ITT Product Quality Support Efforts

- In an attempt to understand the effects that image quality variability might have on FSA county office users, APFO asked ITT to perform a user sensitivity study and recommend best practices, to drive image quality improvements and consistency.

- In addition, quantifying metrics were delivered to aid in the compliance criteria for NAIP imagery.

- Suggestions were made for improved viewing environment at the user level as well.

ITT Study Results

- The study showed users are sensitive to image quality because, degraded image quality impacts the ability to discern CLU boundaries.

- Users desired consistent and sufficiently saturated color reproduction to aid in the determination of crop type for compliance issues.

Pre-Production Sample criteria

- Contractors submit sample images within 21 days of first image acquisition.
- APFO team will evaluate the images within 3 business days.
- Sample images are evaluated against the contract radiometric specifications.
- Sample images are a guide, Contract specifications are concrete.

Georgia Samples 2007

Group 1

Group 2

Group 3

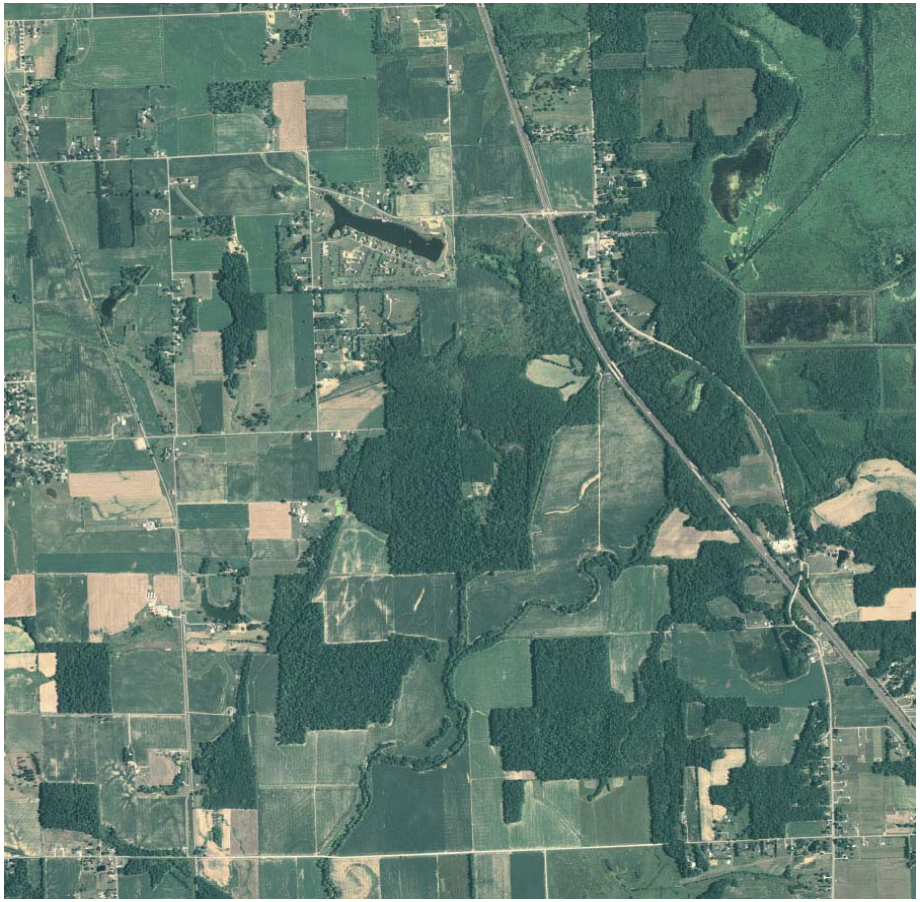
The group 3 image was preferred for color balance and brightness

Florida 2007

This image passes the metric inspection. We feel the image is too green and over saturated

This image passes the metric inspection

Indiana 2007



Saturated green

(Difficult to see CLU boundaries)

Corrected but, washed out

NAIP Inspection Process Background

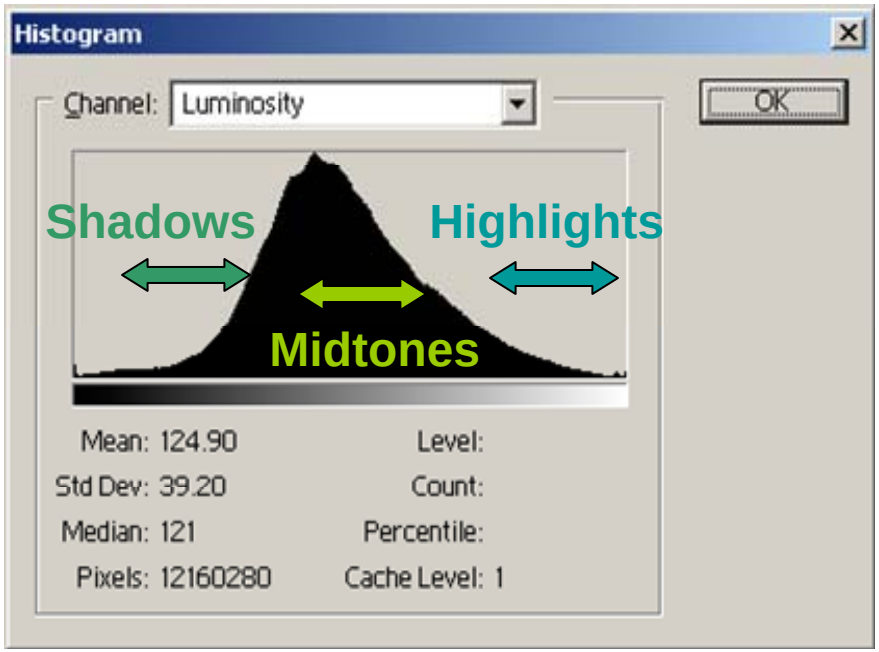
- Vendor sends a sample image which must pass metric inspection criteria.
- Inspection begins when CCM imagery arrives at APFO.
- After data ingestion, imagery is inspected on a first in first out system.
- CCM inspection done in three phases
- Histogram measurements complete inspection

Histogram

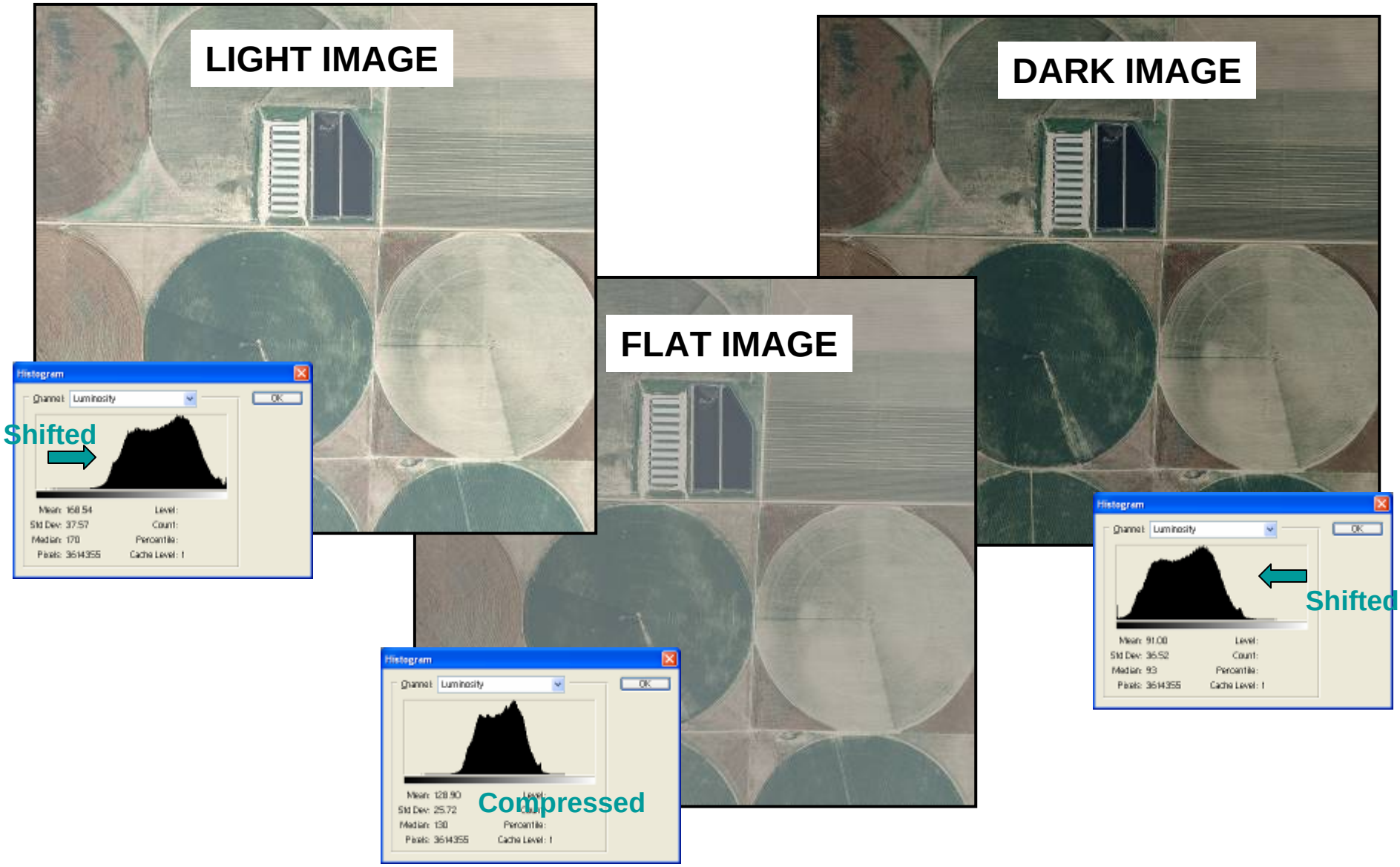
A graph showing the numeric distribution of various tonal values in an image.

The histogram shows “dark” values on the left and “bright” values on the right.

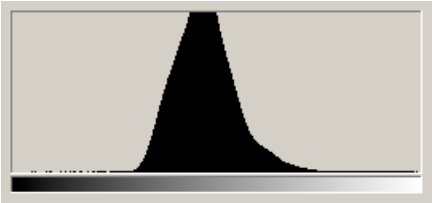
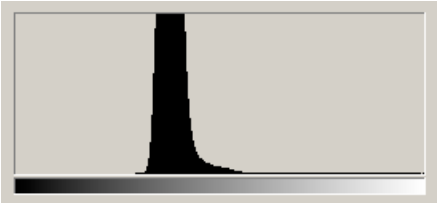
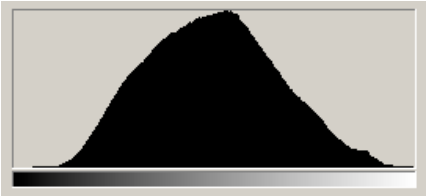
Its purpose is to show the distribution of tone throughout an image.



Examples of Histograms



Example – Mississippi

	2004	2005	2006
			
Contrast	95	47	178
Color Balance	[145,135,125]	[113, 121, 117]	[191, 175, 158]
Peak	118	96	133

Histogram Metrics Readings

- Clipping — The cumulative percent between level 5 and level 250 should be greater than 98

- Contrast — The difference between the reading at 1% level and 99% level, should be greater than 120. 150 is preferred.

Metric Readings (cont.)

- Histogram Peak — At the maximum count the peak level should be between 108 and 148

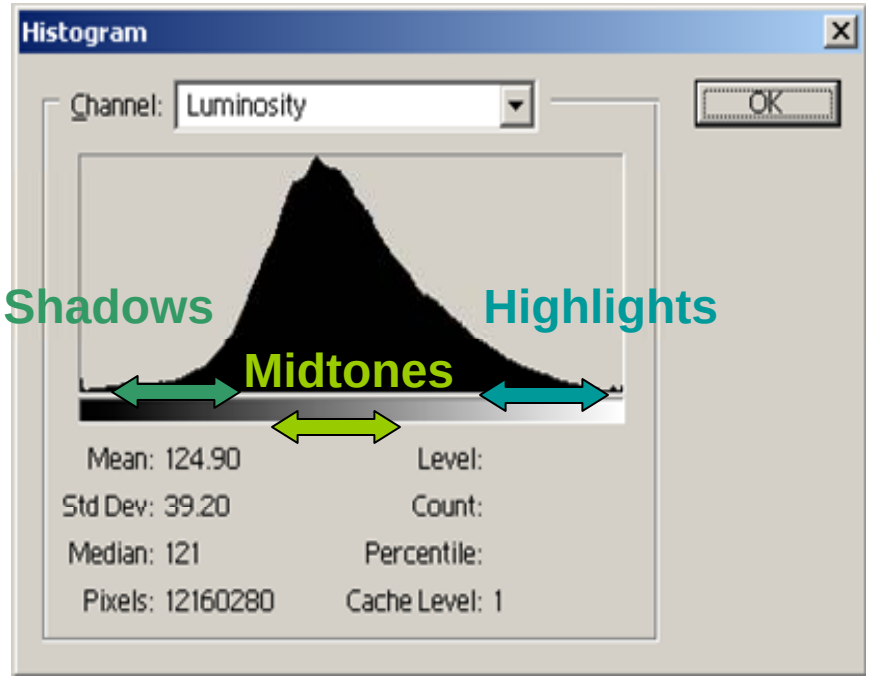
- Color Balance — Using a nearly neutral object in the image, the difference between the minimum and maximum value in R G B triplets shall be less than 10

Histogram

A graph showing the numeric distribution of various tonal values in an image.

The histogram shows “dark” values on the left and “bright” values on the right.

Its purpose is to show the distribution of tone throughout an image.



1 pixel = 2 values: 0 or 1, on or off, black or white

8 byte depth = 256 values

Microsoft Excel - Metrics spredsheet- work sheet2b.xls

HISTOGRAM METRIC READINGS

State Contractor	CLIPPING	CONTRAST	HISTOGRAM PEAK	COLOR BALANCE						
Inspection Date: DD- MM. 2007	Target Range: > 98	Greater than 120 (150)	count level at peak 108 - 148	Less than 10 point spread						
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		
				R		G		B		

Histogram Report Sheet

Clipping Target Range: >98	**Contrast** Min. >120, Ideally >150	**Histogram Peak** count level peak 108-148	**Color Balance** Value Range 10 or less between RGB triplet		
			R	G	B
99.99	155	108	125	127	123
99.98	**115**	114	111	114	108
99.97	149	119	100	103	101
99.99	155	108	96	98	108
99.53	168	**106**	144	144	145
99.92	**110**	117	157	156	157
99.8	143	114	125	126	120
99.99	138	108	140	145	147
100	143	**100**	129	133	129
99.98	178	127	137	136	137
99.99	**116**	128	141	143	135
99.96	128	**106**	148	154	153
99.96	**114**	**105**	136	143	139
99.97	130	109	146	140	144
0 failed	88 failed	**95 failed**	2 failed	0 failed	5 failed
0% failure rate	23.5% failure rate	**25.5 failure rate**	0.01%	0%	0.01%

Illinois Histogram Report

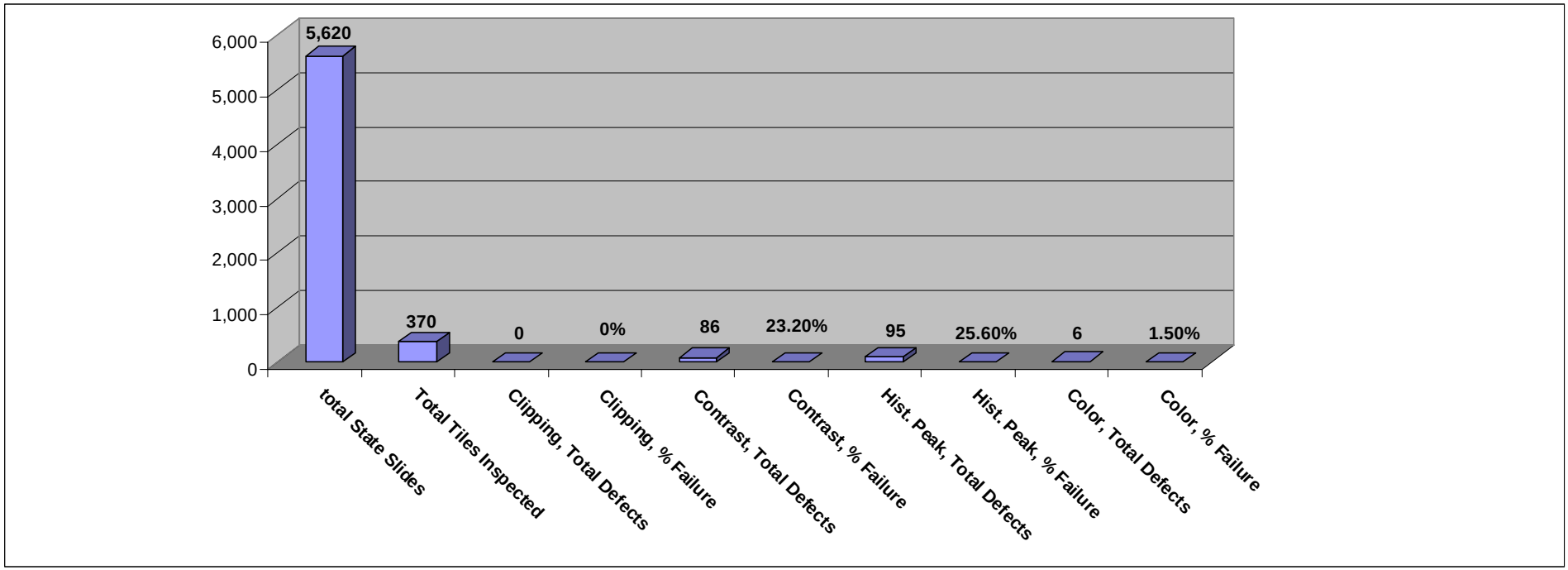
Microsoft Excel - Histogram_il_1700_sample.xls

HISTOGRAM METRICS READINGS

State: **Illinois** Year: 2007 Contractor:

County FIPS_DOQQ	Clipping	Contrast	Histogram Peak	Color Balance		
Image Hyperlink	Target Range: >98	Min. >120, Ideally >150	count level peak 108-148	Value Range 10 or less between RGB triplet		
				R	G	B
17001_3909009ne	99.99	155	108	125	127	123
17001_3909106nw	99.99	140	124	172	178	179
17001_3909108sw	99.93	179	139	183	186	189
17009_3909002sw	99.96	151	98	183	185	184
17033_3808703se	100	160	169	114	111	109
17045_3908711ne	99.99	96	128	105	107	108
17045_3908718ne	100	110	100	156	159	161
17045_3908720se	100	145	124	155	149	149
17045_3908727se	100	139	111	112	114	114
17047_3808725nw	100	172	166	129	127	119
17047_3808832nw	99.99	141	142	109	113	114
17047_3808847se	100	150	108	146	144	143
17049_3808804ne	99.82	164	98	118	121	111
17049_3908850ne	100	145	96	171	168	173
17065_3808852ne	100	126	147	126	124	120
17065_3808859ne	100	160	175	123	128	126
17065_3808862nw	100	113	130	128	123	125
17203_4008809nw	99.96	114	105	136	143	139
17203_4008924ne	99.97	130	109	146	140	144
	0 failed	86 failed	95 failed	2 failed	0 faile	5 failed
FINAL	0% failure rate	23.2% failure rate	25.5 failure rate	0.01%	0%	0.01%

Illinois
2007 Histogram Defects



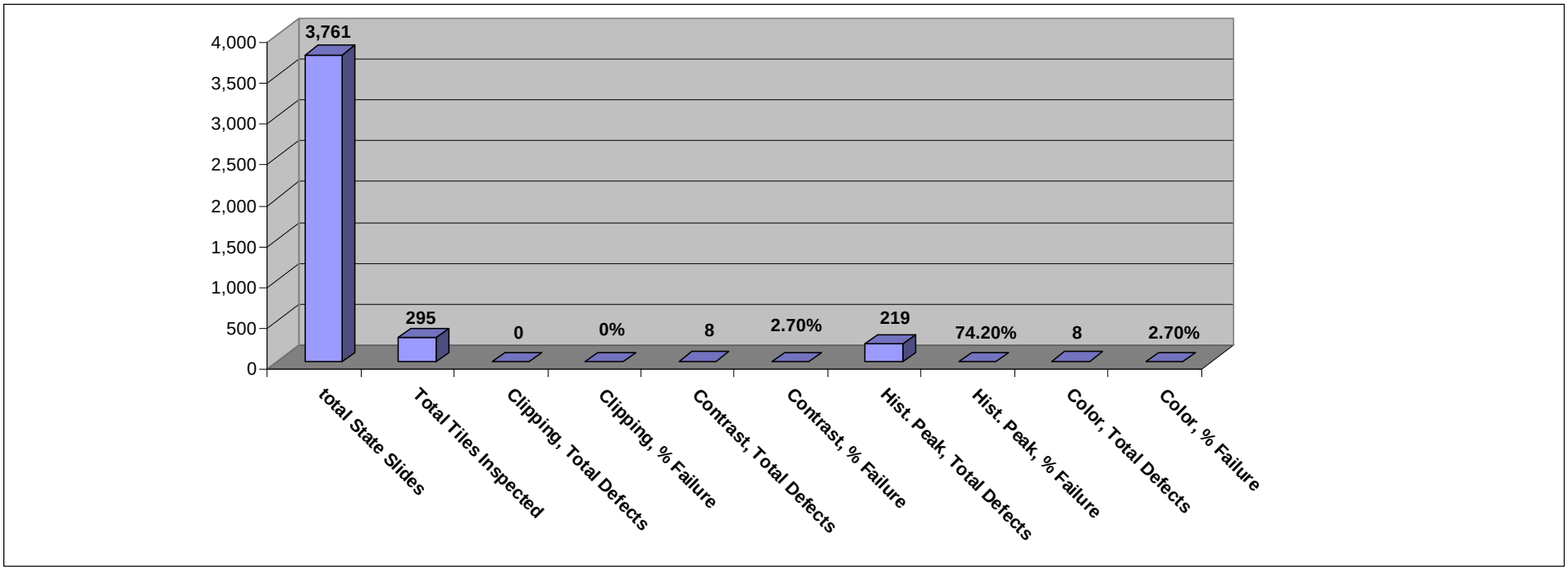
Indiana Histogram Report

Microsoft Excel - Copy of Indiana_07_Histogram_.xls

State: Indiana **Year: 2007** **Contractor:**

County FIPS_DOQQ	Clipping	Contrast	Histogram Peak	Color Balance					
Image Hyperlink	Target Range: >98	Min. >120, Ideally >150	Max. Count Level at Peak: 108 to 148	Value Range 10 or less between RGB triplet					
18001_4008401se	100	155	103	R	179	G	186	B	177
18001_4008410se	99.95	168	107	R	169	G	171	B	166
18001_4008425ne	99.56	164	128	R	163	G	171	B	164
18001_4008524ne	99.91	120	117	R	122	G	140	B	129
18003_4008401ne	100	159	96	R	124	G	131	B	123
18171_4008736se	100	118	98	R	181	G	189	B	181
18175_3808517nw	100	134	95	R	118	G	126	B	120
18175_3808624sw	100	151	111	R	174	G	180	B	182
18175_3808639nw	99.93	151	74	R	169	G	171	B	166
18177_3908401ne	99.93	155	121	R	198	G	203	B	194
18177_3908409se	99.99	163	107	R	144	G	148	B	139
18177_3908515ne	99.77	133	146	R	151	G	160	B	150
18179_4008523se	99.99	141	118	R	107	G	113	B	107
18181_4008609ne	100	180	94	R	118	G	118	B	111
18181_4008611sw	100	165	94	R	147	G	153	B	147
18183_4108552ne	99.99	156	110	R	145	G	152	B	144
18183_4108560nw	100	167	112	R	133	G	138	B	132
295 DOQQ	0	8	219		8 total				
	0%	2.70%	74%		2.70%				

Indiana
2007 Histogram Defects



Missouri Histogram

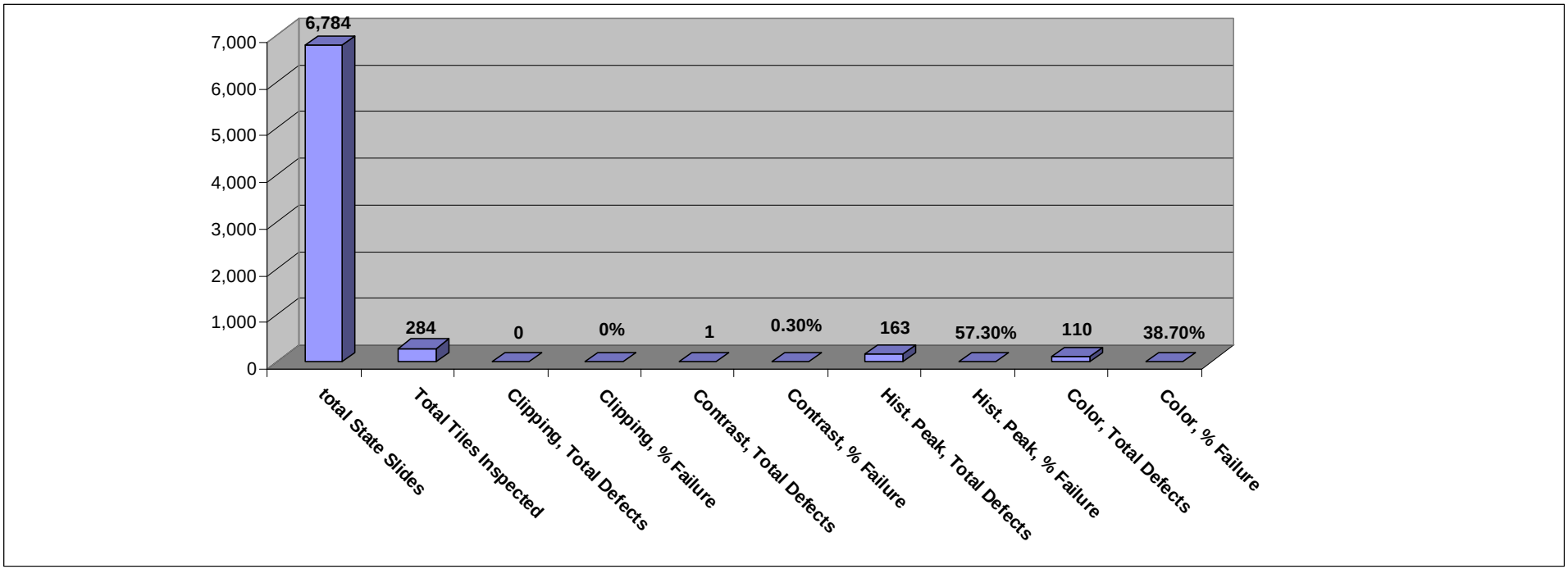
Microsoft Excel - Missouri_2_ Histograms_1700-b.xls

HISTOGRAM METRICS READINGS

State: **Missouri** Year: 2007 Contractor:

County FIPS_DOQQ	Clipping	Contrast	Histogram Peak	Color Balance					
Image Hyperlink	Target Range: >98	Min. >120, Ideally >150	count level peak 108-148	Value Range 10 or less between RGB triplet					
29001_4009242ne	100	162	101	R	105	G	113	B	106
29001_4009244se	100	170	121	R	97	G	103	B	99
29001_4009250se	100	161	153	R	107	G	114	B	104
29003_3909401ne	100	169	158	R	113	G	118	B	116
29003_3909403se	100	155	108	R	84	G	94	B	88
29003_4009457ne	100	152	159	R	109	G	110	B	101
29005_4009546nw	100	144	109	R	105	G	103	B	98
29005_4009537sw	100	155	106	R	81	G	89	B	88
29005_4009535ne	100	152	91	R	121	G	121	B	114
29005_4009529ne	100	150	93	R	89	G	89	B	85
29005_4009526ne	100	165	121	R	82	G	81	B	81
29007_3909141_ne	100	168	150	R	93	G	100	B	97
29009_3609440ne	99.87	191	110	R	255	G	241	B	237
29009_3609416se	99.97	196	145	R	124	G	124	B	110
29009_3609326nw	100	167	161	R	230	G	226	B	217
29009_3609319nw	99.99	178	107	R	109	G	112	B	101
29009_3609312sw	99.99	173	109	R	101	G	99	B	90
29015_3809352ne	100	161	175	R	236	G	229	B	228
29015_3809346ne	100	178	93	R	190	G	176	B	151
284 total	0	1	163			110			
	0%	0.30%	57%		38%				

Missouri
2007 Histogram Defects



Metric Inspection Process

- Manual inspection using Photoshop 7.0
- Inspection of Random Tiles (10%)
- Any imagery problems will also be addressed
- Automated script for histogram data is a long term goal

Viewing Environment Recommendations

- Standard lighting temperature (6500K) and level
- Calibrated computer monitor for brightness and color
- Standard environment
  - No glare
  - Lower ambient light
  - Neutral

Application of Deliverables

- Incorporate quality metrics into the RFP for NAIP for compliance to consistent image quality in contract requirements.

- Incorporate viewing environment suggestions and possible calibration of monitors at the FSA county offices as an improvement for the user.

- Place the Best Practices document on the APFO website for vendors review.