# Survey and Mapping Procedures for Flood Plain Delineation

ENVIRONMENT CANADA

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K1A 0E7.

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# Survey and Mapping Procedures for Flood Plain Delineation

Prepared by

WATER PLANNING AND MANAGEMENT BRANCH
INLAND WATERS DIRECTORATE
ENVIRONMENTAL MANAGEMENT SERVICE
ENVIRONMENT CANADA

In cooperation with

TOPOGRAPHICAL SURVEYS
SURVEYS AND MAPPING BRANCH
DEPARTMENT OF ENERGY, MINES AND RESOURCES

MAY 1976

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## Section 1. General

### 1.01 Scope

This manual on Survey and Mapping Procedures for Flood Plain Delineation outlines the basic features of the required topographic-planimetric mapping scheme as specified in the federal-provincial agreements on flood risk mapping. It assumes that any existing aerial photographs, maps, etc. which may be utilized to circumvent the expense of surveys to effect their duplication will have to satisfy the requirements specified herein in all respects that new work would be required to meet.

The procedures discussed should be regarded more as a set of guidelines to be used in constructing a suitable end product than as a list of rigid specifications to be applied uniformly across the country. Consequently, the methodology employed for each specific mapping project should be clarified by the respective Technical Committee.

### 1.02 Role of the Canada Department of Energy, Mines and Resources

The quality of any contracted mapping work should be regulated by a workable inspection system similar to the one currently in use by the Department of Energy, Mines and Resources (EMR). Since EMR quality control practices for contracted works have included an "Inspector", these aspects of contracted topographic-planimetric mapping under any proposed federal-provincial flood risk mapping agreement will include an EMR Inspector and such other EMR contracting practices and procedures as are desired by the respective Technical Committee.

### 1.03 Scales

Despite the advantages of a systematic approach to any national program, there has to be some flexibility in certain aspects of such a program to cope with varying geographical, economical and technical circumstances. In this light, two separate scales of maps are considered - a mapping scale, upon which the aerial photography, ground surveys, etc. will be planned and implemented; and, a publication scale, at which the multi-colored, mass-produced maps will be published.

A minimum publication scale of 1:10,000 was selected because it is an acknowledged metric scale, and is the smallest scale at which planimetric detail can be reasonably portrayed. This scale is quite adequate for mapping medium and large urban communities in order to portray the overall implications of the flood hazard designation scheme, and the representative Technical Committees may recommend a larger scale for smaller communities or areas where more detail must be shown.

For planning and development purposes in a community designated as a flood risk area, a mapping scale of 1:2,000 may be more appropriate for portraying planimetric and topographic detail.

In areas where adequate maps already exist, or where local planning authorities are using a different scale, it may be more realistic to implement a mapping scale compatible with these situations.

In all cases, the mapping scale will be larger than or equal to the publication scale, and where no adequate existing maps are available, both of these scales will adhere to a metric-oriented representation, unless otherwise specified by the Technical Committee.

The actual mapping process will be carried out at the largest scale decided upon, and the manuscripts to be published will be derived from these at the appropriate stage of the compilation process; and any exceptions to this procedure will be best decided by the Technical Committees on a case-by-case basis.

## Section 2. Aerial Photography and Targeting

### 2.01 Scope

This section covers the provision of new aerial photography and the targeting of both vertical and horizontal control.

The key parameter in this section is the required contour interval.

### 2.02 Aerial Photography

Aerial photography will be carried out in conformance with the procedures laid out in the publication, "Specification for Aerial Survey Photography", 1973, issued by the Interdepartmental Committee on Air Surveys, Canada Department of Energy, Mines and Resources.

Photography will be flown when the ground is free of snow and not obscured by deciduous or other seasonal growth.

The density of aerial photographs (or stereo models) is directly related to the flying height at the time of photography which, in turn, depends on the required optimum contour interval. Many factors are involved in this decision, such as focal length of the camera, plotting limitations of plotters, aircraft stalling speeds and maximum flying heights, shutter speed, film resolution, availability of ground control, economic feasibility, etc.

Past experience has established some general guidelines for modern flight planning to establish the maximum flight heights which permit the achievement of required accuracies with various plotting equipment. The flight-height/plotting machine relationship is determined by a quantity known as the C-factor appropriate for the plotting system to be used.

For example, using a first-order plotter, high density vertical control and a 0.5 metre contour interval:

C = 1500 (with 5 vertical control points per model)

$\therefore$ Flying height = 1500 X 0.5 = 750 metres = 2460 feet.

This effectively states that, for the conditions mentioned, 0.5 metres is the optimum contour interval for photography flown at 2460 feet, and that 90% of all contours will be accurate to plus-or-minus one-half of that contour interval.

Conversely, in areas where well controlled photography already exists, the optimum contour interval and its corresponding reliability may be determined for a particular plotting instrument.

The following table illustrates the inter-relationship between C-factor, flying height and the optimum contour interval:

Determination of Flying Height (feet)

Based on Optimum Contour Interval*

| C-Factor | Contour Interval (feet) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 |
| 1200 | 1200 | 1800 | 2400 | 3000 | 3600 | 4200 | 4800 | 5400 | 6000 |
| 1300 | 1300 | 1950 | 2600 | 3250 | 3900 | 4550 | 5200 | 5850 | 6500 |
| 1400 | 1400 | 2100 | 2800 | 3500 | 4200 | 4900 | 5600 | 6300 | 7000 |
| 1500 | 1500 | 2250 | 3000 | 3750 | 4500 | 5250 | 6000 | 6750 | 7500 |
| 1600 | 1600 | 2400 | 3200 | 4000 | 4800 | 5600 | 6400 | 7200 | 8000 |

* This table assumes the aerial camera is equipped with a standard Wide-Angle lens having a 6-inch length.

2.03 Targeting

All horizontal control required for each section will be targeted, described and photo-identified. Target types must be of a size and nature to ensure positive identification at photo scale. Target design will be subject to the approval of the Inspector.

## Section 3. Vertical Ground Control

### 3.01 Scope

The specifications outlined in this section consist of the provision of vertical ground control. It should be borne in mind that any established or recovered vertical ground control will probably be used for various purposes as part of the flood risk mapping project, and not strictly, or necessarily, for controlling aerial photography.

### 3.02 Existing Primary Control

Descriptions and values for existing vertical data will be provided for by the Inspector, and will, where possible, be based on the Mean Sea Level Datum as established by Geodetic Surveys of Canada.

### 3.03 Survey Procedures

For all contour intervals - in areas where accessibility permits, at least five clearly defined, well-positioned vertical control points will be established per stereo model.

Stereo models containing one-half or less of land mass area within that model will have four vertical control points distributed in each corner of that land mass area wherever possible, and stereo models covering more than the required compilation limits will be adequately controlled.

### 3.04 Bench Marks

The contractor shall place and/or reference permanent and temporary bench marks during his basic levelling. These bench marks shall be so placed, described and/or identified so as to be easily recoverable by others for field checking purposes. Existing bench marks may be used to meet this criterion.

Monument density and design will be specified by the Technical Committee, subject to the approval of the Inspector.

### 3.05 Identification

Positive and precise photo identifications are required for all vertical, and horizontal, survey points used as photogrammetric control.

3.06 Control Presentation

All vertical ground control must be suitably sketched, described and numbered on one set of photos.

3.07 Accuracy

All vertical ground control shall be established to meet third-order specifications as defined in the Canada Department of Energy, Mines and Resources publication "Specifications and Recommendations for Control Surveys and Survey Markers", August 1973, provided the originating control to which it is referred is of a higher order, and suitable checks and ties have been included in the survey procedure. Otherwise, the levelling procedures shall conform to the specifications for second-order vertical control as laid down in the above-mentioned publication.

3.08 Survey Returns

Field survey returns, comprehensively labelled, indexed and cross-referenced, are to be submitted for inspection and verification by the Inspector. The returns will consist of the following:

a) all original vertical control survey notes;
b) a list of final elevations, the method used for the levelling network adjustment, and a tabulation of the resulting statistics;
c) calibration tables (if applicable);
d) all sketches and descriptions;
e) photo identifications and supporting data;
f) a large scale map showing the vertical control layout; and
g) a list of all materials submitted for inspection and verification.

## Section 4. Horizontal Ground Control

### 4.01 Scope

The specifications outlined in this section consist of the provision of horizontal ground control. It should be borne in mind that any established or recovered horizontal ground control will probably be used for various purposes as part of the flood risk mapping project, and not strictly, or necessarily, for controlling aerial photography.

### 4.02 Existing Primary Control

Descriptions and values for suitable existing horizontal control points will be provided for by the Inspector.

### 4.03 New Control

In addition to identifying existing primary control for each flood risk mapping project, the Inspector will prescribe the number and locations of required new control points. Any changes with respect to the location of any of these points will be subject to the approval of the Inspector.

### 4.04 Survey Procedures

Survey configurations are to be structurally sound and contain sufficient mathematical checks to confirm their validity. Except where specifically excluded, all horizontal control surveys will consist of closed traverse loops secured to two or more approved stations, with sufficient cross-ties to ensure a well-conditioned numerical adjustment. The proposed survey layout and method of implementation are subject to approval by the Inspector.

Control points for photogrammetric purposes shall form an integral part of the main survey structure, and single side shots will be avoided.

### 4.05 Monuments

The contractor shall place and/or reference permanent and temporary control monuments at the locations of required new control prescribed by the Inspector in the course of his survey. These markers shall be so placed, described, and identified so as to be easily recoverable by others for field checking purposes.

Monument density and design will be specified by the Technical Committee, subject to the approval of the Inspector.

4.06 Control Presentation

All horizontal ground control must be suitably sketched, described and numbered on one set of photos.

4.07 Accuracy

All horizontal ground control shall be established to meet third order specifications as defined in the Canada Department of Energy, Mines and Resources publication, "Specifications and Recommendations for Control Surveys and Survey Markers", August, 1973, provided the originating control to which it is referred is of a higher order and suitable checks and cross-ties have been included in the survey procedure. Otherwise, the survey procedures shall conform to the specifications for second order horizontal control as laid down in the above-mentioned publication.

4.08 Survey Returns

Field survey returns, comprehensively labelled, indexed and cross-referenced, are to be submitted for inspection and verification by the Inspector. The returns will consist of the following:

a) all original horizontal control survey notes;
b) a list of final horizontal coordinates, the method used for the network adjustment, and a tabulation of the resulting statistics;
c) calibration tables (if applicable);
d) all sketches and descriptions;
e) photo identifications and supporting data;
f) a large scale map showing the horizontal control layout; and
g) a list of all materials submitted for inspection and verification.

## Section 5. Aerial Triangulation and Numerical Adjustment

### 5.01 Scope

In areas where new mapping is required and it is not deemed feasible or expedient to the mapping program to establish the density of horizontal control as stated in 4.03 and 4.04, aerial triangulation and the subsequent numerical adjustment for the aerial surveys of the said areas undertaken will be required pursuant to Schedule C of the Federal-Provincial Flood Risk Mapping Agreement. The Inspector named therein will set the requirements and specifications for each flood risk mapping project. A horizontal only block adjustment may be required.

### 5.02 Equipment

All equipment will be first-order and subject to the approval of the Inspector.

### 5.03 Adjustment Method

The contractor shall use a strip formation and block adjustment method which must give results equivalent to the Schut NRC block adjustment. The method will be subject to approval by the Inspector.

### 5.04 Control

(a) Horizontal - control will be newly established and/or recovered existing ground control, as per Section 4, and will be pre-targeted. An attempt must be made to use all of the horizontal control supplied, and any exceptions will be subject to the approval of the Inspector.

(b) Vertical - the design of the aerial photography is such that in most cases vertical control will be established on a five vertical control points per stereo model basis, and a horizontal block adjustment only will be required. In some case a vertical block adjustment may be required.

### 5.05 Horizontal Accuracy

(a) Control - the mean square error on the position of all horizontal control points used shall be smaller than or equal to ± 45 microns, at plate scale.

(b) Ties - Not more than 10% of the half discrepancy in easting and northing (as defined on page 13 of the NRC publication AP-PR 33, "A Fortran Program for the Adjustment of Strips and of Blocks by Polynomial Transformation" - G.H. Schut) shall be greater than ± 25 microns, at plate scale or its equivalent at ground scale.

5.06 Vertical Accuracy

(a) Control - The mean square error in the vertical control points used shall be smaller than or equal to 50 microns at plate scale or 0.40% H.

(b) Ties - Not more than 10% of the half discrepancy in height (as defined on page 13 of the NRC Publication AP-PR33, "A Fortran Program for the Adjustment of Strips and Blocks by Polynomial Transformation" - G.H. Schut), on the photogrammetric ties shall be greater than 45 microns at plate scale or its equivalent at ground scale.

5.07 Index

All coding will be shown in the form of a neat model index shown on the largest scale National Topographic Series mapping available, and will be prepared on stable base, reproducible material.

5.08 Inspection of Adjustment

In order to facilitate inspection of work done under this section, numerical adjustment data and results will be tabulated on forms similar to Appendix 1.

## Section 6. Mapping

### 6.01 Scope

Specifications for the production of topographic-planimetric maps will be outlined in this section. As stated in 1.01 and 1.03, two scales of maps will generally be produced, i.e. a mapping scale map and a publication scale map. For new mapping, these will be metric scales, unless otherwise specified by the Technical Committee, and the mapping scale will generally be greater than the publication scale, although in some cases, the two may be equal. The smallest acceptable publication scale will be 1:10,000. It is considered that a mapping scale of 1:2,000 will be the most adaptable one for this type of mapping.

In areas where adequate large scale mapping already exists at a scale inconsistent with the metric system or those stated above, the utilization of these maps for compilation, mapping, and/or publication will be at the discretion of the representative Technical Committee.

The following discussion will be concerned with the 1:10,000 publication scale and the 1:2,000 mapping scale; however, the above alternatives where other scales may be employed must be kept in mind.

The contour interval for each flood risk mapping project in (Province) will be set by the Canada-(Province) Technical Committee on Flood Risk Mapping upon the recommendation of the Inspector. Detailed compilation will be required at both the mapping scale and the publication scale along rivers (lakes, streams, etc.) to a "set-back" point inland from the shorelines. Due to the gradients along rivers (streams, etc.), some areas may require additional compilation further inland to a point to be set by the Inspector.

The datum to be used for determining the compilation limits will be set by the Technical Committee. The balance of the area to be depicted at the publication scale will be derived from the largest scale mapping available. Details on this work are covered in Section 7.

### 6.02 Projection System

All maps shall be compiled on the Universal Transverse Mercator Grid Coordinate System, unless otherwise specified by the respective Technical Committee.

### 6.03 Vertical Datum

The vertical datum to be used in the mapping shall be Mean Sea Level as established by Geodetic Survey of Canada, and will be shown in metres (and feet where applicable).

6.04 Language Requirements

All information shown on the maps shall be in English (French in Quebec). Legend details will be presented in English and French.

6.05 Description of Maps Compiled at Publication Scale

The manuscripts compiled at the publication scale will be in a full color format, as outlined in sections 7 and 8. The scale, format, dimensions and number of color separations will be specified by the Technical Committee on the recommendation of the Inspector.

For metric scales, the grid interval will be 10 centimetres at map scale converted to the ground equivalent in northings and eastings.

6.06 Description of Maps Compiled at Mapping Scale

The manuscripts compiled at the mapping scale will be in a simple black and white or monochrome form. This monochrome form will be produced through an "Ozalid", or similar, reproduction process from a set of originals scribed in cronaflex, or similar, controlled plastic film positive form. The scale, format, dimensions, and number of sets of such cronaflexes will be specified by the Technical Committee on the recommendation of the Inspector.

For a scale of 1:2,000, the grid will be shown in intervals of 200 metres in each direction; for any other mapping scale, the grid interval will be that even multiple of 100 metres which most closely approximates 10 centimetres at map scale.

6.07 Machine Manuscripts

Compilation procedures for the drafting or machine manuscripts are outlined in EMR publication, "Large Scale Topographic Mapping Manual". Additional general guidance can be obtained from the EMR publication, "Topographic Mapping Manual of Compilation Specifications and Instructions", Third Edition, 1974, and "Production Specifications for Military City Maps, Scale 1:25,000", Mapping and Charting Establishment, National Defence Headquarters, 1974.

All machine manuscripts will be drawn at either the mapping scale or the publication scale on stable base materials and may be presented in pencil form. Two final products are required: (i) a monochrome map at the mapping scale, and (ii) a monochrome map at the publication scale with separations for future multi-

color reproduction, as described in Sections 7 and 8. The number of separations at the machine manuscript stage will be left to the discretion of the Contractor. Areas may be derived at the publication scale from those compiled at the mapping scale; however, these derived areas must meet the separation requirements previously specified, and an approved registration system will be used for all separation work.

6.08 Equipment

Map compilation shall be done using first-order stereoplotters such as the Wild A-8, or equivalent.

6.09 Inspection

All machine compilation manuscripts will be subject to inspection; random stereo models will also be checked at this stage. All scribe proofs will be subject to final inspection.

6.10 Map Relief

Relief will be depicted only in the areas described by the Inspector. In some cases, the Technical Committee will decide that new mapping will be required only within an arbitrary set-back (such as 1,000 metres back from the river banks) or up to a defineable break-of-slope. In others, the Technical Committee will decide to define the new mapping area on an elevation basis. For example, the new mapping may cover a band of shoreland defined by a sloping line running parallel to, but 4 metres above the mean water mark of a given river, or a contour line 4 metres above the lake shoreline.

For the river shoreline situation where the elevation set-back line approach is used, some "rounding-off" of contour lines to the last incremental contour will be required, based on the vertical control established as per Section 3 of this Manual.

For example, with a given contour interval of 0.5 meters and a given water elevation of 19.6 metres at a point on the river, the minimum compilation limit would be 23.6 metres. The first contour would be 20.0 metres and the last, or top, contour would be 24.0 metres, for a total of nine contours to be drawn.

The term "relief" includes all those features necessary to portray the configuration and differences in heights of the land surface included on the map. In addition to the accuracies specified under Section 6.13, contours shall be drawn so as to correctly portray the character of the terrain.

Additional specifications and procedures for drawing contours and locating spot heights can be found in the Canada Department of Energy, Mines and Resources publication, "Topographic Mapping Manual of Compilation Specifications and Instructions", Third Edition, 1974.

6.11 Map Detail

The new mapping, to be compiled only within the limits as outlined under Section 6.10, Paragraph 1, shall show all topographic and planimetric detail visible on the photograph that can be clearly shown at the mapping scale and publication scale.

The detail to be shown will be that covered by the mapping specifications for the mapping and publication scales as outlined in EMR publication, "Large Scale Topographic Mapping Manual".

Where adequate existing mapping is to be utilized, it must be verified for completeness and accuracy consistent with the requirements for new mapping, as outlined in this Manual, and to the satisfaction of the Inspector.

The amount of cadastral information to be shown will be specified by the Technical Committee.

6.12 Map Accuracy

All basic information concerning the datum controlling the map, such as survey monuments, triangulation stations, projection and grid information, shall be located within ± 0.012 cm. of its true position.

All well-defined features, with the exception of those unavoidably displaced or distorted by symbolization, shall be located within ± 0.05 cm. of their true position.

The accuracies specified above relate to ground not sufficiently obscured by vegetation cover to cause significant error. In checking elevations taken from the manuscript, any vertical error may be decreased by assuming a horizontal displacement within the permissable tolerance.

6.13 Contour Accuracy

Ninety percent of all machine compiled contours will be accurate to within ± 50% of the contour interval.

Ninety percent of all spot heights shall be accurate to within 1/3 of the contour interval, and extra spot heights must be shown in the break-of-slope areas to supplement the contours.

## Section 7. Cartography

### 7.01 Scope

This section covers the cartographic requirements for the mapping scale and publication scale of the flood risk mapping. Two monochrome products are required for each flood risk mapping project, namely:

(a) a set of monochromes scribed with color separations at the publication scale, and

(b) a set of monochromes scribed at the mapping scale.

Final requirements for the manuscripts to be published call for a multi-color map and, consequently, the compilation area will require drafting using a color-separation approach. Those portions of the map sheets falling outside the compilation limits will be derived from existing 1:25,000 maps or the best available alternative.

### 7.02 Map Sheet Format

The map sheet formats will be as described in Sections 6.05 and 6.06.

### 7.03 New Compilation Area

In order to assure the production of a multi-color map of the new compilation area at a later date, the work must be scribed with separations as follows:

(a) Culture: Buildings, roads, railroads, cemeteries, bridges, hydro and telephone lines, trails, footpaths, driveways, fences, quarries, pits, etc. as specified by the Inspector.

(b) Streets: To be specified by the Inspector.

(c) Highways, Major Roads: To be specified by the Inspector.

(d) Drainage: (including storm sewers, culverts, aboiteaux, etc.). To be specified by the Inspector.

(e) Projection, Grid and Datum Features: To be specified by the Inspector.

(f) Vegetation: To be specified by the Inspector.

(g) Names: To be specified by the Inspector.

All symbols and abbreviations will be standardized on a national basis by the Inspector.

7.04 Derived Area Procedures

The portions of each map sheet that are beyond the portions compiled for the purpose of flood risk mapping shall be derived from existing maps at a scale of 1:25,000 or such other maps as are, in the opinion of the Technical Committee, adequate for the purpose.

7.05 General Procedures

All large scale mapping will be reduced to the final publication scale mapping. These reductions will be fitted to projections constructed by a co-ordinatograph or similar precision plotting device. The new compilation areas will then be masked from the enlarged separations. It is anticipated that joins between the new compilation areas and the derived areas will present some difficulties, and it may be necessary to extend detail from the new compilation areas into the derived areas to facilitate ease of tying.

The maximum displacement between the detail resulting from the new compilation or the large scale mapping will be subject to the discretion of the Inspector.

7.06 Nomenclature

Names and symbols will be provided by the Inspector at the machine compilation stage.

7.07 Inspection

For inspection purposes, a scribed proof will be assembled that will be a combined photographic paper-positive in final product form.

7.08 Drafting Specifications

Drafting will be of the highest cartographic quality. All drafting will be done by the scribe method and will conform to the specifications and instructions outlined in the Department of Energy, Mines and Resources publication "Large Scale Topographic Mapping Manual".

7.09 Final Product

The final product will be two combined cronaflex, or equivalent, stable base positives suitable for the production of diazo-type copies. With the exception of the vegetation areas (which will be screened), the new compilation and grid will appear solid.

In the derived areas, the drainage and names will appear solid. The culture, buildings, streets, highways, built-up areas and vegetation may be screened.

7.10 Material Requirements

All drafting and photographic film materials will have a minimum thickness of 0.007 inches, and will be of the highest stability and quality.

## Section 8. Printing

### 8.01 Scope

As outlined in Sections 7.01 and 7.09, the final requirements for the publication scale flood risk mapping project include the production of several hundred (in some cases, several thousand) copies of a full color map sheet.

Additionally, each sheet shall include a 1500 to 2500 word summary of the hydraulics, hydrology, history of the flooding, and the flood hazard in the area covered by that sheet.

This section outlines the specifications to be followed at the publication stage of a flood risk mapping project.

### 8.02 Topographic and Hydrographic Separation

In the planning and programming of each flood risk mapping project, it will be the task of the Technical Committee to ensure that the color separations for the publication scale topographic-planimetric mapping (covered in Sections 6 and 7 of this Manual) are augmented by an additional set of separations illustrating the extent of the designated flood and other floods as required. As a result, up to three extra separations (per map sheet) covering the hydrography will be added to the five or six topographic separations, as specififed in Sections 6 and 7 above, in order to print the final paper positives.

### 8.03 Map Printing

The Technical Committee, on the advice of the Inspector, will decide whether the separations thus achieved will be combined and printed by a contractor or a provincial or federal printing establishment.

### 8.04 Explanatory Text

In addition to the production of the flood risk maps, the Technical Committee will ensure that the accompanying explanatory text is properly written, set in type (with accompanying diagrams as appropriate), proofed and reproduced. Reproduction may take the form of an appropriate text printed on the back of a given sheet, in booklet form enclosed in a cover to which the flood risk map is attached, or any other format specified by the Technical Committee.

APPENDIX 1

AEROTRIANGULATION - NUMERICAL ADJUSTMENT DATA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

SURVEYS AND MAPPING BRANCH, TOPOGRAPHICAL SURVEY DIRECTORATE

Acrotriangulation - Numerical Adjustment Data

Contract #: _____ Location: _____ Client: _____

Contractor: _____ Contractor's Photogrammetrist: _____

Phone No.: _____ Purpose of Contract: _____

_____

Mapping Requirements: Map Scale: _____ Contour Interval: _____ Form Lines: _____

Photographic Coverage: Date: _____ Source: _____

Inspector: _____ Altitude: _____ AMGL Photo Scale: _____

Forward Overlap: _____ Lateral Overlap: _____

Horizontal Control Employed: Source: _____ Datum: _____

Triangulation: ☐ Trilateration: ☐ Aerodist: ☐ Traversing: ☐

Other: _____ Specify: _____

Vertical Control Employed: Source: _____ Datum: _____

Spirit: ☐ Trigonometric: ☐ A.P.R.: ☐ Barometer: ☐

Other: _____ Specify: _____

Horizontal Control Identification: Pre-targeted Control Points: ☐ Field Ident.: ☐

Reference Measurements: ☐ Low Alt. Photography Ident.: ☐

Other: _____ Specify: _____

Coding System: Range/Identification of Code Numbers

| Horizontal | | Vertical | | Photogrammetric Tie: | |
|---|---|---|---|---|---|
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## Aerotriangulation & Numerical Adjustment

Equipment: Point Transfer Device: _____ Stereoplotter: _____

Stereo/Mono Comparator: _____ Electronic Readout Device: _____

Block Adjustment Method: _____

Contract No.: _____ Numerical Adjustment Data _____ Submittal

Table of Values

| Strip No. | No. of Models | Degree of Adjust. | Number of Points Held to / Number of Points Rejected | | | Remarks |
|---|---|---|---|---|---|---|
| | | | Horizontal | Vertical | Photogram. Ties | |
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Standard Deviation in Eastings _____ meters; Plate Scale: _____ µm
Standard Deviation in Northings _____ meters; Plate Scale: _____ µm
Standard Deviation in Elevation _____ meters; Plate Scale: _____ µm

Adjustment approved by: | Date:

Adjustment rejected by:

(Restrictions/Remarks)