

Project Report Appendices

**The following section contains the appendices as listed in
the Long Island Sound, CT 2017
0.5-Meter Orthoimagry Project Report.**

Appendix A

Camera Calibration Report

Calibration Report



Camera:	UltraCam Eagle, S/N UC-Eagle-1-50617043
Manufacturer:	Vexcel Imaging GmbH, A-8010 Graz, Austria
Date of Calibration:	Sep 09 2014
Date of Report:	Jul 27 2016
Camera Revision:	8.0
Revision of Report:	8.0

Calibration Report

Geometric Calibration



Camera:	UltraCam Eagle, S/N UC-Eagle-1-50617043
Manufacturer:	Vexcel Imaging GmbH, A-8010 Graz, Austria
Panchromatic Camera:	ck = 79.800 mm
Multispectral Camera:	ck = 79.800 mm
Date of Calibration:	Sep 09 2014
Date of Report:	Jul 27 2016
Camera Revision:	8.0
Revision of Report:	8.0

Panchromatic Camera

Large Format Panchromatic Output Image

Image Format	long track	68.016mm	13080pixel
	cross track	104.052mm	20010pixel
Image Extent		(-34.01, -55.02)mm	(34.01, 55.02)mm
Pixel Size		5.200µm*5.200µm	
Focal Length	ck	79.800 mm	± 0.002mm
Principal Point (Level 2)	X_ppa	0.000 mm	± 0.002mm
	Y_ppa	0.000 mm	± 0.002mm
Lens Distortion	Remaining Distortion less than 0.002mm		

Multispectral Camera

Medium Format Multispectral Output Image (Upscaled to panchromatic image format)

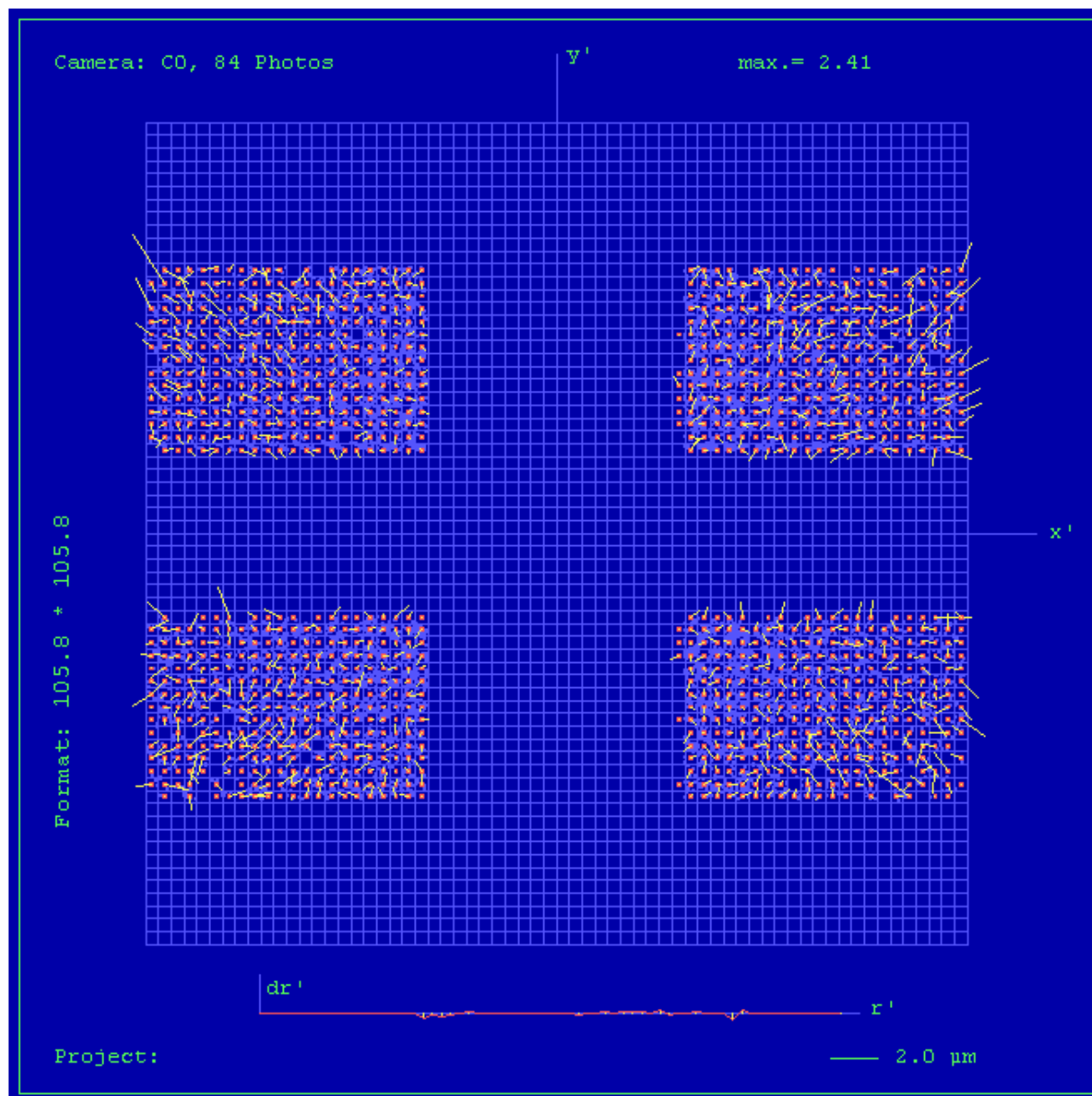
Image Format	long track	68.016mm	4360pixel
	cross track	104.052mm	6670pixel
Image Extent		(-34.01, -55.02)mm	(34.01, 55.02)mm
Pixel Size		15.600µm*15.600µm	
Focal Length	ck	79.800 mm	
Principal Point (Level 2)	X_ppa	0.000 mm	± 0.002mm
	Y_ppa	0.000 mm	± 0.002mm
Lens Distortion	Remaining Distortion less than 0.002mm		

Individual Panchromatic Cone Data

Cone 0, Parametric Description, Not Effective in Output Image

Cone # C0														
Lens				Linor Vexcel Apo-Sironar Digital HR 1:5,6/80mm Linor GmbH, Germany										
Shutter				Prontor Magnetic Prontor-Werk Alfred Gauthier GmbH										
Image Extent (nominally)				(-34.28, -52.22)mm					(34.28, 52.22)mm					
Extent CCD 0				(-34.28, -52.22)mm					(-10.32, -16.28)mm					
Extent CCD 1				(-34.28, 16.28)mm					(-10.32, 52.22)mm					
Extent CCD 2				(10.32, -52.22)mm					(34.28, -16.28)mm					
Extent CCD 3				(10.32, 16.28)mm					(34.28, 52.22)mm					
Parameters			Shift X			ShiftY			Rotation			Scale		
CCD0			-1.0700164E-01 mm ± 0.0004 mm			1.2499571E-01 mm ± 0.0006 mm			-3.7757103E-02 gon ± 0.0001 gon			1.0093635 ± 0.00005		
CCD1			-1.5202992E-01 mm ± 0.0004 mm			7.2734510E-02 mm ± 0.0006 mm			0,0000000 gon			1.0089039 ± 0.00005		
CCD2			-1.4857157E-01 mm ± 0.0004 mm			1.0724521E-01 mm ± 0.0006 mm			-1.3553943E-02 gon ± 0.0001 gon			1.0093238 ± 0.00005		
CCD3			-1.2873444E-01 mm ± 0.0004 mm			1.1149666E-02 mm ± 0.0006 mm			1.1298592E-02 gon ± 0.0001 gon			1.0088753 ± 0.00005		
Radial Distortion														
R [mm]	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	65.0	
dr [µm]	36.8	69.6	100.9	130.7	156.1	172.1	170.9	142.0	72.7	-52.6	-251.9	-545.9	-957.6	

Cone 0, Residual Error Diagram

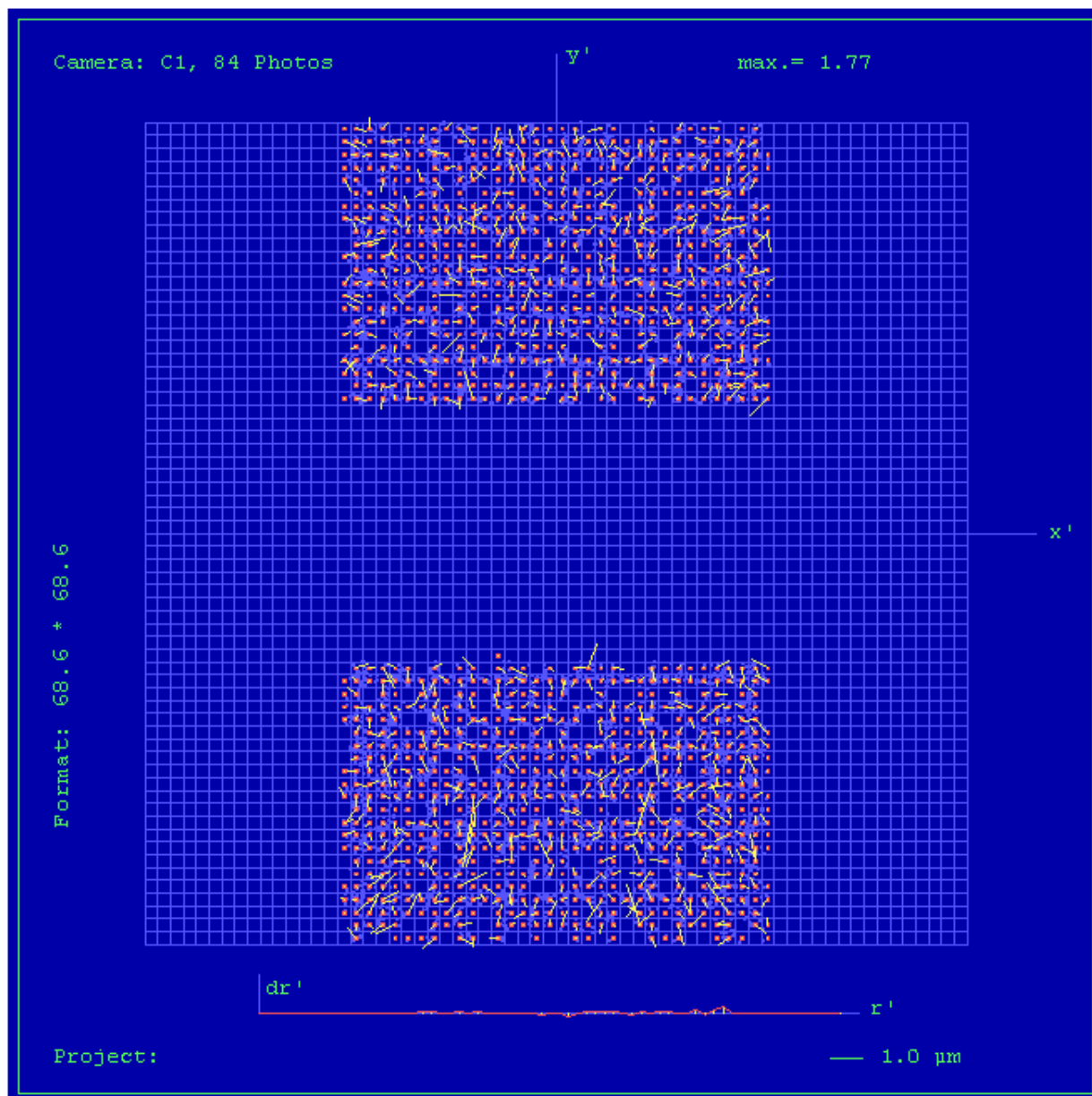


Residual Error (RMS): **0.62 μm**

Cone 1, Parametric Description, Not Effective in Output Image

Cone # C1												
Lens			Linios Vexcel Apo-Sironar Digital HR 1:5,6/80mm Linios GmbH, Germany									
Shutter			Prontor Magnetic Prontor-Werk Alfred Gauthier GmbH									
Image Extent (nominally)			(-34.28, -17.97)mm					(34.28, 17.97)mm				
Extent CCD 0			(-34.28, -17.97)mm					(-10.42, 17.97)mm				
Extent CCD 1			(10.42, -17.97)mm					(34.28, 17.97)mm				
Parameters			Shift X		Shift Y			Rotation			Scale	
CCD0			2.6944994E-03 mm ± 0.0006 mm		9.2538247E-02 mm ± 0.0004 mm			0,0000000 gon			1.0058773 ± 0.00005	
CCD1			-2.0101551E-02 mm ± 0.0006 mm		8.3217601E-02 mm ± 0.0004 mm			-2.6863155E-02 gon ± 0.0001 gon			1.0054263 ± 0.00005	
Radial Distortion												
R [mm]	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0
dr [µm]	16.2	30.5	44.2	56.2	63.2	59.7	37.8	-12.7	-104.4	-251.9	-472.3	-785.1

Cone 1, Residual Error Diagram

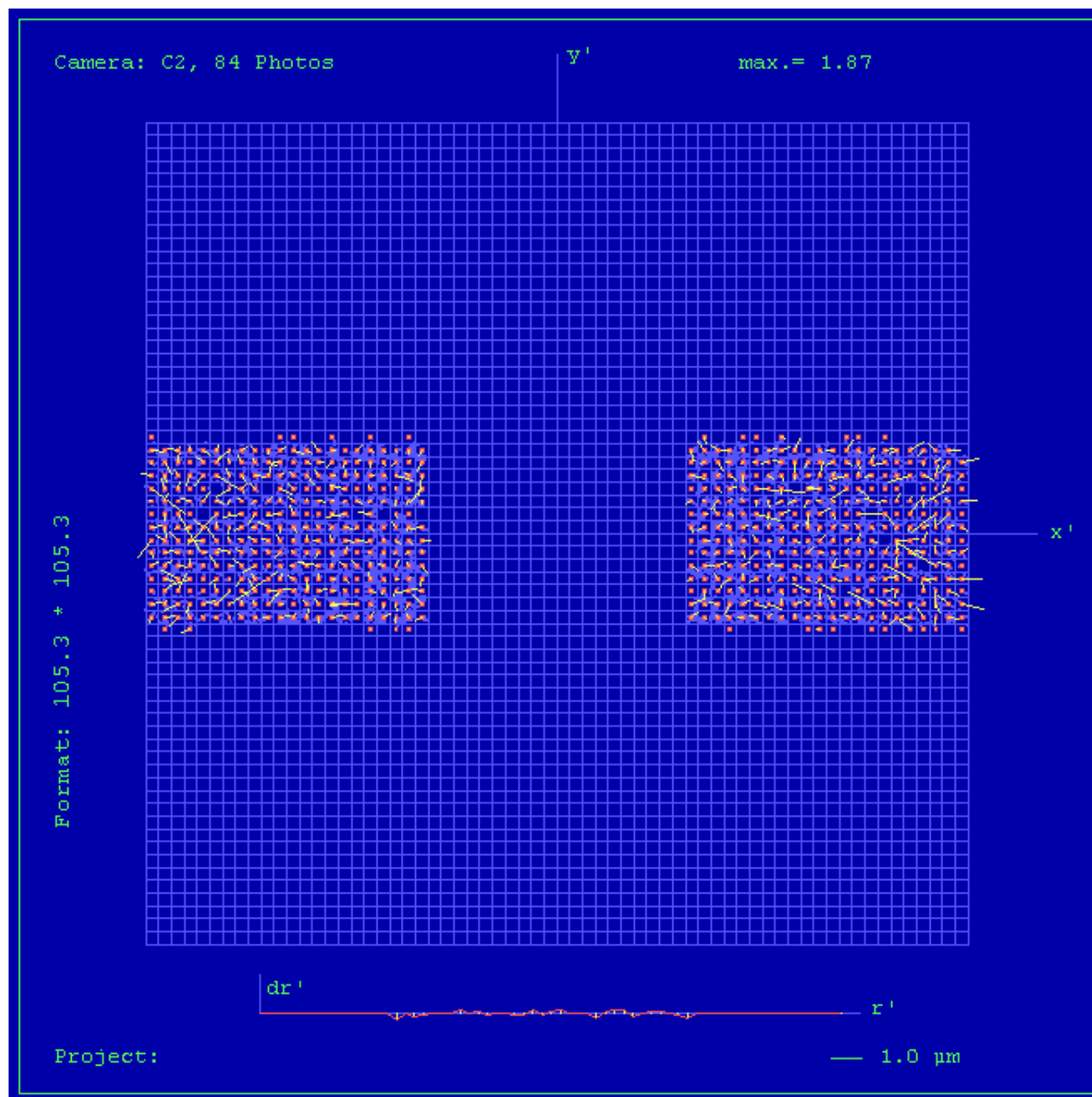


Residual Error (RMS): **0.49 μm**

Cone 2, Parametric Description, Not Effective in Output Image

Cone # C2													
Lens				Linios Vexcel Apo-Sironar Digital HR 1:5,6/80mm Linios GmbH, Germany									
Shutter				Prontor Magnetic Prontor-Werk Alfred Gauthier GmbH									
Image Extent (nominally)				(-11.98, -52.22)mm				(11.98, 52.22)mm					
Extent CCD 0				(-11.98, -52.22)mm				(11.98, -16.28)mm					
Extent CCD 1				(-11.98, 16.28)mm				(11.98, 52.22)mm					
Parameters			Shift X			ShiftY			Rotation			Scale	
CCD0			-8.8772509E-02 mm ± 0.0004 mm			3.0266403E-02 mm ± 0.0015 mm			4.0928998E-02 gon ± 0.0001 gon			1.0085150 ± 0.00005	
CCD1			-1.3948486E-02 mm ± 0.0004 mm			6.6124390E-02 mm ± 0.0015 mm			0,0000000 gon			1.0083516 ± 0.00005	
Radial Distortion													
R [mm]	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	55.0	60.0	
dr [µm]	38.2	73.3	107.4	140.0	168.1	186.3	186.8	159.2	90.6	-34.3	-233.1	-526.3	

Cone 2, Residual Error Diagram

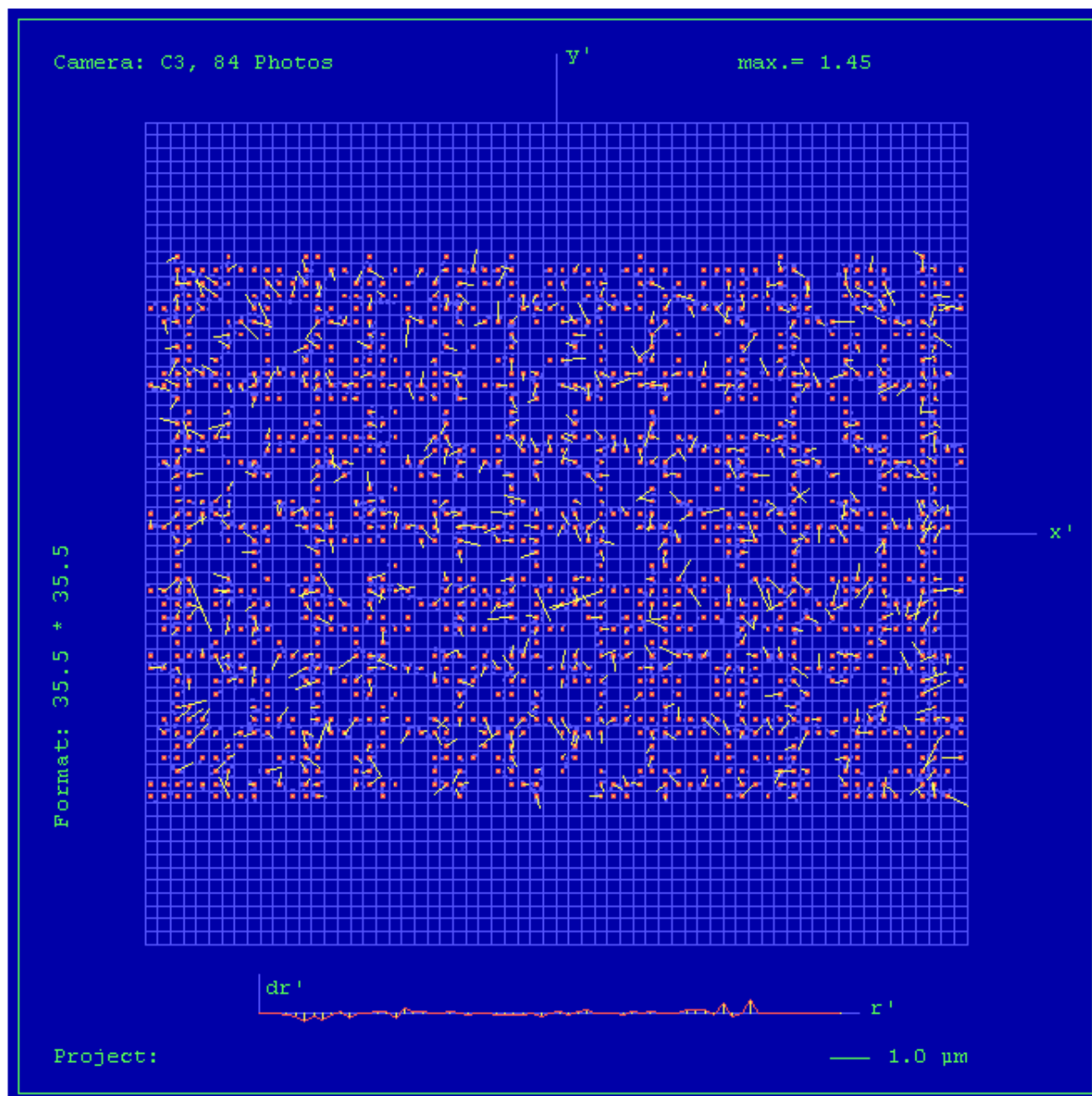


Residual Error (RMS): **0.53 μm**

Cone 3, Parametric Description, Not Effective in Output Image

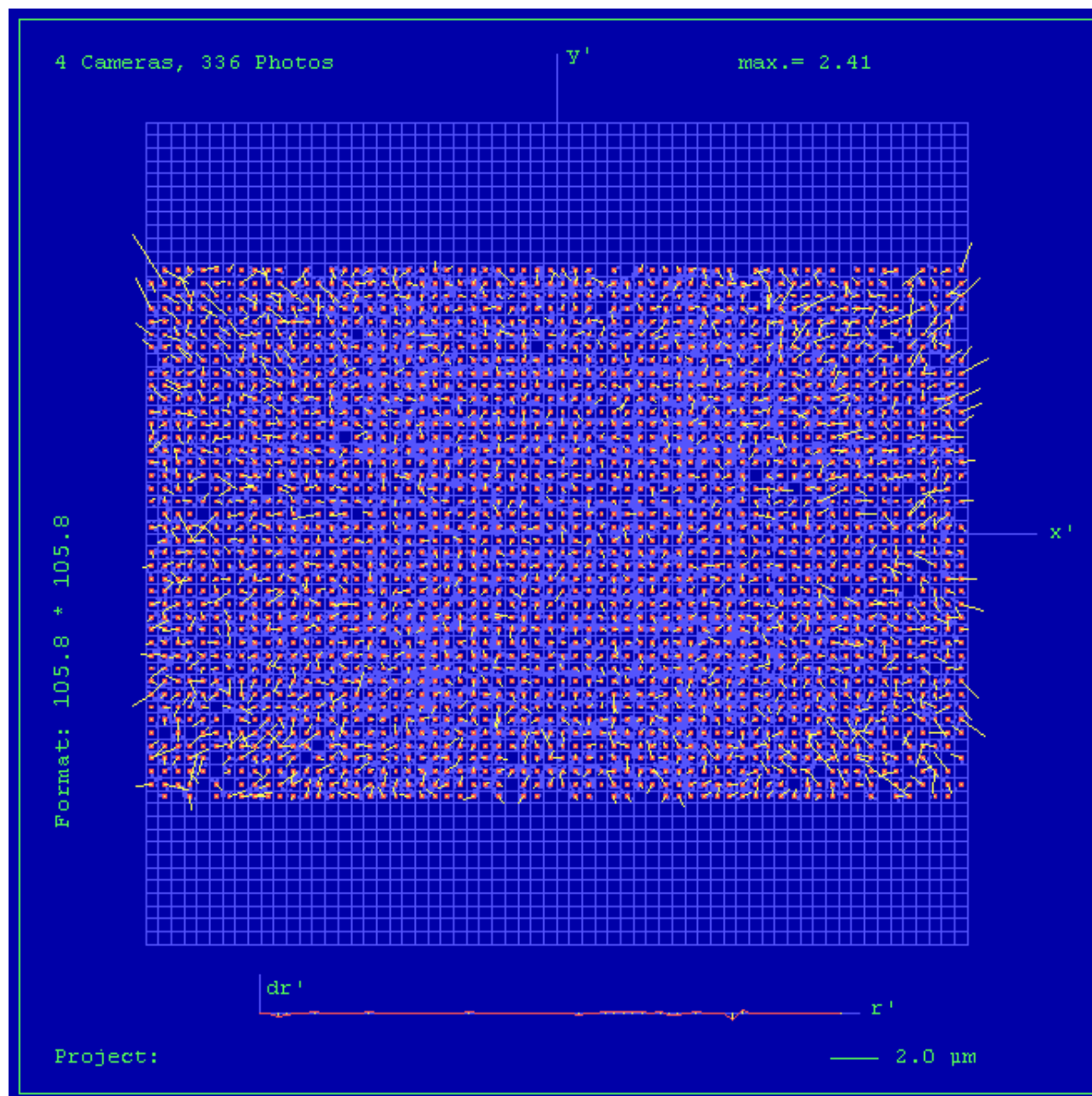
Cone # C3					
Lens		Linor Vexcel Apo-Sironar Digital HR 1:5,6/80mm Linor GmbH, Germany			
Shutter		Prontor Magnetic Prontor-Werk Alfred Gauthier GmbH			
Image Extent (nominally)		(-11.98, -17.97)mm		(11.98, 17.97)mm	
Extent CCD 0		(-11.98, -17.97)mm		(11.98 , 17.97)mm	
Parameters		Shift X	ShiftY	Rotation	Scale
CCD0		3.3943115E-02 mm ± 0.0008 mm	9.7434143E-02 mm ± 0.0020 mm	0,0000000 gon	1.0001235 ± 0.00005
Radial Distortion					
R [mm]	5.0	10.0	15.0	20.0	25.0
dr [µm]	-1.1	-3.0	-4.7	-8.4	-19.6

Cone 3, Residual Error Diagram



Residual Error (RMS): **0.45 μm**

Full Pan Image, Residual Error Diagram



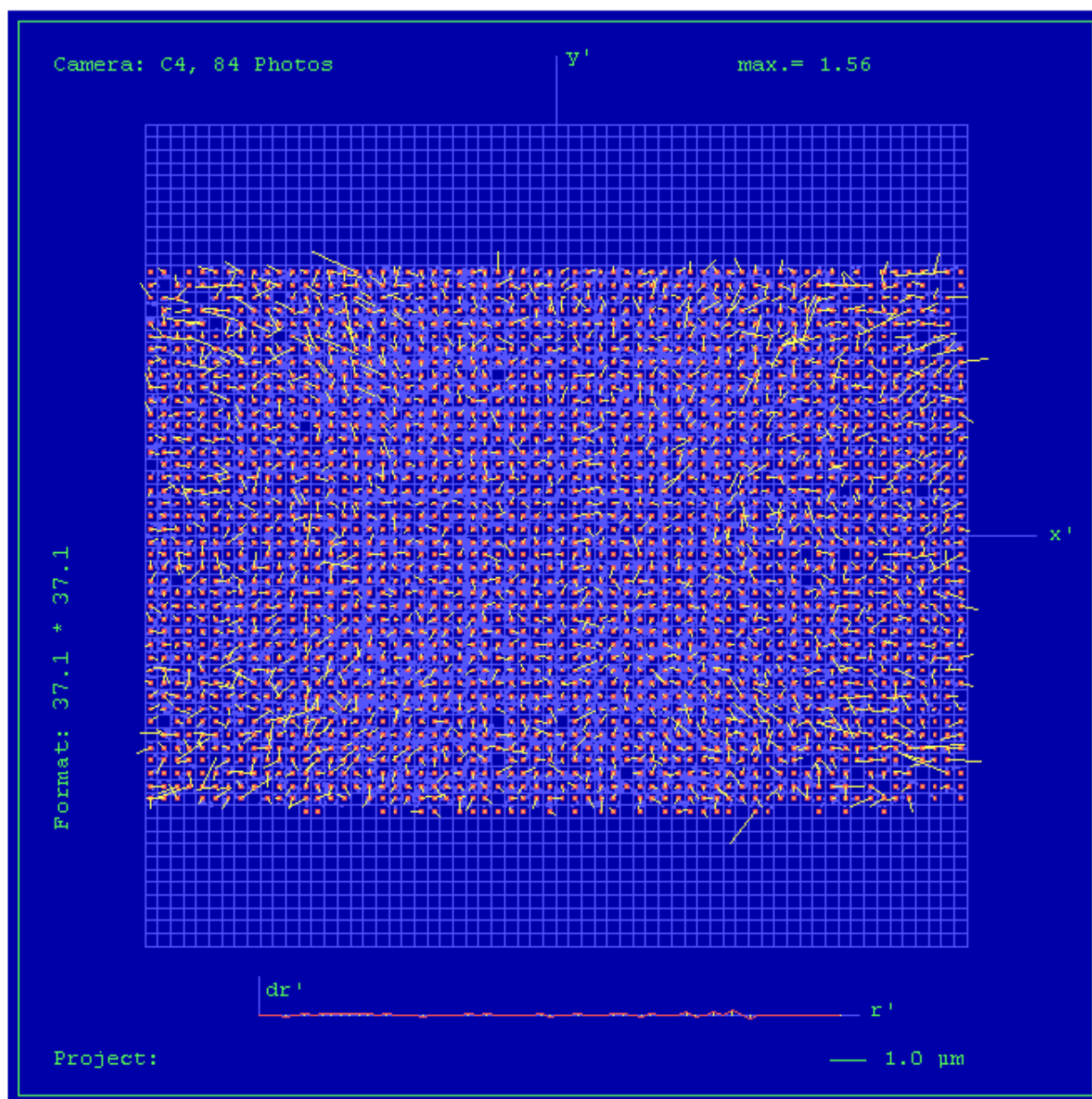
Residual Error (RMS): **0.51 μm**

Individual Multispectral Cone Data

Cone 4, Parametric Description, Not Effective in Output Image

Cone # C4 (red)					
Lens		Linos Vexcel HR Digaron 1:4/27mm Linos GmbH, Germany			
Shutter		Prontor Magnetic Prontor-Werk Alfred Gauthier GmbH			
Image Extent (nominally)		(-11.98, -17.97)mm		(11.98, 17.97)mm	
Extent CCD 0		(-11.98, -17.97)mm		(11.98 , 17.97)mm	
Parameters		Shift X	ShiftY	Rotation	Scale
CCD0		3.8187273E-02 mm ± 0.0000 mm	-6.8702806E-02 mm ± 0.0001 mm	0,0000000 gon	1.0579810 ± 0.00005
Radial Distortion					
R [mm]	5.0	10.0	15.0	20.0	25.0
dr [µm]	114.7	177.0	167.0	119.1	131.1

Cone 4, Residual Error Diagram

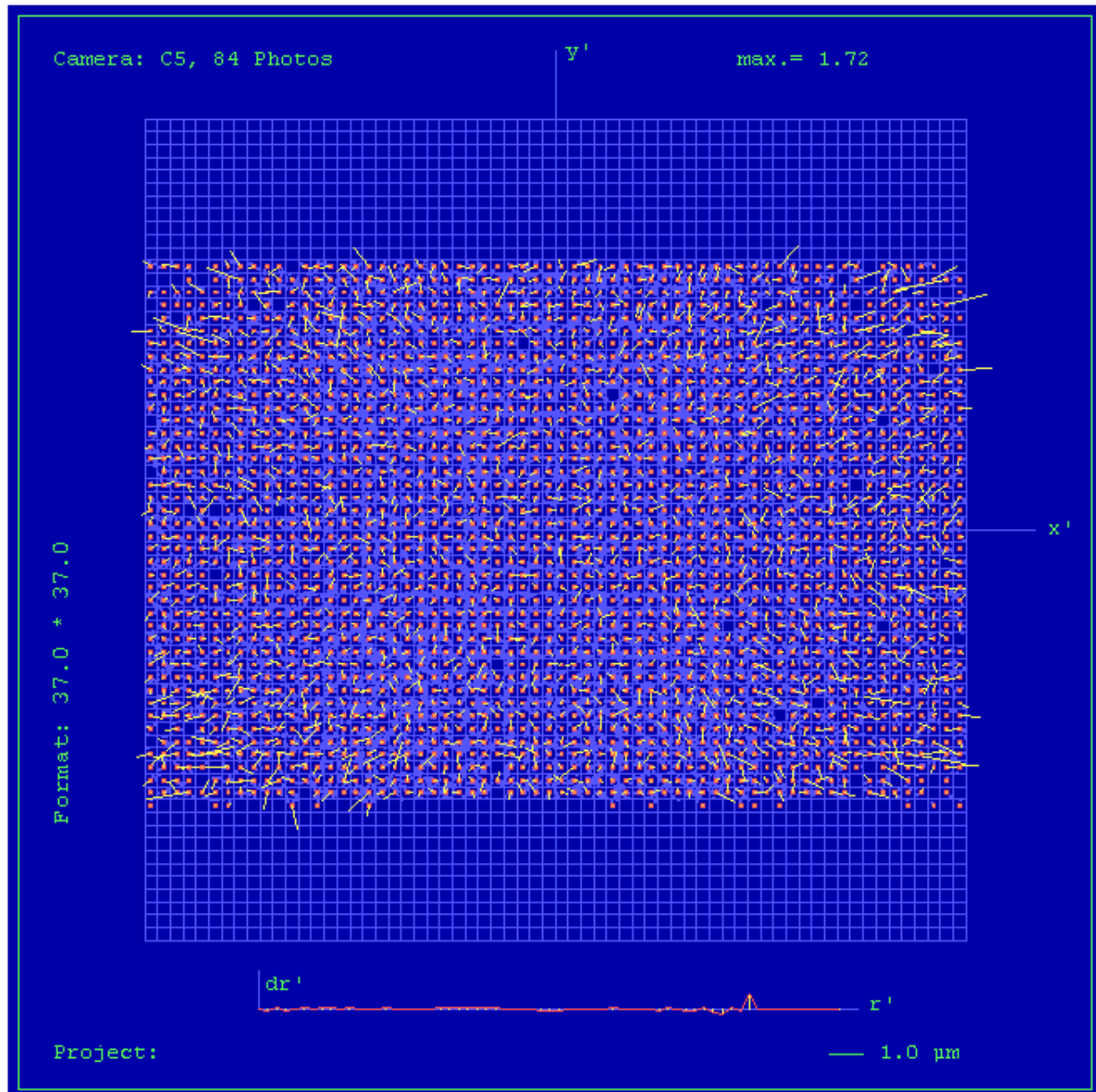


Residual Error (RMS): **0.50 μm**

Cone 5, Parametric Description, Not Effective in Output Image

Cone # C5 (green)					
Lens		Linor Vexcel HR Digaron 1:4/27mm Linor GmbH, Germany			
Shutter		Prontor Magnetic Prontor-Werk Alfred Gauthier GmbH			
Image Extent (nominally)		(-11.98, -17.97)mm		(11.98, 17.97)mm	
Extent CCD 0		(-11.98, -17.97)mm		(11.98 , 17.97)mm	
Parameters		Shift X	Shift Y	Rotation	Scale
CCD0		3.6279563E-02 mm ± 0.0000 mm	-6.9609714E-02 mm ± 0.0001 mm	0,0000000 gon	1.0561058 ± 0.00005
Radial Distortion					
R [mm]	5.0	10.0	15.0	20.0	25.0
dr [µm]	117.0	180.7	170.0	115.3	105.2

Cone 5, Residual Error Diagram

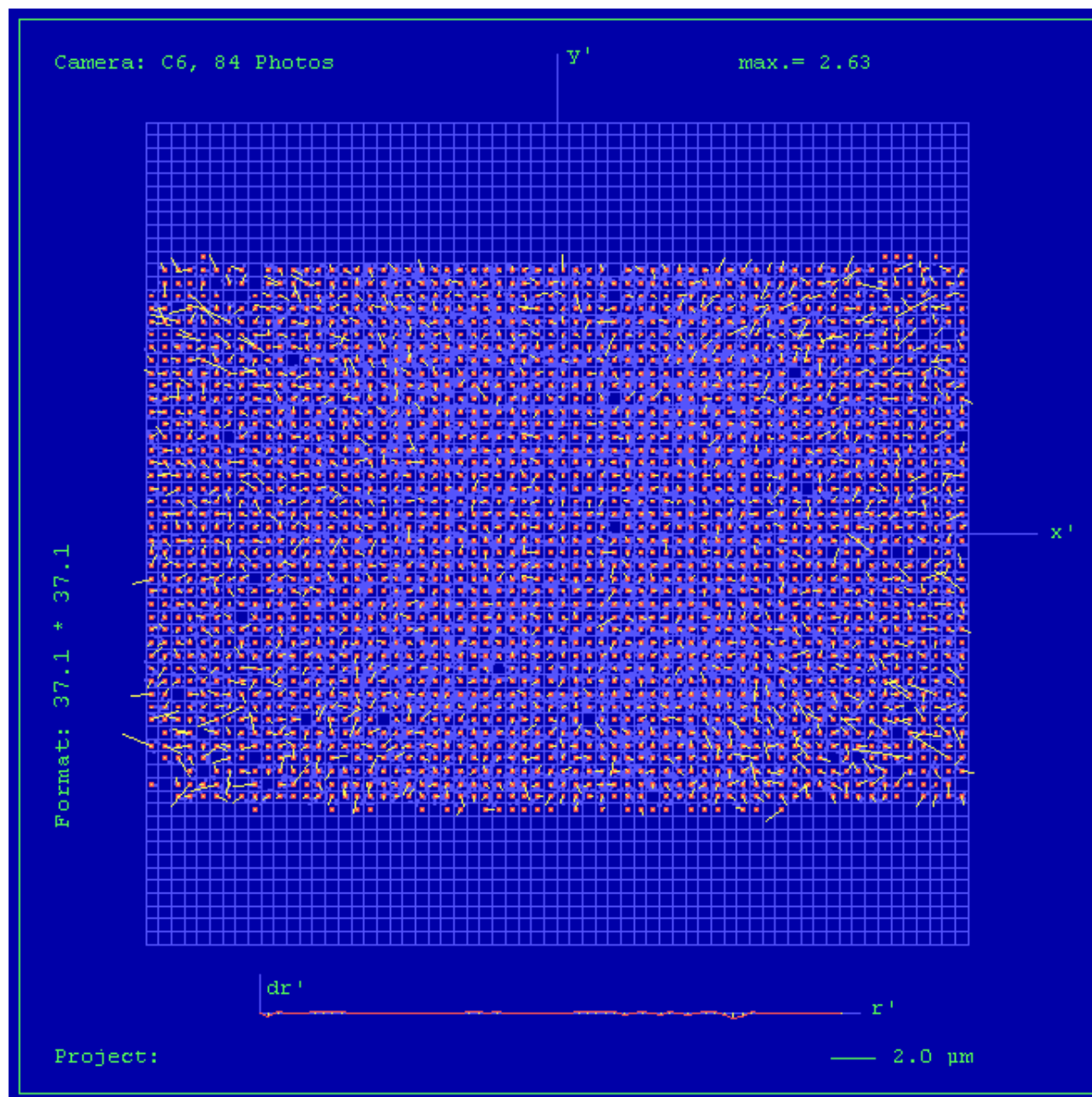


Residual Error (RMS): **0.47 μm**

Cone 6, Parametric Description, Not Effective in Output Image

Cone # C6 (blue)											
Lens		Linor Vexcel HR Digaron 1:4/27mm Linor GmbH, Germany									
Shutter		Prontor Magnetic Prontor-Werk Alfred Gauthier GmbH									
Image Extent (nominally)		(-11.98, -17.97)mm		(11.98, 17.97)mm							
Extent CCD 0		(-11.98, -17.97)mm		(11.98 , 17.97)mm							
Parameters		Shift X		ShiftY		Rotation		Scale			
CCD0		-4.1762180E-02 mm ± 0.0000 mm		-1.8270171E-02 mm ± 0.0001 mm		0,0000000 gon		1.0571127 ± 0.00005			
						Radial Distortion					
R [mm]		5.0		10.0		15.0		20.0		25.0	
dr [µm]		115.3		178.4		169.3		118.4		102.7	

Cone 6, Residual Error Diagram

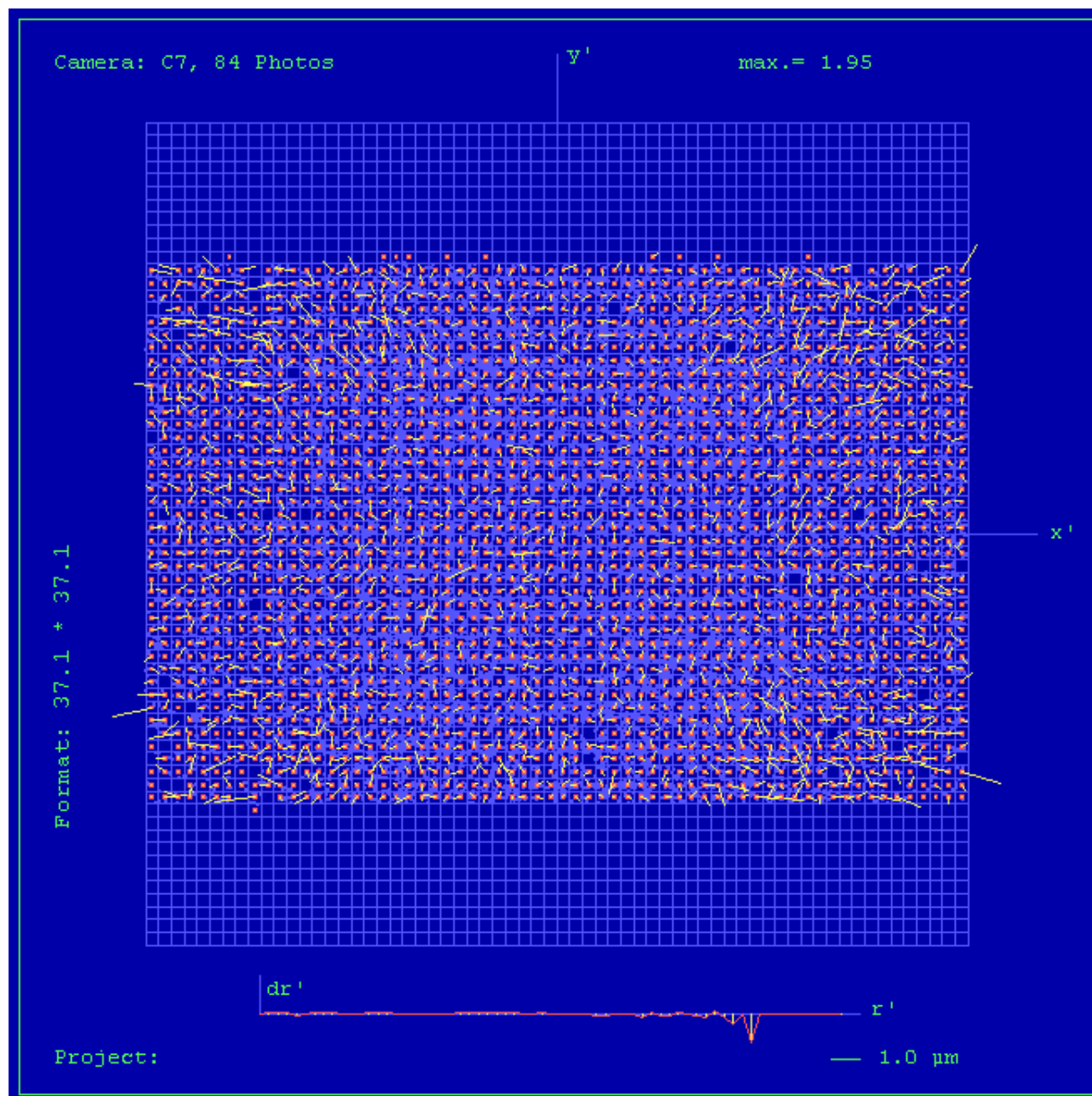


Residual Error (RMS): **0.51 μm**

Cone 7, Parametric Description, Not Effective in Output Image

Cone # C7 (NIR)											
Lens		Linor Vexcel HR Digaron 1:4/27mm Linor GmbH, Germany									
Shutter		Prontor Magnetic Prontor-Werk Alfred Gauthier GmbH									
Image Extent (nominally)		(-11.98, -17.97)mm		(11.98, 17.97)mm							
Extent CCD 0		(-11.98, -17.97)mm		(11.98 , 17.97)mm							
Parameters		Shift X		ShiftY		Rotation		Scale			
CCD0		-3,9236661E-02 mm ± 0.0000 mm		1,5123532E-02 mm ± 0.0001 mm		0,0000000 gon		1,0578234 ± 0.00005			
Radial Distortion											
R [mm]		5.0		10.0		15.0		20.0		25.0	
dr [µm]		117.8		182.7		172.6		121.5		133.0	

Cone 7, Residual Error Diagram



Residual Error (RMS): **0.51 μm**

Explanations:

1) Calibration Method:

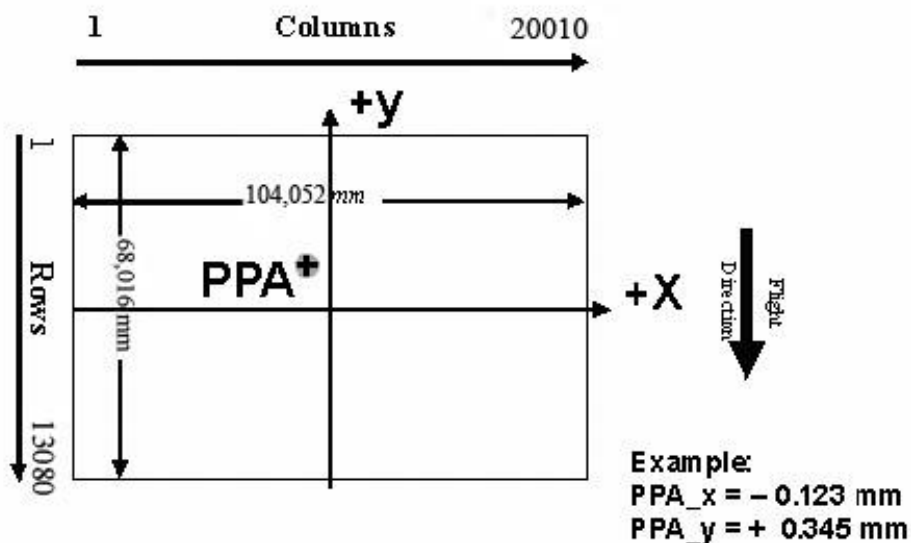
The geometric calibration is based on a set of 84 images of a defined geometry target with 394 GCPs.

Number of point measurements for the panchromatic camera : 20120
 Number of point measurements for the multispectral camera : 78467

Determination of the image parameters by Least Squares Adjustment.
 Software used for the adjustment: BINGO (GIP Eng. Aalen, Germany)

2) Level 2 Image Coordinate System: PAN 20010 pixel by 13080 pixel
 MS 6670 pixel by 4360 pixel

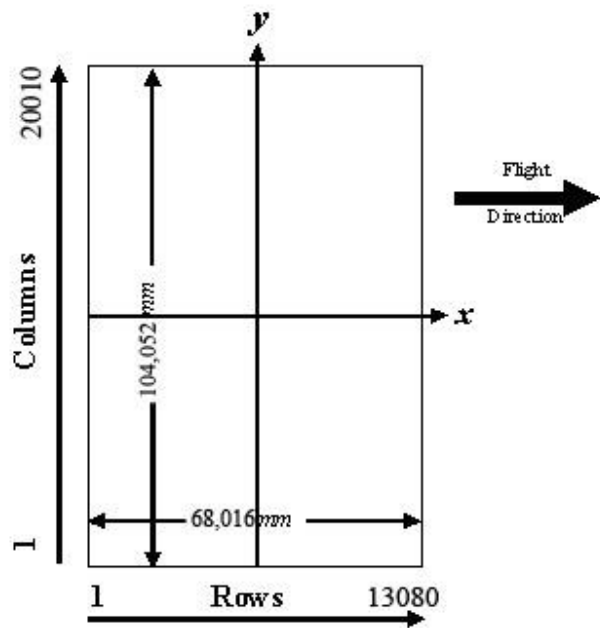
Lvl2, Camera prop. Orientation



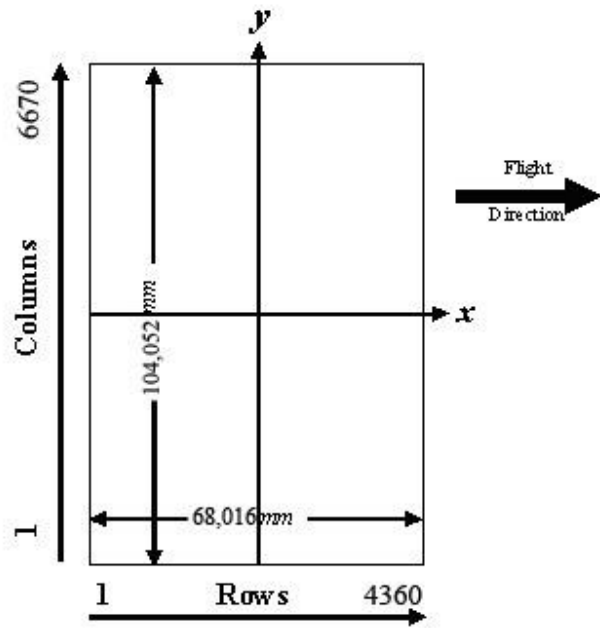
The image coordinate system of the Level 2 images is shown in the above figure. The level 2 image consists of 20010 columns and 13080 rows, which leads to a total image format of 104.052 x 68.016 mm. The coordinate of the principal point in the level 2 image is given on page 3 of this report. The above figure shows the position of an example principal point at the coordinate (-0.123 / 0.345).

3) Level 3 Image Coordinate System:
(after rotation of 270° CW)

PAN 20010 pixel by 13080 pixel
MS 6670 pixel by 4360 pixel



Panchromatic Image Format



Multispectral Image Format

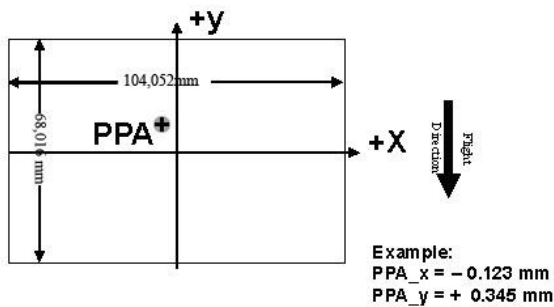
4) Position of Principal Point in Level 3 Image

The position of the principal point in the level 3 image depends on the “rotation” setting used in UltraMap during the pan-sharpening step. The exact position relative to the image center is given in the table below as a function of the rotation setting used in UltraMap. The coordinates are specified for clockwise (CW) rotation in steps of 90 degrees, according to the principal point coordinate given on page 3 for high- and low resolution images.

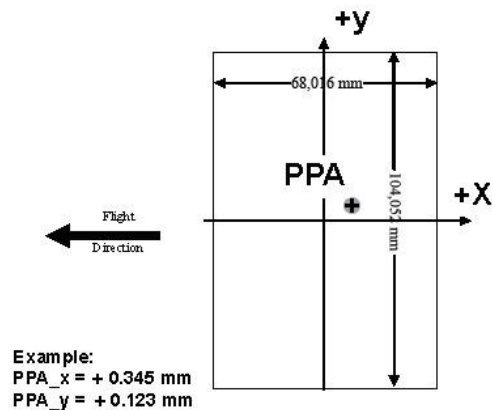
Image Format	Clockwise Rotation (Degree)	PPA	
		X	Y
Level 2	-	0.000	0.000
Level 3	0	0.000	0.000
Level 3	90	0.000	0.000
Level 3	180	0.000	0.000
Level 3	270	0.000	0.000

The coordinates in the figure below are only example values to illustrate the effect of image rotation on the principal point position, and do **not** correspond to the camera described in this report.

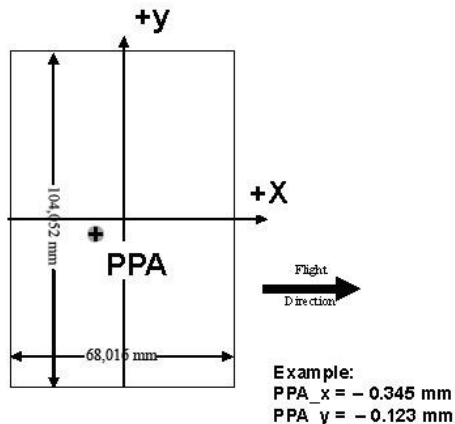
Lvl3, Rotation 0 deg clockwise



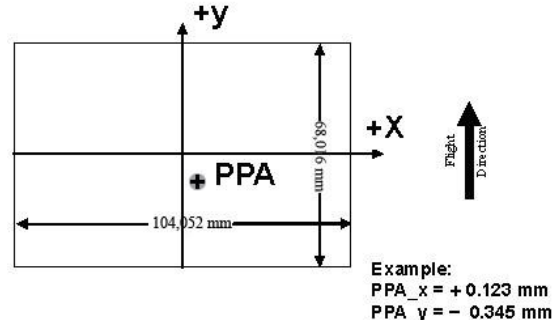
Lvl3, Rotation 90 deg clockwise



Lvl3, Rotation 270 deg clockwise



Lvl3, Rotation 180 deg clockwise



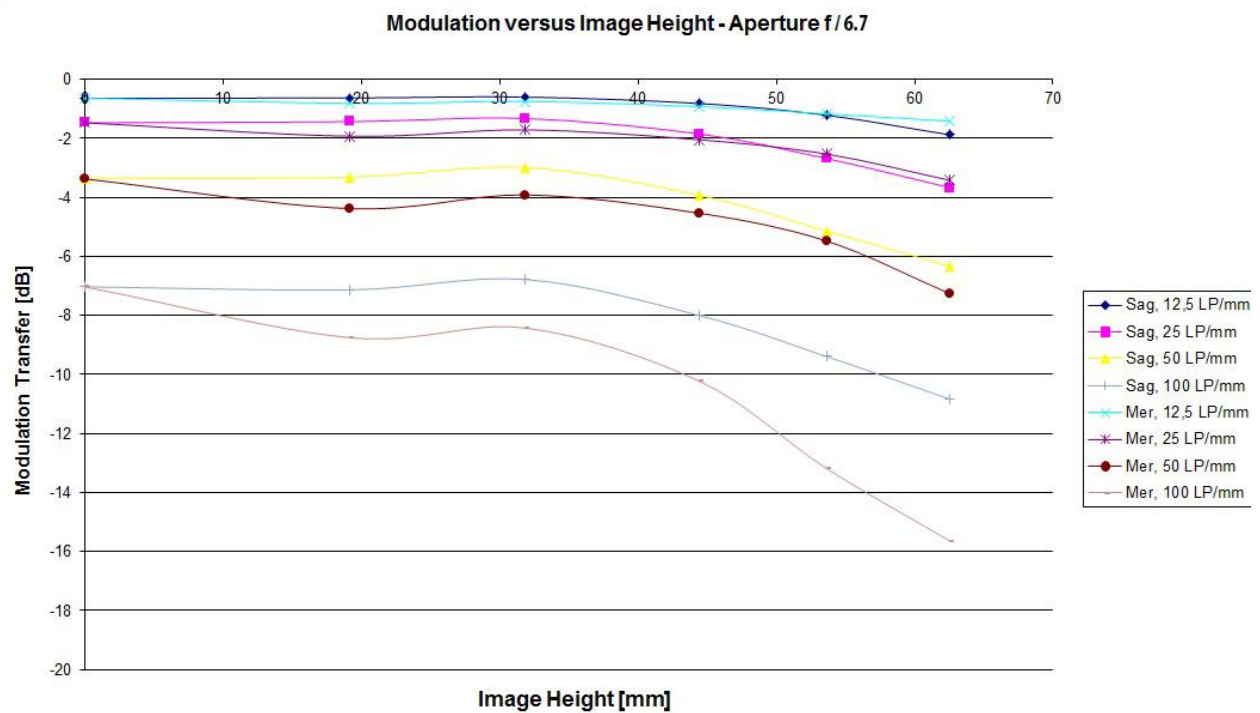
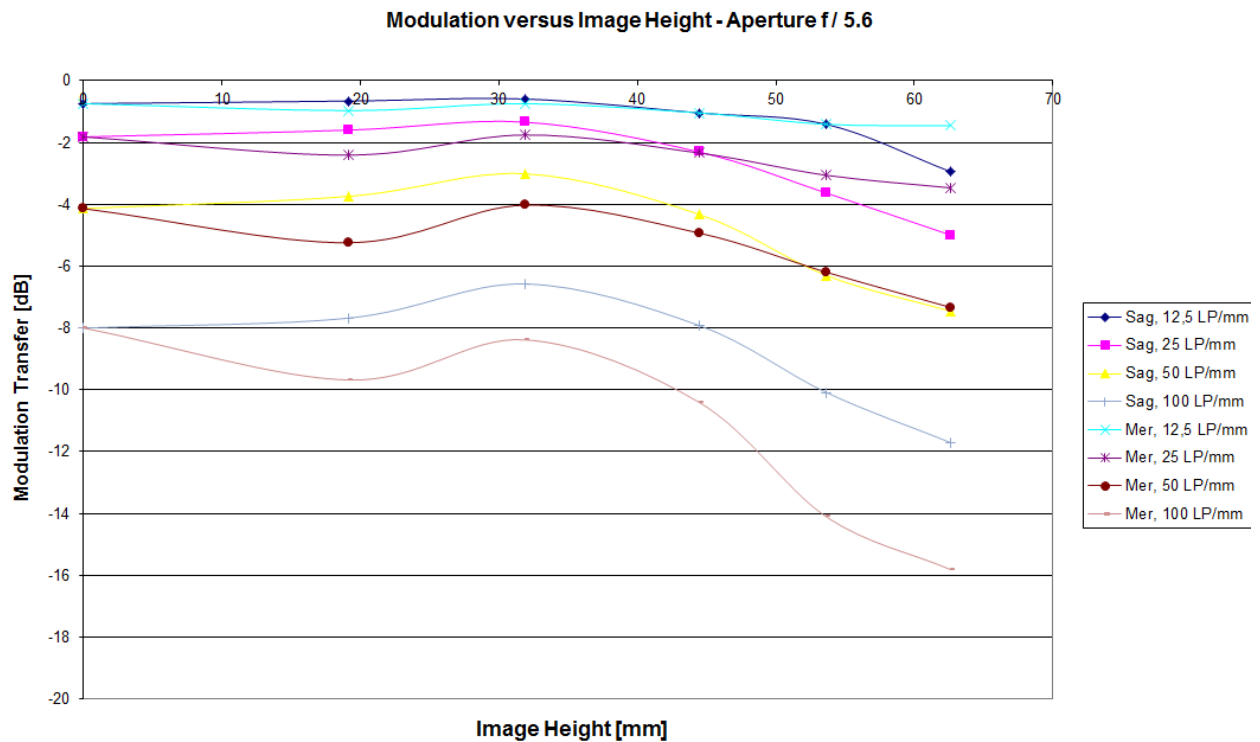
Lens Resolving Power

The following curves show the development of the modulation transfer function across different image heights of the panchromatic cones. Please note that these values have been calculated and can vary up to 10% with optics from production (especially at high LP's).

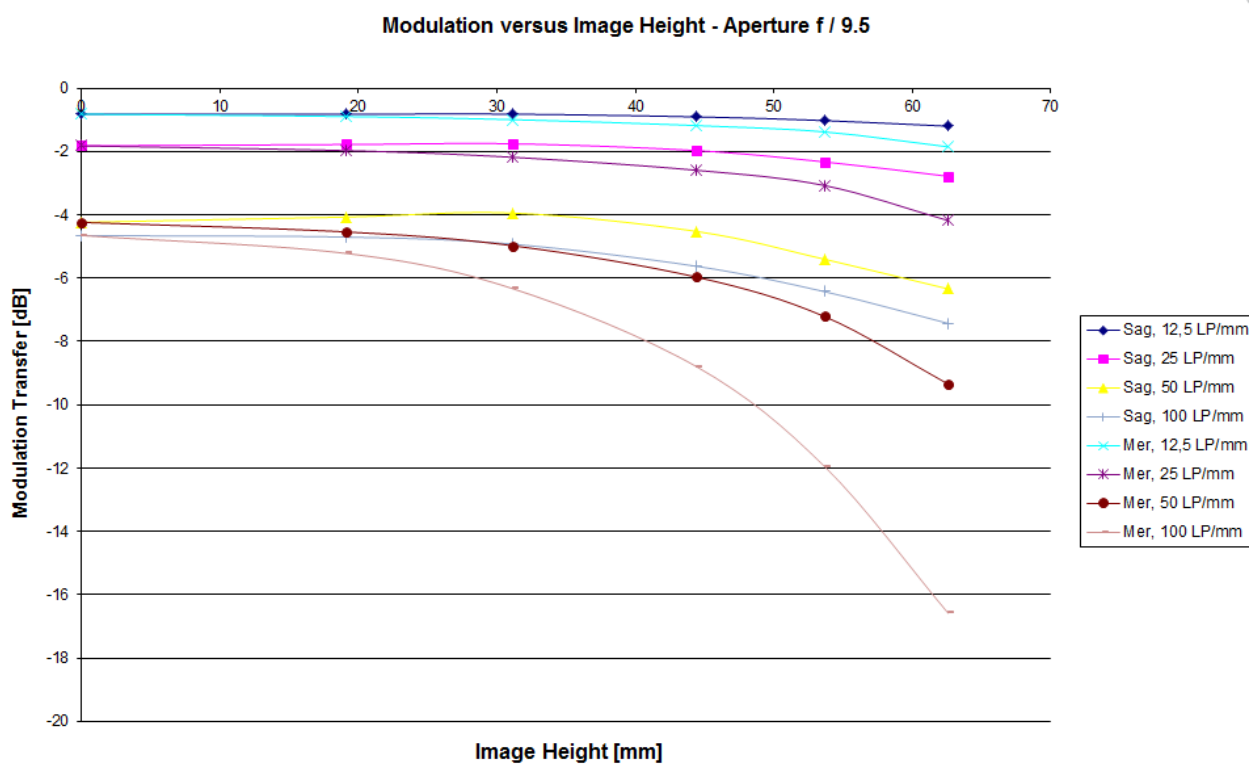
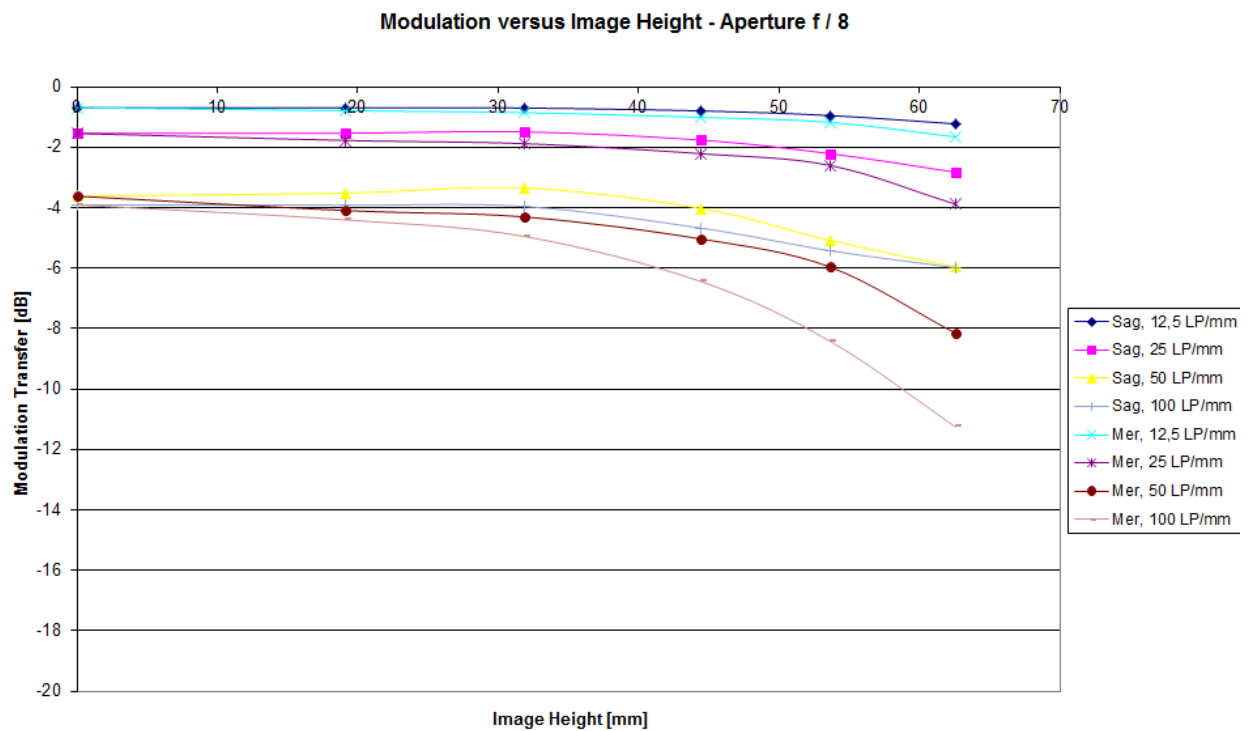
The curves are given for the meridional (tangential) and sagital (radial) component of signals at frequencies of 12.5, 25, 50 and 100 line pairs per millimeter.

As the MTF is a function of the specific aperture size used, one set of curves is given for each aperture size.

UltraCamEagle, Serial Number UC-Eagle-1-50617043

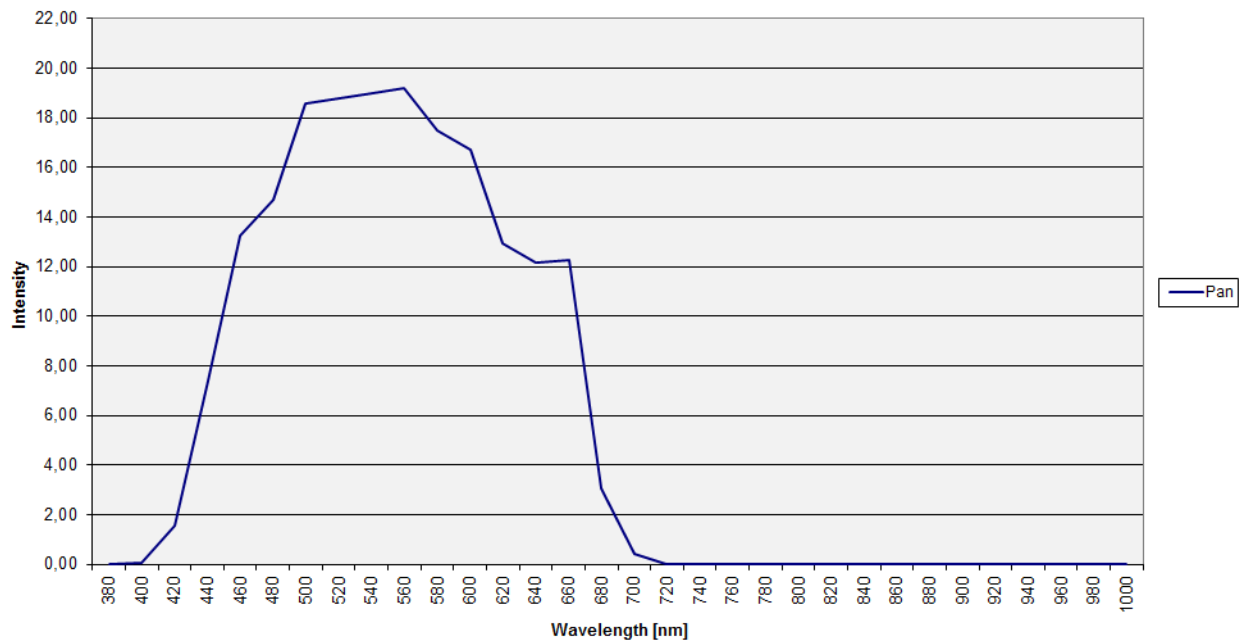


UltraCamEagle, Serial Number UC-Eagle-1-50617043

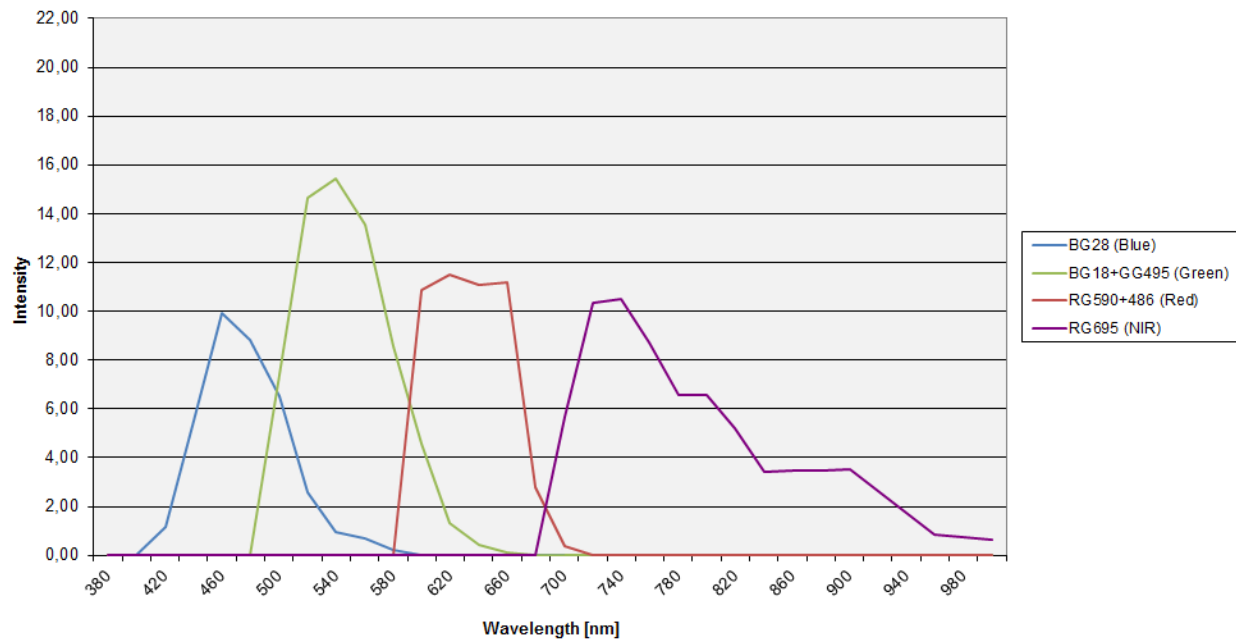


Spectral Sensitivity

Spectral Sensitivity Vexcel UltraCam Eagle - Panchromatic with AR-106 Coating



Spectral Sensitivity Vexcel UltraCam Eagle - Multispectral with AR-106 Coating



Calibration Report

Radiometric Calibration



Camera: UltraCam Eagle, S/N UC-Eagle-1-50617043

Manufacturer: Vexcel Imaging GmbH, A-8010 Graz, Austria

	PAN	R, G, NIR	B
Aperture	F5.6	F8.0	F5.6
	F6.7	F9.3	F6.5
	F8	F11	F8
	F9.5	F13	F9.5
	F11	F16	F11
	F13	F19	F13
	F16	F22	F16
	F22	F27	F22

Date of Calibration: Sep 09 2014

Date of Report: Jul 27 2016

Camera Revision: 8.0

Revision of Report: 8.0

Calibration of Vignetting for Aperture Setting 1

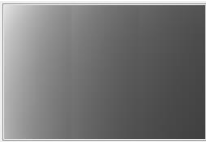
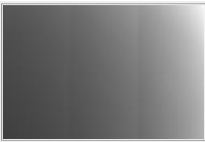
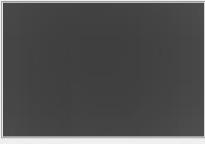
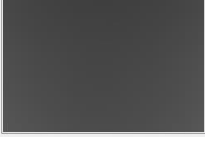
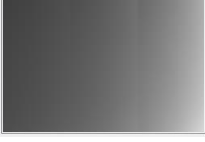
	PAN	R, G, NIR	B
Aperture	F5.6	F8.0	F5.6

Overview of Individual Sensor Gain Values:

Cone_Sensor	Aperture	Minimum Gain $\geq$	Maximum Gain $\leq$
00_00	f / 5.6	1.00	4.00
00_01	f / 5.6	1.00	5.00
00_02	f / 5.6	1.00	4.00
00_03	f / 5.6	1.00	4.00
01_00	f / 5.6	1.00	2.00
01_01	f / 5.6	1.00	2.00
02_00	f / 5.6	1.00	3.00
02_01	f / 5.6	1.00	3.00
03_00	f / 5.6	1.00	2.00
04_00 (red)	f / 8	1.00	4.00
05_00 (green)	f / 8	1.00	3.00
06_00 (blue)	f / 5.6	1.00	3.00
07_00 (NIR)	f / 8	1.00	4.00

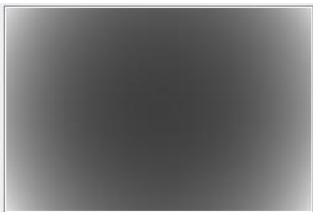
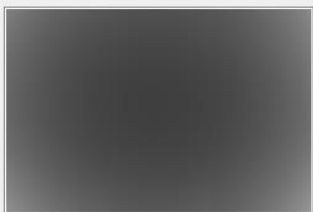
Calibration of Vignetting for Aperture Setting 1

Graphical Overview of Pan Sensor Gain Values:

00_00	01_00	00_01
02_00	03_00	02_01
00_02	01_01	00_03

Graphical Overview of Multispectral Sensor Gain Values:

04_00 (RED)	06_00 (BLUE)
05_00 (GREEN)	07_00 (NIR)

Calibration of Vignetting for Aperture Setting 2

	PAN	R, G, NIR	B
Aperture	F6.7	F9.3	F6.7

Overview of Individual Sensor Gain Values:

Cone_Sensor	Aperture	Minimum Gain $\geq$	Maximum Gain $\leq$
00_00	f / 6.5	1.00	4.00
00_01	f / 6.5	1.00	4.00
00_02	f / 6.5	1.00	3.00
00_03	f / 6.5	1.00	4.00
01_00	f / 6.5	1.00	2.00
01_01	f / 6.5	1.00	2.00
02_00	f / 6.5	1.00	3.00
02_01	f / 6.5	1.00	3.00
03_00	f / 6.5	1.00	2.00
04_00 (red)	f / 9.3	1.00	4.00
05_00 (green)	f / 9.3	1.00	3.00
06_00 (blue)	f / 6.5	1.00	3.00
07_00 (NIR)	f / 9.3	1.00	3.00

Calibration of Vignetting for Aperture Setting 3

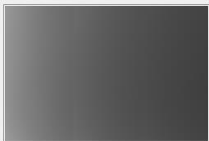
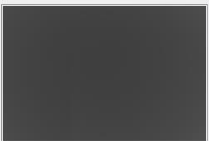
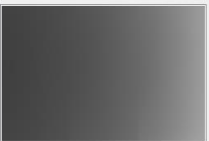
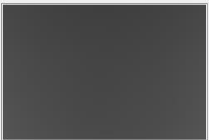
	PAN	R, G, NIR	B
Aperture	F8	F11	F8

Overview of Individual Sensor Gain Values:

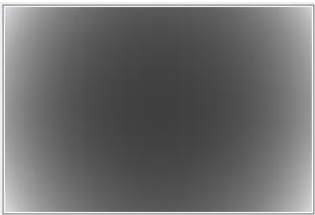
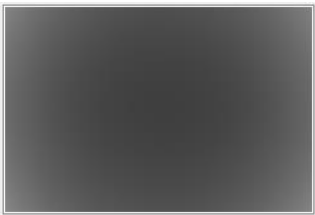
Cone_Sensor	Aperture	Minimum Gain $\geq$	Maximum Gain $\leq$
00_00	f / 8	1.00	4.00
00_01	f / 8	1.00	4.00
00_02	f / 8	1.00	3.00
00_03	f / 8	1.00	4.00
01_00	f / 8	1.00	2.00
01_01	f / 8	1.00	2.00
02_00	f / 8	1.00	3.00
02_01	f / 8	1.00	3.00
03_00	f / 8	1.00	2.00
04_00 (red)	f / 11	1.00	4.00
05_00 (green)	f / 11	1.00	3.00
06_00 (blue)	f / 8	1.00	3.00
07_00 (NIR)	f / 11	1.00	3.00

Calibration of Vignetting for Aperture Setting 3

Graphical Overview of Pan Sensor Gain Values:

			00_00	01_00	00_01
			02_00	03_00	02_01
			00_02	01_01	00_03

Graphical Overview of Multispectral Sensor Gain Values:

		04_00 (RED)	06_00 (BLUE)
		05_00 (GREEN)	07_00 (NIR)

Calibration of Vignetting for Aperture Setting 4

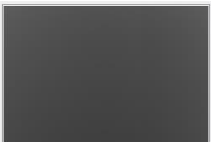
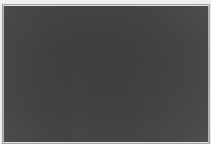
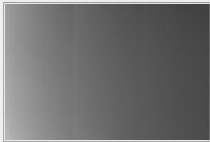
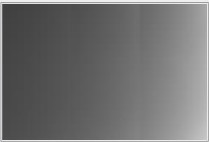
	PAN	R, G, NIR	B
Aperture	F9.5	F13	F9.5

Overview of Individual Sensor Gain Values:

Cone_Sensor	Aperture	Minimum Gain $\geq$	Maximum Gain $\leq$
00_00	f / 9.5	1.00	4.00
00_01	f / 9.5	1.00	4.00
00_02	f / 9.5	1.00	3.00
00_03	f / 9.5	1.00	4.00
01_00	f / 9.5	1.00	2.00
01_01	f / 9.5	1.00	2.00
02_00	f / 9.5	1.00	3.00
02_01	f / 9.5	1.00	3.00
03_00	f / 9.5	1.00	2.00
04_00 (red)	f / 13	1.00	4.00
05_00 (green)	f / 13	1.00	3.00
06_00 (blue)	f / 9.5	1.00	3.00
07_00 (NIR)	f / 13	1.00	3.00

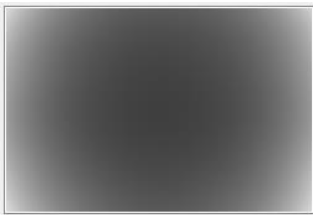
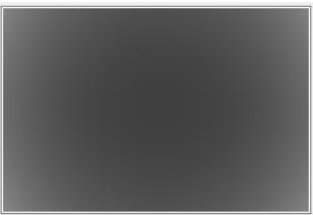
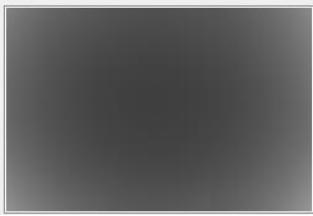
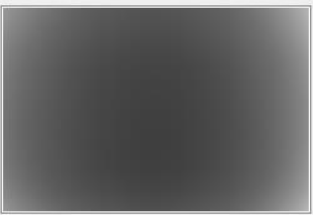
Calibration of Vignetting for Aperture Setting 4

Graphical Overview of Pan Sensor Gain Values:

00_00	01_00	00_01
02_00	03_00	02_01
00_02	01_01	00_03

Graphical Overview of Multispectral Sensor Gain Values:

04_00 (RED)	06_00 (BLUE)
05_00 (GREEN)	07_00 (NIR)

Calibration of Vignetting for Aperture Setting 5

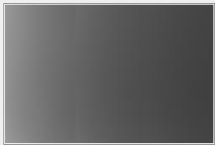
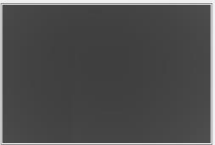
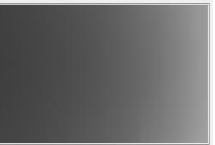
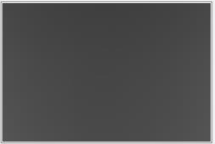
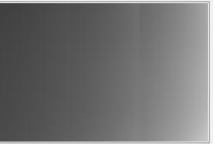
	PAN	R, G, NIR	B
Aperture	F11	F16	F11

Overview of Individual Sensor Gain Values:

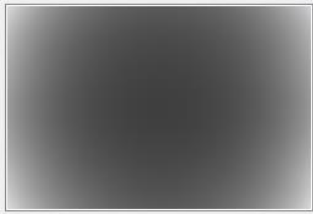
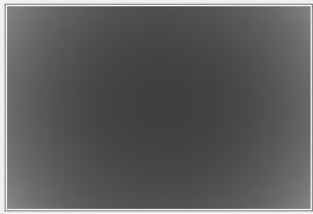
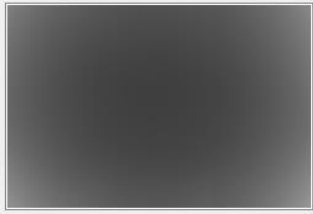
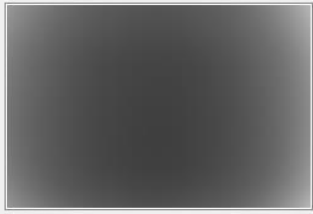
Cone_Sensor	Aperture	Minimum Gain $\geq$	Maximum Gain $\leq$
00_00	f / 11	1.00	4.00
00_01	f / 11	1.00	4.00
00_02	f / 11	1.00	3.00
00_03	f / 11	1.00	4.00
01_00	f / 11	1.00	2.00
01_01	f / 11	1.00	2.00
02_00	f / 11	1.00	3.00
02_01	f / 11	1.00	3.00
03_00	f / 11	1.00	2.00
04_00 (red)	f / 16	1.00	4.00
05_00 (green)	f / 16	1.00	3.00
06_00 (blue)	f / 11	1.00	3.00
07_00 (NIR)	f / 16	1.00	3.00

Calibration of Vignetting for Aperture Setting 5

Graphical Overview of Pan Sensor Gain Values:

			00_00	01_00	00_01
			02_00	03_00	02_01
			00_02	01_01	00_03

Graphical Overview of Multispectral Sensor Gain Values:

		04_00 (RED)	06_00 (BLUE)
		05_00 (GREEN)	07_00 (NIR)

Calibration of Vignetting for Aperture Setting 6

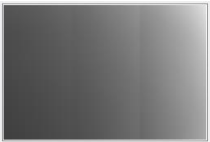
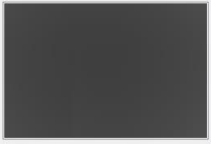
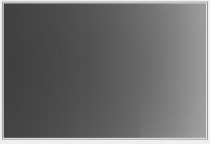
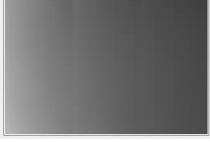
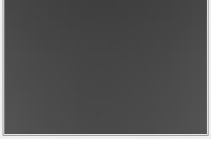
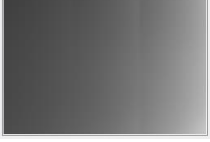
	PAN	R, G, NIR	B
Aperture	F13	F19	F13

Overview of Individual Sensor Gain Values:

Cone_Sensor	Aperture	Minimum Gain $\geq$	Maximum Gain $\leq$
00_00	f / 13	1.00	4.00
00_01	f / 13	1.00	4.00
00_02	f / 13	1.00	3.00
00_03	f / 13	1.00	4.00
01_00	f / 13	1.00	2.00
01_01	f / 13	1.00	2.00
02_00	f / 13	1.00	3.00
02_01	f / 13	1.00	3.00
03_00	f / 13	1.00	2.00
04_00 (red)	f / 19	1.00	4.00
05_00 (green)	f / 19	1.00	3.00
06_00 (blue)	f / 13	1.00	3.00
07_00 (NIR)	f / 19	1.00	3.00

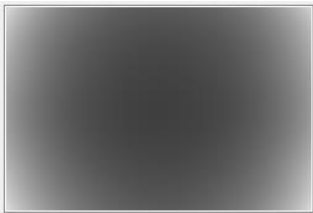
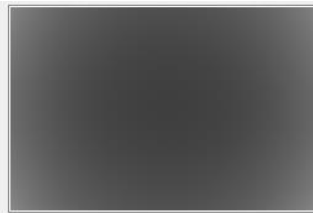
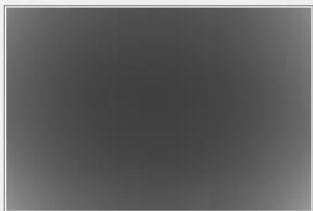
Calibration of Vignetting for Aperture Setting 6

Graphical Overview of Pan Sensor Gain Values:

00_00	01_00	00_01
02_00	03_00	02_01
00_02	01_01	00_03

Graphical Overview of Multispectral Sensor Gain Values:

04_00 (RED)	06_00 (BLUE)
05_00 (GREEN)	07_00 (NIR)

Calibration of Vignetting for Aperture Setting 7

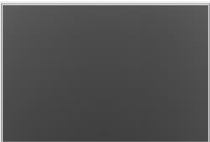
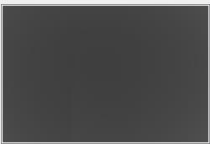
	PAN	R, G, NIR	B
Aperture	F16	F22	F16

Overview of Individual Sensor Gain Values:

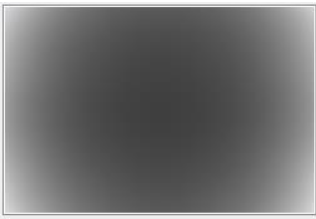
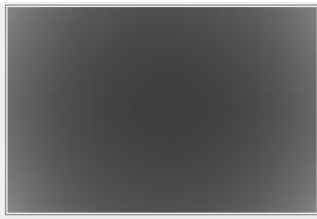
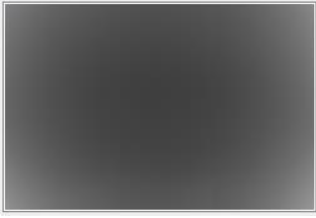
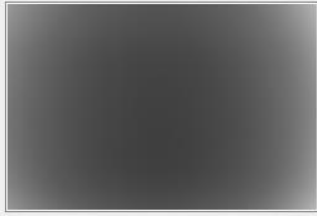
Cone_Sensor	Aperture	Minimum Gain $\geq$	Maximum Gain $\leq$
00_00	f / 16	1.00	4.00
00_01	f / 16	1.00	4.00
00_02	f / 16	1.00	3.00
00_03	f / 16	1.00	4.00
01_00	f / 16	1.00	2.00
01_01	f / 16	1.00	2.00
02_00	f / 16	1.00	3.00
02_01	f / 16	1.00	3.00
03_00	f / 16	1.00	2.00
04_00 (red)	f / 22	1.00	4.00
05_00 (green)	f / 22	1.00	3.00
06_00 (blue)	f / 16	1.00	3.00
07_00 (NIR)	f / 22	1.00	3.00

Calibration of Vignetting for Aperture Setting 7

Graphical Overview of Pan Sensor Gain Values:

			00_00	01_00	00_01
			02_00	03_00	02_01
			00_02	01_01	00_03

Graphical Overview of Multispectral Sensor Gain Values:

		04_00 (RED)	06_00 (BLUE)
		05_00 (GREEN)	07_00 (NIR)

Calibration of Vignetting for Aperture Setting 8

	PAN	R, G, NIR	B
Aperture	F22	F27	F22

Overview of Individual Sensor Gain Values:

Cone_Sensor	Aperture	Minimum Gain $\geq$	Maximum Gain $\leq$
00_00	f / 22	1.00	4.00
00_01	f / 22	1.00	4.00
00_02	f / 22	1.00	3.00
00_03	f / 22	1.00	4.00
01_00	f / 22	1.00	2.00
01_01	f / 22	1.00	2.00
02_00	f / 22	1.00	3.00
02_01	f / 22	1.00	3.00
03_00	f / 22	1.00	2.00
04_00 (red)	f / 27	1.00	4.00
05_00 (green)	f / 27	1.00	3.00
06_00 (blue)	f / 22	1.00	3.00
07_00 (NIR)	f / 27	1.00	3.00

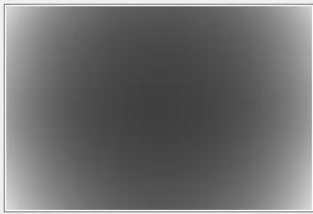
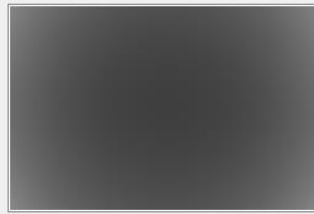
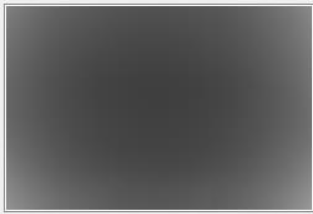
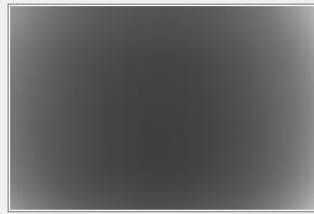
Calibration of Vignetting for Aperture Setting 8

Graphical Overview of Pan Sensor Gain Values:

00_00	01_00	00_01
02_00	03_00	02_01
00_02	01_01	00_03

Graphical Overview of Multispectral Sensor Gain Values:

04_00 (RED)	06_00 (BLUE)
05_00 (GREEN)	07_00 (NIR)

Defective Pixel Report:

Sensor		
Anomaly Type	X	Y

C00-00

PIXEL: 304/ 585
PIXEL: 380/1174
PIXEL: 892/ 474
PIXEL: 1117/3259
PIXEL: 1675/4427
PIXEL: 1879/1543
PIXEL: 2204/4214
PIXEL: 2492/1100
PIXEL: 2626/2109
PIXEL: 2693/ 680
PIXEL: 2852/2522
PIXEL: 2910/3702
PIXEL: 3652/2557
PIXEL: 4046/2297
PIXEL: 4726/2436
PIXEL: 5301/4500
PIXEL: 5460/2903
PIXEL: 5629/1923
PIXEL: 6448/1072
PIXEL: 6551/2116
PIXEL: 6557/ 351
PIXEL: 6959/ 794
PIXEL: 85/1374
PIXEL: 293/ 651
PIXEL: 294/ 652
PIXEL: 295/ 651
PIXEL: 295/ 652
PIXEL: 378/ 208
PIXEL: 4958/ 885
PIXEL: 4958/ 886
PIXEL: 4959/ 885
PIXEL: 4959/ 886
PIXEL: 295/ 652
PIXEL: 293/ 651
PIXEL: 4958/ 885
PIXEL: 4959/ 886

C00-01

PIXEL: 1016/2098
PIXEL: 1398/3265
PIXEL: 1772/1924
PIXEL: 1772/3654
PIXEL: 1795/2887
PIXEL: 2110/1120
PIXEL: 2434/ 903
PIXEL: 2835/ 923
PIXEL: 3196/4079
PIXEL: 3495/3755
PIXEL: 3696/2002
PIXEL: 3820/2975
PIXEL: 4185/2780

UltraCamEagle, Serial Number UC-Eagle-1-50617043

PIXEL: 4845/3668
PIXEL: 5113/3473
PIXEL: 5234/2342
PIXEL: 5455/2762
PIXEL: 5822/3879
PIXEL: 6340/ 340
PIXEL: 6567/3178
PIXEL: 6573/3087
PIXEL: 6675/1301
PIXEL: 1414/1333
PIXEL: 1414/1334
PIXEL: 1486/ 275
PIXEL: 1487/ 276
PIXEL: 1487/ 277
PIXEL: 1488/ 276
PIXEL: 1488/ 277
PIXEL: 4909/2262
PIXEL: 5455/2480
PIXEL: 6305/ 243
PIXEL: 1414/1334
PIXEL: 1486/ 275
PIXEL: 1488/ 276
PIXEL: 1487/ 277

C00-02

PIXEL: 68/ 34
PIXEL: 173/4135
PIXEL: 214/1504
PIXEL: 856/3512
PIXEL: 1612/ 47
PIXEL: 1742/4223
PIXEL: 2191/3816
PIXEL: 2308/3971
PIXEL: 2634/2285
PIXEL: 4034/2315
PIXEL: 4484/ 270
PIXEL: 4767/ 243
PIXEL: 4873/ 373
PIXEL: 4937/ 973
PIXEL: 5207/ 984
PIXEL: 5392/1835
PIXEL: 5866/2309
PIXEL: 5970/ 99
PIXEL: 6721/1197
PIXEL: 1420/ 455
PIXEL: 3881/3976
PIXEL: 4336/2900
PIXEL: 4337/2899
PIXEL: 4338/2899
PIXEL: 4338/2900
PIXEL: 1420/ 455
PIXEL: 3881/3976
PIXEL: 4337/2899
PIXEL: 4338/2900

C00-03

PIXEL: 682/1255
PIXEL: 997/ 758
PIXEL: 1059/4296
PIXEL: 1195/4286
PIXEL: 1428/4327

UltraCamEagle, Serial Number UC-Eagle-1-50617043

PIXEL: 1497/1001
 PIXEL: 1497/1002
 PIXEL: 1521/ 489
 PIXEL: 1691/1506
 PIXEL: 1793/3221
 PIXEL: 2160/1033
 PIXEL: 2945/3897
 PIXEL: 3104/2872
 PIXEL: 3235/4559
 PIXEL: 3808/3048
 PIXEL: 3918/ 54
 PIXEL: 3997/ 316
 PIXEL: 4151/2098
 PIXEL: 4261/4352
 PIXEL: 4753/3316
 PIXEL: 4763/3120
 PIXEL: 4864/2676
 PIXEL: 4959/ 775
 PIXEL: 5110/1091
 PIXEL: 5434/ 424
 PIXEL: 6650/1643
 PIXEL: 6862/4627
 PIXEL: 251/3528
 PIXEL: 252/3528
 PIXEL: 1326/ 447
 PIXEL: 3137/2951
 PIXEL: 5050/3774
 PIXEL: 252/3528
 PIXEL: 1326/ 447
 PIXEL: 5050/3774
 PIXEL: 3137/2951

C01-00

PIXEL: 60/3616
 PIXEL: 137/ 852
 PIXEL: 1094/ 406
 PIXEL: 1498/3724
 PIXEL: 1580/ 757
 PIXEL: 1631/4446
 PIXEL: 1870/1467
 PIXEL: 2721/4223
 PIXEL: 3213/ 227
 PIXEL: 3487/1831
 PIXEL: 4411/1812
 PIXEL: 4953/3431
 PIXEL: 5353/3195
 PIXEL: 5369/ 138
 PIXEL: 5429/4347
 PIXEL: 5555/3475
 PIXEL: 6010/1554
 PIXEL: 6026/3944
 PIXEL: 6037/3183
 PIXEL: 6252/2562
 PIXEL: 365/ 859
 PIXEL: 2902/2082
 PIXEL: 4327/4035
 PIXEL: 4327/4036
 PIXEL: 4328/4037
 PIXEL: 6611/4566
 PIXEL: 1143/4553
 PIXEL: 4327/4035
 PIXEL: 4328/4037

UltraCamEagle, Serial Number UC-Eagle-1-50617043

C01-01

PIXEL: 250/2157
 PIXEL: 933/1719
 PIXEL: 1306/1932
 PIXEL: 1590/2310
 PIXEL: 3040/1317
 PIXEL: 4254/3301
 PIXEL: 4307/3049
 PIXEL: 4323/1622
 PIXEL: 4637/2883
 PIXEL: 4646/2890
 PIXEL: 4647/2890
 PIXEL: 5055/1148
 PIXEL: 5144/1707
 PIXEL: 5390/2935
 PIXEL: 5793/ 579
 PIXEL: 6194/3158
 PIXEL: 6256/4558
 PIXEL: 1045/1950
 PIXEL: 1046/1950
 PIXEL: 3589/ 778
 PIXEL: 3608/4021
 PIXEL: 3608/4022
 PIXEL: 3609/4021
 PIXEL: 1045/1950
 PIXEL: 3589/ 778
 PIXEL: 3608/4022
 PIXEL: 3609/4021

C02-00

PIXEL: 581/1356
 PIXEL: 679/2863
 PIXEL: 1502/3998
 PIXEL: 1568/ 828
 PIXEL: 1922/1891
 PIXEL: 2767/3315
 PIXEL: 4084/4392
 PIXEL: 4146/2757
 PIXEL: 4438/1125
 PIXEL: 4514/1113
 PIXEL: 6025/3004
 PIXEL: 6718/ 309
 PIXEL: 963/2620
 PIXEL: 2053/2041
 PIXEL: 2054/2041
 PIXEL: 2439/1175
 PIXEL: 3129/1560
 PIXEL: 3828/4545
 PIXEL: 6419/ 915
 PIXEL: 2053/2041
 PIXEL: 6419/ 915
 PIXEL: 3828/4545

C02-01

PIXEL: 553/2060
 PIXEL: 894/ 577
 PIXEL: 2636/3905
 PIXEL: 4212/ 609
 PIXEL: 4785/ 363

UltraCamEagle, Serial Number UC-Eagle-1-50617043

PIXEL: 5074/4297
PIXEL: 5096/2787
PIXEL: 5564/1826
PIXEL: 6049/1955
PIXEL: 272/4421
PIXEL: 1215/1619
PIXEL: 1987/ 448
PIXEL: 6386/4191
PIXEL: 6845/ 657
PIXEL: 4433/4601
PIXEL: 272/4421
PIXEL: 6845/ 657

C03-00

PIXEL: 763/4043
PIXEL: 763/4044
PIXEL: 1887/4026
PIXEL: 2129/3275
PIXEL: 3559/ 705
PIXEL: 4194/2383
PIXEL: 4557/ 397
PIXEL: 4594/3514
PIXEL: 4666/1376
PIXEL: 4838/1941
PIXEL: 6535/2509
PIXEL: 4268/3500
PIXEL: 4268/3501
PIXEL: 763/4043

C04-00

PIXEL: 644/3987
PIXEL: 912/3424
PIXEL: 1088/4119
PIXEL: 1560/1978
PIXEL: 1583/ 101
PIXEL: 1851/1585
PIXEL: 1888/2605
PIXEL: 2579/3979
PIXEL: 2942/ 474
PIXEL: 4267/4253
PIXEL: 4785/3981
PIXEL: 5997/2081
PIXEL: 6661/2578
PIXEL: 6724/2050
PIXEL: 1671/ 199
PIXEL: 4050/3527

C05-00

PIXEL: 688/2015
PIXEL: 1897/1917
PIXEL: 1897/2147
PIXEL: 2026/2511
PIXEL: 2026/2512
PIXEL: 4918/4300
PIXEL: 4939/1849
PIXEL: 6400/ 787
PIXEL: 6464/2998
PIXEL: 6829/3503
PIXEL: 3321/1141
PIXEL: 3322/1140

UltraCamEagle, Serial Number UC-Eagle-1-50617043

PIXEL: 3322/1141
 PIXEL: 3322/1142
 PIXEL: 3323/1140
 PIXEL: 3323/1141
 PIXEL: 3323/1140
 PIXEL: 3321/1141
 PIXEL: 3322/1142

C06-00

PIXEL: 1200/2978
 PIXEL: 3058/1258
 PIXEL: 3074/1342
 PIXEL: 3320/3761
 PIXEL: 3523/2267
 PIXEL: 6371/1843
 PIXEL: 234/ 708
 PIXEL: 511/2996
 PIXEL: 955/3148
 PIXEL: 2679/ 916
 PIXEL: 2982/2592
 PIXEL: 3690/ 795
 PIXEL: 5452/ 648
 PIXEL: 5629/3097
 PIXEL: 5632/ 72
 PIXEL: 6301/2281
 PIXEL: 6344/4474
 PIXEL: 6671/4307
 PIXEL: 234/ 708
 PIXEL: 5632/ 72
 PIXEL: 6671/4307
 PIXEL: 2982/2592

C07-00

PIXEL: 135/3620
 PIXEL: 1485/ 632
 PIXEL: 1997/1876
 PIXEL: 2696/ 870
 PIXEL: 3213/1637
 PIXEL: 3512/ 912
 PIXEL: 4139/1062
 PIXEL: 4756/1220
 PIXEL: 4955/3815
 PIXEL: 4997/2907
 PIXEL: 5389/2864
 PIXEL: 5731/1918
 PIXEL: 5782/2428
 PIXEL: 147/ 14
 PIXEL: 369/ 739
 PIXEL: 950/ 174
 PIXEL: 950/ 184
 PIXEL: 950/ 248
 PIXEL: 950/ 331
 PIXEL: 952/ 12
 PIXEL: 952/ 75
 PIXEL: 952/ 185
 PIXEL: 952/ 671
 PIXEL: 952/ 741
 PIXEL: 952/ 758
 PIXEL: 952/4468
 PIXEL: 953/ 534
 PIXEL: 953/ 575

UltraCamEagle, Serial Number UC-Eagle-1-50617043

PIXEL: 953/ 682
 PIXEL: 953/ 780
 PIXEL: 953/1142
 PIXEL: 953/4181
 PIXEL: 953/4573
 PIXEL: 954/ 520
 PIXEL: 954/1127
 PIXEL: 954/3001
 PIXEL: 954/3639
 PIXEL: 954/3993
 PIXEL: 954/4053
 PIXEL: 954/4075
 PIXEL: 954/4255
 PIXEL: 954/4390
 PIXEL: 954/4573
 PIXEL: 954/4620
 PIXEL: 955/ 785
 PIXEL: 955/3926
 PIXEL: 955/4031
 PIXEL: 955/4061
 PIXEL: 955/4246
 PIXEL: 955/4573
 PIXEL: 955/4590
 PIXEL: 956/3636
 PIXEL: 956/3926
 PIXEL: 956/4257
 PIXEL: 956/4429
 PIXEL: 956/4553
 PIXEL: 957/3987
 PIXEL: 2162/1280
 PIXEL: 2573/3337
 PIXEL: 3549/4336
 PIXEL: 3550/4335
 PIXEL: 3550/4336
 PIXEL: 3550/4337
 PIXEL: 3551/4336
 PIXEL: 6650/1088
 PIXEL: 6664/4007
 PIXEL: 6914/1950
 PIXEL: 6923/ 811
 PIXEL: 6953/1297
 PIXEL: 955/4573
 PIXEL: 953/4573
 PIXEL: 955/4590
 PIXEL: 954/4620
 PIXEL: 956/4553
 PIXEL: 147/ 14
 PIXEL: 950/ 184
 PIXEL: 952/ 185
 PIXEL: 950/ 174
 PIXEL: 950/ 248
 PIXEL: 950/ 331
 PIXEL: 953/ 682
 PIXEL: 952/ 671
 PIXEL: 952/ 741
 PIXEL: 955/ 785
 PIXEL: 953/ 780
 PIXEL: 952/ 758
 PIXEL: 952/4468
 PIXEL: 956/4429
 PIXEL: 3550/4335
 PIXEL: 3550/4337
 PIXEL: 6664/4007

UltraCamEagle, Serial Number UC-Eagle-1-50617043

PIXEL: 6953/1297
PIXEL: 6923/ 811
PIXEL: 6914/1950
PIXEL: 6650/1088
PIXEL: 2162/1280
PIXEL: 956/3926
PIXEL: 957/3987
PIXEL: 955/4031
PIXEL: 954/4053
PIXEL: 955/4061
PIXEL: 954/4075

Notes

COLUMN anomaly: all pixels below the Qmax detector at location (X,Y) may be affected.

PIXEL anomaly: single detector at location (X,Y) is not functioning within normal range

The Level0 coordinates exclude the two leftmost pixels containing the line index: the corresponding pixel can therefore be located at column (X+2,Y).

Explanations:

Calibration Method:

The radiometric calibration is based on a series of 50 flat field images for each aperture size and sensor. The flat field is illuminated by eight normal light lamps with known spectral illumination curves.

These images are used to calculate the specific sensitivity of each pixel to compensate local as well as global variations in sensitivity. Sensitivity tables are calculated for each sensor and aperture setting, and applied during post processing from level 0 to level 1.

Outlier Pixels that do not have a linear behavior as described in the CCD specifications are marked as defective during the calibration procedure. These pixels are not used or only partially used during post processing and the information is restored by interpolation between the neighborhood pixels surrounding the defective pixels.

Certain pixels that are named Qmax pixels due to the fact that they can only store and transfer charge up to a certain maximum amount are detected in an additional calibration step. These pixels are treated differently during post processing, since their behavior can affect not only single pixel values but whole columns.

Calibration Report

Shutter Calibration



Camera:	UltraCam Eagle, S/N UC-Eagle-1-50617043
Manufacturer:	Vexcel Imaging GmbH, A-8010 Graz, Austria
Panchromatic Camera:	4 * Prontor Magnetic 0 Prontor-Werk Alfred Gauthier GmbH, Germany
Multispectral Camera:	4 * Prontor Magnetic 0 Prontor-Werk Alfred Gauthier GmbH, Germany
Date of Calibration:	Sep 09 2014
Date of Report:	Jul 27 2016
Camera Revision:	8.0
Revision of Report:	8.0

Calibration of Shutter Release Times:

The shutter release times measured during the calibration describe the time from the moment when the electrical current through the shutter is turned off by the electronics, until the shutter is mechanically closed.

This time is relevant for the exposure control and needs to be known before image recording can take place.

Cone Number	Lens Serial Number	SRT F5.6 [ms]	SRT F6.7 [ms]	SRT F8 [ms]	SRT F9.5 [ms]	SRT F11 [ms]	SRT F13 [ms]	SRT F16 [ms]	SRT F22 [ms]	Measurement Tolerance [ms]
C0 (Pan 4CCD)	12 05 85 35	11.0	11.3	11.8	12.3	12.5	12.7	12.8	13.2	+/- 0.2
C1 (Pan 2CCD V)	12 05 85 31	9.9	10.2	10.6	10.9	11.1	11.4	11.5	11.8	+/- 0.2
C2 (Pan 2CCD H)	12 05 85 28	10.5	10.8	11.2	11.5	11.8	12.0	12.2	12.5	+/- 0.2
C3 (Pan Central)	12 05 85 27	9.7	10.1	10.6	10.9	11.2	11.3	11.5	11.9	+/- 0.2
C4 (Red)	12 08 78 31	12.5	12.6	12.8	13.1	13.1	13.3	13.4	13.5	+/- 0.2
C5 (Green)	12 06 00 72	13.4	13.7	13.8	14.1	14.1	14.2	14.4	14.5	+/- 0.2
C6 (Blue)	12 08 78 35	11.6	11.6	11.6	11.7	12.0	12.3	12.3	12.6	+/- 0.2
C7 (NIR)	12 06 00 75	12.2	12.6	12.8	12.9	12.9	13.0	13.1	13.3	+/- 0.2

Calibration Report

Electronics and Sensor Calibration



Camera:	UltraCam Eagle, S/N UC-Eagle-1-50617043
Manufacturer:	Vexcel Imaging GmbH, A-8010 Graz, Austria
Panchromatic Camera:	9 * FTF7040-M Area CCD Sensor by DALSA
Multispectral Camera:	4 * FTF7040-M Area CCD Sensor by DALSA
Date of Calibration:	Sep 09 2014
Date of Report:	Jul 27 2016
Camera Revision:	8.0
Revision of Report:	8.0

Calibration of Negative Substrate Voltage (VNS):

For optimum performance of the DALSA CCD sensors, the negative substrate voltage is adjusted to a value specified by DALSA.

This voltage value is measured to achieve the best anti-blooming performance possible for each particular sensor.

Cone_Sensor	Sensor Type	Sensor Serial Number	VNS Voltage [V]
00_00	FTF7046-M	148611/009	25.00
00_01	FTF7046-M	146698/059	24.20
00_02	FTF7046-M	148493/023	26.60
00_03	FTF7046-M	148493/022	24.20
01_00	FTF7046-M	146857/011	24.20
01_01	FTF7046-M	146858/010	24.20
02_00	FTF7046-M	146857/017	24.20
02_01	FTF7046-M	146858/012	24.20
03_00	FTF7046-M	146857/003	25.00
04_00 (red)	FTF7046-M	146858/007	24.40
05_00 (green)	FTF7046-M	146858/008	24.20
06_00 (blue)	FTF7046-M	146857/004	24.20
07_00 (NIR)	FTF7046-M	146857/001	25.20

Calibration of Intensity Threshold for Exposure Control:

Each CCD sensor and electronics module varies slightly in global sensitivity and intensity scale.

Therefore the maximum possible intensity of each sensor needs to be measured to evaluate the sensitivity behavior of the CCD and electronics.

This value is used as a threshold for the exposure control dialogue shown in the in-flight user interface of the Eagle.

Cone_Sensor	Sensor Type	Sensor Serial Number	Intensity Threshold [DN]
00_00	FTF7046-M	148611/009	13280
00_01	FTF7046-M	146698/059	13370
00_02	FTF7046-M	148493/023	13190
00_03	FTF7046-M	148493/022	13890
01_00	FTF7046-M	146857/011	13320
01_01	FTF7046-M	146858/010	13060
02_00	FTF7046-M	146857/017	13880
02_01	FTF7046-M	146858/012	13690
03_00	FTF7046-M	146857/003	12770
04_00 (red)	FTF7046-M	146858/007	13480
05_00 (green)	FTF7046-M	146858/008	13730
06_00 (blue)	FTF7046-M	146857/004	13740
07_00 (NIR)	FTF7046-M	146857/001	13060

Calibration Report

Summary



Camera: UltraCam Eagle, S/N UC-Eagle-1-50617043

Manufacturer: Vexcel Imaging GmbH, A-8010 Graz,
Austria

Date of Calibration: Sep 09 2014

Date of Report: Jul 27 2016

Camera Revision: 8.0

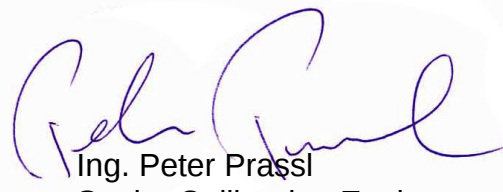
Revision of Report: 8.0

The following calibrations have been performed for the above mentioned digital aerial mapping camera:

- Geometric Calibration
- Verification of Lens Quality and Sensor Adjustment
- Radiometric Calibration
- Calibration of Defective Pixel Elements
- Shutter Calibration
- Sensor and Electronics Calibration

This equipment is operating fully within specification as defined by Vexcel Imaging GmbH.


Dr. Michael Gruber
Chief Scientist, Photogrammetry
Vexcel Imaging GmbH


Ing. Peter Prassl
Senior Calibration Engineer
Vexcel Imaging GmbH

Appendix B

Flight Logs

There was one total lift. Flight logs are shown on the following pages.

Jun 28, 2017-A (N87WS, SN50617043)	2
Flight Log.....	3

Jun 28, 2017-A (N87WS, SN50617043)

Flight Log

[illegible]

Appendix C

Survey Report



August 13, 2017

Survey Report of
Ortho Control & Check Points

USGS Contract: G16PC00016

CT_Long Island Sound Coastal
Ortho_2017_D17

USGS Task Order: G17PD00636

Presented to:



Presented By:





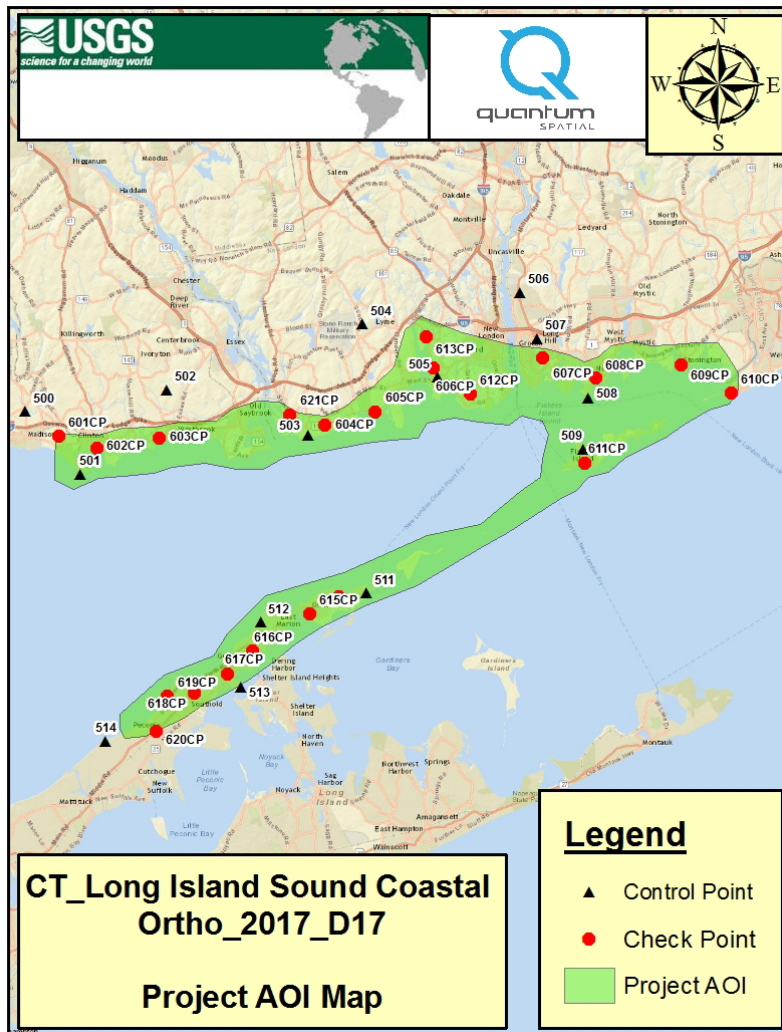
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• <i>Control Points.....</i>	<i>4</i>
• <i>Check Points.....</i>	<i>5</i>
<i>Point Location & Accuracy Data Sheets.....</i>	<i>6</i>
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Summary

Quantum Spatial, Inc. was contracted by USGS under task order G17PD00636 to survey photo identifiable control and quality control points in support of CT_Long Island Sound Coastal Ortho_2017_D17. This is the report of the technical approach used and detail of each point surveyed.



Date Range: July 11, 2017 – July 14, 2017

Equipment Used:

Field crews used Trimble R8 dual frequency GNSS receivers.



GNSS Methodology:

The RTK GPS survey procedure involved placing a GPS receiver on a control/check point and collecting three minute observations. RTK GPS corrected observations were provided from a Virtual Reference Station System (VRS network – KeyNetGPS, Inc.). KeyNetGPS is a series of continuously operating, high precision GNSS reference stations working through a cellular modem. A minimum of two observations were taken at each check point and the two coordinates were compared and averaged. Published control check points were also located with RTK methods.

A data log sheet was filled out on each occupation. In addition, Quantum Spatial captured four (4) photographs of each control/check point. A copy of the log data sheets with photographs is located in Section III of this report.

All of the GPS information was downloaded, processed and analyzed using Trimble Business Center processing software.

The following table provides results of NGS horizontal and vertical control monument checks. These results serve as the basis for validating the GNSS derived positions.

PID	Averaged Position (m)			Published Position (m)			Difference (NGS minus QSI)		
	Northing	Easting	Elev.	Northing	Easting	Elev.	Northing	Easting	Elev.
LX0452	200814.787	317426.070	2.078	200814.790	317426.056	2.147	0.003	-0.014	0.069
LW0720	210129.714	370951.464	3.278	n/a	n/a	3.316	n/a	n/a	0.038
						Min	0.003	-0.014	0.038
						Max	0.003	-0.014	0.069
						Mean	0.003	-0.014	0.053

Fourteen control points (500 – 514) and twenty-one check points (601CP – 621CP) were surveyed. The control points were incorporated into the production of the ortho images. The check points were not used in production and delivered to the client for quality control purposes.

All point coordinates have been reported in the North American Datum of 1983 (NAD83 2011). Points are projected in Connecticut State Plane coordinates in meters. All elevations are relative to the North American Vertical Datum of 1988 (NAVD 88) which were derived using the Geoid 12B model and are reported in meters.



Final Point Coordinates
Connecticut State Plane - Meters

*Control Point Coordinates*

Horizontal Datum - NAD83(2011)
CONNECTICUT STATE PLANE
Vertical Datum - NAVD 88
Geoid - GEOID12B
Units – Meters

Point ID	Northing (m)	Easting (m)	Elev. (m)
500	204382.343	317086.554	30.024
501	198803.505	321962.205	1.778
502	206299.601	329615.721	62.796
503	202220.794	342190.953	2.868
504	212105.300	346950.311	73.546
505	207392.052	353586.381	31.363
506	214929.637	360912.387	23.543
507	210833.324	362454.545	40.080
508	205509.883	366994.691	1.127
509	201054.142	366479.463	4.280
511	188281.646	347310.029	1.125
512	185686.217	337945.863	13.953
513	179938.535	336228.001	1.217
514	175132.490	324174.272	3.128

*Check Point Coordinates*

Horizontal Datum - NAD83(2011)
CONNECTICUT STATE PLANE
Vertical Datum - NAVD 88
Geoid - GEOID12B
Units – Meters

Point ID	Northing (m)	Easting (m)	Elev. (m)
601CP	202162.642	320066.461	15.470
602CP	201146.483	323443.781	4.415
603CP	201973.253	329022.023	2.590
604CP	203158.023	343704.015	5.966
605CP	204332.307	348134.410	9.873
606CP	208259.604	353286.221	7.441
607CP	209080.675	363008.896	6.576
608CP	207341.873	367637.096	18.121
609CP	208471.958	375204.728	1.795
610CP	205952.149	379646.403	0.720
611CP	199787.819	366742.088	15.999
612CP	205871.456	356534.019	25.183
613CP	210998.253	352637.398	9.731
614CP	187927.627	344943.711	3.029
615CP	186425.696	342288.858	3.390
616CP	183113.231	337282.740	2.827
617CP	181097.816	335055.550	2.371
618CP	179430.805	332130.850	9.524
619CP	179094.218	329721.031	1.953
620CP	176033.088	328711.392	9.951
621CP	204064.321	340590.164	5.364



Point Data and Accuracy Log Sheets



Control Point Log Sheets



Point ID	500
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New Haven
Quad	Clinton

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
204382.343	317086.554	30.024

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-11-17
RMSE Hz	0.031
RMSE Z	0.040
GPS Method	KEYNET VRS

PHOTOS:





Point ID	501
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New Haven
Quad	Clinton

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
198803.505	321962.205	1.778

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-11-17
RMSE Hz	0.022
RMSE Z	0.034
GPS Method	KEYNET VRS

PHOTOS:





Point ID	502
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	Middlesex
Quad	Essex

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
206299.601	329615.721	62.796

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-11-17
RMSE Hz	0.025
RMSE Z	0.026
GPS Method	KEYNET VRS

PHOTOS:





Point ID	503
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Old Lyme

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
202220.794	342190.953	2.868

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.019
RMSE Z	0.022
GPS Method	KEYNET VRS

PHOTOS:





Point ID	504
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Niantic

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
212105.300	346950.311	73.546

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.015
RMSE Z	0.020
GPS Method	KEYNET VRS

PHOTOS:





Point ID	505
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Niantic

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
207392.052	353586.381	31.363

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.016
RMSE Z	0.020
GPS Method	KEYNET VRS

PHOTOS:





Point ID	506
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Uncasville

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
214929.637	360912.387	23.543

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.013
RMSE Z	0.022
GPS Method	KEYNET VRS

PHOTOS:





Point ID	507
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	New London

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
210833.324	362454.545	40.080

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.015
RMSE Z	0.023
GPS Method	KEYNET VRS

PHOTOS:





Point ID	508
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	New London

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
205509.883	366994.691	1.127

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.015
RMSE Z	0.019
GPS Method	KEYNET VRS

PHOTOS:





Point ID	509
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	New London

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
201054.142	366479.463	4.280

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-14-17
RMSE Hz	0.018
RMSE Z	0.029
GPS Method	KEYNET VRS

PHOTOS:





Point ID	511
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Plum Island

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
188281.646	347310.029	1.125

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.019
RMSE Z	0.023
GPS Method	KEYNET VRS

PHOTOS:





Point ID	512
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Orient

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

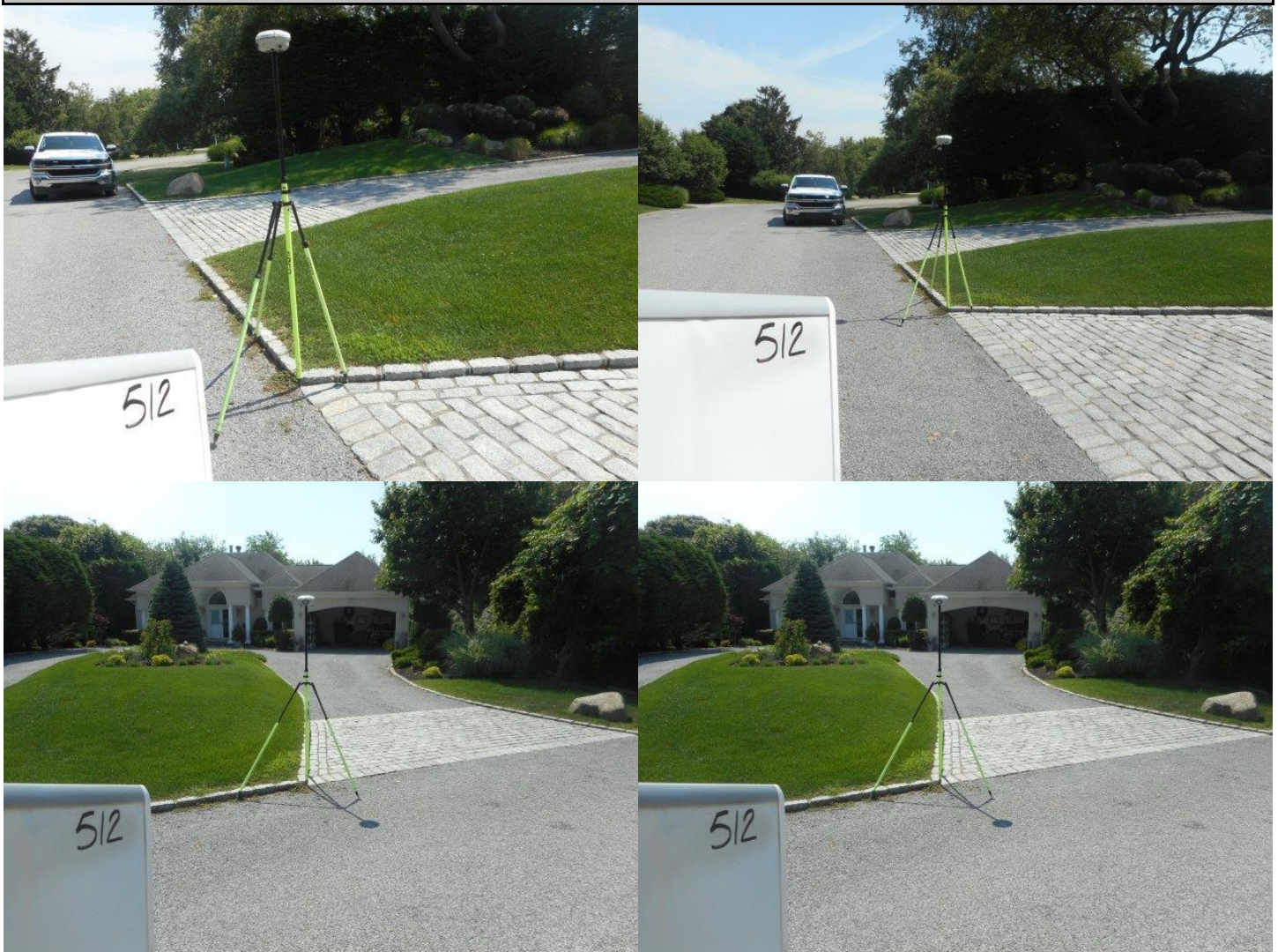
Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
185686.217	337945.863	13.953

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.019
RMSE Z	0.029
GPS Method	KEYNET VRS

PHOTOS:





Point ID	513
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Southold

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
179938.535	336228.001	1.217

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.018
RMSE Z	0.030
GPS Method	KEYNET VRS

PHOTOS:





Point ID	514
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Mattiuck Hills

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

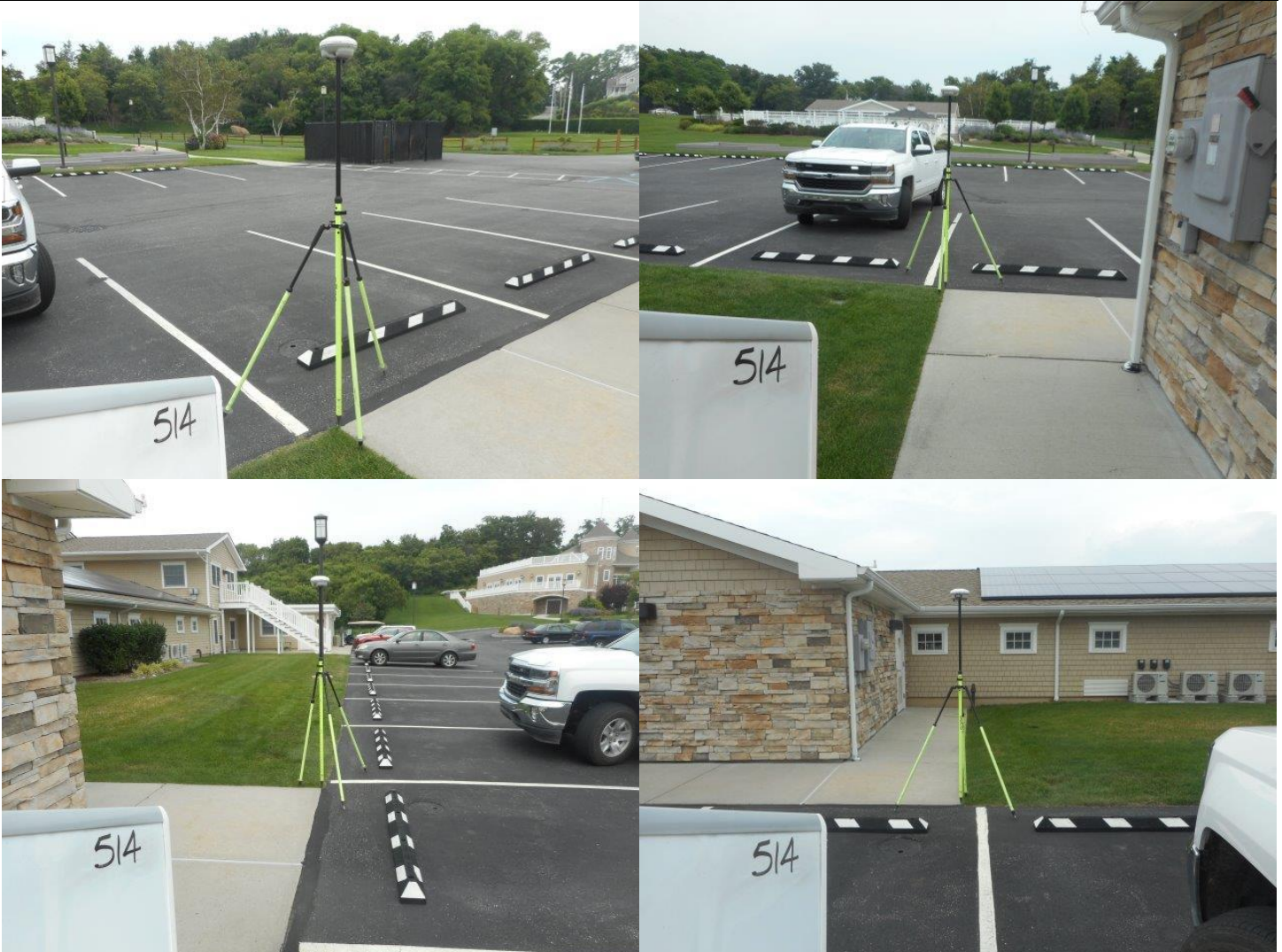
Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
175132.490	324174.272	3.128

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.018
RMSE Z	0.020
GPS Method	KEYNET VRS

PHOTOS:





Check Point Log Sheets



Point ID	601CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New Haven
Quad	Clinton

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
202162.642	320066.461	15.470

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-11-17
RMSE Hz	0.028
RMSE Z	0.038
GPS Method	KEYNET VRS

PHOTOS:





Point ID	602CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	Middlesex
Quad	Clinton

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
201146.483	323443.781	4.415

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-11-17
RMSE Hz	0.018
RMSE Z	0.020
GPS Method	KEYNET VRS

PHOTOS:





Point ID	603CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Middlesex
Quad	Essex

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
201973.253	329022.023	2.590

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-11-17
RMSE Hz	0.026
RMSE Z	0.024
GPS Method	KEYNET VRS

PHOTOS:





Point ID	604CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Old Lyme

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
203158.023	343704.015	5.966

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.019
RMSE Z	0.025
GPS Method	KEYNET VRS

PHOTOS:





Point ID	605CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Niantic

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
204332.307	348134.410	9.873

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.018
RMSE Z	0.027
GPS Method	KEYNET VRS

PHOTOS:





Point ID	606CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Niantic

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
208259.604	353286.221	7.441

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.016
RMSE Z	0.024
GPS Method	KEYNET VRS

PHOTOS:





Point ID	607CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	New London

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
209080.675	363008.896	6.576

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.013
RMSE Z	0.018
GPS Method	KEYNET VRS

PHOTOS:





Point ID	608CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Mystic

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
207341.873	367637.096	18.121

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.016
RMSE Z	0.018
GPS Method	KEYNET VRS

PHOTOS:





Point ID	609CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Mystic

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
208471.958	375204.728	1.795

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.016
RMSE Z	0.023
GPS Method	KEYNET VRS

PHOTOS:





Point ID	610CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Rhode Island
County	Washington
Quad	Watch Hill

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
X	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
205952.149	379646.403	0.720

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.015
RMSE Z	0.027
GPS Method	KEYNET VRS

PHOTOS:





Point ID	611CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	New London

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
199787.819	366742.088	15.999

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-14-17
RMSE Hz	0.017
RMSE Z	0.032
GPS Method	KEYNET VRS

PHOTOS:





Point ID	612CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Niantic

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
205871.456	356534.019	25.183

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.017
RMSE Z	0.020
GPS Method	KEYNET VRS

PHOTOS:





Point ID	613CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Niantic

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
210998.253	352637.398	9.731

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.016
RMSE Z	0.019
GPS Method	KEYNET VRS

PHOTOS:





Point ID	614CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Orient

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
187927.627	344943.711	3.029

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.019
RMSE Z	0.023
GPS Method	KEYNET VRS

PHOTOS:





Point ID	615CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Orient

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
186425.696	342288.858	3.390

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.022
RMSE Z	0.030
GPS Method	KEYNET VRS

PHOTOS:





Point ID	616CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Greenport

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
183113.231	337282.740	2.827

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.019
RMSE Z	0.030
GPS Method	KEYNET VRS

PHOTOS:





Point ID	617CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Southold

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
181097.816	335055.550	2.371

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.019
RMSE Z	0.029
GPS Method	KEYNET VRS

PHOTOS:





Point ID	618CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Southold

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
179430.805	332130.850	9.524

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.019
RMSE Z	0.027
GPS Method	KEYNET VRS

PHOTOS:





Point ID	619CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Southold

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
179094.218	329721.031	1.953

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.020
RMSE Z	0.024
GPS Method	KEYNET VRS

PHOTOS:





Point ID	620CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	New York
County	Suffolk
Quad	Southold

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
176033.088	328711.392	9.951

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-13-17
RMSE Hz	0.020
RMSE Z	0.024
GPS Method	KEYNET VRS

PHOTOS:





Point ID	621CP
Project No.	30398
Project Name	Long Island Sound Coastal
State	Connecticut
County	New London
Quad	Old Lyme

	Aerial Target
	LiDAR Ground Control
	LiDAR QC Point
	New Control
x	Photo ID
	Published Control

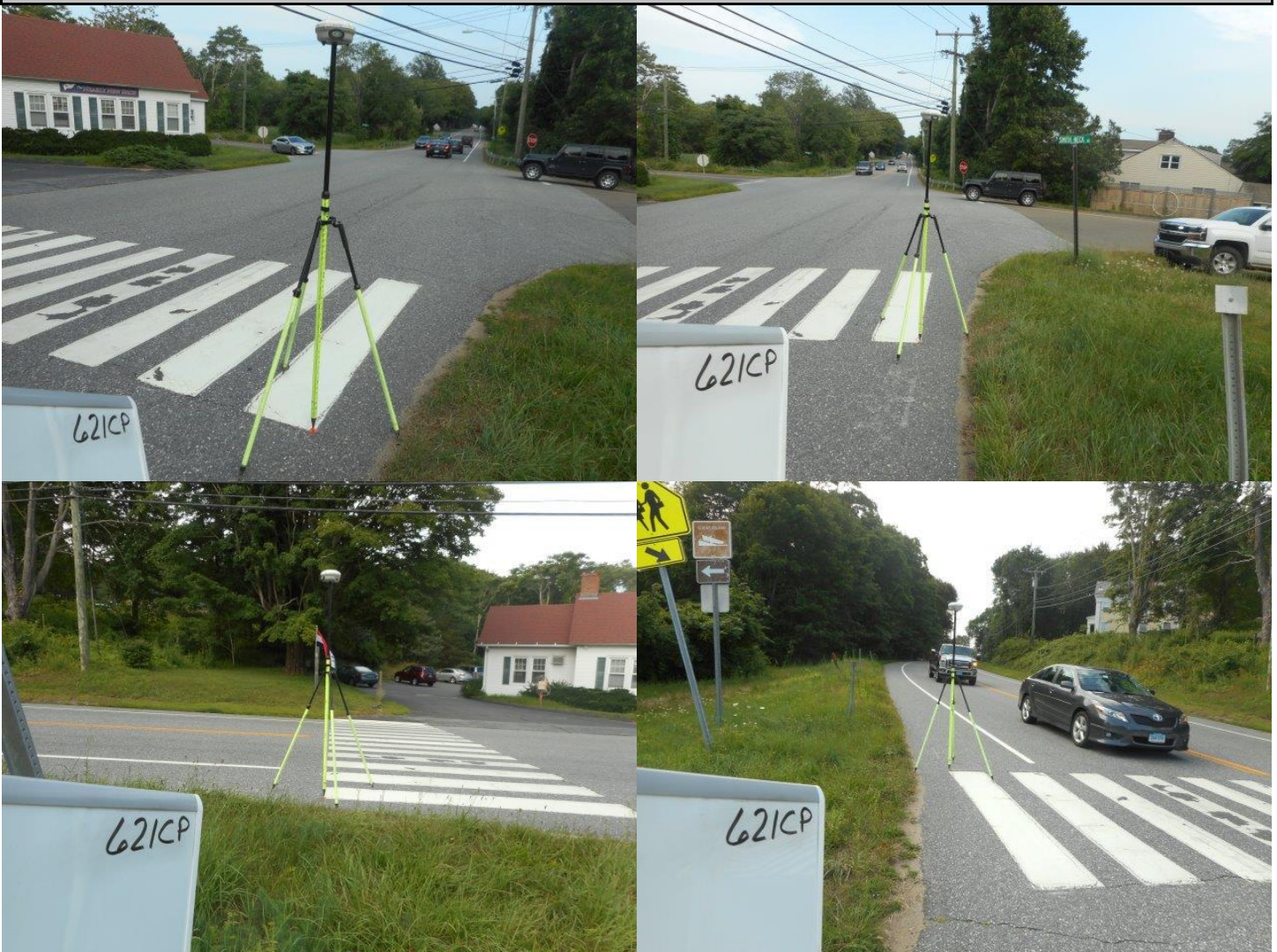
Coordinate System
NAD83(2011)
CT SPCS 0600 –ZONE
NAVD88
GEOID12B
Meters

Northing	Easting	Elevation
204064.321	340590.164	5.364

Operator	Kenny Roberts
Receiver Model	Trimble R8 4
Receiver S/N	5407454087
Antenna Height	2.000 Meters

Date (MM-DD-YYYY)	7-12-17
RMSE Hz	0.020
RMSE Z	0.023
GPS Method	KEYNET VRS

PHOTOS:





NGS Data Sheets

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.2

1 National Geodetic Survey, Retrieval Date = AUGUST 11, 2017

LW0720 *****

LW0720 DESIGNATION - Y 37

LW0720 PID - LW0720

LW0720 STATE/COUNTY- CT/NEW LONDON

LW0720 COUNTRY - US

LW0720 USGS QUAD - MYSTIC (1984)

LW0720

LW0720 *CURRENT SURVEY CONTROL

LW0720

LW0720* NAD 83(1986) POSITION- 41 21 01.6 (N) 071 57 34.3 (W) HD_HELD2

LW0720* [NAVD 88](#) ORTHO HEIGHT - 3.316 (meters) 10.88 (feet) ADJUSTED

LW0720

LW0720 GEOID HEIGHT - -30.618 (meters) GEOID12B

LW0720 DYNAMIC HEIGHT - 3.315 (meters) 10.88 (feet) COMP

LW0720 MODELED GRAVITY - 980,273.3 (mgal) NAVD 88

LW0720

LW0720 VERT ORDER - FIRST CLASS I

LW0720

LW0720.The horizontal coordinates were established by autonomous hand held GPS

LW0720.observations and have an estimated accuracy of +/- 10 meters.

LW0720.

LW0720.The orthometric height was determined by differential leveling and

LW0720.adjusted by the NATIONAL GEODETIC SURVEY

LW0720.in June 1991.

LW0720

LW0720.Significant digits in the geoid height do not necessarily reflect accuracy.

LW0720.GEOID12B height accuracy estimate available [here](#).

LW0720

LW0720.[Photographs](#) are available for this station.

LW0720

LW0720.The dynamic height is computed by dividing the NAVD 88

LW0720.geopotential number by the normal gravity value computed on the

LW0720.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45

LW0720.degrees latitude (g = 980.6199 gals.).

LW0720

LW0720.The modeled gravity was interpolated from observed gravity values.

LW0720

	North	East	Units	Estimated Accuracy
LW0720;				
LW0720;SPC CT	- 210,132.	370,952.	MT	(+/- 10 meters HH2 GPS)

LW0720

LW0720_U.S. NATIONAL GRID SPATIAL ADDRESS: 19TBF5240781887(NAD 83)

LW0720

LW0720 SUPERSEDED SURVEY CONTROL

LW0720

LW0720 NGVD 29 (??/??/92) 3.607 (m) 11.83 (f) ADJ UNCH 1 1

LW0720

LW0720.Superseded values are not recommended for survey control.

LW0720

LW0720.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.

LW0720.See file [dsdata.pdf](#) to determine how the superseded data were derived.

LW0720

LW0720_MARKER: DB = BENCH MARK DISK

LW0720_SETTING: 66 = SET IN ROCK OUTCROP

LW0720_STAMPING: Y 37 1965

LW0720_STABILITY: A = MOST RELIABLE AND EXPECTED TO HOLD
LW0720+STABILITY: POSITION/ELEVATION WELL
LW0720_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
LW0720+SATELLITE: SATELLITE OBSERVATIONS - September 28, 2008

LW0720

LW0720	HISTORY	- Date	Condition	Report By
LW0720	HISTORY	- 1965	MONUMENTED	CGS
LW0720	HISTORY	- 1984	GOOD	USPSQD
LW0720	HISTORY	- 1988	GOOD	USPSQD
LW0720	HISTORY	- 20000110	GOOD	USPSQD
LW0720	HISTORY	- 20080928	GOOD	GEOCAC

LW0720

LW0720 STATION DESCRIPTION

LW0720

LW0720'DESCRIBED BY COAST AND GEODETIC SURVEY 1965

LW0720'0.5 MI SE FROM MYSTIC.

LW0720'0.5 MILE SOUTHEAST ALONG U.S. HIGHWAY 1 FROM THE POST OFFICE

LW0720'AT MYSTIC, NEAR THE ENTRANCE TO THE MYSTIC MOTOR INN, ACROSS

LW0720'THE HIGHWAY FROM THE EAST CORNER OF A CEMETERY, SET ON THE TOP

LW0720'OF A LARGE MASS OF EXPOSED BEDROCK, 73 FEET NORTHEAST OF THE

LW0720'CENTER LINE OF THE HIGHWAY, 111 FEET NORTH OF AND ACROSS A

LW0720'DRIVEWAY FROM THE NORTHWEST END OF THE NORTHEAST IRON GUARD RAIL

LW0720'FOR BRIDGE OVER PEQUOSEPOS BROOK, 22.5 FEET NORTHWEST OF THE

LW0720'NORTHWEST CURB OF ENTRANCE TO MYSTIC MOTOR INN, AND ABOUT 2 FEET

LW0720'ABOVE THE LEVEL OF THE HIGHWAY.

LW0720

LW0720 STATION RECOVERY (1984)

LW0720

LW0720'RECOVERY NOTE BY US POWER SQUADRON 1984

LW0720'RECOVERED IN GOOD CONDITION.

LW0720

LW0720 STATION RECOVERY (1988)

LW0720

LW0720'RECOVERY NOTE BY US POWER SQUADRON 1988 (AFA)

LW0720'RECOVERED IN GOOD CONDITION.

LW0720

LW0720 STATION RECOVERY (2000)

LW0720

LW0720'RECOVERY NOTE BY US POWER SQUADRON 2000

LW0720'RECOVERED IN GOOD CONDITION.

LW0720

LW0720 STATION RECOVERY (2008)

LW0720

LW0720'RECOVERY NOTE BY GEOCACHING 2008 (RLM)

LW0720'RECOVERED IN GOOD CONDITION.

*** retrieval complete.

Elapsed Time = 00:00:01

The NGS Data Sheet

See file [dsdata.pdf](#) for more information about the datasheet.

PROGRAM = datasheet95, VERSION = 8.12.2

1 National Geodetic Survey, Retrieval Date = AUGUST 11, 2017

LX0452 *****

LX0452 CBN - This is a Cooperative Base Network Control Station.

LX0452 TIDAL BM - This is a Tidal Bench Mark.

LX0452 DESIGNATION - P 36

LX0452 PID - LX0452

LX0452 STATE/COUNTY- CT/NEW HAVEN

LX0452 COUNTRY - US

LX0452 USGS QUAD - CLINTON (1984)

LX0452

LX0452 *CURRENT SURVEY CONTROL

LX0452

LX0452*	NAD 83(2011) POSITION-	41 16 09.03394(N) 072 35 57.56238(W)	ADJUSTED
LX0452*	NAD 83(2011) ELLIP HT-	-28.085 (meters) (06/27/12)	ADJUSTED
LX0452*	NAD 83(2011) EPOCH	- 2010.00	
LX0452*	NAVD 88 ORTHO HEIGHT	- 2.147 (meters) 7.04 (feet)	ADJUSTED

LX0452

LX0452	GEOID HEIGHT	- -30.237 (meters)	GEOID12B
LX0452	NAD 83(2011) X	- 1,435,720.549 (meters)	COMP
LX0452	NAD 83(2011) Y	- -4,581,200.114 (meters)	COMP
LX0452	NAD 83(2011) Z	- 4,184,919.629 (meters)	COMP
LX0452	LAPLACE CORR	- -2.68 (seconds)	DEFLEC12B
LX0452	DYNAMIC HEIGHT	- 2.146 (meters) 7.04 (feet)	COMP
LX0452	MODELED GRAVITY	- 980,290.7 (mgal)	NAVD 88

LX0452

LX0452 VERT ORDER - FIRST CLASS I

LX0452

LX0452 Network accuracy estimates per FGDC Geospatial Positioning Accuracy Standards:

LX0452	FGDC (95% conf, cm)	Standard deviation (cm)	CorrNE
LX0452	Horiz Ellip	SD_N SD_E SD_h	(unitless)
LX0452	-----	-----	-----
LX0452	NETWORK 0.33 0.51	0.15 0.11 0.26	-0.18612006
LX0452	-----	-----	-----

LX0452 Click [here](#) for local accuracies and other accuracy information.

LX0452

LX0452

LX0452.The horizontal coordinates were established by GPS observations

LX0452.and adjusted by the National Geodetic Survey in June 2012.

LX0452

LX0452.NAD 83(2011) refers to NAD 83 coordinates where the reference frame has

LX0452.been affixed to the stable North American tectonic plate. See

LX0452.[NA2011](#) for more information.

LX0452

LX0452.The horizontal coordinates are valid at the epoch date displayed above

LX0452.which is a decimal equivalence of Year/Month/Day.

LX0452

LX0452.The orthometric height was determined by differential leveling and

LX0452.adjusted by the NATIONAL GEODETIC SURVEY

LX0452.in June 1991.

LX0452

LX0452.Significant digits in the geoid height do not necessarily reflect accuracy.

LX0452.GEOID12B height accuracy estimate available [here](#).

LX0452

LX0452.This Tidal Bench Mark is designated as VM 2253

LX0452

LX0452

STATION DESCRIPTION

LX0452

LX0452'DESCRIBED BY COAST AND GEODETIC SURVEY 1965

LX0452'1 MI SW FROM MADISON.

LX0452'0.3 MILE WEST ALONG U.S. HIGHWAY 1 FROM THE POST OFFICE AT

LX0452'MADISON, THENCE 0.7 MILE SOUTH ALONG ISLAND AVENUE, ABOUT 0.1

LX0452'MILE EAST OF THE MADISON BEACH CLUB AT MIDDLE BEACH, AT THE

LX0452'JUNCTION OF A STREET LEADING NORTH, 37 FEET SOUTH OF THE CENTER

LX0452'OF STREET JUNCTION, 11 FEET WEST OF THE EXTENDED CENTER LINE OF

LX0452'STREET LEADING NORTH, SET ON THE TOP OF THE NORTH END OF A 2-FOOT

LX0452'WIDE CONCRETE WALL WHICH PROJECTS OUT TO THE NORTH FROM A SEA

LX0452'WALL, 1.2 FEET SOUTH OF THE NORTH END OF THE WALL AND 2 FEET

LX0452'ABOVE THE LEVEL OF THE STREET.

LX0452

LX0452

STATION RECOVERY (2000)

LX0452

LX0452'RECOVERY NOTE BY CONNECTICUT GEODETIC SURVEY 2000 (RB)

LX0452'0.3 MILE WEST ALONG U. S. HIGHWAY 1 FROM THE POST OFFICE AT

LX0452'MADISON, THENCE 0.7 MILE SOUTH ALONG ISLAND AVENUE, ABOUT 0.1 MILE

LX0452'EAST OF THE MADISON BEACH CLUB AT MIDDLE BEACH, AT THE JUNCTION OF

LX0452'A STREET LEADING NORTH, 37 FEET SOUTH OF THE CENTER OF STREET

LX0452'JUNCTION, 11 FEET WEST OF THE EXTENDED CENTER LINE OF STREET

LX0452'LEADING NORTH, SET ON THE TOP OF THE NORTH END OF A 2-FOOT WIDE

LX0452'CONCRETE WALL WHICH PROJECTS OUT TO THE NORTH FROM A SEA WALL,

LX0452'1.2 FEET SOUTH OF THE NORTH END OF THE WALL, 2 FEET ABOVE THE LEVEL

LX0452'OF THE STREET, TIDAL STATION NO. 19, CONNECTICUT, MADISON (BEACH

LX0452'CLUB) LONG ISLAND SOUND, 24.3 FT SOUTH OF POLE NUMBER 4446.

LX0452'

LX0452'

LX0452'

LX0452

LX0452

STATION RECOVERY (2001)

LX0452

LX0452'RECOVERY NOTE BY CONNECTICUT GEODETIC SURVEY 2001 (DM)

LX0452'RECOVERED AS DESCRIBED.

LX0452'

LX0452

LX0452

STATION RECOVERY (2004)

LX0452

LX0452'RECOVERY NOTE BY WOOLPERT CONSULTANTS 2004 (CS)

LX0452'1.5 FT EAST OF A 5 FT TALL WOODEN FENCE

LX0452

LX0452

STATION RECOVERY (2005)

LX0452

LX0452'RECOVERY NOTE BY CONNECTICUT GEODETIC SURVEY 2005

LX0452'RECOVERED AS DESCRIBED IN NGS DATABASE

LX0452

LX0452

STATION RECOVERY (2007)

LX0452

LX0452'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2007 (HAS)

LX0452'RECOVERED IN GOOD CONDITION.

LX0452

LX0452

STATION RECOVERY (2009)

LX0452

LX0452'RECOVERY NOTE BY INDIVIDUAL CONTRIBUTORS 2009 (PJC)

LX0452'RECOVERED IN GOOD CONDITION.

LX0452

LX0452

STATION RECOVERY (2016)

LX0452

LX0452'RECOVERY NOTE BY CT DOT GEODETIC SURV 2016 (RB)

LX0452'RECOVERED IN GOOD CONDITION.

*** retrieval complete.

Elapsed Time = 00:00:02

Appendix D

Aerotriangulation Report

CT / Long Island

Aerial Triangulation Report

Prepared for

USGS

Photo Science, Inc. Project No. 30398

July 26, 2017

Produced By:



523 Wellington Way, Suite 375
Lexington, KY 40503

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1.0 Project Details

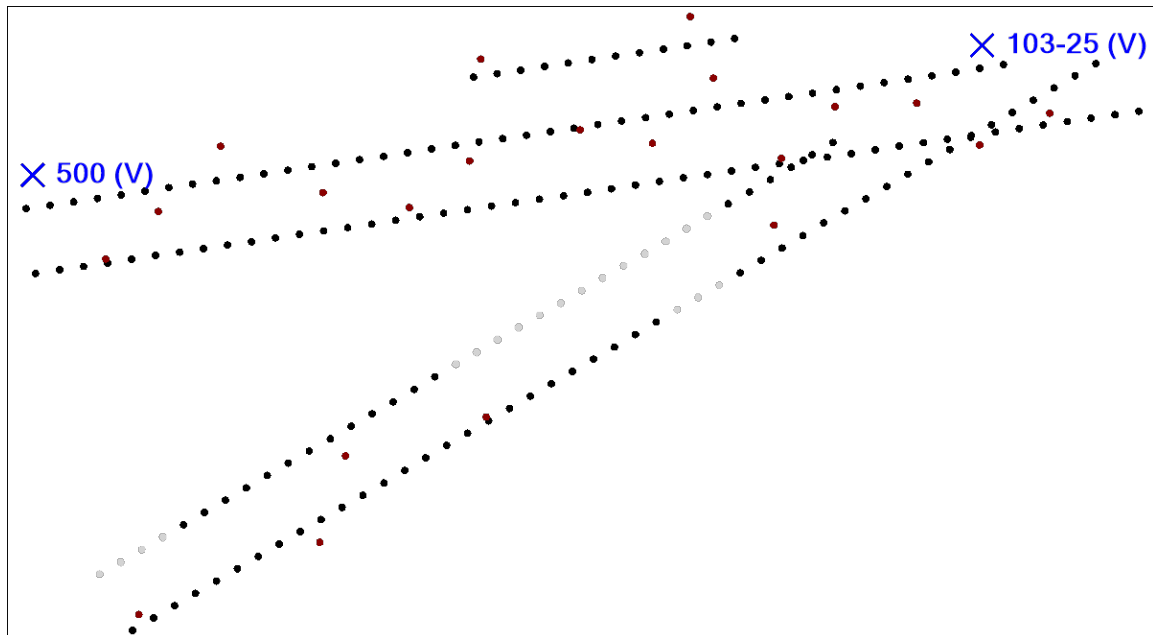
The scope of this project consists of providing color aerial photography, ground control, aerial triangulation, color digital orthos.

2.0 Aerial Photography

A total of 5 flight lines of 4Band photography, consisting of 184 stereo frame photographs, were taken at an altitude of 15,665 feet above ground level for a 1"=2,611' photo scale. The photography was obtained on June 28, 2016 using an UltraCam Eagle digital mapping camera (serial number 70914123) having a focal length of 79.80.

Following is a list of the flight lines and frames:

Flight Line Number	Frame Numbers
1	137 - 148
2	95 - 136
3	48 - 94
4	149 - 184
5	1 - 47
5 flight lines	184 frames



● Used Image | ● Un-Used Image | ● Tie-Control
X Control | X Control, Horizontal Only | X Control, Vertical Only | X Check Points

3.0 Control

The ground control was established by QSI using GPS technology. Please refer to the ground control report for more specific detail. The X, Y, Z coordinates of each photo

center is included in the final AT adjustment. A total of 23 photo identification control points were used. The location of the control points are shown on the photo center diagram.

All statistical data for the control points are given in the Aerial Triangulation section.

See attached Control_RMSE file:
30398_Control_RMSE.txt

Ground Control Points

Point ID	X	Y	Z
103-11	380197.258	206395.864	6.745
103-25	380378.684	213017.587	22.641
107-11	384873.179	208513.308	2.905
205-11	325461.395	201957.461	14.460
209-9	336437.679	203217.128	3.550
212-10	346210.245	205324.154	8.770
216-10	358391.891	206507.147	16.500
221-12	370558.092	208946.293	2.330
222-11	376007.943	209173.107	10.420
500	317086.554	204382.343	30.024
501	321962.205	198803.505	1.778
502	329615.721	206299.601	62.796
503	342190.953	202220.794	2.868
504	346950.311	212105.300	73.546
505	353586.381	207392.052	31.363
506	360912.387	214929.637	23.543
507	362454.545	210833.324	40.080
508	366994.691	205509.883	1.127
509	366479.463	201054.142	4.280
511	347310.029	188281.646	1.125
512	337945.863	185686.217	13.953
513	336228.001	179938.535	1.217
514	324174.272	175132.490	3.128

4.0 Aerial Triangulation Measurement

The measurement of the pass points, flight ties and control data was performed on Intergraph's ISAT, version 100.0, automated aerotriangulation system. Pass points were selected automatically using a sophisticated auto correlation algorithm.

All images were from the DMC mapping camera has a scan resolution of 12 microns.

5.0 Aerial Triangulation Adjustment

The adjustment of the measurements was performed using a robust aerotriangulation software package on softcopy photogrammetric workstations. The final adjustment of the block was accomplished by using a rigorous simultaneous least squares bundle adjustment. The general procedure is to remove all blunders from the data using automatic blunder detection. The bundle adjustment is then run with minimal ground control to test the photogrammetric measurements for consistency. Next, the full ground control data set, including the ABGPS data, is added to the adjustment holding the horizontal control very loose and the vertical control very tight. Since horizontal control errors can affect the vertical control but not vice-versa, we can detect errors in the vertical control. The horizontal control is then tightened and the effect on the vertical control and the photogrammetric residuals are inspected. The final adjustment makes sure that all of the measurements are in balance with each other and properly represent the actual conditions.

The following Weights, or Estimated Standard Errors, were used in the final adjustment:

Photogrammetric measurements:	<5 microns
Horizontal Control:	0.5m
Vertical Control:	0.5m
Tie Control	0.5m
IMU Control	0.05deg
ABGPS Horizontal Control	0.5m
ABGPS Vertical Control	0.5m

The Estimated Standard Errors are exactly what the name implies. This shows how close the measurements are to their actual value. The above values were chosen based upon previous experience, requested specifications, and industry standards.

6.0 Aerial Triangulation Results

The aerial triangulation results are given in three sections: airborne GPS (ABGPS), photogrammetric measurements, and ground control. The following parameters were used during the A/T data reduction:

PhotoT Triangulation Options

Adjustment Mode	: Absolute
Precision Computation	: Enabled
Error Detection	: Disabled
Camera Calibration	: Disabled
Self-Calibration	: Disabled
Given EO/GPS	: Enabled
Antenna Offsets	: Disabled
GPS Shift/Drift Correction	: Enabled
INS Shift/Drift Correction	: Disabled

Parameters

Parameter	X/Omega	Y/Phi	Z/Kappa	XY
RMS Control	0.071	0.086	0.091	0.079
RMS Check				
RMS Limits	0.500	0.500	0.500	
Max Ground Residual	0.159	0.258	0.166	
Residual Limits	1.000	1.000	1.000	
Mean Std Dev Object	0.125	0.143	0.264	
RMS Photo Position	0.065	0.064	0.093	
RMS Photo Attitude	0.004	0.009	0.006	
Mean Std Dev Photo Position	0.163	0.208	0.141	
Mean Std Dev Photo Attitude	0.002	0.003	0.002	

Key Statistics

Sigma: 1.4 um
 Number of iterations: 3
 Degrees of Freedom: 6063

Solution Successful.

Current Count

Control Points Used: 23
 Check Points Used: 0
 Photos Used: 164
 Photos Not Used: 20
 Image Points Used: 4982

6.1 ABGPS Results

See attached Airborne GPS RMSE file: 30398_ABGPS.txt

6.2 Least Squares Ground Residuals

The observations in a simultaneous block adjustment are the photo or model points, and the ground control. The least squares residual for an observation is how much the measured value is moved during the adjustment.

7.0 Control and Tie Point Problems

None

8.0 Delivery Data/Materials

- 30398_CTL.txt-Control and Residuals
- 30398_ ABGPS.txt-ABGPS and Residuals
- 30398AT_Report.doc-A/T report
- 30398_BulkOrient.txt-RO, AO, and Photo Resection solutions

9.0 Aerotriangulation Approval

9.1 Aerotriangulation Results Summary

The aerial triangulation results for CT / Long Island are summarized in the following table:

Parameter	Results
Sigma Naught	1.4
Number of Images	164
Total Points	23
Image Measurements	4982
Average # of Points per Image	30
Control Points	23 Horz/Vert Photo ID Point
Point Weighting	Photo Measurements – <5 microns ABGPS – 0.5m Ground Control – 0.5m
Final Pixel RMSE	0.079 pixels
Ground Control RMSE's	X –0.071 feet Y –0.086 feet Z –0.091 feet

Appendix E

Accuracy Analyst Report



CompassData, Inc.
12353 E. Easter Ave.
Centennial, CO 80112
(303) 627-4058



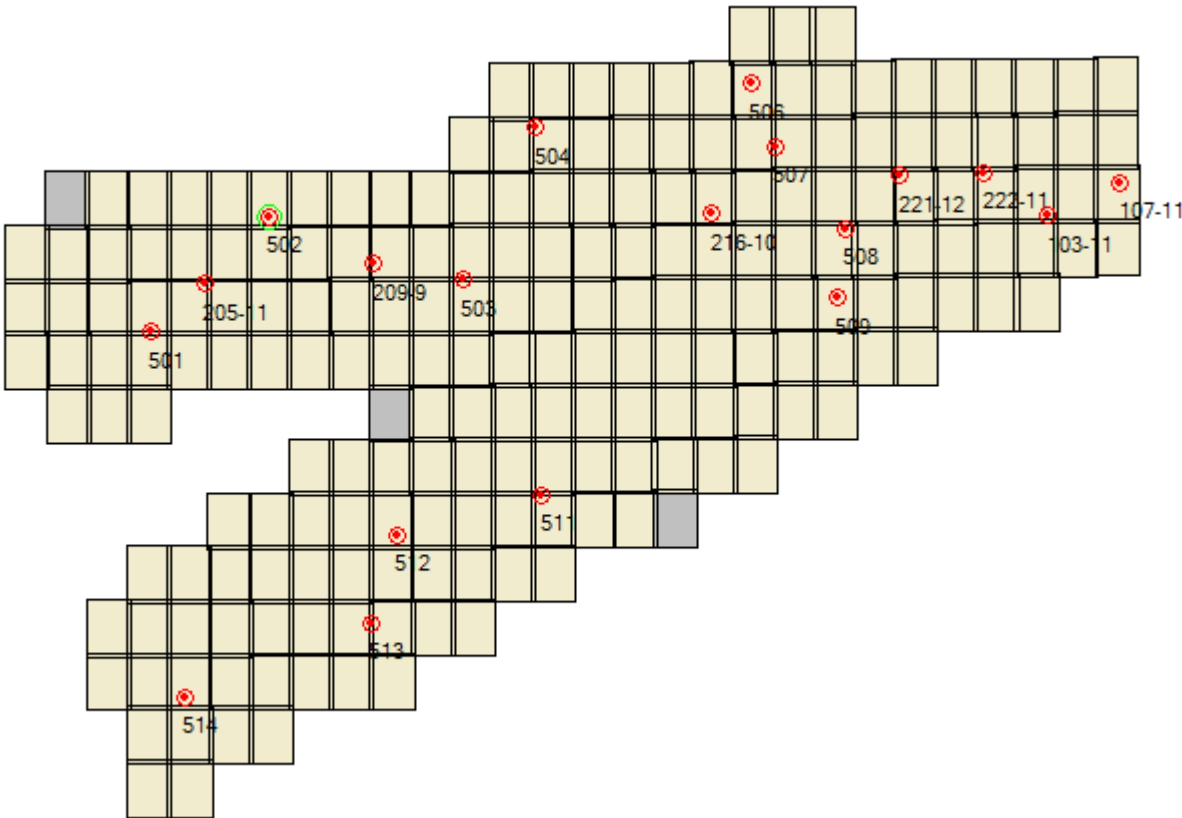
Project Information

Prepared By: Matthew McClure
Project Name: Long Island Sound Coastal
Sensor Info: Vexcel UltraCam Falcon Prime
Sensor Resolution: 0.31
Vendor Name: QSI
Date of Aquisition: Start: 6/28/2017 Finish: 6/28/2017

Metadata Information

Index File Name: 2017_index.shp
of Polygons: 214
of Matching Images: 211
Polygon ID: Name
Units: Meters
Image Folder Path: S:\ORTHO\30398_Long_Island_Sound_Coastal_deliverables\GTIF
Threshold: NSSDA: 0.605
Scaling Used: 1:50

Tiled-Image Area

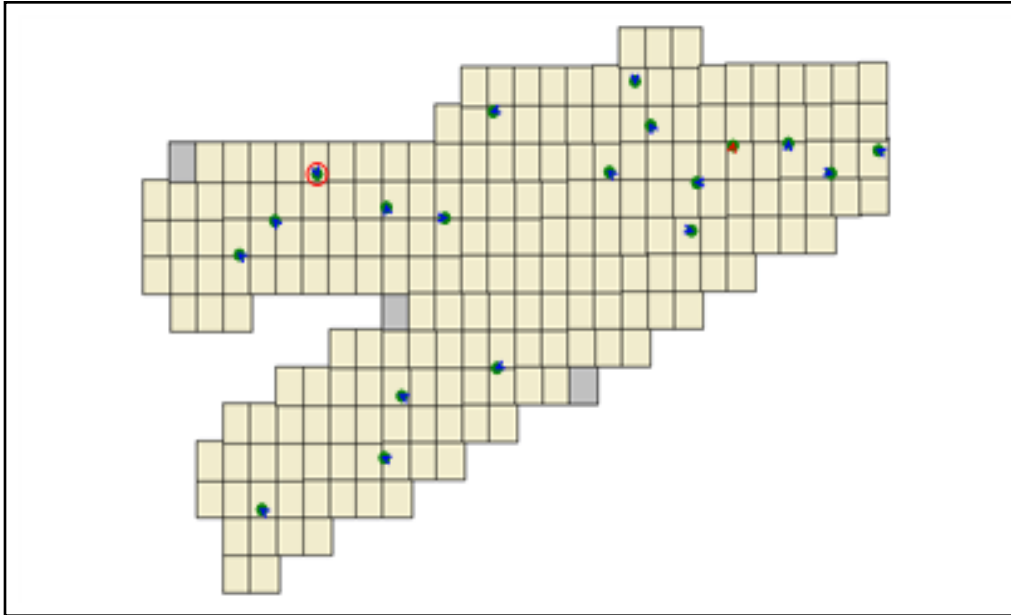




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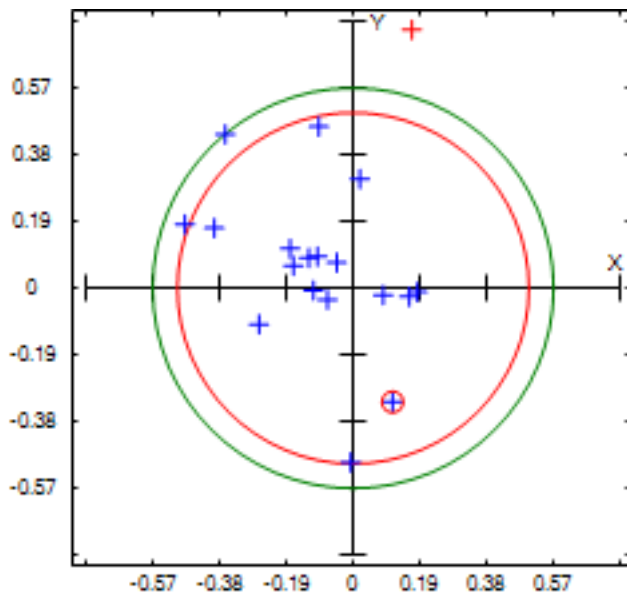


Vector Offset



Scaling Factor: 200

Circular Error



Error Statistics

Min ΔX :	-0.478
Min ΔY :	-0.496
Max ΔX :	0.183
Max ΔY :	0.736
Mean ΔX :	-0.089
Mean ΔY :	0.09
RmseX:	0.207
RmseY:	0.282
RmseH:	0.349
NSSDA:	0.605
No. Obs.:	19



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Coordinates and Offsets of Analyzed Locations

ID							
		Survey X	Survey Y	Photo X	Photo Y	ΔX	ΔY
1)	☒ 222-11						
		376007.94	209173.107	376007.963	209173.418	0.02	0.311
2)	☒ 221-12						
		370558.09	208946.293	370558.259	208947.029	0.167	0.736
3)	☒ 216-10						
		358391.89	206507.147	358391.79	206507.237	-0.101	0.09
4)	☒ 209-9						
		336437.68	203217.128	336437.582	203217.588	-0.097	0.46
5)	☒ 205-11						
		325461.4	201957.461	325461.032	201957.899	-0.363	0.438
6)	☒ 107-11						
		384873.18	208513.308	384873.01	208513.372	-0.169	0.064
7)	☒ 103-11						
		380197.26	206395.864	380197.418	206395.84	0.16	-0.024
8)	☒ 514						
		324174.27	175132.49	324174.146	175132.576	-0.126	0.086
9)	☒ 513						
		336228	179938.535	336227.523	179938.717	-0.478	0.182
10)	☒ 512						
		337945.86	185686.217	337945.468	185686.388	-0.395	0.171



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ID							
		Survey X	Survey Y	Photo X	Photo Y	ΔX	ΔY
11)	☒ 511						
		347310.029	188281.646	347309.956	188281.613	-0.073	-0.033
12)	☒ 509						
		366479.463	201054.142	366479.549	201054.122	0.086	-0.02
13)	☒ 508						
		366994.691	205509.883	366994.579	205509.876	-0.112	-0.007
14)	☒ 507						
		362454.545	210833.324	362454.499	210833.397	-0.046	0.073
15)	☒ 506						
		360912.387	214929.637	360912.38	214929.141	-0.007	-0.496
16)	☒ 504						
		346950.311	212105.3	346950.043	212105.197	-0.268	-0.103
17)	☒ 503						
		342190.953	202220.794	342191.136	202220.783	0.183	-0.011
18)	☒ 502						
		329615.721	206299.601	329615.833	206299.277	0.112	-0.324
19)	☒ 501						
		321962.205	198803.505	321962.026	198803.617	-0.179	0.112



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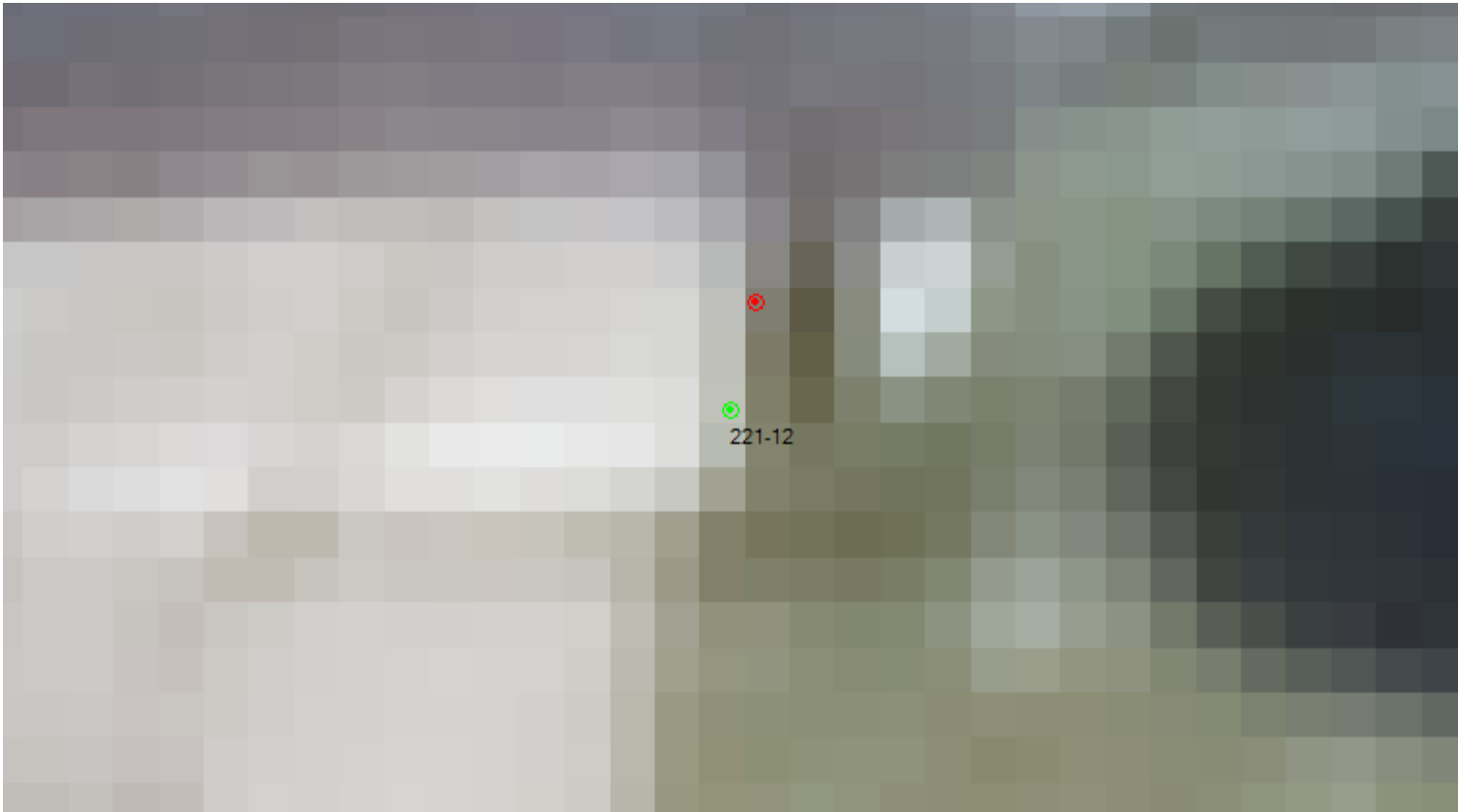
Point 222-11:

X1: 376007.943 Y1: 209173.107 X2: 376007.963 Y2: 209173.418 Delta X: 0.02 Delta Y: 0.311



Point 221-12:

X1: 370558.092 Y1: 208946.293 X2: 370558.259 Y2: 208947.029 Delta X: 0.167 Delta Y: 0.736



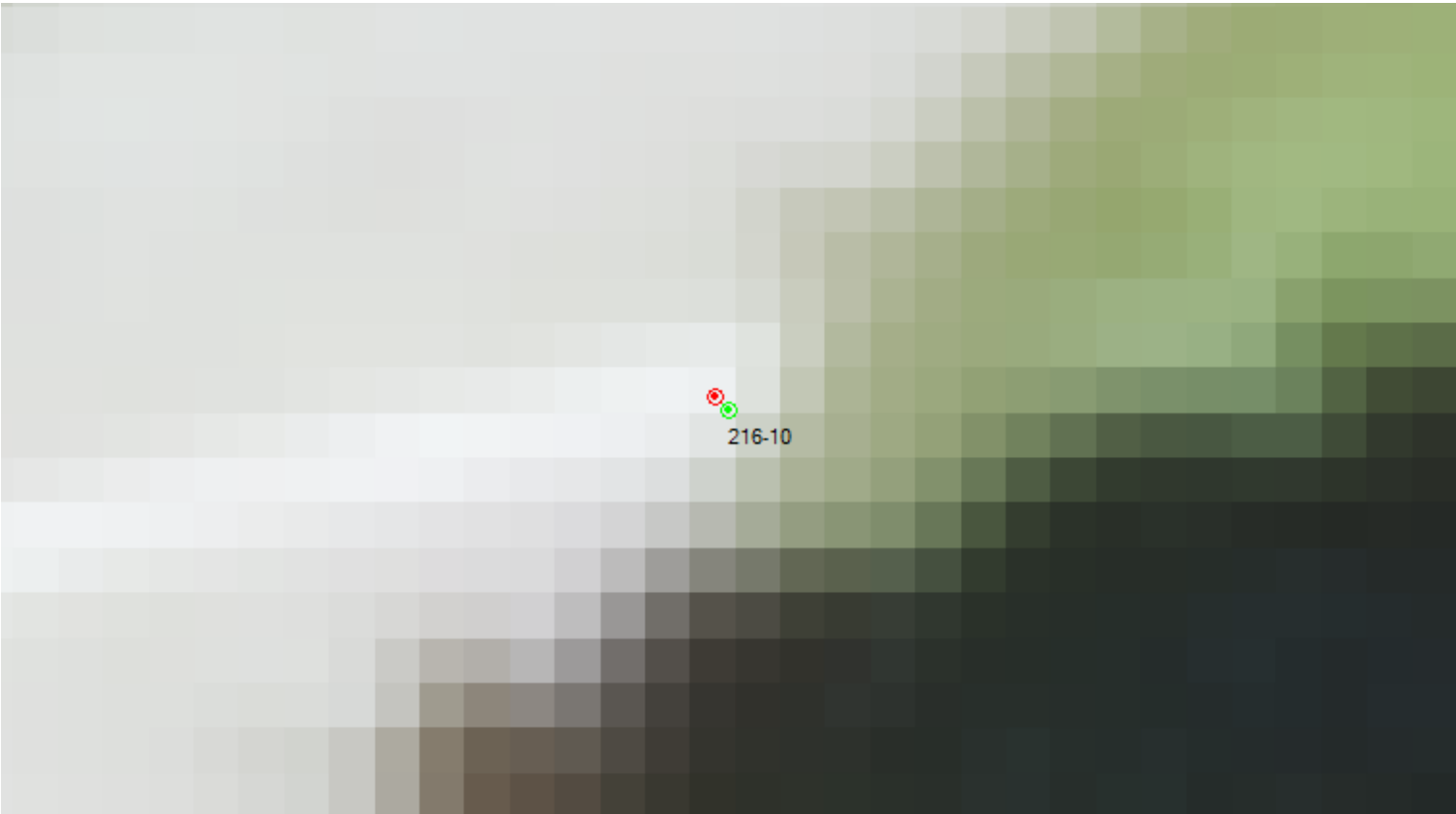


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Point 216-10:

X1: 358391.891 Y1: 206507.147 X2: 358391.79 Y2: 206507.237 Delta X: -0.101 Delta Y: 0.09



Point 209-9:

X1: 336437.679 Y1: 203217.128 X2: 336437.582 Y2: 203217.588 Delta X: -0.097 Delta Y: 0.46





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Point 205-11:

X1: 325461.395 Y1: 201957.461 X2: 325461.032 Y2: 201957.899 Delta X: -0.363 Delta Y: 0.438



Point 107-11:

X1: 384873.179 Y1: 208513.308 X2: 384873.01 Y2: 208513.372 Delta X: -0.169 Delta Y: 0.064



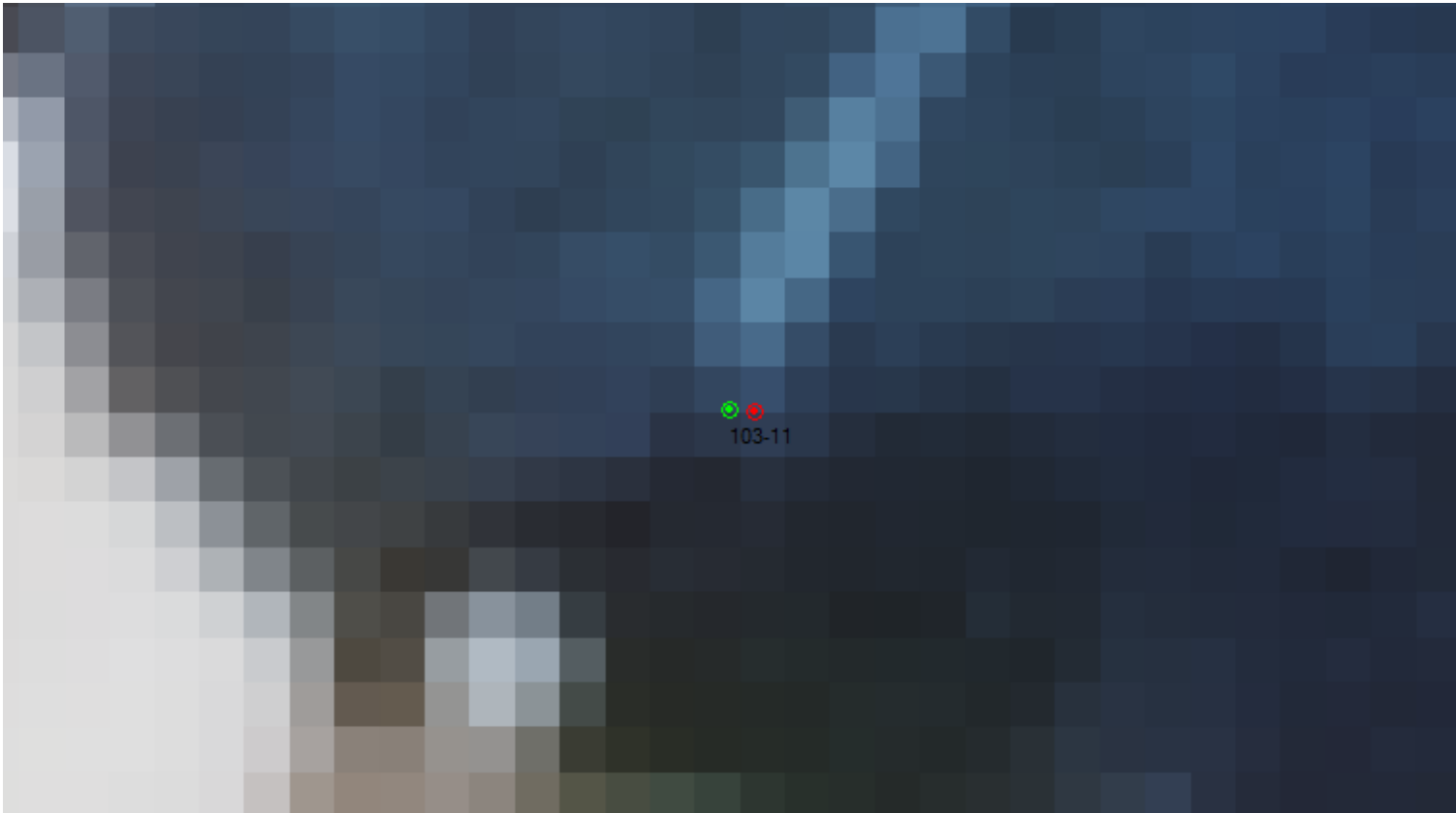


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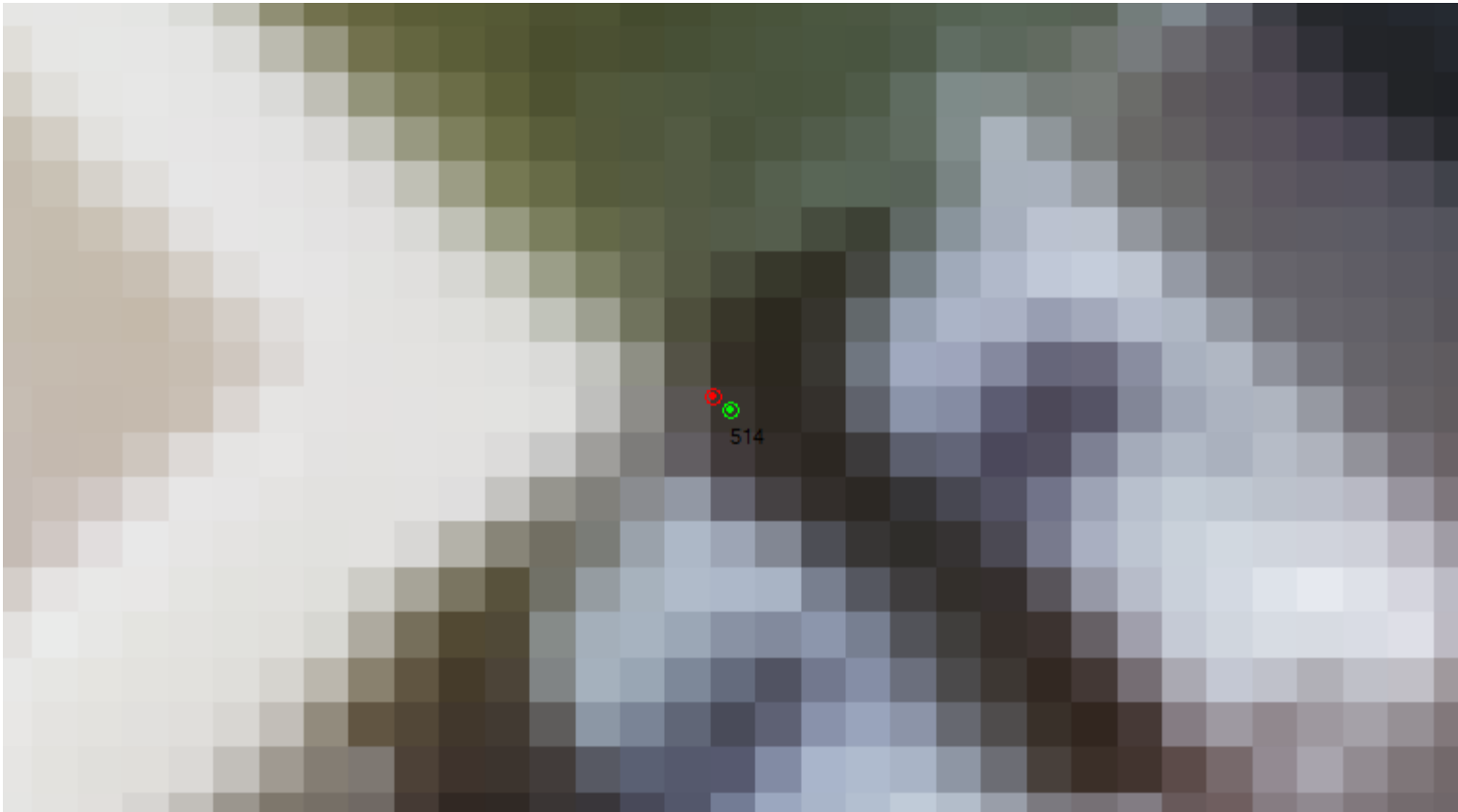
Point 103-11:

X1: 380197.258 Y1: 206395.864 X2: 380197.418 Y2: 206395.84 Delta X: 0.16 Delta Y: -0.024



Point 514:

X1: 324174.272 Y1: 175132.49 X2: 324174.146 Y2: 175132.576 Delta X: -0.126 Delta Y: 0.086





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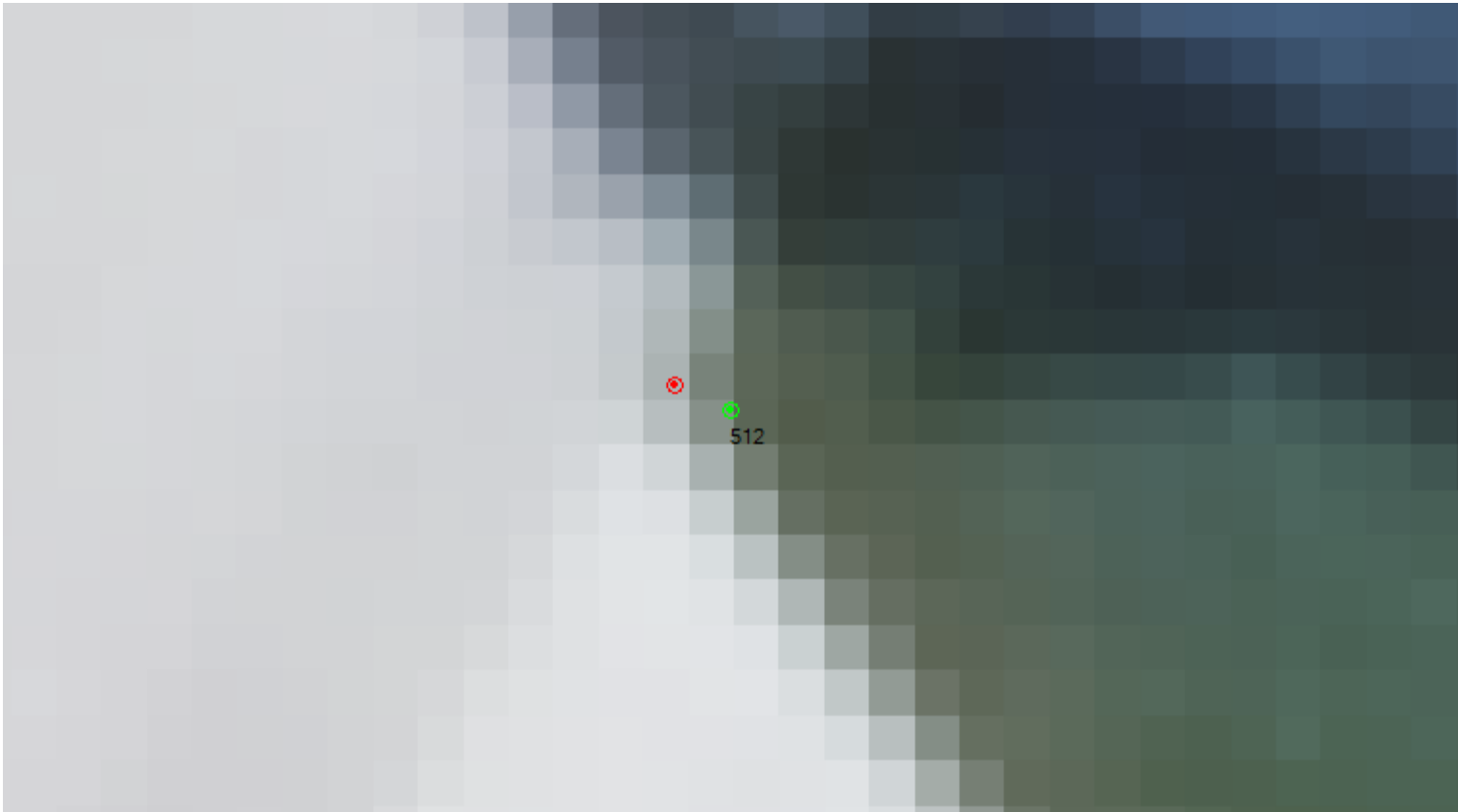
Point 513:

X1: 336228.001 Y1: 179938.535 X2: 336227.523 Y2: 179938.717 Delta X: -0.478 Delta Y: 0.182



Point 512:

X1: 337945.863 Y1: 185686.217 X2: 337945.468 Y2: 185686.388 Delta X: -0.395 Delta Y: 0.171





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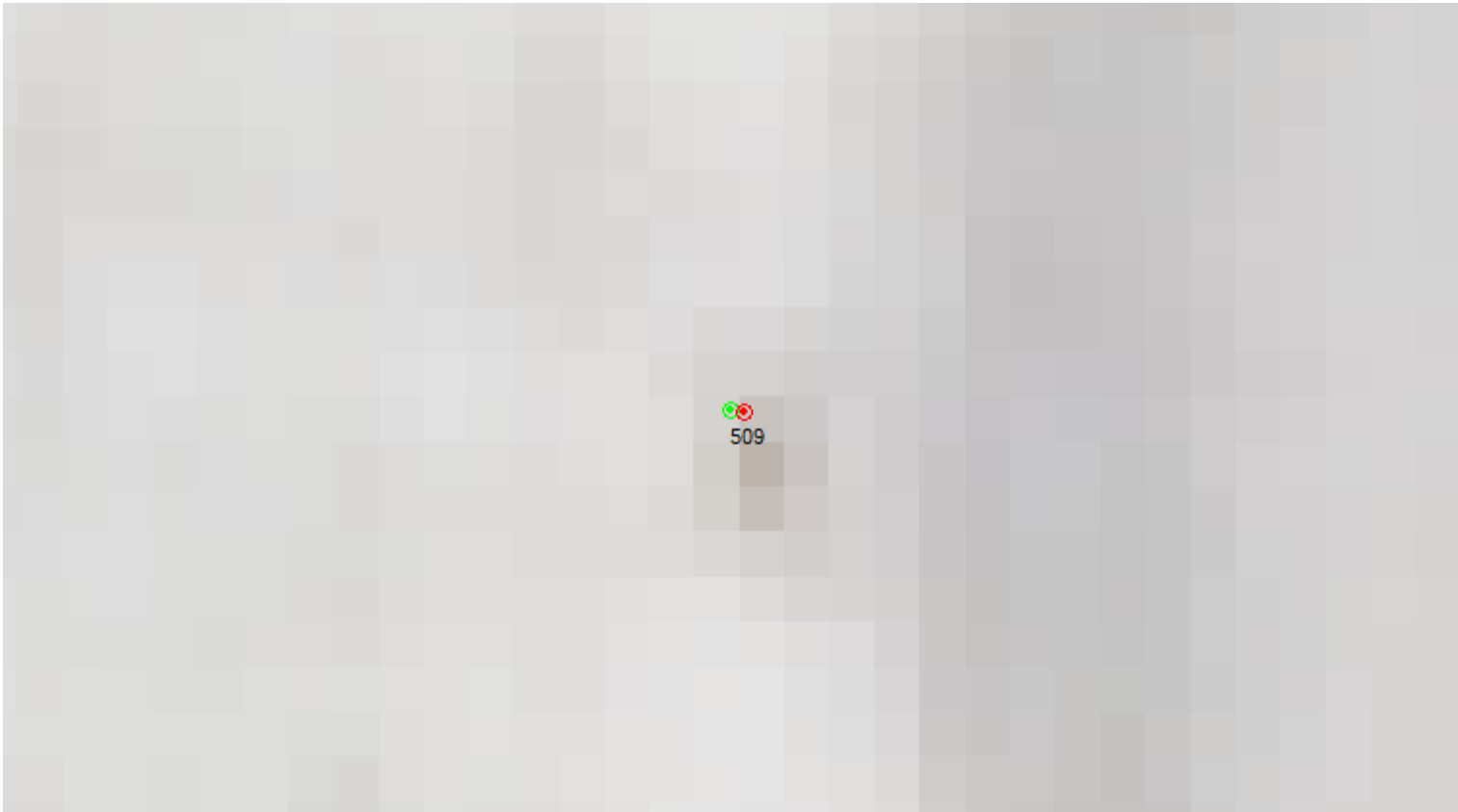
Point 511:

X1: 347310.029 Y1: 188281.646 X2: 347309.956 Y2: 188281.613 Delta X: -0.073 Delta Y: -0.033



Point 509:

X1: 366479.463 Y1: 201054.142 X2: 366479.549 Y2: 201054.122 Delta X: 0.086 Delta Y: -0.02



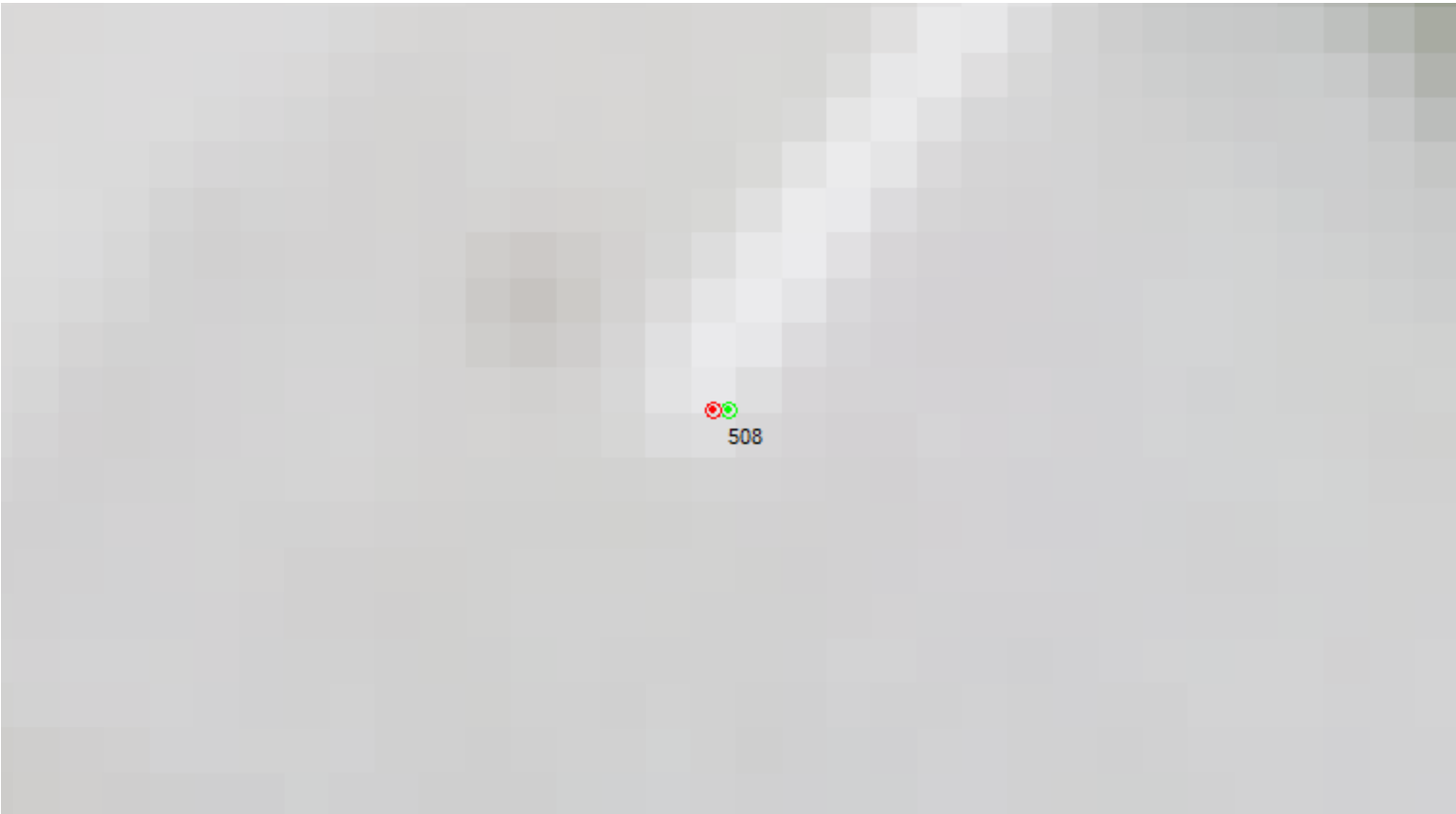


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Point 508:

X1: 366994.691 Y1: 205509.883 X2: 366994.579 Y2: 205509.876 Delta X: -0.112 Delta Y: -0.007



Point 507:

X1: 362454.545 Y1: 210833.324 X2: 362454.499 Y2: 210833.397 Delta X: -0.046 Delta Y: 0.073





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Point 506:

X1: 360912.387 Y1: 214929.637 X2: 360912.38 Y2: 214929.141 Delta X: -0.007 Delta Y: -0.496



Point 504:

X1: 346950.311 Y1: 212105.3 X2: 346950.043 Y2: 212105.197 Delta X: -0.268 Delta Y: -0.103





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Point 503:

X1: 342190.953 Y1: 202220.794 X2: 342191.136 Y2: 202220.783 Delta X: 0.183 Delta Y: -0.011



Point 502:

X1: 329615.721 Y1: 206299.601 X2: 329615.833 Y2: 206299.277 Delta X: 0.112 Delta Y: -0.324





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Point 501:

X1: 321962.205 Y1: 198803.505 X2: 321962.026 Y2: 198803.617 Delta X: -0.179 Delta Y: 0.112





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Coordinates and Offsets of Unanalyzed Locations

ID				
		Survey X	Survey Y	Reason For Exclusion
1)	☐ 212-10			
		346210.245	205324.154	Obscure Location
2)	☐ 103-25			
		380378.684	213017.587	
3)	☐ 505			
		353586.381	207392.052	Ambiguous Location
4)	☐ 500			
		317086.554	204382.343	



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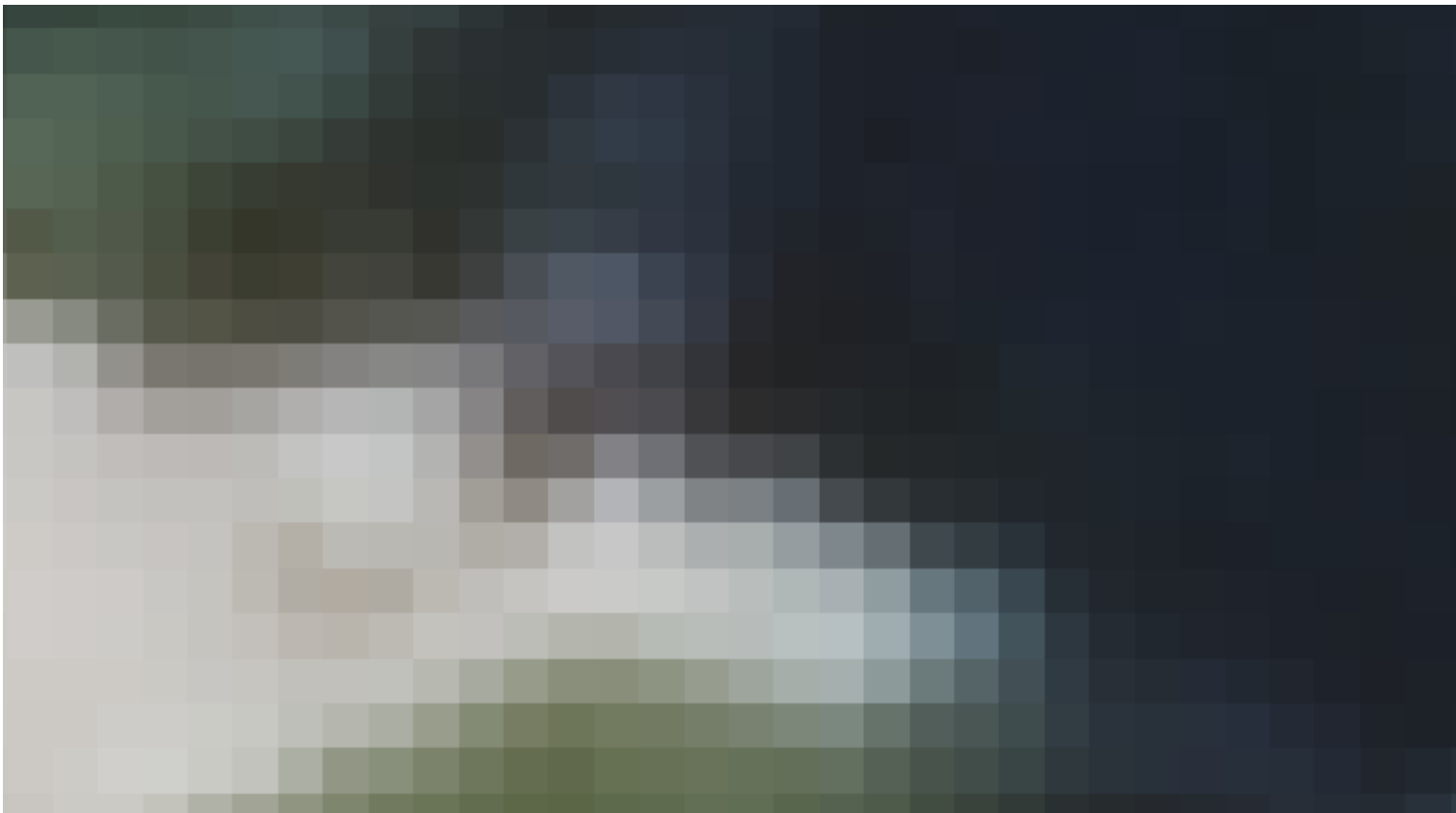
Point 212-10:

X1: 346210.245 Y1: 205324.154 Reason For Exclusion: Obscure Location



Point 103-25:

X1: 380378.684 Y1: 213017.587 Reason For Exclusion:





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Point 505:

X1: 353586.381 Y1: 207392.052 Reason For Exclusion: Ambigious Location



Point 500:

X1: 317086.554 Y1: 204382.343 Reason For Exclusion:

