Quality Review Plan
for
Channel Islands Regional Geographic Information System, Inc.

Prepared by
GeoSpatial Consulting Services

April 2020

GEOSPATIAL CONSULTING SERVICES

CIRGIS COLLABORATIVE

TABLE OF CONTENTS

1. INTRODUCTION AND CONTACT INFORMATION 2

PURPOSE AND BACKGROUND 2
CONTACT INFORMATION 3

2. GOALS AND METHODOLOGY 4

PROJECT SCOPE OF WORK 4

3. ACCEPTANCE CRITERIA 5

DIGITAL PHOTOGRAPHY ACQUISITION 5
GROUND CONTROL 6
AEROTRIANGULATION 7
DIGITAL TERRAIN MODEL 8
PILOT PROJECT 9
ORTHOPHOTOGRAPHY 10

1. Introduction and Contact Information

PURPOSE AND BACKGROUND

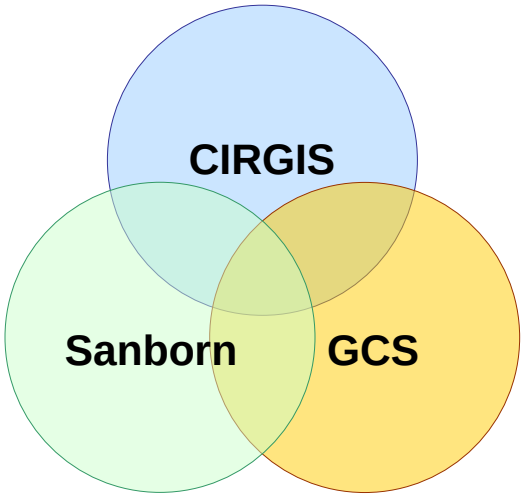
This Quality Review Plan presents the process that assures quality products for the 2020 Color Orthophotography Services Project. This document identifies quality oversight processes and independent review for all work to be conducted under this project.

It is the job of GCS's Project Manager, Bill Zeman, to see that the 5 key tasks of GCS's Quality Plan are implemented for CIRGIS, as necessary to meet or exceed client expectations. Those key tasks are

- Maintain communications with CIRGIS and Sanborn
- Prepare good acceptance criteria
- Prepare an effective Quality Review Plan
- Perform an effective independent inspection on all deliverables
- Maintain good report documents and track all communications for clients review

In order to establish clear, concise project goals, deliverables and schedules, GCS will incorporate work management and cost control procedures that have been established to specifically handle the flow of work with multiple assignments across the Team.

GCS's partnership approach to communication will closely bond our team and CIRGIS along with Sanborn. Good communication is invaluable, but if that information is not properly disseminated to the appropriate team members, it fails to meet its objectives. We will build consensus, discuss the status of projects, technical issues, and perform one or more quality audits throughout the project in support of all services and products.



CONTACT INFORMATION

David Burkhart
Channel Islands Regional GIS
1047 Cove Street, #200
Ventura, CA 93001-3907
Tel:
Fax:
drburkhart@earthlink.net

Bridget Marcotte
Sanborn
1935 Jamboree Drive, Suite 100
Colorado Springs, CO 80920
Tel:
Fax:
bmarcotte@sanborn.com

Bill Zeman
GeoSpatial Consulting Services
951-2 Old County Road #342
Belmont, CA 94002
Tel: 650 208 2661
billzeman@gcsmapping.com

2. Goals and Methodology

Quality can be defined as meeting or exceeding the client's expectations and those expectations should be clearly detailed in the Quality Review Plan. The Quality Review Plan is designed to make sure that CIRGIS's expectations are met. GeoSpatial Consulting Services is contracted by CIRGIS to ensure the acceptance criteria are satisfied and CIRGIS's expectations are satisfied.

GeoSpatial Consulting Services approach to communication is to work closely with CIRGIS to build a consensus, review project status, and discuss any technical issues that might arise. Communication is imperative to the successful completion of a project and GeoSpatial Consulting Services is committed to making that happen.

1. Develop a Quality Review Plan for CIRGIS including acceptance criteria for digital photography, aerial triangulation, ground control, digital terrain model and digital orthophotos.

2. Monitor Digital Photography Collection and Prepare Reports

3. Review ground control, AT and DTM compared with the acceptance criteria. Prepare a report for each AT block with results of adjustment statistics compared with AT Acceptance Criteria.

4. Review tiles for completeness and that there are no gaps in coverage. Review tiles and compare aesthetic and geometric characteristics to Orthophoto Acceptance Criteria. Prepare horizontal accuracy assessment reports consistent with NSSDA (National Standard for Spatial Data Accuracy) specifications.

PROJECT SCOPE OF WORK

We understand that CIRGIS has selected Sanborn to collect the following resolutions:

A. Project Area #1: 3 inch coverage - Net Square Miles = ~350

B. Project Area #2: 6 inch coverage - Net Square Miles = ~80

GCS will work closely with CIRGIS to make sure that all the imagery meet specifications.

3. Acceptance Criteria

DIGITAL PHOTOGRAPHY ACQUISITION

We will assist CIRGIS in reviewing the proposed flight map and control layout with consideration of the proposed flying methods, flight breaks, and other details. During the aerial photography period we will be available to inspect the imagery to determine if it meets the standards for aerial photography set forth by ASPRS.

GCS will monitor the collection of the digital photography by Sanborn. All materials will be inspected to determine if it meets all contract requirements and specifications. Any exposures provided that, in GCS's or its clients reasonable opinion, do not meet the specifications shall be deemed rejected and Sanborn shall be provided prompt written notice thereof which includes the specific basis for the rejection. We will conduct an inspection of selected raw digital images during the aerial mission to verify consistency.

A California licensed land surveyor will review the flight map and control layout documentation.

- Review control layout map
- Review flight map for flight breaks and flying height
- Review camera calibration
- Review image quality (on site if needed)
- Review control methodology and final network adjustment

GCS will keep a daily flight log of weather that day, flight lines and exposures captured on that day, time of day flights occurred and which cameras were active that day. This will be kept as both a spreadsheet and as a graphic representation. These files will be available to CIRGIS each week to review.

All imagery shall be collected to conform to the American Society for Photogrammetry and Remotes Sensing (ASPRS) Draft Aerial Photography Standard (1995). These standards include at a minimum optimal climatic and atmospheric conditions and forward and side overlap of flight lines. Other specifications include individual exposure specifications: including tip, tilt and crab standards. Imagery should not be obtained when the ground is obscured by haze, snow, dust, floodwaters or environmental factors that may misrepresent ground features. All efforts should be taken to minimize the exposure to smoke plumes from fires. If any major fires are underway during the flight mission, the aerial mission should be discontinued. Clouds and/or shadows of clouds shall not appear in the image. Additionally, there should not be any distortions in the photography caused by solar altitude during the time of the flight. Therefore, the mission should be flown during desirable weather conditions and generally between the hours of 10:00 AM and 3:00 PM PST.

GROUND CONTROL

We will review existing ground control supplied by the partners as well as any additional ground control used by the vendor to verify that it is all in the same datum and epoch. We will also verify that it is signed off by a licensed California Land Surveyor.

There must be adequate ground control to meet the accuracy requirements of the selected scale of mapping. We will check the control layout to insure that adequate ground control is used in conjunction with airborne GPS. All control used in the production of products for this effort shall conform to acceptable errors as set forth by the FGDC or FGCC as stated below:

Ground Control Acceptance Criteria

Criteria	Measure of Acceptability
Report Format	Conforms to required convention
Report Completeness	All information complete and readable
Approval	CA Licensed Surveyor Signature and Seal
Monument Record Form	Sufficient information to revisit point, description and picture
Network	Meet FGDC or FGCC specifications for Order and Class
Horizontal Accuracy	Second Order Class 1 tied to NGS monuments.
Vertical Accuracy	Third Order.
Coordinate System	California Coordinate System of NAD ‘83, Zone 5,
Working Units	US Survey Feet
Epoch	Epoch date: 1991.35
Vertical Datum	NAVD 1988

AEROTRIANGULATION

We will review the Bulk Orientation values to look for any anomalies. The bulk orientation files contain both the Relative Orientation and the Absolute Orientation solutions for each stereo model computed from the AT results. This information ultimately drives the positional accuracy of all mapping products generated from the AT run. We will closely examine the Sigma values in both the Relative and Absolute Orientation against the criteria established for the project. Any models that did not compute or those with high sigma values will be pointed out to CIRGIS in the AT summary report and could potentially be noted as a possible source of error in the mapping products that were produced from that AT solution.

Aerotriangulation Acceptance Criteria

Criteria	Measure of Acceptability
Report Format	Conforms to required convention
Report Completeness	All information complete and readable
AT Software	Conforms to AT software output file for model setting.
1"=100' map scale AT Horizontal accuracy against ground control	For 1:1200 AT blocks, $RMSE_x$ and $RMSE_y$ values are acceptable up to 0.35'. Higher RMSE values than .5 feet are subject to review.
1"=200' map scale AT Horizontal accuracy against ground control	For 1:2400 AT blocks, $RMSE_x$ and $RMSE_y$ values are acceptable up to 0.7'. Higher RMSE values than 1.0 foot are subject to review.
RMSE of control and tie points.	<GSD. Higher RMSE values are subject to review.

DIGITAL TERRAIN MODEL

We will review the existing DTM to verify that it meets the necessary accuracy requirements to produce the products for this high resolution imagery collection. The digital elevation model must at minimum meet the accuracy standards sufficient to produce the digital orthophotography at the selected scale. If collected by standard photogrammetric means or by LiDAR the data should meet those standards.

Digital Terrain Model Acceptance Criteria (for orthorectification only)

Criteria	Measure of Acceptability
Media:	Media is readable, all files accessible, no files corrupted
File organization	Files written one per ortho tile delivered.
File name	Conforms to required convention
Format	
Georeferencing	CA State Plane Coordinates NAD ’83 Zone 5
Mass point locations	Mass points sufficient to accurately build terrain to support orthophotos.
Breakline locations	Breaklines as needed to control bridges and overpasses when and where image photo centers do not compensate for orthorectification, none in open water.
Continuity	No spikes, holes or blunders; no gaps of sufficient size to affect orthorectification, regardless of perspective center.

PILOT PROJECT

GCS will work with the CIRGIS Regional GIS Committee to designate the areas for the pilot project, review the prototype images with CIRGIS, and work with Sanborn and CIRGIS to verify that all imagery meets the acceptance criteria and that the imagery meets the accuracy requirements. GCS would recommend that CIRGIS deliver a minimum of four surveyed check points in each of the four prototype areas so that we can do a NSSDA accuracy check to verify that the delivered imagery will meet the stated accuracy specifications.

The pilot area will be composed of four to six tiles in all scales of the project as stated in the contract with Sanborn. GCS will do an aesthetic and geometric check of all tiles in the prototype to verify that they meet the image acceptance criteria for orthophotos developed in this Quality Review Plan. These prototype images will become the standard by which future deliveries of orthophotography will be judged.

ORTHOPHOTOGRAPHY

GCS would like to receive imagery from Sanborn on a regular basis as soon as they begin the final orthophoto processing. Each delivery is to only include tiles not previously QC'd by GCS. Sanborn should provide a file listing of all tiles included in each delivery. GCS will download all files to a server and verify that all files were received. Any discrepancy will be reported immediately to Sanborn.

GCS's initial review process includes automated and visual steps. GCS will review **all** tiles for aesthetic and geometric compliance with the acceptance criteria. GCS recommends that CIRGIS also have a NSSDA accuracy assessment developed to verify that the delivered data set meets the stated accuracy requirements. GCS can provide the necessary effort to develop the assessment, but the budget does not allow for the collection of the necessary survey grade check points. If CIRGIS can provide those check points we would be happy to do the calculations.

GCS will scroll the set of images at zoom level, allowing the user to stop at any point to mark any errors discovered on the image. The technician will enter the type of error encountered (by pre-determined library of abbreviations) to a discrepancy database linked to Shape files with exact coordinates. The technician can also add a comment, providing more detailed information on the nature of the problem.

The technician continues through each image in the same fashion until all areas have been reviewed. Once processing is complete, a report is generated listing all errors, and their location on the images. Error reports are transmitted to Sanborn for correction and to CIRGIS for information. GCS will load all image tiles/files for the project area. As file names are displayed, this also provides the ability to easily review file names/numbers for adjacent files/tiles.

We will zoom-in or zoom-out to review images at different scales, and the process is designed so as to methodically scroll all image areas at speeds set to examine the imagery in greater detail and to identify areas for red-lining. Deficiencies are recorded with annotations so small files can be emailed to CIRGIS and Sanborn. Accepted tiles are cataloged with as green, and rejected tiles are cataloged as red. Yellow are used for tiles pending approval. GCS will perform re-reviews to ensure corrections have been made.

Orthophotography Acceptance Criteria

Criteria	Measure of Acceptability
All Scales Natural Digital Orthoimagery (100 Scale & 200 Scale)	
Media: External Drives	Media is readable, all files accessible, no files corrupted
Media label	As specified by CIRGIS
File organization	Files written in tile sheet order
File name	Conforms to required convention
GeoTIFF format	File reads in ESRI
Files must open in correct location	Files must open with ESRI software
Pixel definition	File must reference to the center of the pixel located in the upper left hand corner of the tile as the point of origin. Pixel size 0.25 ft. and 0.50 ft.
Vertical Datum	NAVD88
Projection	NAD 1983 State Plane – California Zone 5(1991.35)
Datum	NAD 83 reference datum
Units	U.S. Survey Feet
24 bit natural color	256 levels of value for each band, 0=black, 255=white
Tonal quality	< 2 percent of values at 0 or 255, to the extent possible per client's radiometry choices
Conformance of tile index grid	tile matches grid, no gaps between tiles at 1:1 view.
Image Appearance	The difference in average pixel values on either side of a mosaic seam-line should generally not exceed 70 (30 preferred), when measured on a homogeneous surface with similar characteristics (water surfaces are exempt from this requirement). Greater differences may be allowed if the correction will cause significant degradation of the image content on either side. No image will be rejected for such radiometry inconsistencies without prior approval of CIRGIS. Image acquisition should be obtained with acceptable weather conditions per ASPRS standards.
Radiometry	Radiometry should be consistent throughout the imagery, on large and small scales. Mosaic seamlines should not produce great visual (tonal, brightness) differences in imagery on either side (water being exempt from this requirement). In some instances, greater differences may be allowed if the correction will cause significant degradation of the image content on either side. Color balancing between tiles should be as consistent as possible. Image prototypes will be reviewed and approved by the CIRGIS prior to orthoimagery production. The prototypes will provide a guide and expectation of final imagery appearance.
Smears	Normally corrected by adding mass points or breaklines to DEM/DSM as necessary to reflect actual terrain or by image processing where appropriate. Where DSM/DEM corrections or image processing will result in reduced horizontal accuracy or misrepresentation of the location or appearance of important features (buildings, roads, etc.), the smear will

	remain untreated. No image will be rejected for smears without prior approval of CIRGIS.
Wavy features	Distinct linear ground features (such as road markings, and curbs) should not deviate from their apparent path by more than 3 feet measured perpendicular to the feature within any 100 foot distance measured along the feature length.
Mosaic lines	No mosaic lines through buildings. No mosaic lines through above ground transportation structures carrying automobiles or trains unless unavoidable.
Metadata	Complies with minimum FGDC Content Standard.
Building lean within Downtown areas	The maximum displacement of a 10 story building at the edge of a model will be 16 feet (approximately 1.6 feet per story)
Bridges	Accuracy of multi-layered bridge decks identified by CIRGIS**.**
Coverage	Full Tiles
Tile grid layout	Matches CIRGIS grid

3 inch GSD, equivalent to 1”=100’-scale (1:1200)	
Ground Resolution	quarter foot
Tile size	3000’ X 2000’
RMSE of QA/QC points measured on the image	$RMSE_r$ = 1.4 ft. NSSDA 95% = 2.45 ft.
NSSDA radial accuracy	NSSDA accuracy (20+ points) (95%) < 2.45 ft.
Mismatch of features along mosaic lines and production block boundaries of equal scale	Equal to or less than 3 pixels on well defined ground features (roads, sidewalks, curbs).
6 inch GSD, equivalent to 1”=200’-scale (1:2400)	
Ground Resolution	half foot
Tile size	6000’ X 4000’
RMSE of known ground points measured on the image	$RMSE_r$ = 2.8 ft. NSSDA 95% = 4.89 ft.
NSSDA radial accuracy	NSSDA accuracy (20+ points) (95%) < 4.89 ft.
Mismatch of features along mosaic lines between pixel resolution blocks of equal scale	Equal to or less than 3 pixels on well defined ground features (roads, sidewalks, curbs).