va_cnty proj_coqds
Unioning proj_quads with va_cnty to create proj_coqds
Sorting...
Intersecting...
Assembling polygons...
Creating new labels...
Creating proj_coqds.PAT...
** Item "AREA" duplicated, Join File version dropped **
** Item "PERIMETER" duplicated, Join File version dropped **
** Item "AREA" duplicated, Join File version dropped **
** Item "PERIMETER" duplicated, Join File version dropped **
```

Always BUILD the resulting coverage:

```
ARC: build proj_coqds.pat
Building polygons...
```

Check that the needed items appear in the resulting coverage's .PAT:

```
Arc:items proj_coqds.pat
COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME INDEXED?
1 AREA 4 12 F 3 - -
5 PERIMETER 4 12 F 3 - -
9 PROJ_COQDS# 4 5 B - -
13 PROJ_COQDS-ID 4 5 B - -
17 PROJ_QUADS# 4 5 B - -
21 PROJ_QUADS-ID 4 5 B - -
25 USGSNAME 40 40 C - -
65 USGSCODE 8 8 C - -
73 QDSOURCE 10 10 C - -
```

```
83 VA_CNTY# 4 5 B - -
87 VA_CNTY-ID 4 5 B - -
91 VAFIPS 5 5 I - -
96 COUNTY 20 20 C - -
116 COSOURCE 10 10 C - -
Arc:
```

Note that items from both the input and union coverage are retained in the resulting coverage.

Section 6

For Arc/Info users, use the IDENTITY command to capture that information in one coverage, which lies inside the features of another. The resulting coverage has all the features of the identity_cover> plus those of the <in_cover> which are inside the <identity_cover>.

NOTE: With the IDENTITY command, the <identity_cover> must be a polygon cover.

The <in_cover> can be point, line, or polygon.

```
Arc: identity
Usage: IDENTITY <in_cover> <identity_cover> <out_cover> {POLY | LINE | POINT}
{fuzzy_tolerance} {JOIN | NOJOIN}
Arc: identity usfsland proj_coqds proj_coqdsfed poly
Arc: identity usfsland proj_coqds proj_coqdsfed poly
Producing identity of usfsland with proj_coqds to create proj_coqdsfed
Sorting...
Intersecting...
Assembling polygons...
Creating new labels...
Creating test.PAT...
** Item "AREA" duplicated, Join File version dropped **
** Item "PERIMETER" duplicated, Join File version dropped **
** Item "AREA" duplicated, Join File version dropped **
** Item "PERIMETER" duplicated, Join File version dropped **
Arc: items proj_coqdsfed.pat
COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME INDEXED?
1 AREA 8 18 F 5 -
9 PERIMETER 8 18 F 5 -
17 PROJ_COQDSFED# 4 5 B - -
21 PROJ_COQDSFED-ID 4 5 B - -
25 PROJ_COQDS# 4 5 B - -
29 PROJ_COQDS-ID 4 5 B - -
33 PROJ_QUADS# 4 5 B - -
37 PROJ_QUADS-ID 4 5 B - -
41 USGSNAME 40 40 C - -
81 USGSCODE 8 8 C - -
89 QDSOURCE 10 10 C - -
99 COUNTY 20 20 C - -
119 COSOURCE 10 10 C - -
```

```
129 FOREST_AGENCY 15 15 C - -
144 FORSOURCE 10 10 C - -
```

Use the dropitem command to drop unnecessary .PAT items:

```
Arc: dropitem proj_coqdsfed.pat proj_coqdsfed.pat va_cnty#
```

TIP: When dropping several items from a .PAT, typing:

dropitem proj_coqdsfed.pat proj_coqdsfed.pat

Brings up a Arc prompt which allows to to specific many items:

```
Arc:dropitem proj_coqdsfed.pat proj_coqdsfed.pat
Enter item names (type END or a blank line when done):
==================================================
Enter the 1st item:
```

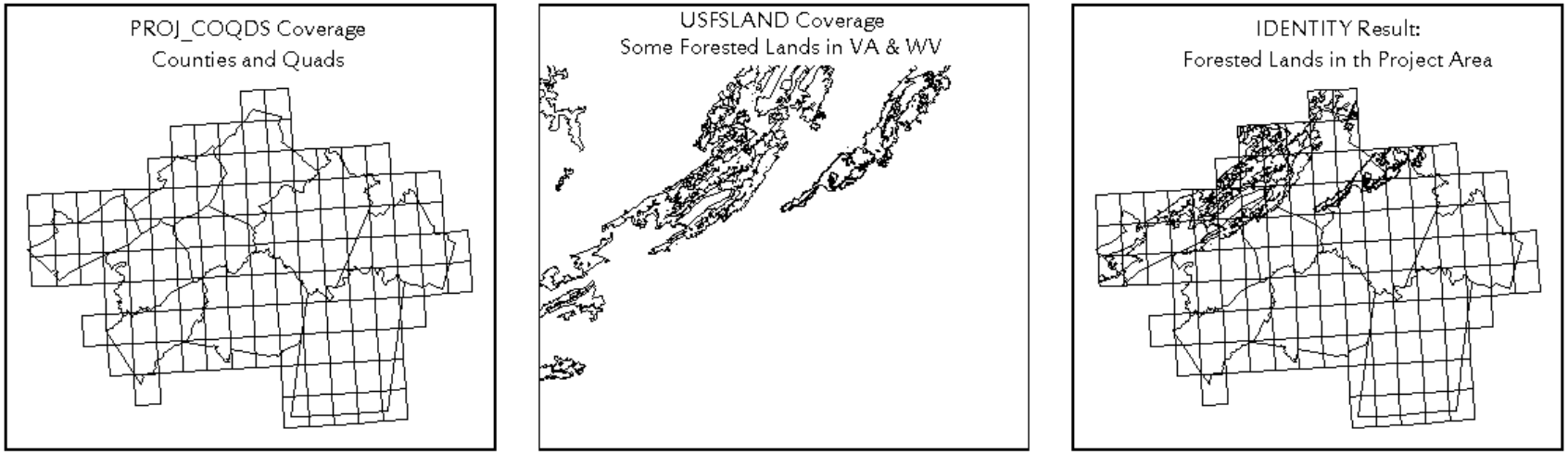

PROJ_COQDS Coverage
Counties and Quads
USFSLAND Coverage
Some Forested Lands in VA & WV
IDENTITY Result:
Forested Lands in th Project Area

Figure 2

Section 7

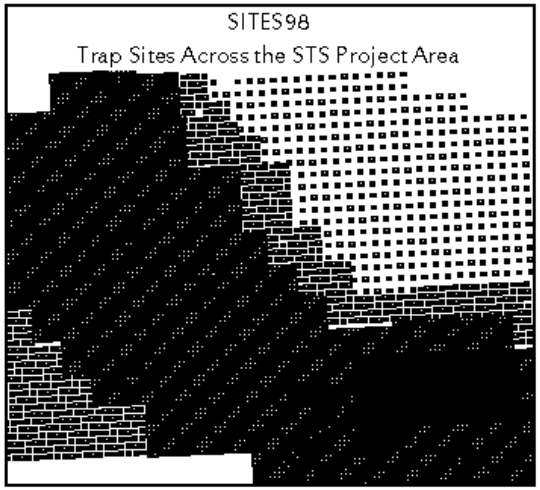
Wise Arc/Info users will guess that the IDENTITY command could be used to capture those data points within the project's area. It might be useful, however, to retain those points as a separate point coverage (the IDENTITY command would combine the sites with the poygon <identity_cover> so that data base ready files can be easily extracted. For this section, use the CLIP command:

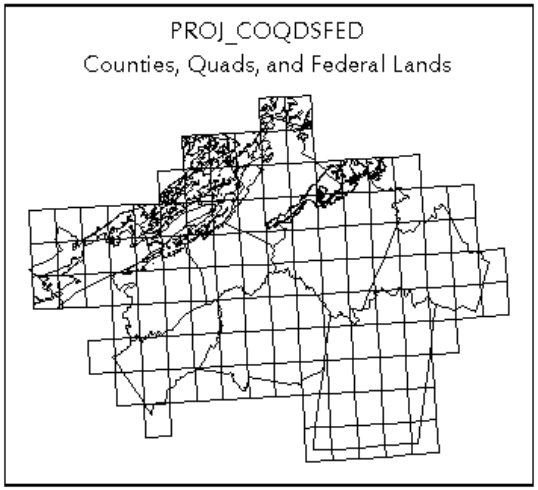
```
Arc: clip

Usage: CLIP <in_cover> <clip_cover> <out_cover>

{POLY | LINE | POINT | NET | LINK | RAW} {fuzzy_tolerance}

Arc: clip sites_cctp proj_coqds proj_sites point

Clipping sites_cctp with proj_coqds to create proj_sites.

Overlaying points...

Creating proj_sites.PAT...

Arc: build proj_sites points

Building points...

Arc:
```

The resulting point coverage contains the following items:

```
Arc: items proj_sites.pat

COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME INDEXED?

1 AREA 4 12 F 3 -

5 PERIMETER 4 12 F 3 -

9 PROJ_SITES# 4 5 B - -

13 PROJ_SITES-ID 4 5 B - -

17 UTME 6 6 I - -

23 UTMN 7 7 I - -

30 SITENO 4 4 I - -

34 GRID 5 5 I - -

Arc:
```

In a later section the "proj_sites" coverage is combined with "proj_coqdsfed" to assign useful attributes (such as county, USGS quad, etc.) to the sites.


SITES98
Trap Sites Across the STS Project Area


PROJ_COQDSFED
Counties, Quads, and Federal Lands

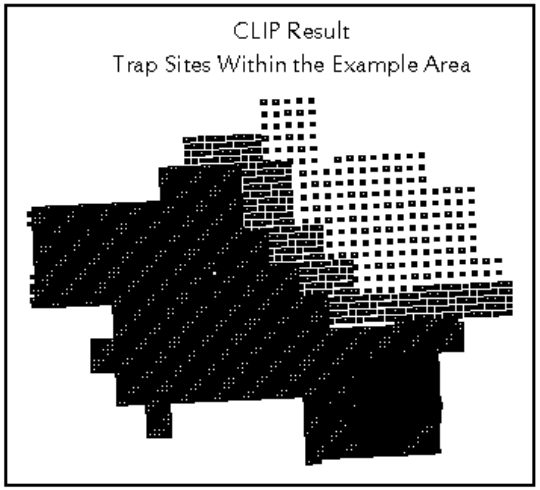

CLIP Result
Trap Sites Within the Example Area

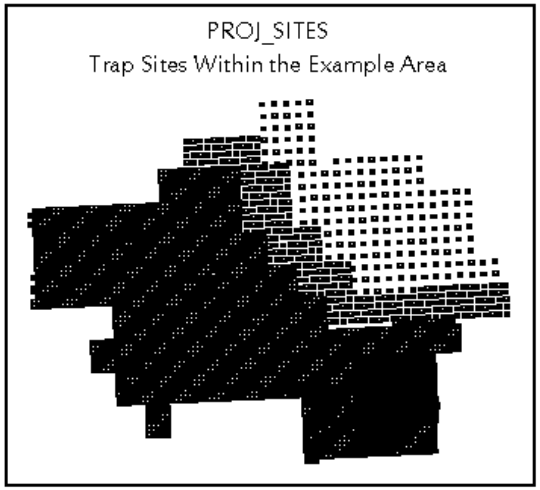
Figure 3

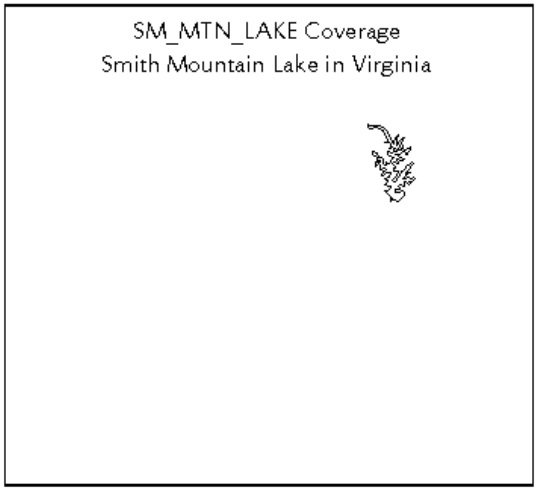
Section 8

For Arc/Info users, the ERASE command uses the polygons of one coverage to remove corresponding features from another coverage. Use ERASE to remove those trap sites from the "proj_sites" point coverage, which fall into Smith Mountain Lake. Name the resulting coverage "sites_final"

```
Arc: erase

Usage: ERASE <in_cover> <erase_cover> <out_cover>

{POLY | LINE | POINT | NET | LINK | RAW} {fuzzy_tolerance}

Arc: erase proj_sites sm_mtn_lake sites_final point

Erasing proj_sites with sm_mtn_lake to create sites_final

Overlaying points...

Creating sites_final.PAT...

Arc: build sites_final point

Building points...

Arc:
```

Use ArcPlot or ArcEdit to examine "sites_final" with "sm_mtn_lake" as a background. Note that four traps we eliminated; all remaining traps are land-based.


PROJ_SITES
Trap Sites Within the Example Area


SM_MTN_LAKE Coverage
Smith Mountain Lake in Virginia

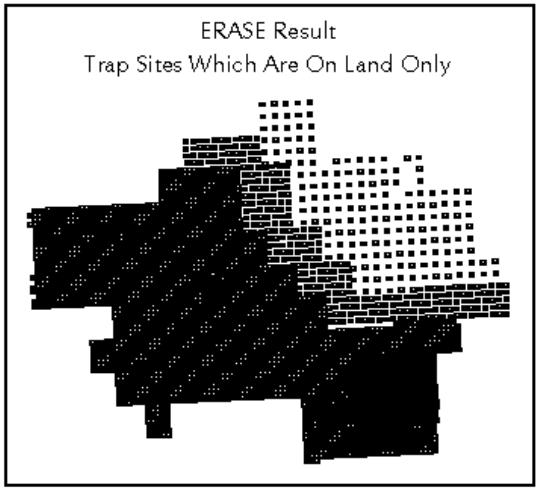

ERASE Result
Trap Sites Which Are On Land Only

Figure 4

Section 9

Arc/Info Users can either the IDENTITY or INTERSECT command to combine the "sites_final" and "proj_coqdsfed" coverages. The use of IDENTITY here is arbitrary; INTERSECT is discussed in a later example. Name the resulting coverage "sites_all":

```
Arc: identity proj_sites proj_coqdsfed sites_all point
Producing identity of proj_sites with proj_coqdsfed to create sites_all
Overlaying points...
items sites_all.pat
Creating sites_all.PAT...
** Item "AREA" duplicated, Join File version dropped **
** Item "PERIMETER" duplicated, Join File version dropped **
** Item "AREA" duplicated, Join File version dropped **
** Item "PERIMETER" duplicated, Join File version dropped **
Arc: items sites_all.pat
COLUMN ITEM NAME WIDTH OUTPUT TYPE N.DEC ALTERNATE NAME INDEXED?
1 AREA 8 18 F 5 -
9 PERIMETER 8 18 F 5 -
17 SITES_ALL# 4 5 B - -
21 SITES_ALL-ID 4 5 B - -
25 UTME 6 6 I - -
31 UTMN 7 7 I - -
38 SITENO 4 4 I - -
42 GRID 5 5 I - -
47 USGSNAME 40 40 C - -
87 USGSCODE 8 8 C - -
95 QDSOURCE 10 10 C - -
105 VA_CNTY# 4 5 B - -
109 VA_CNTY-ID 4 5 B - -
113 VAFIPS 5 5 I - -
118 COUNTY 20 20 C - -
138 COSOURCE 10 10 C - -
148 USFSLAND# 4 5 B - -
152 USFSLAND-ID 4 5 B - -
156 FOREST_AGENCY 15 15 C - -
171 FORSOURCE 10 10 C - -
Arc:
```

Next, go into INFO to create the data base file using INFO's OUTPUT and PRINT commands:

```
Arc: info
INFO EXCHANGE CALL
03/06/1998 18:40:22
INFO 9.42 11/11/86 52.74.63*
Copyright (C) 1994 Doric Computer Systems International Ltd.
All rights reserved.
Proprietary to Doric Computer Systems International Ltd.
US Govt Agencies see usage restrictions in Help files (Help Restrictions)
ENTER USER NAME>ARC
ENTER COMMAND >SEL SITES_ALL.PAT
5516 RECORD(S) SELECTED
ENTER COMMAND >ITEMS
DATAFILE NAME: SITES_ALL.PAT 06/03/1998
20 ITEMS: STARTING IN POSITION 1
COL ITEM NAME WDTH OPUT TYP N.DEC ALTERNATE NAME
1 AREA 8 18 F 5
9 PERIMETER 8 18 F 5
17 SITES_ALL# 4 5 B -
21 SITES_ALL-ID 4 5 B -
25 UTME 6 6 I -
31 UTMN 7 7 I -
38 SITENO 4 4 I -
42 GRID 5 5 I -
47 USGSNAME 40 40 C -
87 USGSCODE 8 8 C -
95 QDSOURCE 10 10 C -
105 VA_CNTY# 4 5 B -
109 VA_CNTY-ID 4 5 B -
113 VAFIPS 5 5 I -
118 COUNTY 20 20 C -
138 COSOURCE 10 10 C -
148 USFSLAND# 4 5 B -
152 USFSLAND-ID 4 5 B -
```

```
156 FOREST_AGENCY 15 15 C -
171 FORSOURCE 10 10 C -
ENTER COMMAND >RESEL FOR COUNTY CN 'CRAIG'
450 RECORD(S) SELECTED
ENTER COMMAND >OUTPUT ../CRAIG.DAT
ENTER COMMAND >CALC $COMMA-SWITCH = -1
ENTER COMMAND >PRINT SITENO,UTME,UTMN,FOREST_AGENCY,USGSNAME,USGSCODE
ENTER COMMAND >Q STOP
```

Use your system's file browser/editor to look at craig.dat:

```
SITENO UTME UTMN AGENCY USGSNAME USGSCODE
121 566000 4140000 JNF_Blacksburg Craig Springs 37080-D3
111 556000 4140000 JNF_New Castle Craig Springs 37080-D3
116 550000 4140000 JNF_Blacksburg Waiteville 37080-D4
114 548000 4140000 JNF_Blacksburg Waiteville 37080-D4
142 576000 4138000 JNF_New Castle Looney 37080-D2
140 574000 4138000 JNF_New Castle Looney 37080-D2
138 572000 4138000 JNF_New Castle Looney 37080-D2
143 566000 4138000 JNF_Blacksburg Craig Springs 37080-D3
141 564000 4138000 JNF_Blacksburg Craig Springs 37080-D3
1013 565500 4133000 JNF_Blacksburg McDonalds Mill 37080-C3
55 588000 4160000 VDACS New Castle 37080-E1
77 588000 4158000 VDACS New Castle 37080-E1
75 586000 4158000 VDACS New Castle 37080-E1
67 578000 4158000 VDACS New Castle 37080-E1
70 570000 4158000 VDACS Potts Creek 37080-E2
77 566000 4158000 VDACS Paint Bank 37080-E3
97 586000 4156000 VDACS New Castle 37080-E1
95 584000 4156000 VDACS New Castle 37080-E1
93 582000 4156000 VDACS New Castle 37080-E1
```

The file looks complete and is ready to be sent via e-mail or ftp to the Craig County administrator.

Section 10

Arc/Info Users can use the FREQUENCY command to derive an INFO file of statistics from a coverage. Run a frequency on proj_coqdsfed.pat and name the resulting file proj_stats:

```
Arc: frequency
Usage: FREQUENCY <in_info_file> <out_info_file> {case_item}
Arc: frequency proj_coqdsfed.pat proj_stats
Enter Frequency item names (type END or a blank line when done):
============================================================
Enter the 1st item: agency
Enter the 2nd item:
Done entering item names (Y/N)? y
Do you wish to use the above items (Y/N)? y
Enter Summary item names (type END or a blank line when done):
============================================================
Enter the 1st item: area
Enter the 2nd item:
Done entering item names (Y/N)? y
Do you wish to use the above items (Y/N)? y
```

Now go into INFO and output proj_stats:

```
Arc: info
INFO EXCHANGE CALL
03/06/1998 19:05:04
INFO 9.42 11/11/86 52.74.63*
Copyright (C) 1994 Doric Computer Systems International Ltd.
All rights reserved.
Proprietary to Doric Computer Systems International Ltd.
US Govt Agencies see usage restrictions in Help files (Help Restrictions)
ENTER USER NAME>ARC
ENTER COMMAND >SEL PROJ_STATS
6 RECORD(S) SELECTED
ENTER COMMAND >LIST
$RECNO CASE# FREQUENCY AGENCY AREA
1 1 82 GWNF 406,890,068.387467
2 2 89 JNF_B 466,652,662.325159
```

```
3 3 77 JNF_GL 300,939,578.135164
4 4 99 JNF_N 566,464,549.283207
5 5 6 JNF_W 10,091,498.234800
6 6 525 VDACS 16884628275.990430
ENTER COMMAND >OUTPUT ../PROJ.STATS
ENTER COMMAND >PRINT FREQUENCY,AGENCY,AREA
ENTER COMMAND >Q STOP
```

Section 11

For Arc/Info users, first extract the Hardy quadrangle polygon from the "proj_quads" coverage. Do this in ArcEdit:

```
Arc: ae
Copyright (C) 1982-1997 Environmental Systems Research Institute, Inc.
All rights reserved.
ARCEDIT (COGO) Version 7.1.1 (Thu Feb 6 23:26:50 PST 1997)
Arcedit: ec proj_quads
The edit coverage is now /HOME/TAPITTS/CCTP/PROJ_QUADS
WARNING the Map extent is not defined
Defaulting the map extent to the BND of /HOME/TAPITTS/CCTP/PROJ_QUADS
Arcedit: de arcs labels
Arcedit: draw
Arcedit:
ef poly
122 element(s) for edit feature POLY
Arcedit:
sel for usgsname cn 'Hardy'
1 element(s) now selected
Arcedit: put hardy
Creating /HOME/TAPITTS/CCTP/HARDY
ec hardy
Copying the polygon(s) into /HOME/TAPITTS/CCTP/HARDY...
draw
1 polygon(s) copied
4 arc(s) copied
1 label(s) copied
Arcedit: The edit coverage is now /HOME/TAPITTS/CCTP/HARDY
Arcedit: Arcedit:
save
Saving changes for /HOME/TAPITTS/CCTP/HARDY
Saving arcs...
** NOTE ** Arc(s) unchanged
Reopening arcs...
Saving labels...
** NOTE ** Label(s) unchanged
```

```
Reopening labels...
BND replaced into /HOME/TAPITTS/CCTP/HARDY
q
Arcedit: Leaving ARCEDIT...
build hardy
Arc: Building polygons...
Re-building AAT...
Arc:
```

Again in ArcEdit, extract from "sites_all" those sites which are in Franklin County:

```
Arcedit: ec sites_all
The edit coverage is now /HOME/TAPITTS/CCTP/SITES_ALL
WARNING the Map extent is not defined
Defaulting the map extent to the BND of /HOME/TAPITTS/CCTP/SITES_ALL
Arcedit: de labels
Arcedit: draw
Arcedit: ef label
5516 element(s) for edit feature LABEL
Arcedit: show items
AREA PERIMETER SITES_ALL# SITES_ALL-ID UTME UTMN SITENO GRID USGSNAME
USGSCODE QDSOURCE VA_CNTY# VA_CNTY-ID VAFIPS COUNTY COSOURCE USFSLAND#
USFSLAND-ID FOREST_AGENCY FORSOURCE
Arcedit: sel for county cn 'FRANKLIN'
450 element(s) now selected
Arcedit: put sites_frank
Creating /HOME/TAPITTS/CCTP/SITES_FRANK
Copying the label(s) into /HOME/TAPITTS/CCTP/SITES_FRANK...
450 label(s) copied
Arcedit: ec sites_frank
The edit coverage is now /HOME/TAPITTS/CCTP/SITES_FRANK
Arcedit: draw
Arcedit: be arcs
Arcedit: bc hardy 3
/HOME/TAPITTS/CCTP/HARDY
is now background coverage 1 with draw symbol 3
```

```
Arcedit: draw

Arcedit: q

Leaving ARCEDIT...

Arc:

build sites_frank point

Building points...

Arc:
```

Now using the INTERSECT command, combine "hardy" with "sites_frank":

```
Arc: intersect

Usage: INTERSECT <in_cover> <intersect_cover> <out_cover> {POLY | LINE |
 POINT}

{fuzzy_tolerance} {JOIN | NOJOIN}

Arc: intersect sites_frank hardy sites_har_fr point

Intersecting sites_frank with hardy to create sites_har_fr

ae

Overlaying points...

Creating sites_har_fr.PAT...
```

This point coverage now contains only those trap sites in both the Hardy quadrangle and Franklin County.

As in the previous examples, go into INFO to output a file from sites_har_fr.pat. This file can be sent to the County EPA liaison.

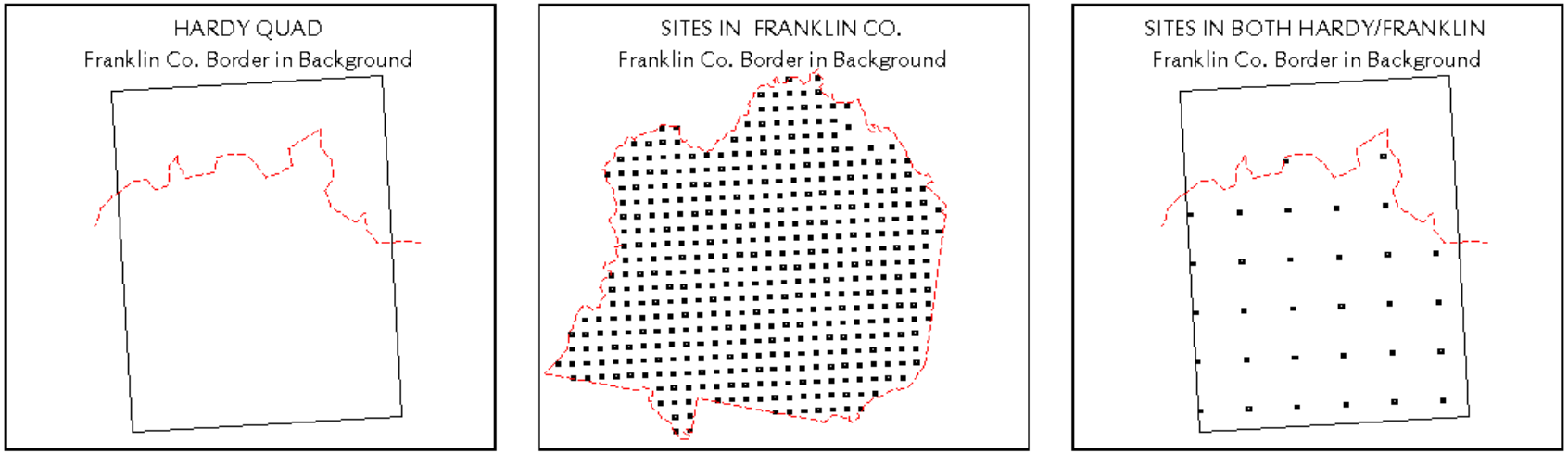

HARDY QUAD
Franklin Co. Border in Background
SITES IN FRANKLIN CO.
Franklin Co. Border in Background
SITES IN BOTH HARDY/FRANKLIN
Franklin Co. Border in Background

Figure 5