

The logo for the United States Department of Agriculture (USDA) is partially visible on the left side of the slide. It features the word "USDA" in a blue serif font, with a green and white stylized landscape graphic below it.

USDA

The USDA FSA National Agriculture Imagery Program (NAIP)

Brian Vanderbilt
Chief, Geospatial Services Branch
USDA-FSA-APFO

brian.vanderbilt@slc.usda.gov



Abstract

- "The National Agriculture Imagery Program (NAIP) is an aerial imagery acquisition program managed by the United State Department of Agriculture (USDA) Farm Service Agency (FSA) Aerial Photography Field Office (APFO). NAIP seeks to acquire peak growing season GIS ready ortho imagery in order to maintain the Common Land Unit (CLU) dataset and to support FSA farm and conservation programs. Attendees will learn about the technical aspects of NAIP and recent updates in specifications, to include contract requirements and deliverables, file formats, compression, absolute accuracy and control point database, seamline polygons, 4-band, sensor types, radiometric improvements, and quality control processes."

Outline

- Overview of NAIP
- NAIP Specifications
- Sensor Types
- Compression
- 4-band
- Absolute Accuracy & Control Point Database
- Seamline Shapefile
- Radiometric Improvements
- Quality Control Processes





USDA





Overview of NAIP – History

- USDA created May 15, 1862
- Agricultural Adjustment Act of 1933
 - Part of New Deal (FDR)
 - Result of the effects from the Great Depression
 - Created new programs to help farmers



Overview of NAIP – History

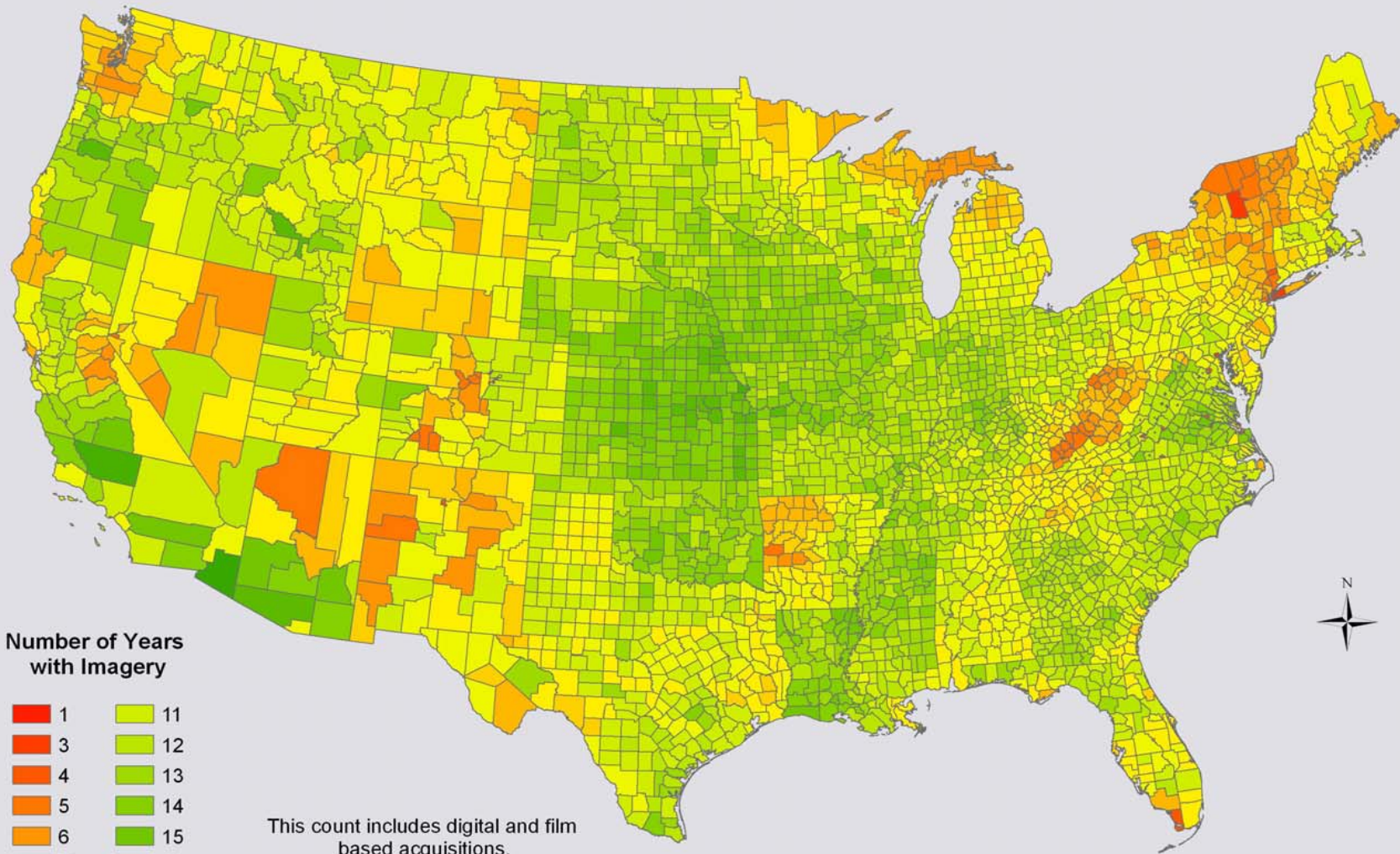
- Aerial photo labs created in 1937
 - Initially in Washington, D.C. and Salt Lake City
 - Established to provide rectified aerial photography for accurate field measurements, in support of these then newly created farm programs
 - 70+ years of aerial photography



Overview of NAIP – History

- Aerial Photography Field Office
 - 1975-present located in Salt Lake City
 - Primary source of aerial imagery for USDA
 - Current holdings
 - 60,000 archived rolls of film from 1955-present (over 10 million images)
 - >100 terabytes of digital geospatial data
 - Much of this is NAIP

APFO's Historical Imagery Collection: How Many Different Years of Imagery Represent Each County?



Number of Years with Imagery



This count includes digital and film
based acquisitions.

Each year is counted only once.
(For example, film flown for NHAP and
later used for NDOP is counted once.)



USDA



Bay Area,
CA



Overview of NAIP – History

- NAPP (National Aerial Photography Program)
 - 1987-2003 (replaced NHAP)
 - USGS coordinated interagency program
 - 48 states & Hawaii, 5-7 year cycle
 - Coverage varied due to budget
 - 1:40,000 scale
 - 20,000 feet flying altitude above mean terrain elevation
 - 1 meter spatial resolution



Overview of NAIP – History

- Hardcopy to Digital
 - MDOQ (mosaicked digital ortho quad)
 - Process ran from 1997-2004
 - Seamed and color balanced
 - 16 DOQQs (digital ortho quarter quad) to create 1 MDOQ
 - 4 primary + 12 surrounding
 - Used as base layer in GIS
 - CCM (compressed county mosaic) created from these MDOQs

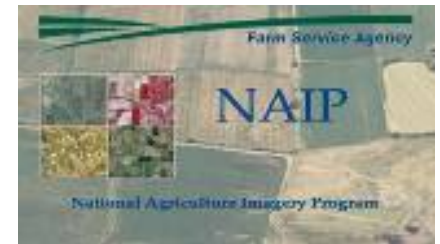


1990's CCM created from MDOQs – Laramie, Wyoming

Overview of NAIP

○ NAIP

- 2002-present
- Began as a pilot program
- Response to need for **more current** imagery to support USDA programs





Overview of NAIP - Samples



Carroll Co, MO
2007 NAIP QQ



Macon Co, MO
2007 NAIP QQ



2008 SWUG



2006 NAIP CCM – Laramie, Wyoming



COLORADO STATE



COLORADO STATE

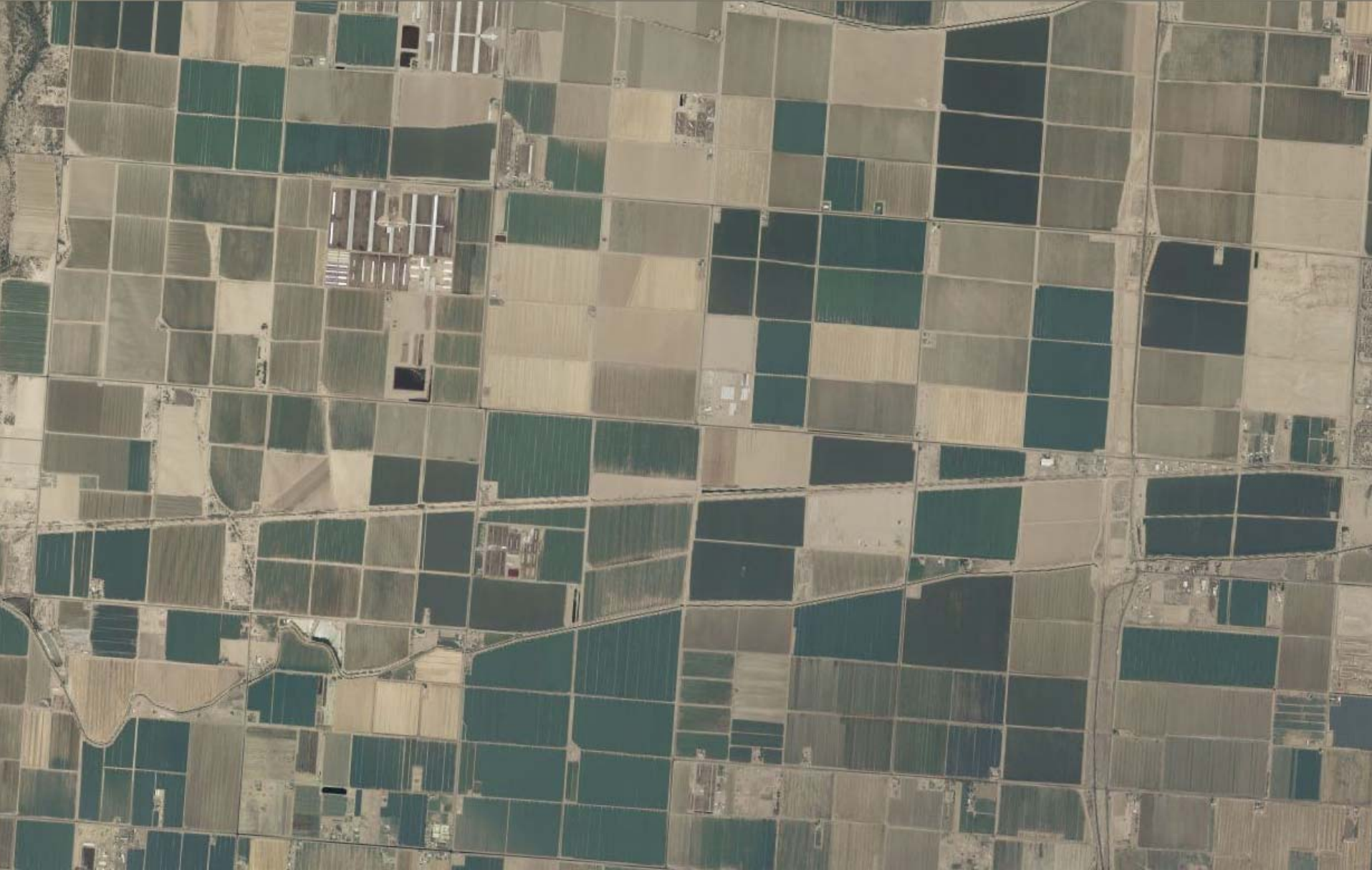
77



2006 NAIP from ArcIMS Service - Yellowstone River Delta, South End Yellowstone Lake



2006 NAIP from ArcIMS Service – 4 Corners



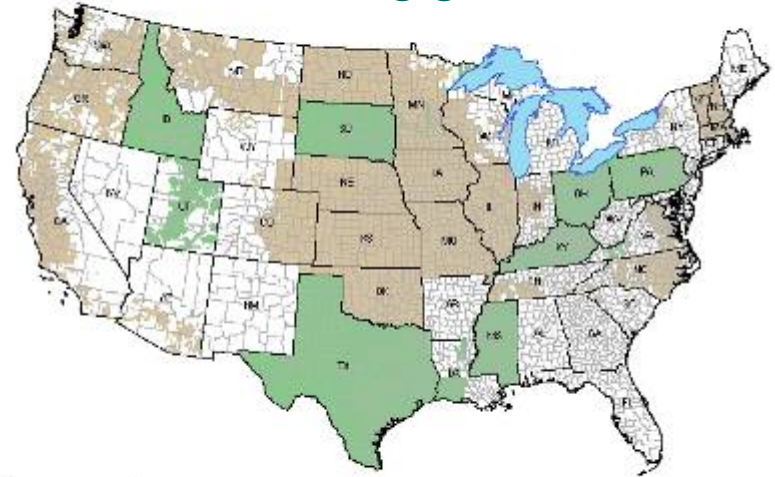
2007 NAIP from Image Server – Cropland West of Phoenix

2003



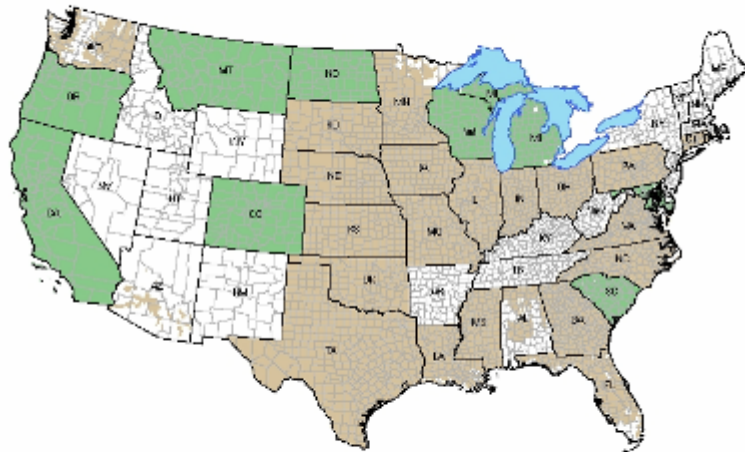
USDA/FSA/APHIS

2004



USDA/FSA/APHIS

2005



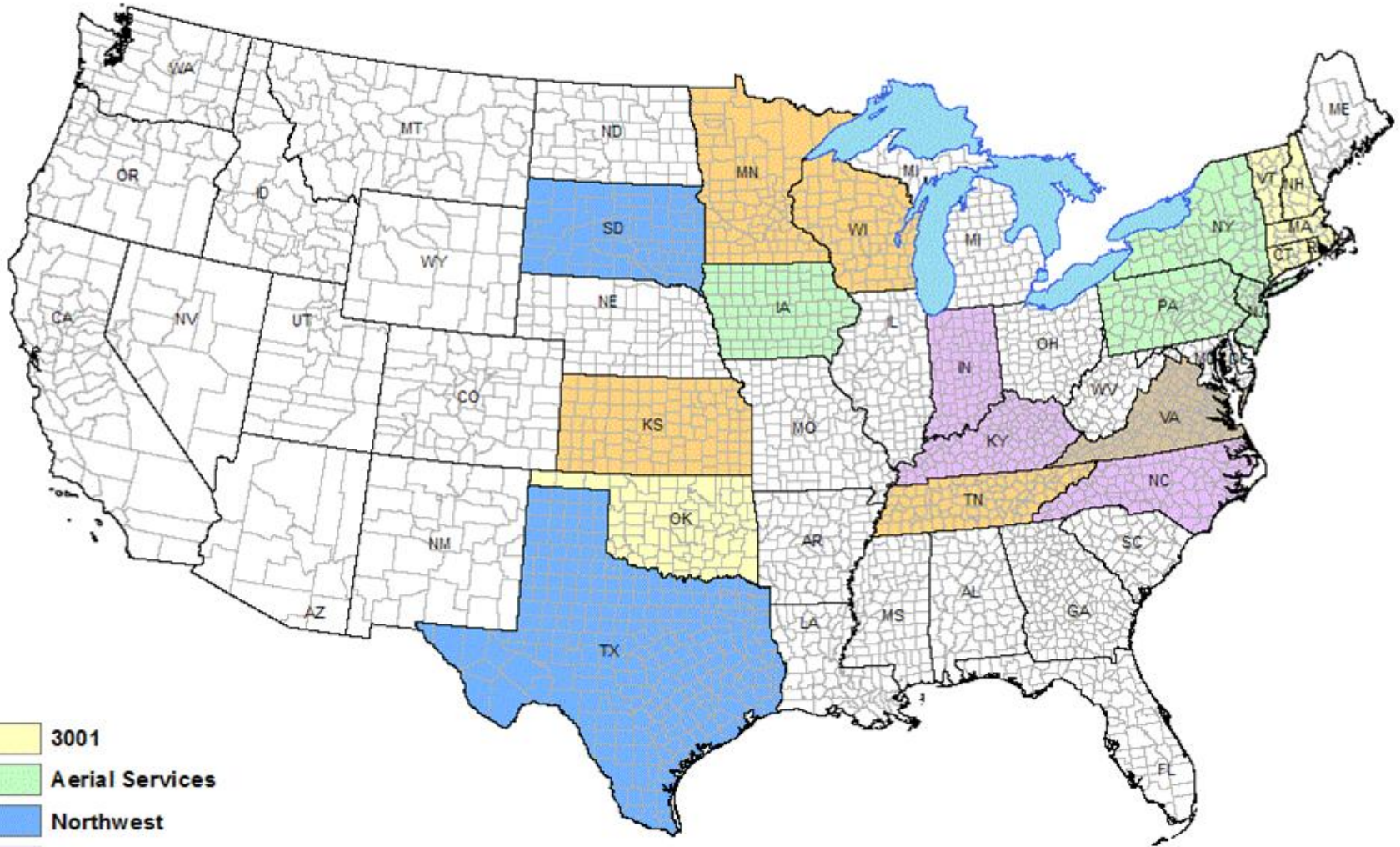
USDA/FSA/APHIS

2006



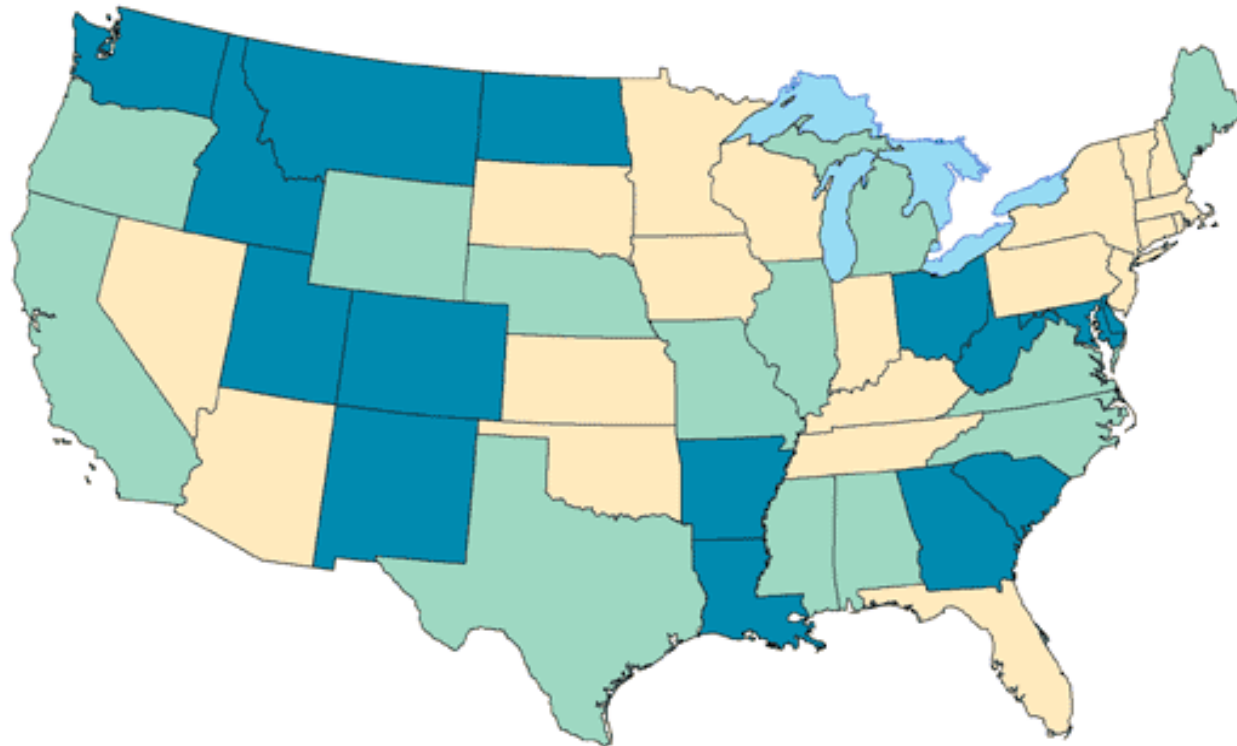
USDA/FSA/APHIS

2008 NAIP Contractors

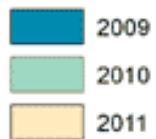


- 3001
- Aerial Services
- Northwest
- Photoscience
- Sanborn
- Surdex

Proposed NAIP Acquisition Cycle



Cycle Dates





NAIP Specifications

- Base imagery on a 3 year cycle
 - NAIP 2009-2011
 - Build in more stability and consistency
 - 1-meter resolution
 - Based on CLU coverage
 - Continually improve quality
 - Transition to better accuracy specification

NAIP Specifications

- Basic Contract Requirements
 - On APFO Website (<http://www.apfo.usda.gov>)
 - Contract: http://www.fsa.usda.gov/Internet/FSA_File/naip-3-07_mod1_51508.pdf
 - Task Order: http://www.fsa.usda.gov/Internet/FSA_File/naip-to-3-08-1v1.pdf
- Flying Season
 - Peak crop growing conditions
- Projection
 - NAD83 UTM
 - Single zone Compressed County Mosaics
- Cloud Cover
 - 10%



NAIP Specifications

- Basic Contract Deliverables
 - CCMs
 - 15:1 Compression
 - MrSID MG3 Format for natural color
 - JPEG 2000 for 4-band
 - Delivered 30 days after flying season
 - QQs
 - GeoTIFF
 - Uncompressed
 - Delivered to partners after QA/contract close
- Additional Information
 - Partnership Information
 - <http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=docs&topic=nai>

Sensor Types

- Film Based
 - Frame based
 - Can take RGB or CIR image
- Digital Sensor
 - May or may not be “frame based”
 - Can take, RGB, CIR, or 4-band...or more...

Sensor Types

Airborne digital sensor ADS40
Parallel Line Perspective

Each CCD line
 1 pixel wide by
 12,000 pixels long

100% overlap of pixel carpets

Digital Frame Camera
Patched Central Perspective

overlapping frame images

11

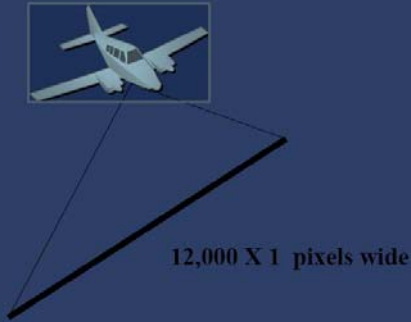
- when it has to be right



Source: Hull, Dave. *ADS40 Airborne Digital Sensor* ; ASPRS Potomac Region Chapter, Large Format Digital Camera Symposium. August 29, 2007.


Sensor Types

Pushbroom Sensor (ADS 40)



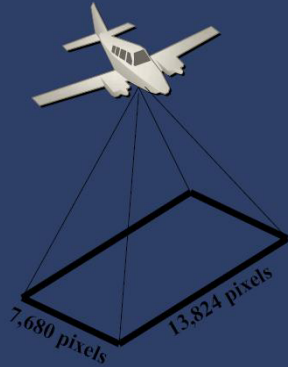
12,000 X 1 pixels wide

Geographic Information Systems for Local Government Conference
The Penn Stater Conference Center Hotel, State College, PA




 **Digital sensors collect data in different "shapes."** The ADS40 (Leica) and Digital Mapping Camera, or DMC (Intergraph) are two of the main, but not the only, camera types used for digital imagery acquisition.

Framing Sensor (DMC)



7,680 pixels
13,824 pixels

Geographic Information Systems for Local Government Conference
The Penn Stater Conference Center Hotel, State College, PA




ADS40



DMC

Compression

- MrSID MG2
 - Prior to 2005
- MrSID MG3
 - 2005 and later
- JPEG 2000
 - 4-band
- Information Sheet
 - http://www.fsa.usda.gov/Internet/FSA_File/compression_2006_updatep.pdf



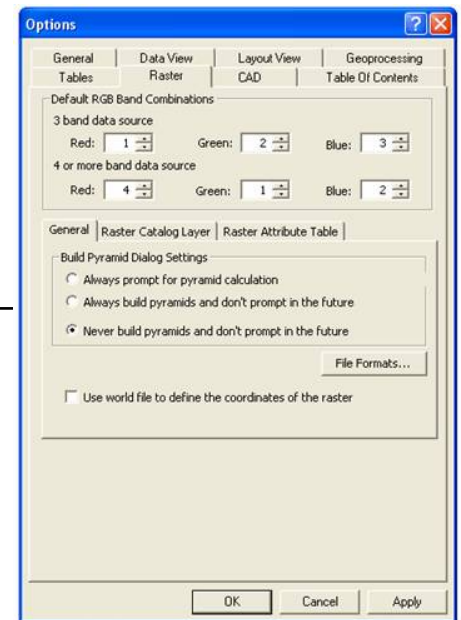
Compression

- The compression format used for the NAIP program has been a topic of consideration for several years
- 2008 states receiving 4-band imagery receive CCMs compressed in the JPEG 2000 format. MrSID, which has been used until now, currently does not readily allow more than three bands



4-band Imagery

- Natural color is default
 - Band Order in ArcGIS – RGBIR
 - Tools, Options, Raster...
- 2008 4-band CCMs – JPEG 2000
 - RFI was released Nov 07 asking for end user/industry input on settings
 - Settings were published in 2008 RFP
- Information Sheet on 4-band
 - http://www.fsa.usda.gov/Internet/FSA_File/fourband_info_sheet_2008pdf.pdf



4-band Imagery

2007 NAIP (AZ)



4-band Imagery

2007 NAIP (AZ)





2007 NAIP (AZ)

Absolute Horizontal Accuracy

- Large investment in CLU digitizing
 - Tied to the original 1990s “MDOQ”
 - Tie new imagery to true ground, not older imagery

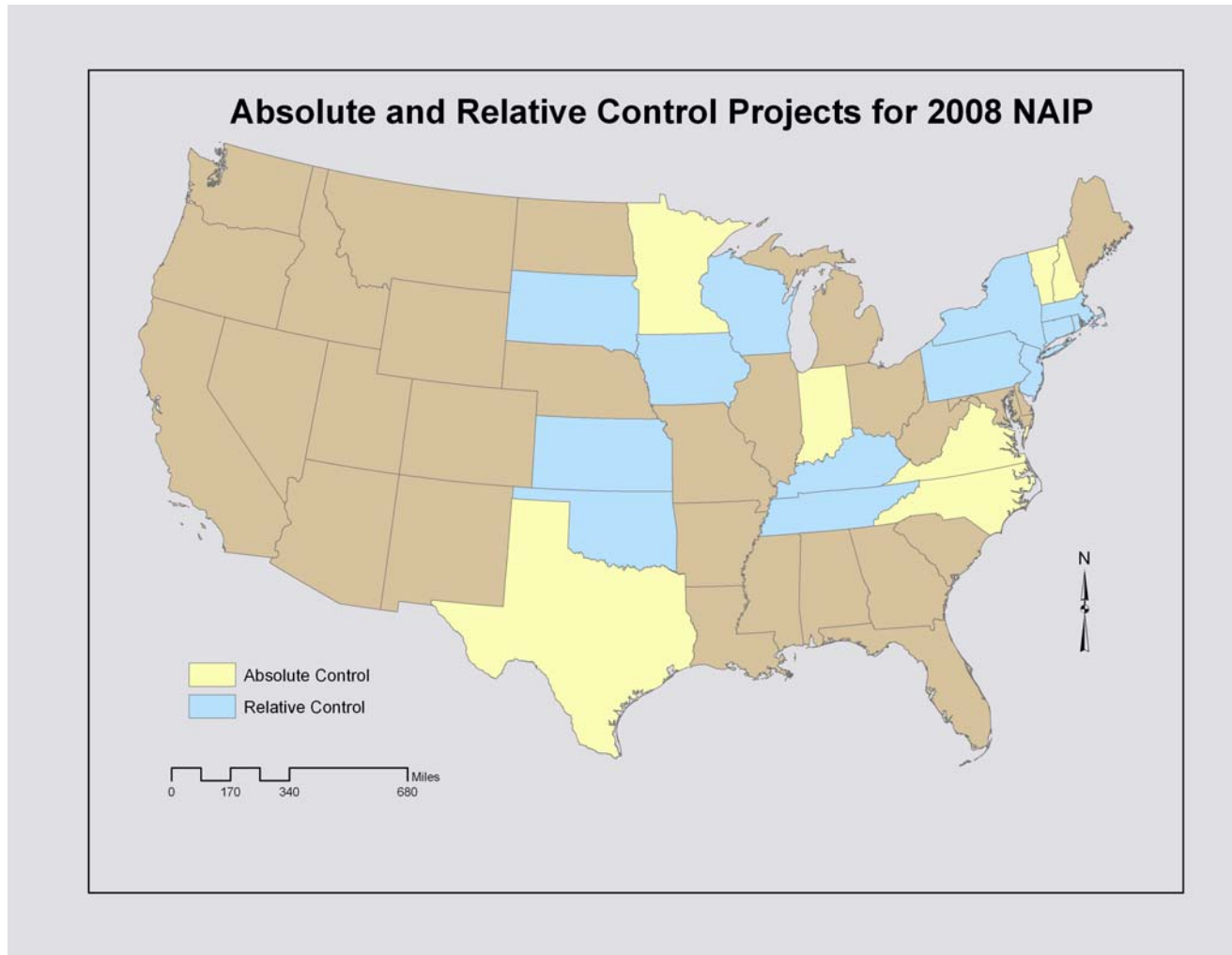


Absolute Horizontal Accuracy

- Need for absolute identified
 - Partners were requesting change
 - Dataset accuracy is better described
- Pilots conducted
 - 2006 (UT)
 - UT: 3.40m RMSE (400+ check points)
 - 2007 (AZ)
 - AZ: 2.87m RMSE (530 check points)
- Future states will be phased in
 - 7 states in 2008
 - 15 states in 2009
 - Once converted, state will not revert
- NAIP 1m GSD Requirement
 - 95% of well-defined points tested shall fall within 6 meters of true ground



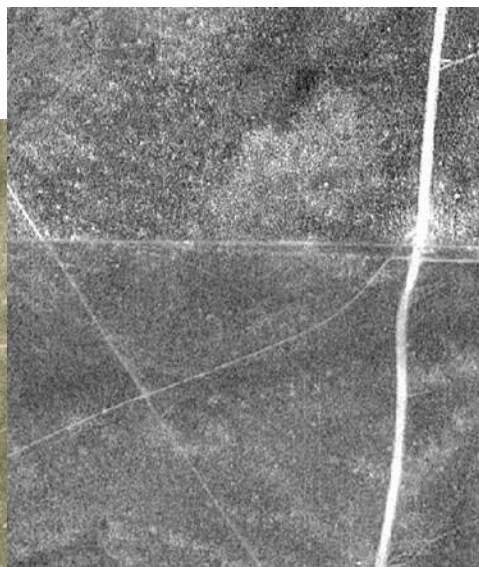
Absolute Horizontal Accuracy



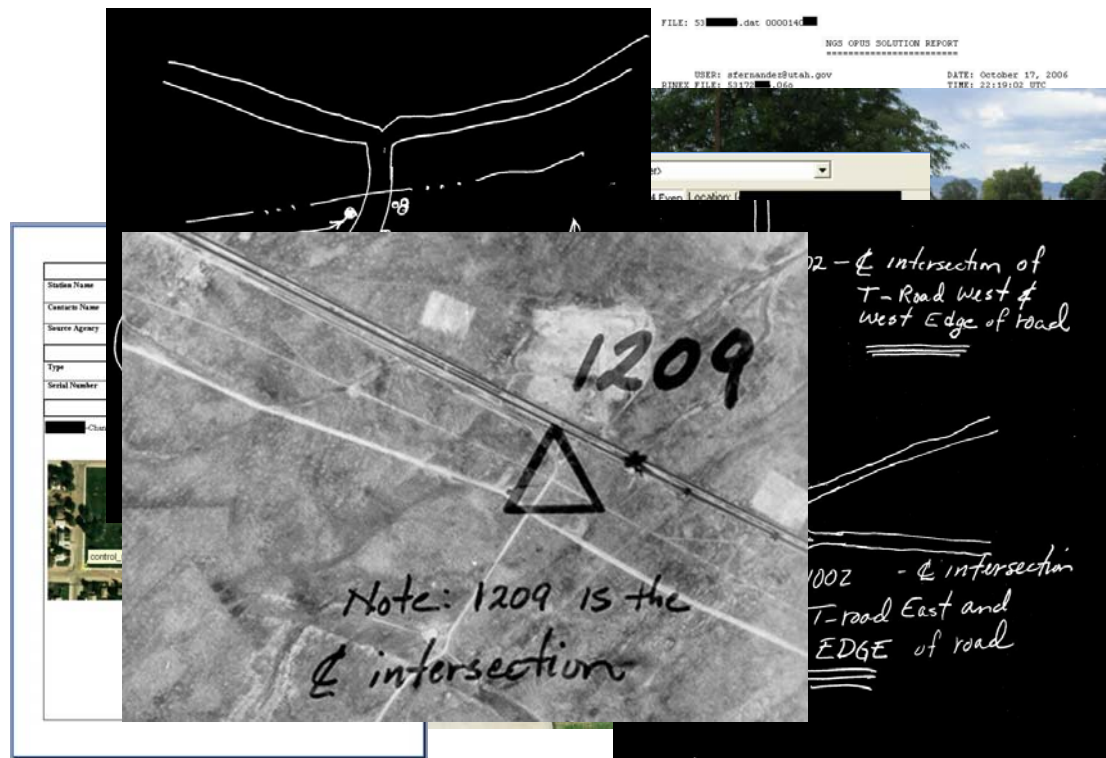
Absolute Horizontal Accuracy

- The engine behind the move of NAIP from relative to absolute control specs is the photo identifiable control database and supplemental data
- Semi-automated inspection process

Relative



Absolute



FILE: 53... .darc 000148
 NOG CPUS SOLUTION REPORT
 USER: sferandez@utah.gov DATE: October 17, 2006
 INPUT FILE: 5310... .img TIME: 23:19:00 UTC

| |
|---------------|
| Station Name |
| Contact Name |
| Source Agency |
| Type |
| Serial Number |

1209

Note: 1209 is the intersection

02 - intersection of T-Road West & West Edge of road

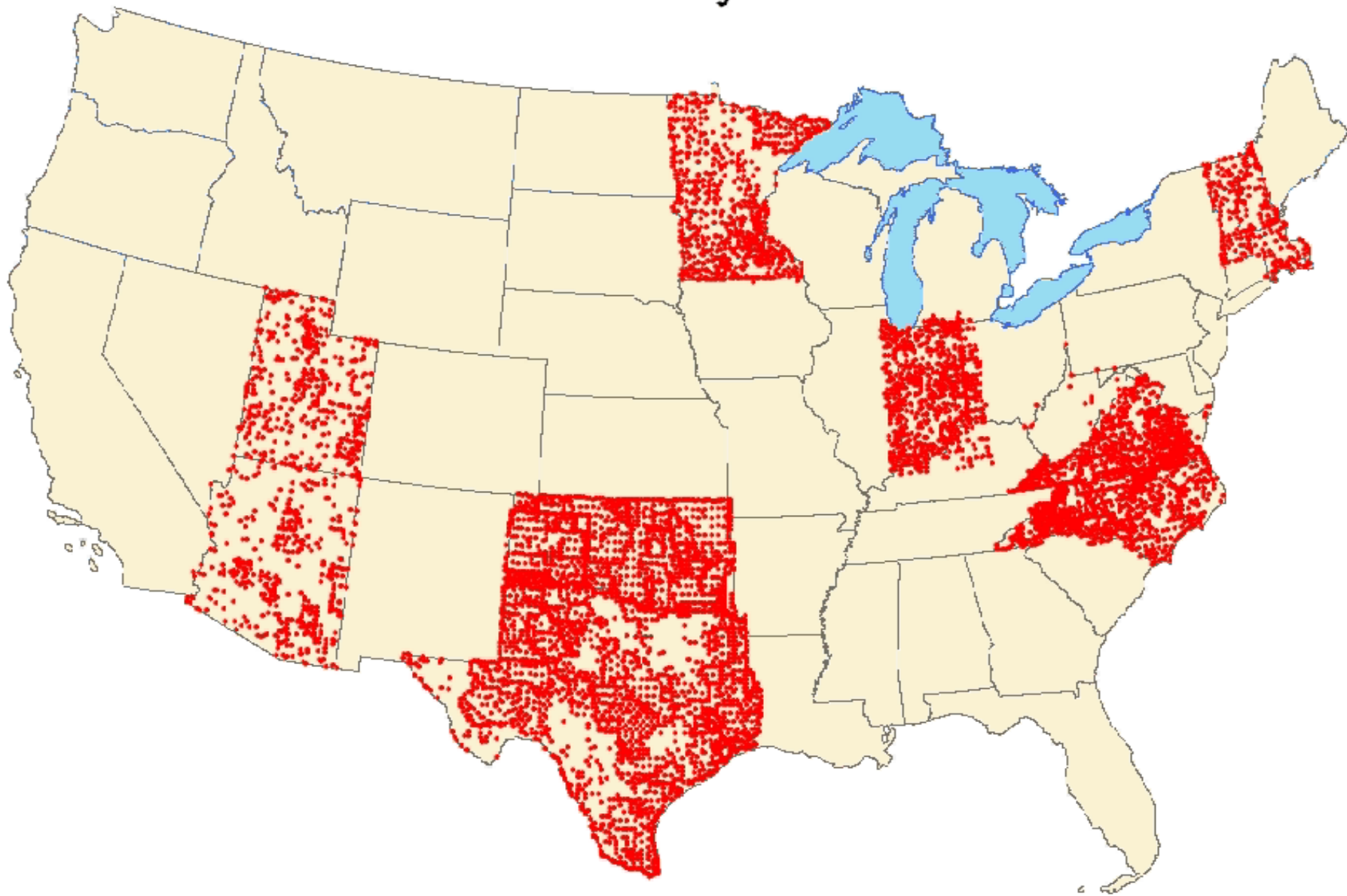
002 - intersection T-road East and EDGE of road



Absolute Horizontal Accuracy

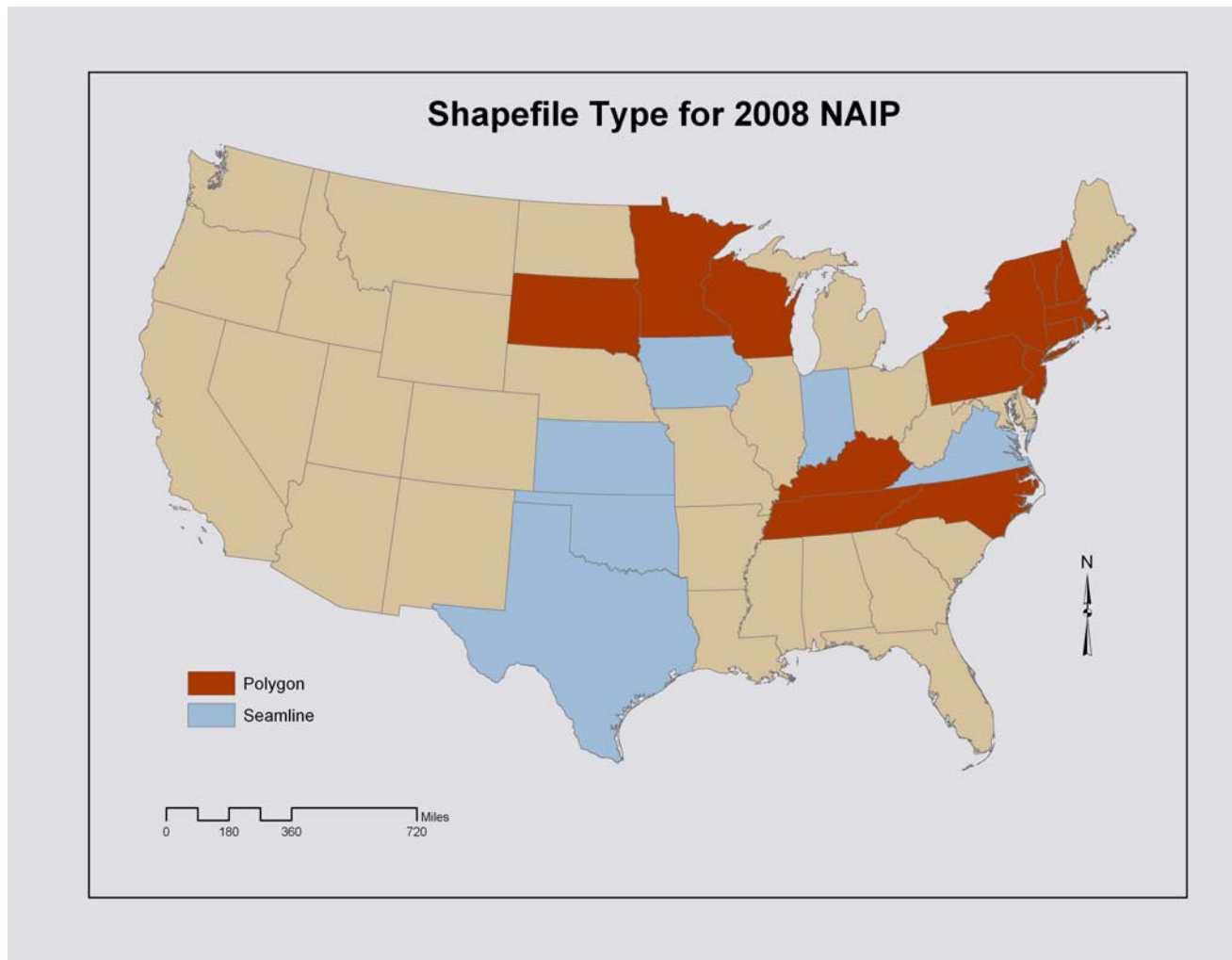
- Working with other Federal and State agencies to create a photo identifiable control database for QA check points
- Will be asking for assistance, if we haven't already
 - Thanks for your efforts

Absolute Accuracy Control Points



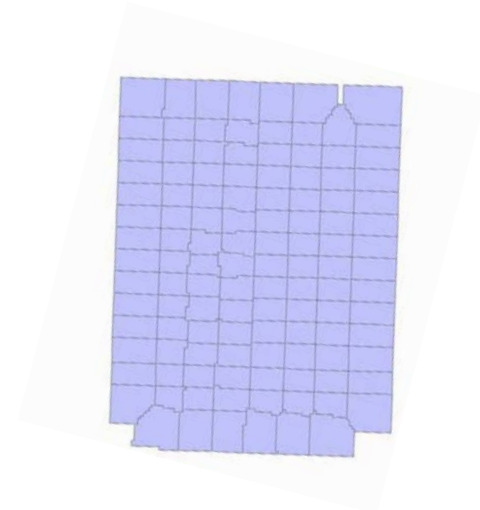
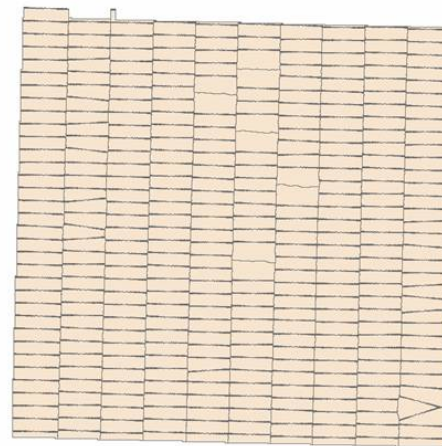


Seamline Shapefile



Seamline Shapefile

- 2007 NAIP Pilot (AZ)
 - Better represent image dates
 - Majority dates in QQ
- “Look” can vary greatly by sensor





Seamline Shapefile

- Expanded seamline shapefile requirements in 2008
 - Test different digital camera footprints
 - Resolve “unknowns” before proceeding to all states

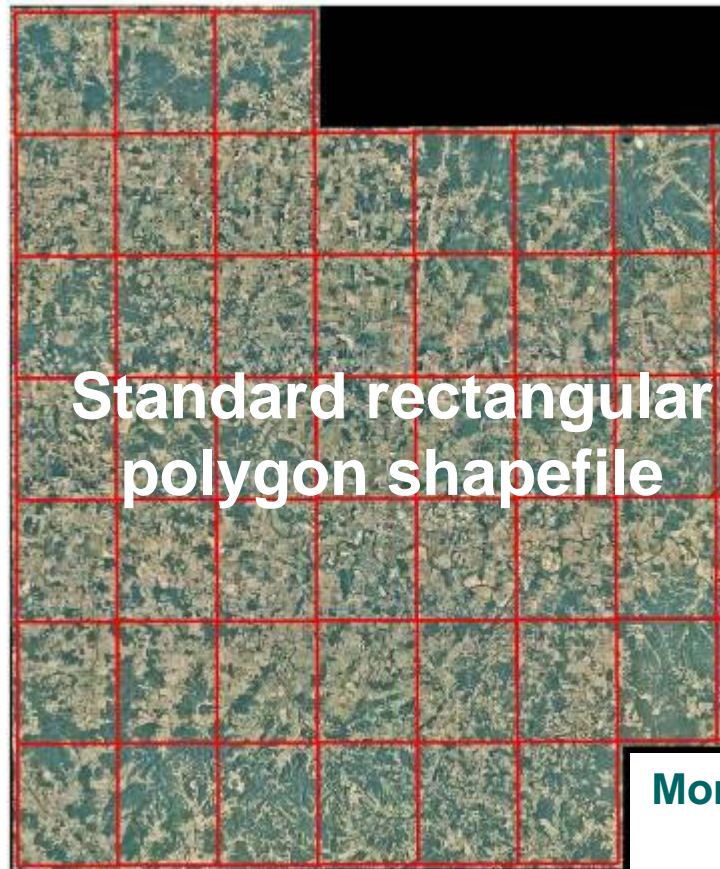


Seamline Shapefile

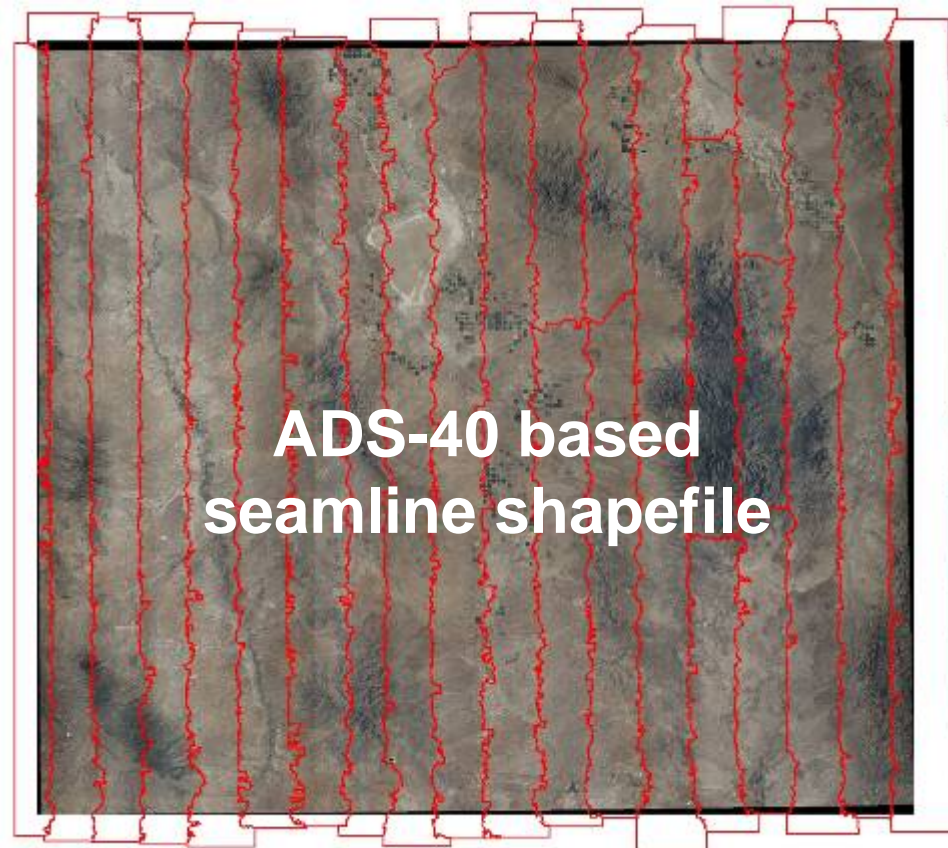
| IDAT | SDATE | EDATE | CAM_TYPE | CAM_MAN | CAM_MOD | SENSNUM | SHAPE_AREA |
|-----------|------------------|------------------|----------|------------------|---------|---------|---------------------|
| 6/9/2007 | 06/09/2007 15:37 | 06/09/2007 16:10 | Digital | Leica Geosystems | ADS52 | 30022 | 137390000.000000000 |
| 6/9/2007 | 06/09/2007 16:14 | 06/09/2007 16:38 | Digital | Leica Geosystems | ADS52 | 30022 | 113220000.000000000 |
| 6/9/2007 | 06/09/2007 16:43 | 06/09/2007 17:15 | Digital | Leica Geosystems | ADS52 | 30022 | 113690000.000000000 |
| 6/9/2007 | 06/09/2007 17:19 | 06/09/2007 17:43 | Digital | Leica Geosystems | ADS52 | 30022 | 766640000.000000000 |
| 6/9/2007 | 06/09/2007 17:47 | 06/09/2007 18:19 | Digital | Leica Geosystems | ADS52 | 30022 | 521530000.000000000 |
| 6/9/2007 | 06/09/2007 18:22 | 06/09/2007 18:46 | Digital | Leica Geosystems | ADS52 | 30022 | 569680000.000000000 |
| 6/10/2007 | 06/10/2007 15:13 | 06/10/2007 15:46 | Digital | Leica Geosystems | ADS52 | 30022 | 420920000.000000000 |
| 6/10/2007 | 06/10/2007 15:50 | 06/10/2007 16:13 | Digital | Leica Geosystems | ADS52 | 30022 | 416480000.000000000 |
| 6/10/2007 | 06/10/2007 16:18 | 06/10/2007 16:37 | Digital | Leica Geosystems | ADS52 | 30022 | 50555000.000000000 |
| 6/10/2007 | 06/10/2007 16:41 | 06/10/2007 16:58 | Digital | Leica Geosystems | ADS52 | 30022 | 27035000.000000000 |
| 6/25/2007 | 06/25/2007 16:18 | 06/25/2007 16:46 | Digital | Leica Geosystems | ADS52 | 30022 | 860710000.000000000 |
| 6/25/2007 | 06/25/2007 16:50 | 06/25/2007 17:19 | Digital | Leica Geosystems | ADS52 | 30022 | 124170000.000000000 |
| 6/25/2007 | 06/25/2007 17:16 | 06/25/2007 17:45 | Digital | Leica Geosystems | ADS52 | 30102 | 719610000.000000000 |
| 6/25/2007 | 06/25/2007 17:22 | 06/25/2007 17:50 | Digital | Leica Geosystems | ADS52 | 30022 | 107160000.000000000 |
| 6/25/2007 | 06/25/2007 17:54 | 06/25/2007 18:22 | Digital | Leica Geosystems | ADS52 | 30022 | 110290000.000000000 |
| 6/25/2007 | 06/25/2007 18:26 | 06/25/2007 18:54 | Digital | Leica Geosystems | ADS52 | 30022 | 106930000.000000000 |
| 6/25/2007 | 06/25/2007 18:57 | 06/25/2007 19:24 | Digital | Leica Geosystems | ADS52 | 30022 | 108260000.000000000 |
| 6/25/2007 | 06/25/2007 19:28 | 06/25/2007 19:56 | Digital | Leica Geosystems | ADS52 | 30022 | 986610000.000000000 |
| 6/30/2007 | 06/30/2007 15:14 | 06/30/2007 15:33 | Digital | Leica Geosystems | ADS52 | 30022 | 333340000.000000000 |
| 6/30/2007 | 06/30/2007 15:37 | 06/30/2007 15:46 | Digital | Leica Geosystems | ADS52 | 30022 | 544800000.000000000 |
| 6/30/2007 | 06/30/2007 16:04 | 06/30/2007 16:23 | Digital | Leica Geosystems | ADS52 | 30022 | 592820000.000000000 |
| 6/30/2007 | 06/30/2007 16:34 | 06/30/2007 16:43 | Digital | Leica Geosystems | ADS52 | 30022 | 684610000.000000000 |
| 6/30/2007 | 06/30/2007 16:47 | 06/30/2007 17:00 | Digital | Leica Geosystems | ADS52 | 30022 | 699940000.000000000 |
| 6/30/2007 | 06/30/2007 17:09 | 06/30/2007 17:24 | Digital | Leica Geosystems | ADS52 | 30022 | 110070000.000000000 |
| 6/30/2007 | 06/30/2007 17:28 | 06/30/2007 17:47 | Digital | Leica Geosystems | ADS52 | 30022 | 106750000.000000000 |
| 6/30/2007 | 06/30/2007 17:56 | 06/30/2007 18:16 | Digital | Leica Geosystems | ADS52 | 30022 | 108140000.000000000 |

Seamline Shapefile

2007 NAIP (TN)



Standard rectangular polygon shapefile



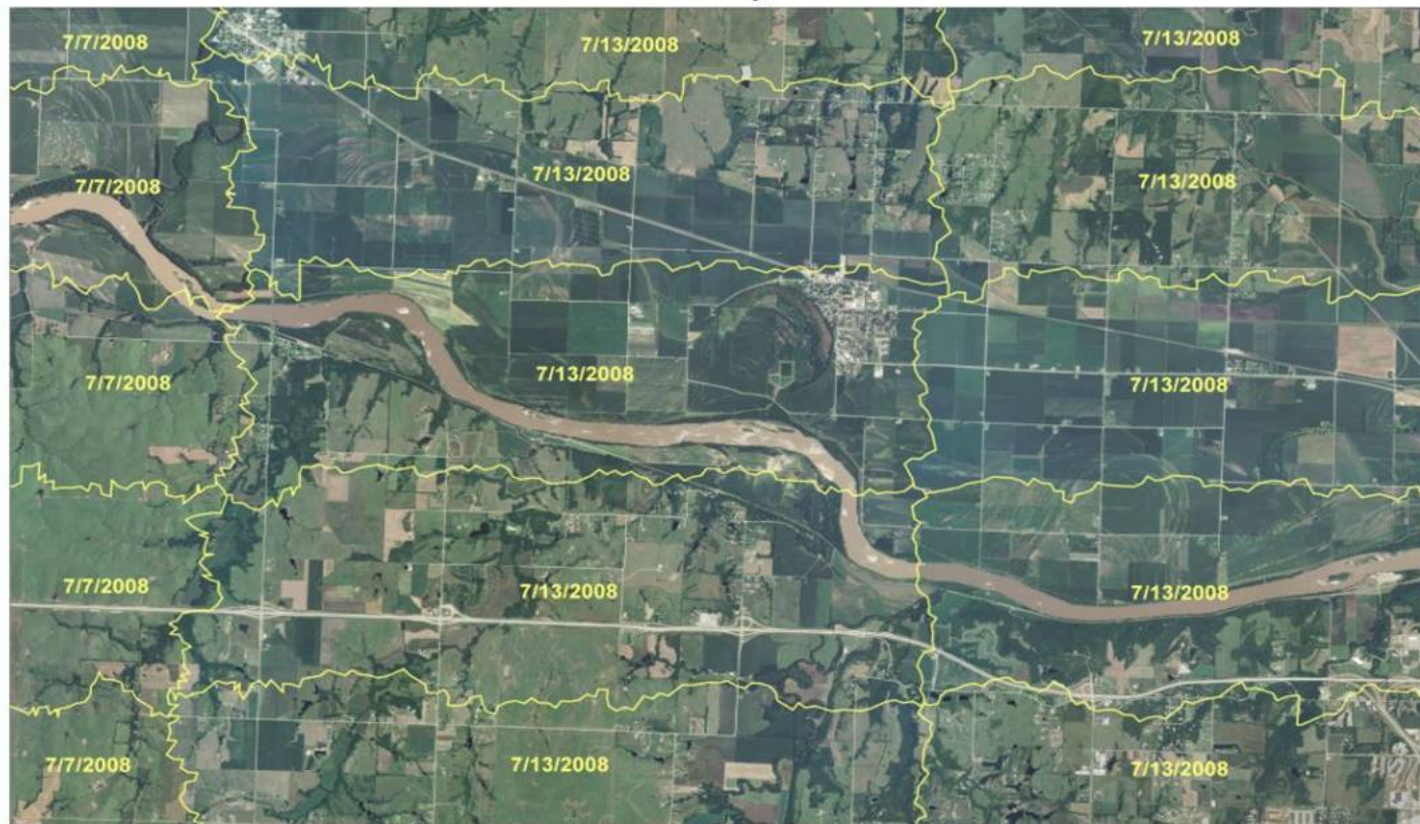
ADS-40 based seamline shapefile

2007 NAIP (AZ)

More accurate representation of exposure dates

Seamline Shapefile

2008 Acquisition Dates for NAIP Imagery
Shawnee County, Kansas



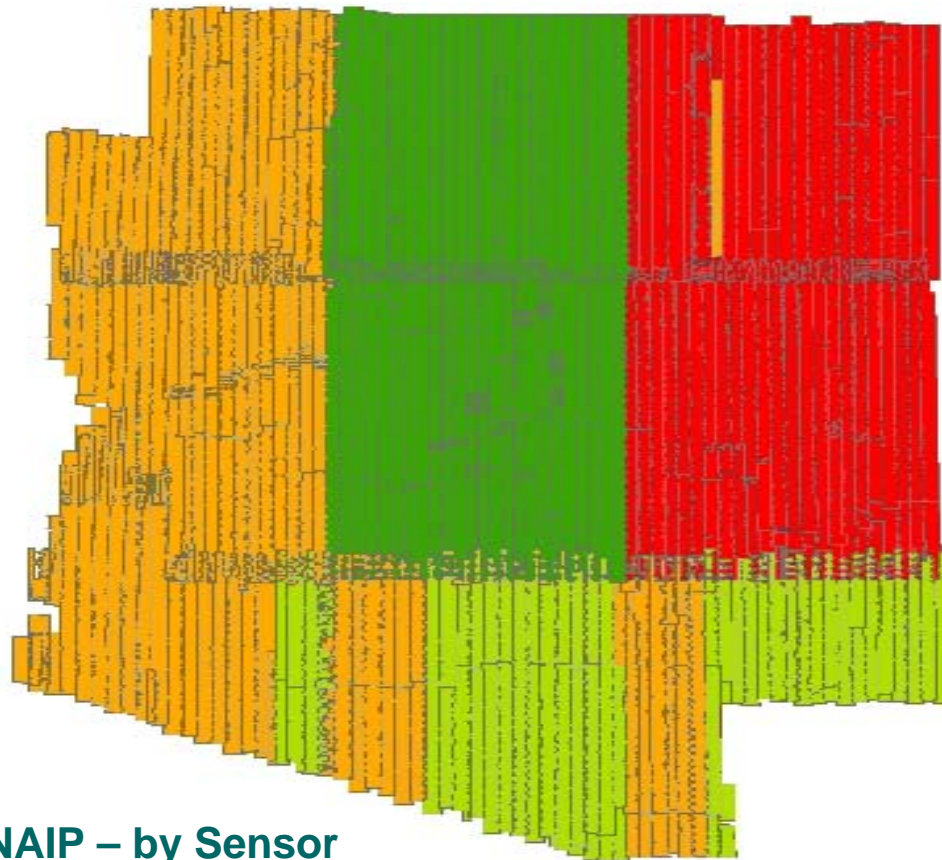
0 0.5 1 2 Miles



Imagery acquired from DMC sensor



Seamline Shapefile



**2007 AZ NAIP – by Sensor
Number (SENSNUM)**

Radiometric Improvements

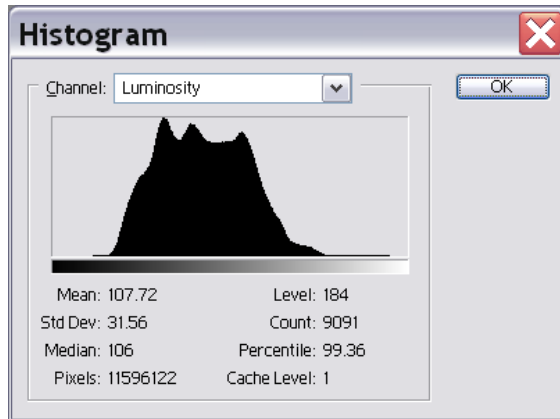
- Problem: Quality was not consistent

Actual NAIP imagery (2004-2006)



Radiometric Improvements

Original 2006



Clipping – 0%

Contrast – 131

Histogram Peak – 80

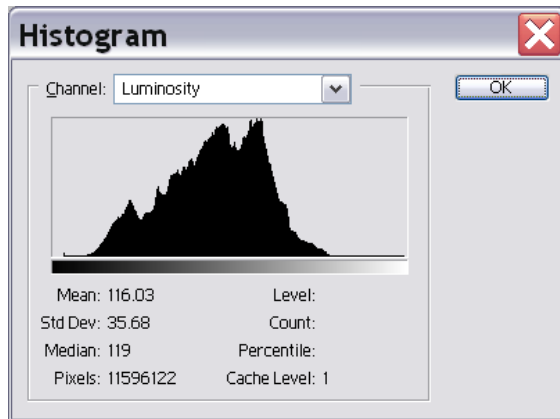
Color Balance (RGB) – 147,128,105





Radiometric Improvements

Adjusted 2006



Clipping – 0.02%

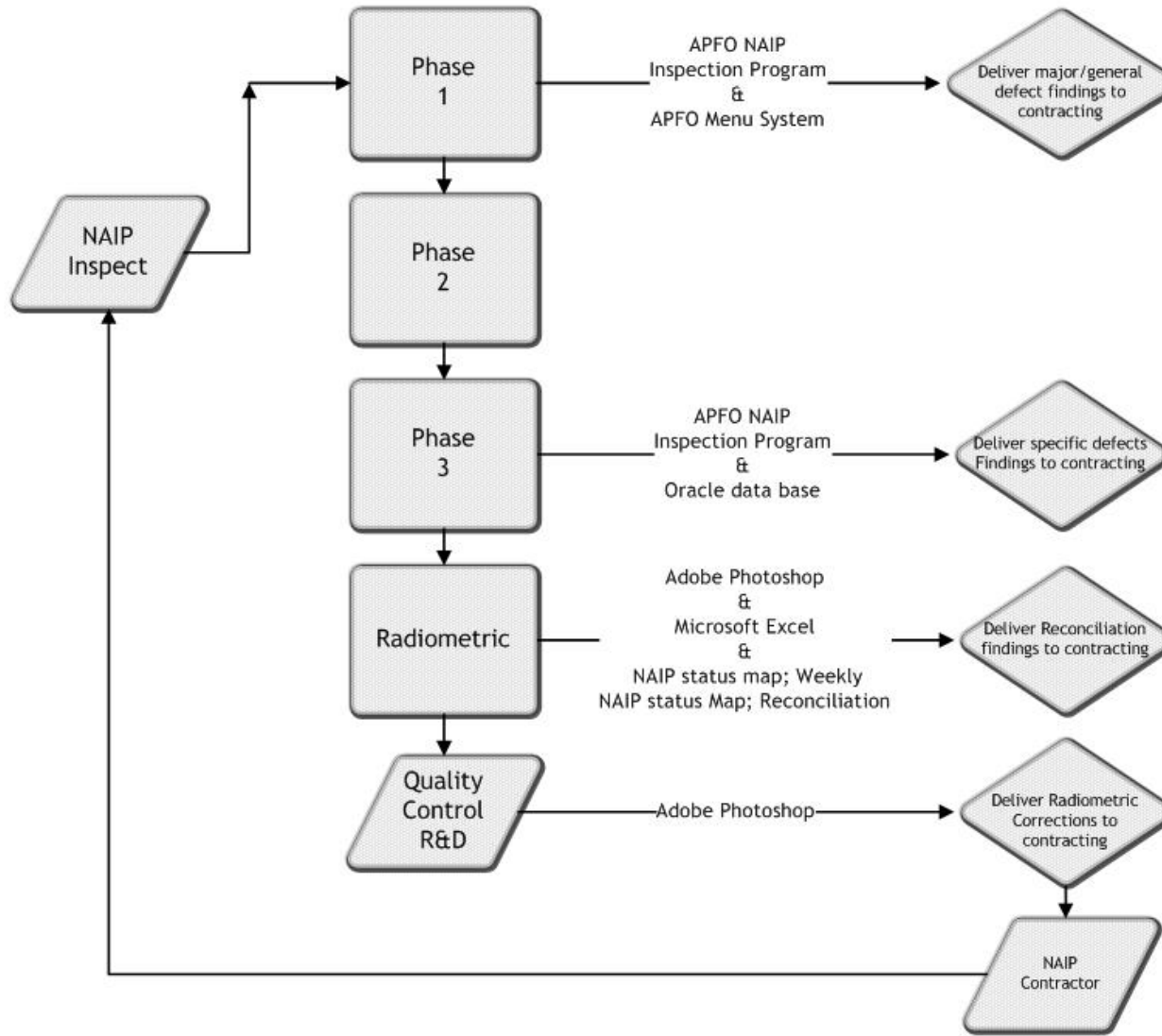
Contrast – 151

Histogram Peak – 147

Color Balance (RGB) – 192,194,191



Quality Control Processes





Quality Control Processes

Phase #1: previews Compressed County Mosaic (CCM) at a scale of 1:24000. Focus of inspection is on missing imagery and imagery offset.

Phase #2: detailed inspection of CCM at a scale of 1:7,500 focus of inspection in on horizontal accuracy, missing imagery, cloud cover, artifacts, foreign imagery, offsets, specular reflectance.

Phase #3: 50% random DOQQs sample of obscured buffer quadrants due to mosaic process at a scale of 1:5500, and 100% pre-annotated DOQQs anomaly defects.

Distribution

- Distribution Services
 - Hard Copy, CD/DVD, Hard Drive, Bulk Order, etc.
 - APFO Customer Service Section
 - (801) 844-2922 apfo.sales@slc.usda.gov
 - David Parry, Customer Service Section Supervisor (801) 844-2923 david.parry@slc.usda.gov
 - General Information (our website)
 - USDA/Farm Service Agency/APFO
 - <http://www.apfo.usda.gov>



Distribution

- Distribution Services
 - Downloads
 - USDA Geospatial Data Gateway
 - <http://datagateway.nrcs.usda.gov/>
 - APFO Geodata Warehouse
 - ArcIMS Service
 - gdw.apfo.usda.gov (Add ArcIMS Server)
 - ArcGIS Server Image Server Service
 - <http://gis.apfo.usda.gov/arcgis/services> (Add ArcGIS Server)
 - ArcIMS Website
 - <http://gdw.apfo.usda.gov/naip/viewer/viewer.htm>
 - <http://gdw.apfo.usda.gov/mdoq/viewer/viewer.htm>



Contacts

Kent Williams

NAIP Manager

801-844-2908

kent.williams@slc.usda.gov

Cindy Sessions

NAIP Partnership Coordinator

801-844-2909

cindy.sessions@slc.usda.gov

Brian Vanderbilt

Geospatial Services Branch Chief

801-844-2930

brian.vanderbilt@slc.usda.gov

