

SPECIFICATIONS FOR DIGITAL PHOTOGRAMMETRIC SERVICES

This document is a reference guide for those providing photogrammetric mapping services for Central Federal Lands Highway Division (CFLHD) of the Federal Highway Administration (FHWA), Lakewood, Colorado.

A. GENERAL DESCRIPTION

The work consists of digital mapping and terrain modeling in CFLHD U.S. Customary Units format; also known as the U.S. Survey Foot (one meter equals 3937/1200 feet.). The mapping will follow the existing road or a pre determined area. Microstation files containing contours, utilities and planimetrics, as well as a 3-D digital terrain model in Microstation V8 format are to be provided to CFLHD. The technical requirements section of this specification document indicates more specific requirements.

B. EQUIPMENT REQUIREMENTS

Photogrammetric digitizing will be done with softcopy. The final files will be in Microstation V8 format. Contours are to be generated using Geopak Road Design software.

C. TECHNICAL REQUIREMENTS

1. GRAPHICS FILES

All 3-D design files will be created from the seed file furnished by CFLHD: **Sur_ft3D.dgn**. This seed file is being provided to establish proper parameters (e.g., working units, global origin, etc.) to assure CFLHD compatibility. The accepted level, color, text style, line style, line weight and cell and symbology structure is found in the MS Word document named "**CFLHD-map-symbol-cell-table-V8-k.doc**". Current CFLHD file naming convention guidelines will be followed. The Verdana font is to be used to label descriptive text. All text should be upper case.

- a. A 3-D compilation index file will be created with the "ndx" extension and symbolized with the photo outlines on named level E_MAP_Mapping_Flight_Line, color 0, line code 2 and weight 1; the outline of the actual mapping area will be on named level E_MAP_Misc_Described_Line, color 4, line code 3 and weight 1. Place flight line labels on E_MAP_Mapping_Flight_Line using text size 20 and color magenta.
- b. Create a 3-D digital terrain model (dtm extension) file containing line strings, ground shots and closed line strings. These symbolized features shall depict the topography in the true X, Y, Z position. The line strings are further broken into two types; each with a specific function and specified parameters, the most critical being the correct level.
 - 1) Discontinuity lines (break lines) are line strings (NOT COMPLEX LINES OR ARCS) with the characteristics: line code 0; weight 1; color 0 and placed on the named level E_GEO_Break_Line. These line strings establish the X, Y, Z coordinates of the existing ground as digitized.

- a) Discontinuity line strings will be digitized longitudinally along all natural and man made “break lines” or discontinuities. A shot is to be recorded at each break along the discontinuity and at intervals so that the distance between recorded shots does not exceed 25 feet.
 - b) Establishing accurate discontinuities is very critical for highway design. The features of importance include, but are not limited to: 1) edge of pavement, 2) roadway ditch, 3) top of roadway cut, 4) toe of roadway fill, 5) drainage lines, 6) ridges, 8) edge of water and 8) retaining walls, etc..
- 2) Obscurity lines are line strings used to denote the boundaries of obscured areas with the characteristics: line code 3; weight 0; color 3 (red); named level E_MAP_Obscured_Area .
- a) If the digitizer cannot see the ground over a large area due to shadows, vegetation, buildings or no stereo coverage, the obscured area should be outlined with a closed line string. Any data inside an obscurity boundary is disregarded by CFLHD software. Therefore, ground shots and discontinuity lines should not extend into an obscured area. It is anticipated that, except for buildings, the number of obscurities shall be minimal. CFLHD should be contacted before proceeding if many areas are obscured.
 - b) The line strings which comprise obscured areas **must** form a closed shape. The data points used to form the shape are part of contour interpolation and therefore must represent the X, Y and Z coordinate of the ground at each respective point.
- 3) Ground shots shall be shown with center justification, using the cell named “ground shot” symbolize using weight 5, color 3, line code 0 and on named level E_MAP_Ground_Shot.
- a) The portion of the model which is within the designated mapping limits is to be digitized by placing a cell at the appropriate X,Y and Z coordinates. The ground shots may be placed in a grid pattern, not to exceed 40 feet transversely or longitudinally to the direction of the flight line. Additional shots should be taken where spot elevations need to be shown on the final map. These areas include all tops, saddles and depressions. Other locations pertinent to highway engineering, such as road intersections, road crests and sags, the centerline of a road at culvert crossings and the flow line of visible culvert inlets and outlets are to be depicted with a spot elevation in the map file.
 - b) Ground shots will **not** be digitized within 1 foot of a discontinuity or break line. A vertical discrepancy between a ground shot and a discontinuity point, which are digitized at approximately the same X, Y coordinate, may result in contouring problems. Therefore, it is recommended that discontinuities be digitized prior to the ground shots.
 - c) Although the ground shots will generally be spaced at regular intervals, it is not mandatory. If it is advantageous to deviate from the normal grid pattern to depict a

unique feature or in order to avoid heavy vegetation, shadows, etc., this is allowed to the extent that the deviation does not exceed 1 foot in any direction.

- c. Create a 3-D graphics file containing line string contours extracted from the 3-D dtm file. This file's extension shall be "con". The contour interval shall be one foot with five foot index lines. The index contours shall be labeled with the appropriate elevation with spacing of not more than 200 feet. Index contours less than 200 feet in length, shall have a minimum of two labels. Labels are to be placed so that they read uphill. The contours will be edited and regenerated if bad shots are evident. Modifications to the contours need to be made to 1) show depressions (using the depression line style), 2) delete contours where buildings coexist and 3) show contours that may not meet the accuracy requirements due to obscurities (using closed line strings).
- e. Create a 2-D "map" file containing all man made land use features, structures, and utilities that are visible on the aerial photography or annotated on control photos. All features will be digitized or symbolized in their true ground coordinate position. Features pertinent to highway engineering (such as road turnouts, parking areas, wide shoulders, rock slide areas, etc.) are to be digitized and labeled in the file accordingly. CFLHD cells are located in the cell library **smrowV8-k2006.cel** and line styles are available in the resource file **CFL_LineStyles.rsc**. Use the symbology, color, text style, line style, line weight and cell symbol listed in the MS Word file "**CFLHD-map-symbol-cell-table-V8-k.doc**" to depict features. Spot elevations should be labeled to the nearest 0.1 foot.
 - 1) The principal point (photo center) of each photograph used in the mapping will be shown in its correct position oriented perpendicular to the line of flight. Digitizing will not be done from areas of the stereo model outside the neat model lines, unless requested by CFLHD. A line for line join will be made between adjoining flight lines.
 - 2) Traverse points, (targeted 3000 series) will be shown using the t-point cell symbol. Analytical points and wing points should not be shown in the map file. All traverse points are to be labeled with the appropriate name with elevations NOT shown. Traverse points are in the traverse printout provided to the Contractor. Place t-point symbology using precision input or by "snapping" to the exact location. Monument elevations shown in the printout may be different from the ground elevations used for the stereo setups.

2. ACCURACY

- a. Spot elevations, ground shots: Ninety percent of the shots recorded will have a vertical accuracy of 0.2 foot and a horizontal accuracy of 0.4 foot.
- b. Break Lines: Ninety percent of the shots recorded will have a vertical accuracy of 1 foot and a horizontal accuracy of 0.2 foot.
- c. Planimetrics: Well-defined features will be within 0.2 foot horizontally of their actual location.
 - 1) As indicated above, the accuracy requirements are more stringent than those required for typical contour mapping. The 3-D digital terrain files are to be used by CFLHD for triangulation and cross section extraction and thus require cross section accuracy.