GIS Research – Image Acquisition and Processing

Contract Number: BD# 543 WO 11

March 2009

Final Report

DISCLAIMER

“The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.”

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
AREA				
in^2	squareinches	645.2	square millimeters	mm^2
ft^2	squarefeet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
TEMPERATURE (exact degrees)				
^oF	Fahrenheit	5(F-32)/9 or (F-32)/1.8	Celsius	^oC

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
ILLUMINATION				

fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS TO SI UNITS

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
AREA				
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL

TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m²	candela/m²	0.2919	foot-Lamberts	fl

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in²

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16. Abstract

The GIS base map is an Arc/INFO coverage comprised of arcs, nodes, and a route system that geographically represents the roadways maintained in the Roadway Characteristics Inventory (RCI). Because of Florida's continued rapid growth, up-to-date imagery is constantly needed to help maintain the road system and plan for the future. The purpose of this project is to research the existence, acquisition and processing of imagery that is more recent than the 2004 DOQQs.

As a result of this project the FDOT has been able to acquire high resolution imagery for all of Florida's 67 counties. An inventory of the more up-to-date imagery was created, the imagery acquired and finally reformatted for use in the FDOT's Transportation Statistics Office and throughout other offices as well.

The FDOT can now more effectively manage the base map, which is used for several purposes, including:

- Providing a QA tool for RCI feature lengths.
- Dynamic segmentation - the creation of GIS data layers from RCI features.
- Map production.
- Creation of the State's city-to-city mileage matrix.
- Modeling.

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GIS, Imagery, DOQQ, Ortho-imagery	No Restrictions

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Executive Summary

The 2025 Florida Transportation Plan (FTP), developed in 2005, provides the framework for how the state will meet the various transportation needs of not just our citizens, but also tourists and businesses. Federal, state, regional, local, and private entities will invest over $161 billion in this system over the next two decades. These investments will be a key determinant of whether Florida is able to meet its economic and livability goals. The plan provides goals and objects for all aspects of transportation planning and also offers guidance on how transportation funds should be directed during constrained funding times.[1]

Visualization of existing transportation infrastructure, land use, and population growth patterns is essential to planning for an effective Strategic Intermodal System in Florida.[2] Up-to-date aerial photography serves as a vital tool for planners, statisticians, and others involved in looking ahead for what is needed to ensure the mobility of people and commerce in an ever changing and evolving future.

In planning for future road improvements and development the FDOT often uses aerial photography. In the past one of the main sources of that photography was from the United States Geological Survey (USGS). In 1994, 1999 and for a final time in 2004 USGS produced a set of imagery known as the Digital Ortho(-photography) Quarter-Quads or DOQQs. The coverage was complete for the state and used a color infrared film (or sensor) at a one meter resolution. In many parts of the state the images were quickly out of date and resolution not high enough for effective planning. Due to budget constraint, the USGS no longer has a work program to capture imagery but is often willing to partner with organizations capturing imagery for strategic US cities.[3] During this contract period Florida was able to secure over two million dollars for image acquisition projects.

The Florida Department of Revenue (DOR) has as one of its mandates the requirement to supply aerial photography to each of Florida's counties every three years. For the most part, DOR has been coordinating the contracting of these projects and paying for them with state allocated funds. A handful of the more populous counties handle their own projects and have slightly different products to work with but follow the DOR specification fairly closely. Recent legislation changes the level of funding for this effort and may affect the availability of imagery in the future.

As budgets continue to be squeezed in this economic climate it will be interesting to see if there is any attempt to acquire imagery less often or to use more relaxed standards in the future. Either one of these would impact the ability of the FDOT to effectively plan for the future.

This project addresses the process of finding the more accurate and up-to-date imagery in Florida and supplying it to the Transportation Statistics Office for use in assessing Florida's road systems and planning for the future. An inventory of imagery was produced and used to track the process of modifying the imagery to meet the GIS needs of the FDOT. Imagery for all 67 counties has been made available as result of this project. A naming convention was established and technical issues resolved in manipulating the imagery into products that could be integrated directly into the FDOT's mapping and GIS efforts.

1 2025 Florida Transportation Plan, http://www.dot.state.fl.us/planning/ftp/2025FTP-LowRes.pdf
2 Florida's Strategic Intermodal System, A transportation system to guide strategic investments linked to Florida's future economy, http://www.dot.state.fl.us/planning/sis/
3 The 133 Urban Areas initiative is part of the HSIP program, and has its origins in the Nunn-Lugar-Domenici Act (Defense Against Weapons of Mass Destruction Act 1996) where the Department of Defense was tasked to assist state and local governments in preparing for and responding to chemical, biological and nuclear incidents in 120 major cities. After 9-11, NGA and USGS expanded the list to 133 by adding the remaining state capitals not on the original list.

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Introduction

The Transportation Statistics Office GIS Support Section at the Florida Department of Transportation (FDOT) is responsible for maintaining the Florida official GIS basemap. The basemap is an ArcInfo (ESRI) route coverage of the State Highway System, and is a geographic representation of the roads maintained in the Office's Roadway Characteristics Inventory (RCI). The basemap is modified daily by the Transportation Statistics Office GIS Support Section utilizing the United States Geological Survey's (USGS) digital orthophoto quarter-quads (DOQQs) and imagery provided by a previous research project as the sources for these editing tasks. However, the DOQQs being used were originally created in 1999 and are currently updated on a five year cycle. With Florida continuing to lead the nation in many growth areas there is often a need for more up-to-date imagery in order to keep up with the dynamic nature of Florida's roads.

More accurate and up-to-date imagery is needed to better understand what the true situation is on the ground. The DOQQs are one meter in resolution and do a good job of depicting what is on the ground but break down when more accuracy is needed. Road edges blur in close up viewing of the imagery making it impossible to obtain some of the information needed for effective planning. The DOQQs use the infrared spectrum of light waves. The reasoning behind this choice over visible light (RGB) is because the infrared portions allow users of the imagery to gain more knowledge concerning vegetation (type, health) than does the visible portion. This however makes it a bit harder to interpret in many cases and can lead to confusion for those using the imagery for purposes other than vegetation analysis.

Since September 11, 2001 the mission and focus of USGS has been changing. Florida was able to obtain a 2004 set of DOQQs (having previously cost shared imagery sets for 1994 and 1999) but had to pay the entire bill with USGS acting only as the contract manager. All current indications are that USGS will not be in the business of aiding the states in the future with one meter DOQQ acquisition but is willing to cost share in certain locations where there is a more national security concern (National Imagery and Mapping Agency [NIMA] 133 Cities Project). Florida is aware of this situation and is taking steps to address the high resolution image acquisition needs of the future. Without a source for current imagery, the planning and maintenance of the state's road system will be seriously hindered.

Inventory

The inventory of available imagery has been maintained from the previously funded project. We continue to work with the Department of Revenue (DOR) as the main point of contact. Detailed lists were obtained that indicated the schedules for image acquisition planned for the three years horizon. The list included what organization was in charge of the acquisition, the resolution, miscellaneous other relevant data.

None of the imagery would be the infrared spectrum of light. This was because the DOR supplies the imagery specifically to the county Property Appraisers and, in general, they are not interested in classifying vegetation, but rather depicting where on the ground land ownership occurs. None of the imagery for this project was captured in black and white. Only two of the approximately 130 county projects completed for this project used a traditional film capture of the imagery and then scanned to a digital product. The remainder used a digital camera which is more accurate, less expensive and eliminates the scanning and associated film issues (scanner calibration, film development, etc) that had to be dealt with previously.

Other state departments were contacted concerning the availability of imagery. Many of them had image data sets, but because this project is specifically looking for ortho-rectified imagery and complete county coverage, no other state agency contacted was able to provide additional data sets.

Documentation - Metadata Collector and Data Retrieval

The importance of metadata (data/information about data) is becoming more and more important as there are an ever increasing number of image data sets available in Florida. Descriptions of the imagery are necessary not only to keep up with what data is available, but also knowledge of details about that imagery is essential for understanding exactly what the data represents.

The concept of metadata has been around for a long time but is something that is often ignored by many data managers. During this project we evaluated the Federal Geographic Data Committee (FGDC) standards for digital imagery and have developed standards for imagery data sets that we feel are comprehensive. Teleconferences and a full day workshop were held to help both the state and private vendors come to an agreement as to how to document the image data sets. All metadata now is required to pass the FGDC validation routines and makes for a much more valuable document not just for now but perhaps equally as important, the future.

Each county image data set is now cataloged in the Florida Geospatial Metadata Index (http://clearinghouse.labins.org). Figure 1 below shows the home page for the Clearinghouse. The system will allow the user to search for specific image datasets or browse through all that have been entered.

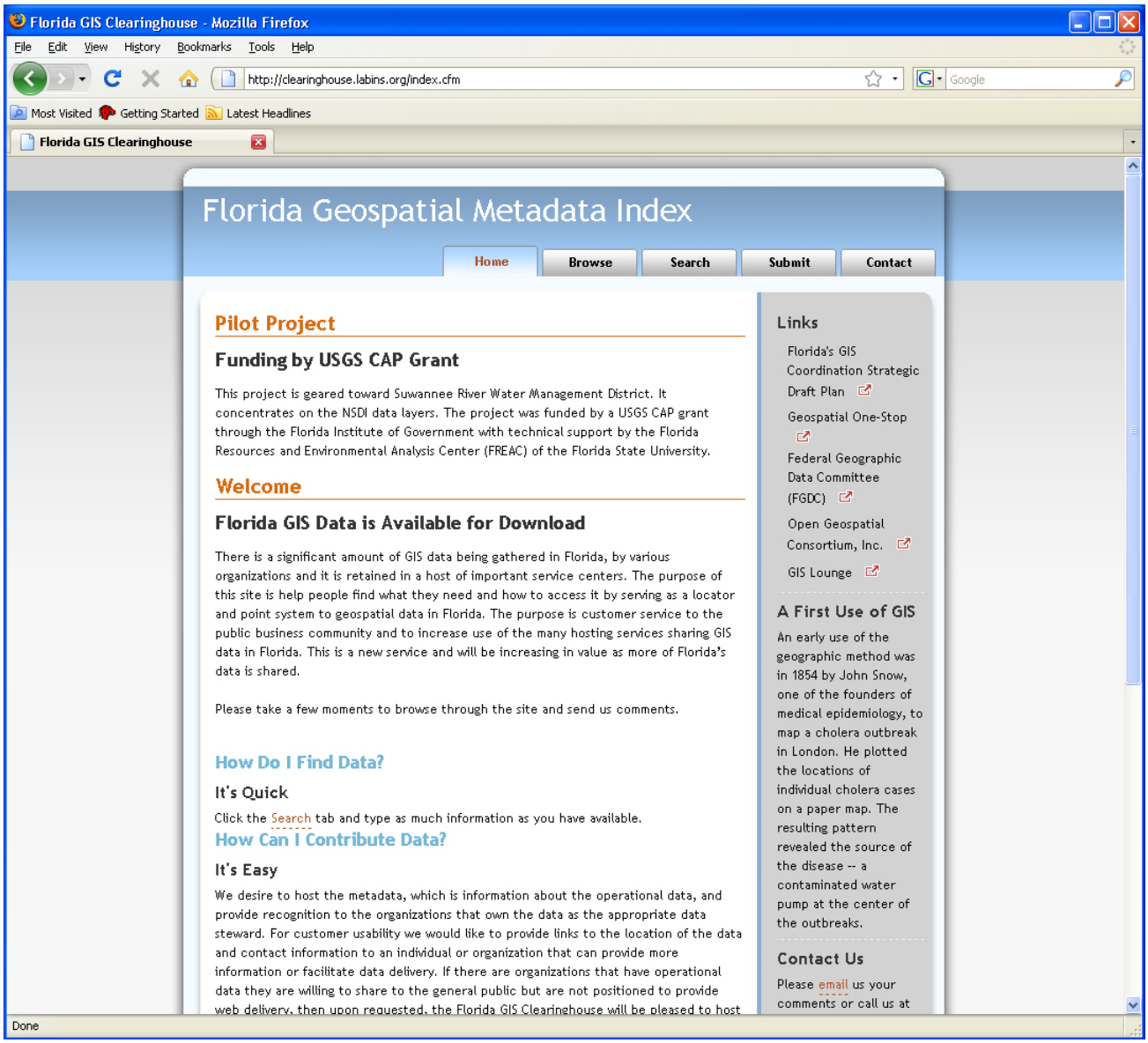

Figure 1

Figures 2 and 3 below show sample screens for the browse and search capabilities.

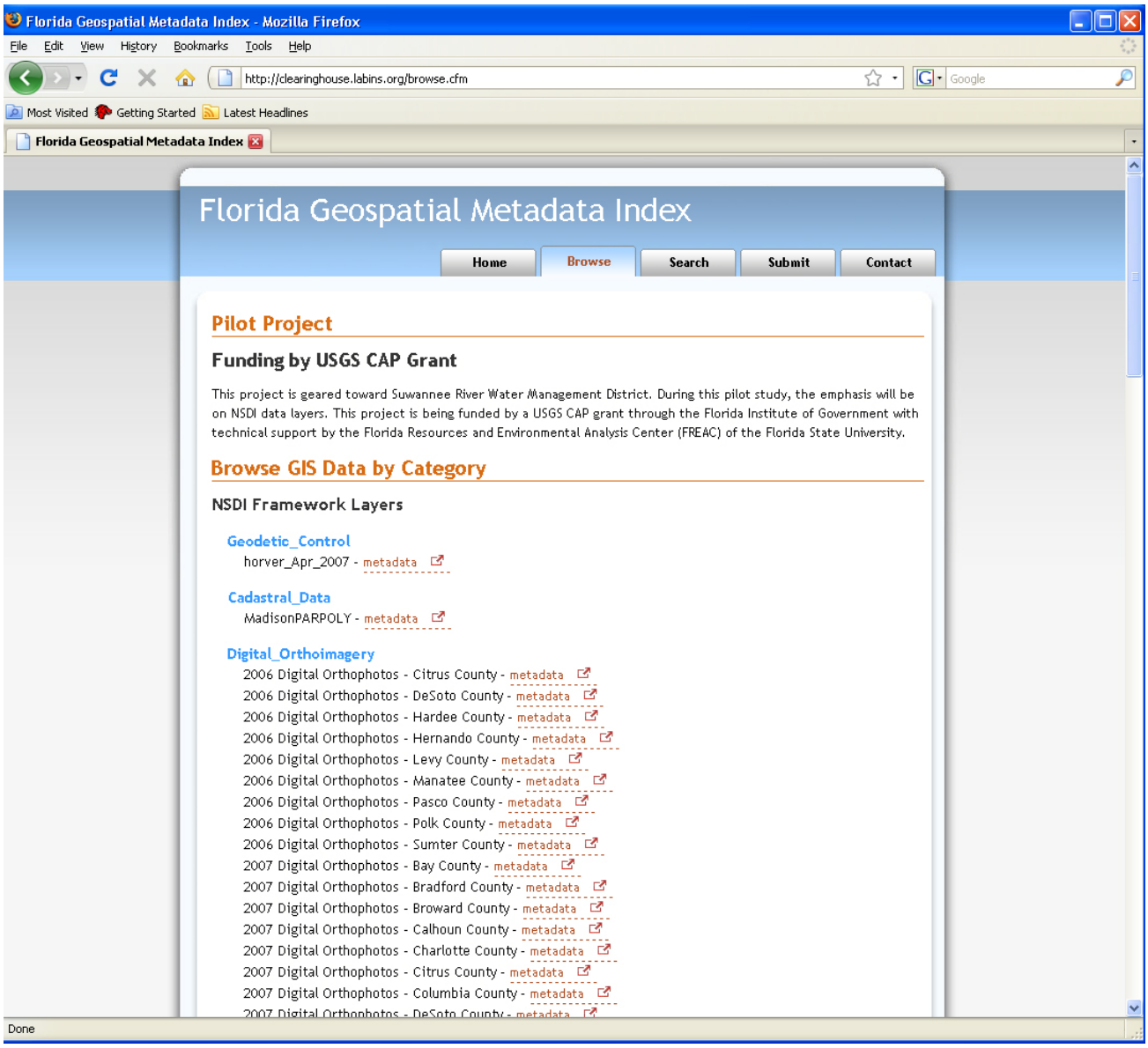

Figure 2 Example of browsing the Metadata Index

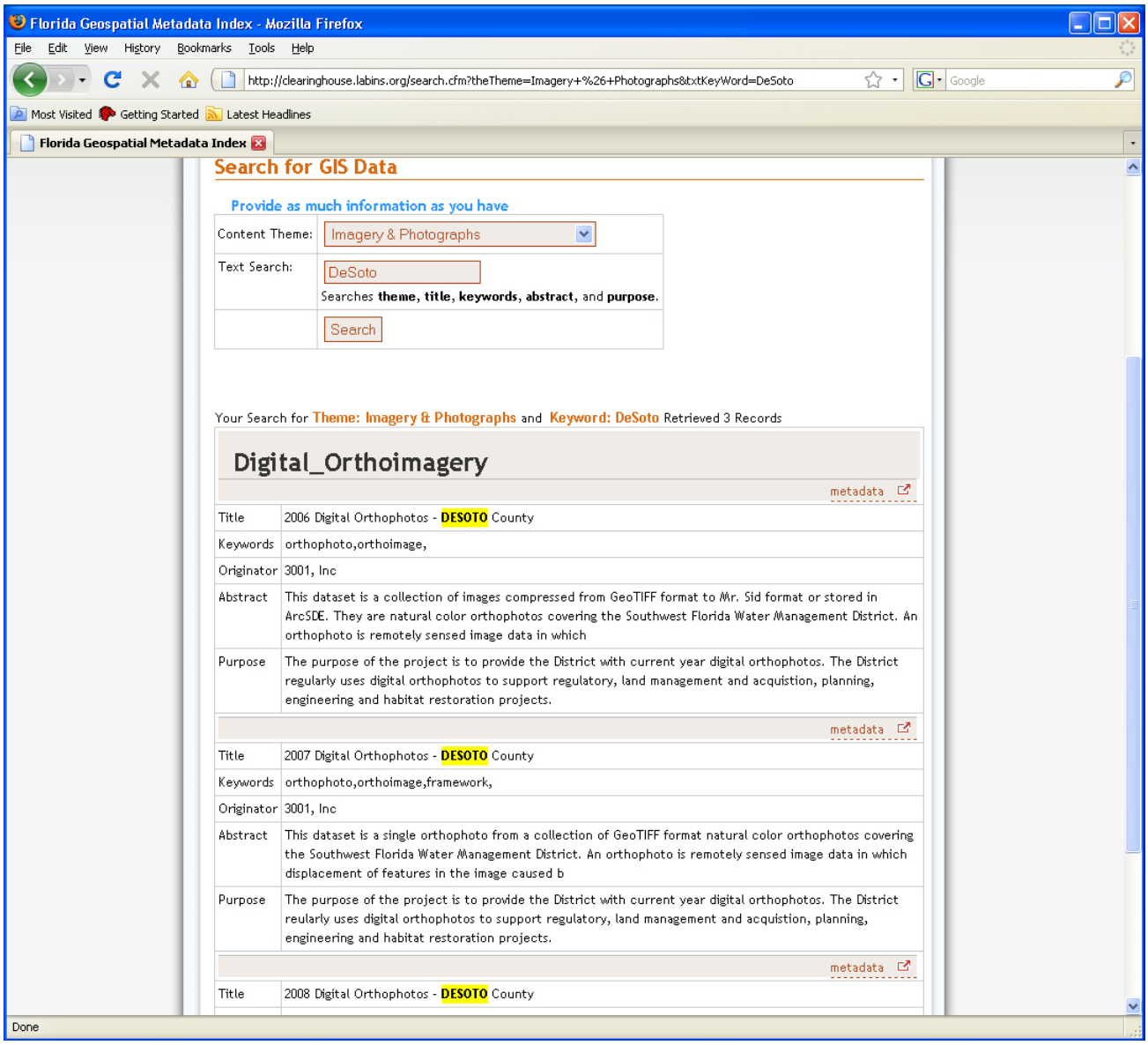

Figure 3 Example of a search for imagery for DeSoto County.

The site feeds the national metadata portal referred to as Geospatial One Stop or GOS (http://www.geodata.gov).

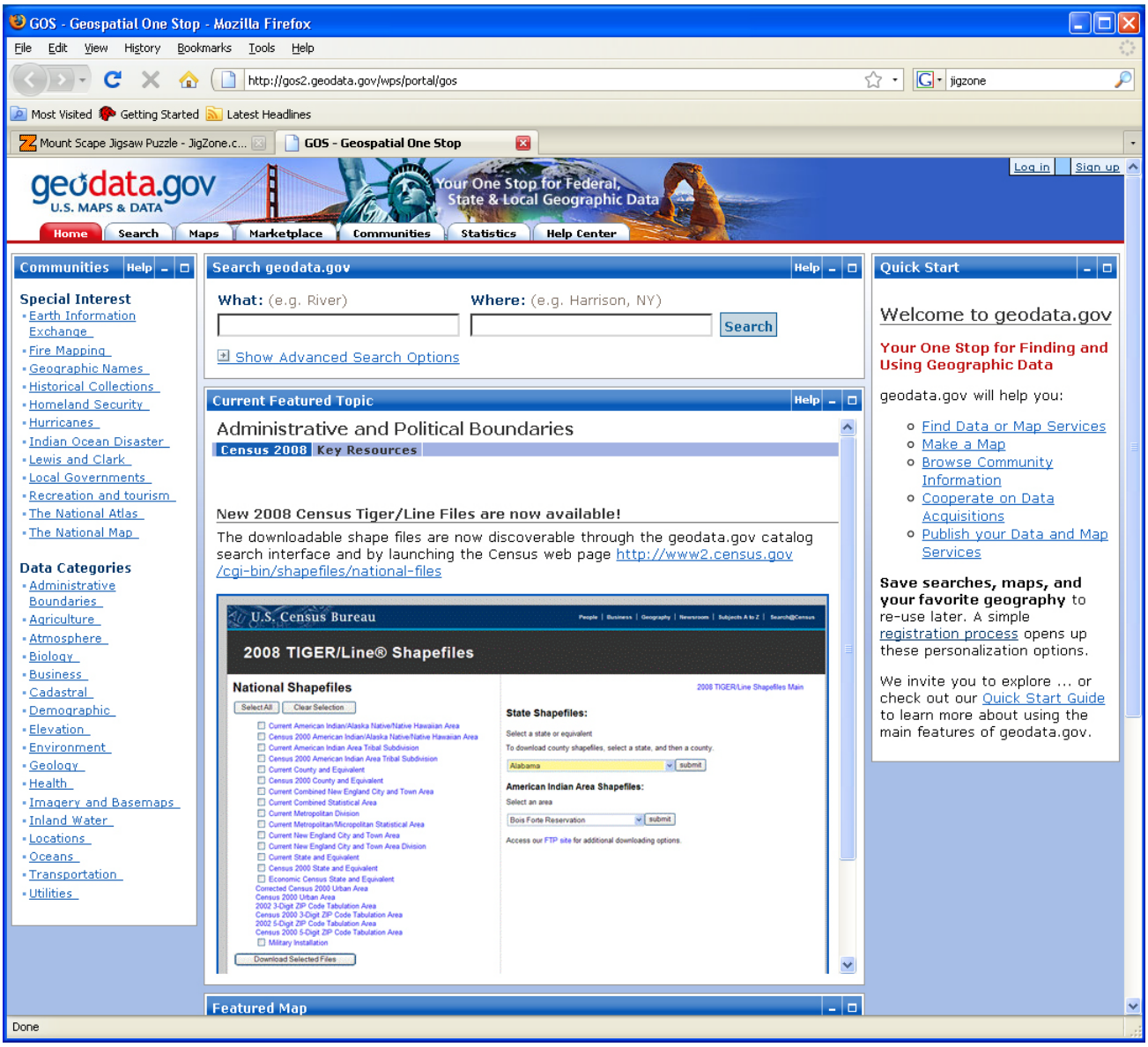

Figure 4 The National Geospatial Clearinghouse

Data Management

One of the more interesting challenges of this project was how to deliver the images to DOT. It involved two aspects: a grid and a naming convention.

The Grid

When this project first began there was no standard way for vendors to deliver images. Some attempted to follow the Section/Township/Range grid, but many simply allow the vendor to deliver the image in what ever size chunks it wanted. The original images that we obtained were in many different sizes and projections.

The goal that we decided upon for a standard grid for this project was one that would produce image that, when compressed to a JPG format, would be a "reasonable" size to work with. Very large compressed images would take too long to display as they were being uncompressed during the draw phase and images that were fairly small would produce too many images creating somewhat of a management challenge for the FDOT. Care was taken when evaluating grid size to allow for variations in original image pixel size and whether or not the image was color or black and white. In general, color images will be about three times the size of a black and white image.

In the end, a 2,000 meter grid was decided upon. A point in the Gulf of Mexico was strategically chosen so to ensure the that the lower left coordinates of each grid or cell would always be whole numbers and ending with the last three digits of "000". This would be critical to the naming convention explained in the next section.

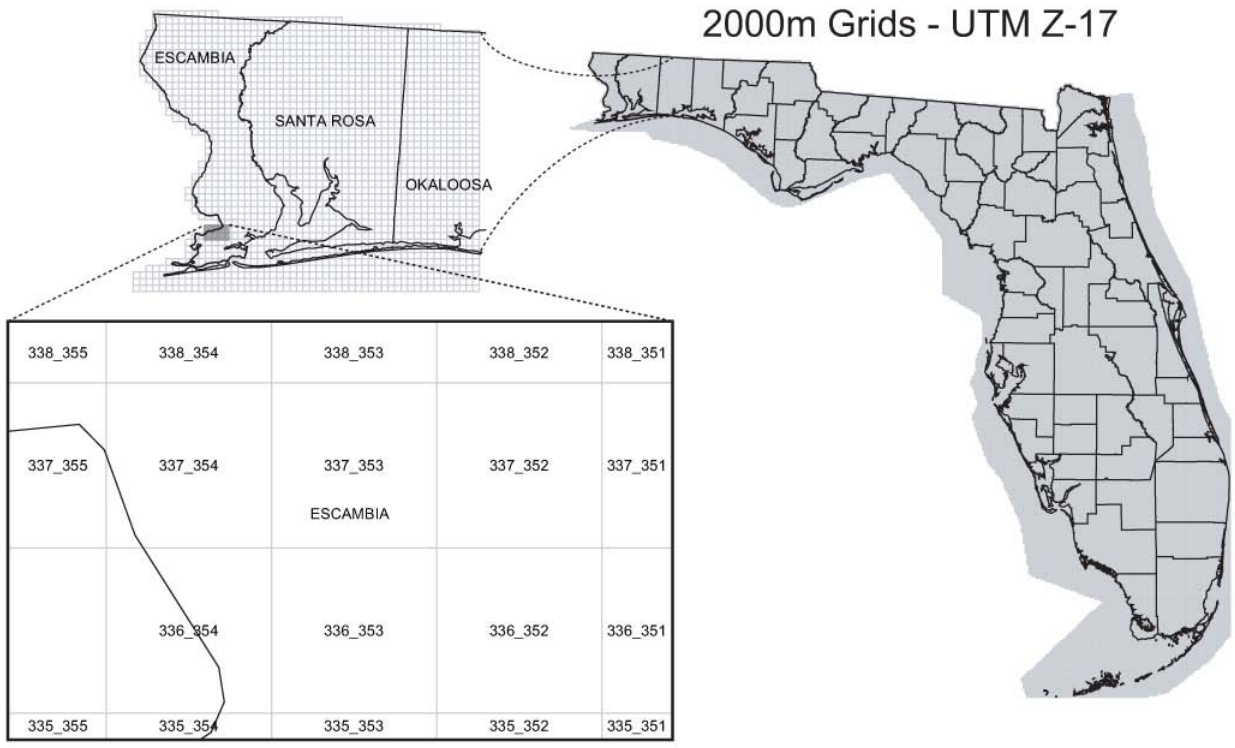
2000m Grids - UTM Z-17
ESCAMBIA
SANTA ROSA
OKALOOSA
338_355
338_354
338_353
338_352
338_351
337_355
337_354
337_353
ESCAMBIA
337_352
337_351
336_354
336_353
336_352
336_351
335_355
335_354
335_353
335_352
335_351

Figure 5

The Image Name

In January 2003 work began to develop a strategic approach for a statewide large-scale aerial photography program. Representatives from the FDOT, the Department of Revenue, the Water Management Districts, and the Department of Environmental Protection considered options for developing a program. One of the topics discussed was the development of a naming convention for individual images. A smaller workgroup was established to consider different approaches. Because of FREAC's work to develop an imagery inventory as part of this project, we were tasked with the responsibility of developing a naming convention. Other members on the naming convention workgroup consisted of representatives from DOT, DOR, and the WMDs. The first draft developed was a meaningful convention consisting of year, format, resolution, coordinate system, county, and state. The committee rejected this proposal recommending that a minimal level of meaningful data be kept in the name and that all metadata should be kept in an associated file. The final version of the name consisted of one digit defining the projection of the image, a three digit row followed by a three digit column number, a four digit year and a three digit sequential number that could be used to tie back to the more detailed metadata. The row and column numbers were extracted from the coordinates by stripping off the final three digits ("000").
Example:

7_262_067_2001_002.jpg

- 7 – Projection is UTM
- 262 – Row number
- 067 – Column number
- 2001 – Year the images was captured
- 002 – Image collection number

(IMPORTANT NOTE: The year portion of the name did undergo a slight modification during the last portion of the contract. The strategy that had always been used for the year was to select the oldest year of the flying season. A typical flying season for Florida is from late November to late March. For example imagery for a county may have been collected during late December of 2007 and early January of 2008. Another example might be that imagery was completely captured in February of 2008. Up until 2008 the year portion of the name would have been 2007 in both previous examples. For the 2007-2008 flying season and beyond the year portion for the examples will be the later of the two years (2008 for the examples). The original strategy led to some confusion with users of the imagery. The users might find out that a particular county had 2008 imagery and that only the 2007 imagery was loaded into the DOT system. In fact DOT had the latest imagery, it was just named differently. This new naming strategy will produce what looks like a gap (no 2007 imagery) in the image datasets that in fact doesn't exist.)

The Process

The objective of this project is to re-project high resolution aerial photos of Florida counties to a Universal Transverse Mercator (UTM) Zone 17 projection using the North American Datum (NAD) for 1983 (GRS80) and clip them to a 2000 meter grid. The final product is a JPG image with 25% compression and second order standard deviation stretch.

Since the resolution of the photos ranged from one quarter of a foot to two feet, to keep a realistic file size for the output image, a new grid of 2000 meter quadrates for entire state was created (Figure 5.) The re-projected aerial photos were then clipped to this new grid. The output files are named using the naming convention established in the earlier phase of the project.

Processing was done using ERDAS Imagine 8.7 (testing has been done using the newest release – 9.1), ArcGIS 9.2 and Microsoft Access 2000 software packages. Perhaps the most challenging issue encountered during processing was the removal of the black edges created during the re-projection phase (Figure 6).

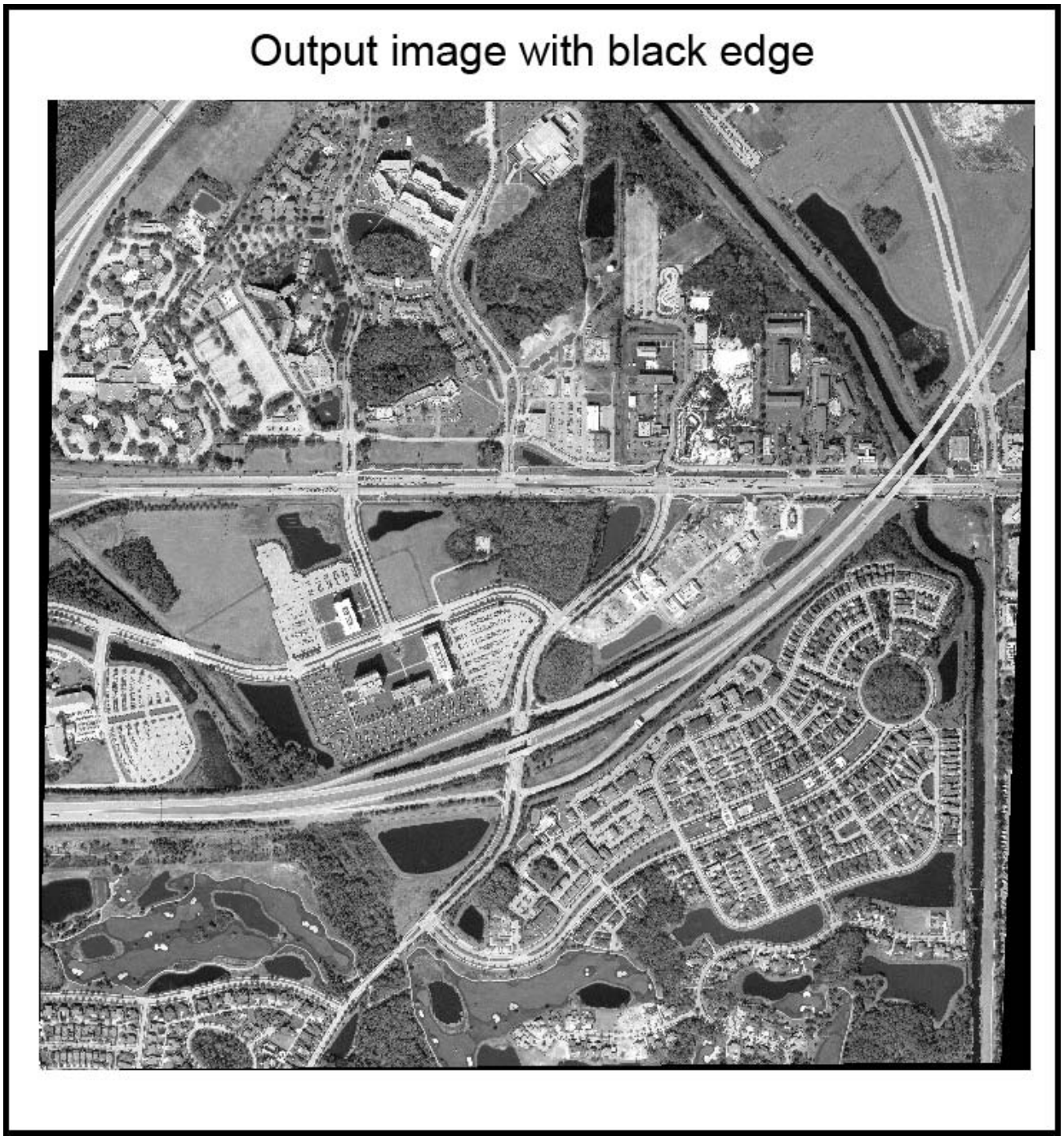

Figure 6

Because the aerial photos in their original format were in State Plane (feet) and were then re-projected to UTM Zone 17, datum NAD83 (meters), the final images were slightly rotated from their original orientation. Also, the output pixel size had to be expressed in terms of meters thus creating a dimension that had to be expressed in terms of a decimal number with many places of precision rather than two, or less, decimal places used in the original images. Decisions had to be made on the number of decimal places of resolution in the output pixel to carry so that there would not be any part of a pixel falling outside the “area of interest (AOI)” (each 2000 meter grid cell), thus adding an extra black pixel of NODATA.

For example, when processing a one and one half foot original resolution image, the resolution of the output would be 0.4572009608 meters. Through trial and error it was discovered that a 0.4575 meters pixel was necessary to ensure that no part of a pixel was extended outside the AOI. Each original image pixel size had to be experimented with in order to find the number of decimals needed for the exact fit needed. Simply using four decimals each time did not work. See figure 7 for how the final image is clipped to the exact boundary of the grid.

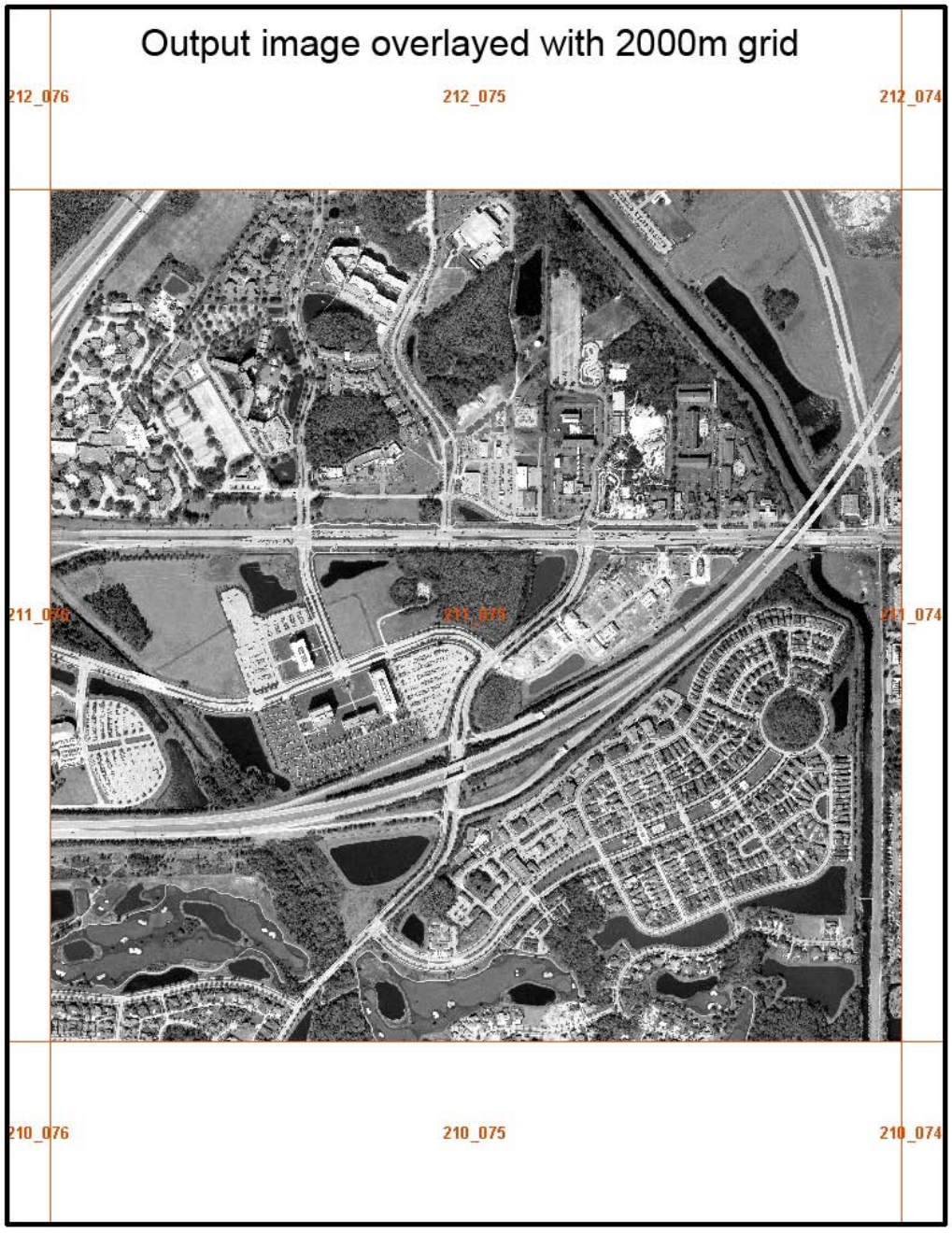

Figure 7

Other issues dealt with while processing were the input image formats and file sizes. While some counties had the images in the MrSid format others were in TIF, JPG or ECW (ER Mapper) formats. If the file format is JPG and the resolution was very high (say one quarter of a foot), it was necessary to convert the original JPG files to IMG (ERDAS) format in order to speed up processing times. Due to a bug in the ERDAS software we also had to import some of the TIF files to an IMG format for purposes of assigning the original projection information to them.

Appendix A lists all of the counties that were processed by quarter.

Table 1 shows the counties that were processed for this project. The Year_Sq column is what is used to link back to the metadata.

Counties Processed

County	Year_Sq
Alachua	2003_027
Alachua	2008_004
Baker	2005_011
Baker	2008_005
Bay	2005_018
Bay	2006_027
Bradford	2005_012
Bradford	2006_004
Brevard	2004_004
Brevard	2005_008
Broward	2004_002
Broward	2006_025
Calhoun	2004_005
Calhoun	2006_005
Charlotte	2005_002
Charlotte	2006_044
Charlotte	2008_011
Citrus	2005_029
Citrus	2006_032
Citrus	2008_012
Clay	2005_007
Clay	2008_006
Collier	2005_003
Columbia	2005_004
Columbia	2006_006
Miami-Dade	2004_003
Miami-Dade	2005_009
Miami-Dade .25 ft	2008_001
Miami-Dade	2008_002
DeSoto	2003_028
DeSoto	2005_028
DeSoto	2006_043
DeSoto	2008_013
Dixie	2003_029
Dixie	2006_020
Duval	2004_013
Duval	2008_007
Escambia	2004_006
Escambia	2006_021
Flagler	2004_017
Flagler	2008_008
Franklin	2003_030
Franklin	2006_007
Gadsden	2004_007
Gadsden	2006_008
Gilchrist	2006_003
Glades	2004_008
Glades	2008_014
Gulf	2005_019
Gulf	2006_009
Hamilton	2004_009
Hamilton	2006_010
Hardee	2003_031
Hardee	2005_035
Hardee	2006_042
Hardee	2008_015
Hendry	2004_010
Hendry	2006_016

Table 1.

Table 1 continued.

Counties Processed

Hernando	2003_032
Hernando	2005_030
Hernando	2006_035
Hernando	2008_017
Highlands	2004_011
Highlands	2005_036
Hillsborough	2005_023
Hillsborough	2006_038
Holmes	2006_028
Indian River	2005_013
Indian River	2008_009
Jackson	2006_011
Jefferson	2005_014
Jefferson	2006_012
Lafayette	2004_012
Lafayette	2006_022
Lake	2005_005
Lee	2008_010
Leon	2006_001
Levy	2005_031
Liberty	2006_013
Madison	2005_001
Madison	2006_023
Manatee	2005_025
Manatee	2006_040
Manatee	2008_022
Marion	2004_018
Marion	2005_032
Martin	2006_026
Monroe	2006_014
Nassau	2004_019
Okaloosa	2006_015
Okeechobee	2005_015
Orange	2005_010
Osceola	2005_021
Palm Beach	2005_016
Pasco	2005_033
Pasco	2006_036
Pinellas	2005_024
Pinellas	2006_037
Polk	2005_026
Putnam	2005_020
Putnam	2008_030
Santa Rosa	2004_014
Santa Rosa	2006_024
Sarasota	2004_021
Sarasota	2005_034
Sarasota	2006_041
Seminole	2003_033
Seminole	2005_022
St Johns	2004_015
St. Johns	2008_003
St Lucie	2005_017
Sumter	2005_027
Sumter	2006_033
Suwannee	2004_020
Suwannee	2006_016
Taylor	2004_022
Taylor	2006_017
Union	2006_018
Volusia	2005_006
Wakulla	2006_002
Walton	2004_016
Walton	2006_019
Washington	2006_029

Table 1.

It is expected that by March 31, 2009 these additional counties will have been completed.

Highlands	2008_018
Hillsborough	2008_019
Lake	2008_020
Levy	2008_021
Marion	2008_023
Nassau	2008_024
Orange	2008_025
Osceola	2008_026
Pasco	2008_027
Pinellas	2008_028
Polk	2008_029
Sarasota	2008_033
Seminole	2008_031
Sumter	2008_032

Table 2.

Appendix A. Processed Counties by Quarter

The following is a list of each county that was processed during the entire contract. The number of counties processed in a given quarter varies for a number of different reasons. During the early stages of the contract, strategies and procedures were being worked out causing fewer counties to be completed. At times, availability of imagery may have also limited production.

Over the life of the contract several counties have been acquired at one half foot resolution rather than the more standard one foot. This means that there are four times as many images to process and this will dramatically increase processing time. The 2008 Miami-Dade County imagery was captured at one quarter of a foot resolution. Several resampling steps were needed to pre-process the imagery because of memory constraints of the software being used to develop the final products.

Counties that appear near each other chronologically in the list do so for several reasons. A problem may have been discovered with the processing of the imagery or problems with the original imagery have at times caused counties or parts of counties to be re-processed. Various strategies were used to look for problems with imagery both before and after the images were processed. The sixteen counties in the Southwest Florida Water Management District have been on an acquisition schedule of every year since 2006. As a general practice, FREAC pushes these counties to the end of the priority order knowing that the oldest data set that DOT would have would be about one year whereas the other 51 counties are on an approximate three year rotation.

Quarter 1
July 1 – September 30, 2005

1. Escambia
2. Dixie
3. Calhoun
4. Brevard

Quarter 2
October 1 – November 30, 2005

1. Franklin
2. Gadsden
3. Hernando

Quarter 3
January 1 – March 31, 2006

1. St. Johns
2. Gadsden
3. Duval
4. Brevard
5. Glades
6. Calhoun

Quarter 4
April 1 – June 30, 2006

1. Alachua
2. De Soto
3. Flagler
4. Hardee
5. Hendry
6. Highlands
7. Lafayette
8. Marion
9. Nassau
10. Santa Rosa
11. Seminole
12. Suwannee
13. Taylor
14. Walton
15. Madison

Quarter 5
July 1 – September 30, 2006

1. Collier
2. Orange
3. Clay
4. Columbia
5. Lake
6. Volusia
7. Brevard
8. Miami-Dade

Quarter 6
October 1 – December 31, 2006

1. Bay
2. Baker
3. Gulf
4. Bradford
5. Indian River
6. Jefferson
7. Okeechobee
8. Putnam
9. St. Lucie
10. Seminole

Quarter 7
January 1 – March 31, 2007

1. Charlotte
2. De Soto
3. Sarasota
4. Polk
5. Hardee

6. Highlands
7. Manatee
8. Hillsborough

Quarter 8
April 1 – June 30, 2007

1. Levy
2. Marion
3. Sumter
4. Leon
5. Citrus
6. Hernando
7. Pasco

Quarter 9
July 1 – September 30, 2007

1. Osceola
2. Palm Beach
3. Pinellas
4. Broward
5. Wakulla
6. Martin
7. Bradford

Quarter 10
October 1 – December 31, 2007

1. Calhoun
2. Columbia
3. Dixie
4. Franklin
5. Gadsden
6. Gilchrist
7. Jefferson
8. Lafayette
9. Liberty
10. Suwannee
11. Taylor
12. Union
13. Monroe
14. Gulf
15. Hamilton
16. Escambia
17. Okaloosa

Quarter 11
January 1 – March 31, 2008

1. Bay
2. Citrus
3. Hernando
4. Holmes

5. Jackson
6. Madison
7. Pasco
8. Pinellas
9. Sumter
10. Walton
11. Washington

Quarter 12
April 1 – June 30, 2008

1. Charlotte
2. De Soto
3. Hardee
4. Hillsborough
5. Manatee
6. Sarasota
7. Miami-Dade (one foot portion)

Quarter 13
July 1 – September 30, 2008

1. Alachua
2. Baker
3. Clay
4. Miami-Dade (one foot resampled) this is the whole county
5. Flagler
6. Indian River
7. Lee
8. St Johns

Quarter 14
October 1 – December 31, 2008

1. Charlotte
2. Citrus
3. De Soto
4. Duval
5. Glades
6. Hardee
7. Hendry
8. Hernando
9. Manatee
10. Putnam