
General Specifications for Aeronautical Surveys

Volume III Airport Ground Surveys

Pilot Project, Second Edition, January 2001

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National
Geodetic
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**AIRPORT GROUND SURVEYS
GENERAL SPECIFICATIONS
for the
AERONAUTICAL SURVEY PROGRAM
NATIONAL GEODETIC SURVEY**

**NATIONAL OCEAN SERVICE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION**

DRAFT



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AIRPORT GROUND SURVEYS GENERAL SPECIFICATIONS for the AERONAUTICAL SURVEY PROGRAM NATIONAL GEODETIC SURVEY

1. INTRODUCTION

These General Specifications list requirements for ground surveys at airports needed to support the Aeronautical Survey Program (ASP). The ASP is administered by the National Geodetic Survey (NGS), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA) in accordance with a Federal Aviation Administration (FAA)/ NOAA Interagency Agreement. For additional information, see: <http://www.ngs.noaa.gov/AERO/AboutUs.htm>.

2. ADMINISTRATION

2.1 SPECIFICATIONS - These General Specifications provide general standards and specifications for the airport ground surveys required by NGS. In addition, the Contractor will be issued a set of Supplemental Instructions (or scope of work) for each airport. The Supplemental Instructions will take precedence over the General Specifications since the Supplemental Instructions provide detailed and often unique information about each airport in the Project. The requirements for reporting deviations, unusual circumstances, etc. described in the following paragraphs, apply to the General Specifications and to the Supplemental Instructions.

2.2 CONVENTIONS - The following conventions have been adopted for this Project. The term “should” implies that compliance is not required, but is strongly recommended. The terms “shall,” “will,” and “must” mean that compliance is mandatory. The contraction “N/A” means not applicable. The term “position” means horizontal position (latitude and longitude) unless specified otherwise. The term “elevation” means the distance of a point above a specified datum, measured along the direction of gravity. The term “vertical” refers to the direction in which the force of gravity acts. The term “height” means the distance, measured along a perpendicular, between a point and a datum. See Section 4.

2.3 GENERAL REQUIREMENTS - The Contractor will provide all labor, equipment, supplies and material to produce and deliver data and related products as required under these General Specifications. The Contractor will be responsible for ensuring that all employees (including sub-contractors) meet all airport security requirements and that they make arrangements for escorts, radios, training, and any other airport authority requirements.



2.4 MODIFICATIONS - All requests for modifications shall be submitted by the Contractor in writing to the Contracting Officer (CO) prior to the due date and as soon as possible. Send a copy to the NGS points of contact listed in Section 13.

2.5 UNUSUAL CIRCUMSTANCES - The Contractor will notify the CO and NGS of any unusual circumstances that occur during the performance of these General Specifications which might affect the deliverables or their quality (see Sections 6 & 7). Especially note any deviation from these General Specifications, except those specified in the Supplemental Instructions.

2.6 REPORTS - Thorough reporting is required. The Contractor will submit a project status report via email each week and a Project Completion Report for each airport. In addition, a Quality Control Plan (see Section 7) and a Survey Plan (see Section 10) will be submitted.

2.7 MAINTENANCE AND CALIBRATION - All surveying equipment used on this Project will have maintenance logs showing routine preventative maintenance and repairs, and Electronic Distance Measuring Instruments (EDMI) will have been calibrated on an EDM Calibration Base Line (CBL). Equipment model and serial numbers, and EDM calibrations will be included in the Project Completion Report. For information on CBL see: <http://www.ngs.noaa.gov/CBLINES/calibration.html> NGS has additional written material explaining the use of CBL. If a hand-held EDM is used, its distance measuring accuracy will be compared to a distance measured with a calibrated EDM, and the results reported in the Project Completion Report.

2.8 ORIGINAL DATA - Observation logs and other original records generated during this project are legal records which will be retained for data accountability and stored in the National Archives. It is very important that these logs be original, legible, neat, clear, and fully completed in indelible black ink. Original data will be saved, unmodified, whether in hand written or computer recorded form. In the original records (paper or digital), nothing is to be erased or obliterated. All available spaces on the recording forms should be completed. If a mistake is made on a form, draw a single line through the mistake and write the correction above or to the side. If space is too limited to permit a field correction, restart with a new log sheet, however, do not recopy the form in the office in order to make a "clean" copy. An explanatory note should be made for all corrections to the original recorded figures. It is essential that all recorded information be neat and legible. All editing of computer recorded data will be done on a copy of the original. Always submit the original version of the data, not a hand-made copy nor a photocopy nor a digital copy.



3. GOVERNMENT SUPPLIED MATERIALS

The following items will be supplied, if applicable:

- 3.1 Transmittal Letter
 - 3.2 Supplemental Instructions
 - 3.3 Runway End Sketches (if available)
 - 3.4 Contact Photographs
 - 3.5 Enlarged Photographic Prints
 - 3.6 Field Plot Sheet
 - 3.7 Quadrangles
 - 3.8 Appropriate pages from U.S. Terminal Procedures (Approach Plates)
 - 3.9 Appropriate pages from Airport/Facility Directory
 - 3.10 FAA National Flight Data Digest (NFDD), if applicable
 - 3.11 Obstruction Surface Analysis (OSA)
 - 3.12 CD-ROM containing scanned images from the NGS Airport Record Package, if available.
 - 3.13 CD-ROM containing Digital Exchange File, and General and Supplemental Instructions
 - 3.14 FAA Form 5010, Airport Master Record
 - 3.15 Brass disks, pre-stamped with NGS standard stamping
 - 3.16 Survey nails with survey washers, pre-stamped with "NGS"
- See Attachment A for explanations of items listed above.

4. REFERENCE SYSTEMS

- 4.1 HORIZONTAL REFERENCE - NAD 83 (19XX OR 20XX, year of latest adjustment)
NAD 83 = North American Datum of 1983
Note, the year of adjustment is on the NGS Data Sheet next to the latitude and longitude.

4.2 VERTICAL REFERENCE:

Orthometric heights - NAVD 88; For information on NAVD 88 see:

http://www.ngs.noaa.gov/PUBS_LIB/NAVD88/navd88report.htm

NAVD 88 = North American Vertical Datum of 1988

Ellipsoidal heights - NAD 83 (GRS 80)

- 4.3 REFERENCE SYSTEM - Ground control will be tied to the NGS Continuously Operating Reference System (CORS).

For information on the National Spatial Reference System (NSRS) see:

http://www.ngs.noaa.gov:80/~george/ds_description.html

For information on CORS see: <http://www.ngs.noaa.gov/CORS/>

For information on the High Accuracy Reference Network (HARN) see:

<http://www.ngs.noaa.gov:80/faq.shtml>



4.4 GEOID MODEL - GEOID 99, or later, current version

For information see: <http://www.ngs.noaa.gov/GEOID/GEOID99/geoid99.html>

For explanations of many of the terms in Section 4, see: <http://www.ngs.noaa.gov:80/faq.shtml>

5. REFERENCES AND GLOSSARIES

5.1 REFERENCES - Note, the Contractor MUST become thoroughly familiar with reference A.

A. STANDARDS FOR AERONAUTICAL SURVEYS AND RELATED PRODUCTS, FAA No. 405, Fourth Edition, September 1996, including Change 1, April 1998. This document is available as two separate Adobe Acrobat files at:

<http://www.ngs.noaa.gov/AERO/FAA405.htm>

B. RUNWAY END, STOPWAY END, AND DISPLACED THRESHOLD IDENTIFICATION FOR SURVEYORS, First Edition, January 1998. This document is available as two separate Adobe Acrobat files at:

<http://www.ngs.noaa.gov/AERO/rwyman.htm>

C. GENERAL SPECIFICATIONS FOR AERONAUTICAL SURVEYS, VOLUME 1, June 2000, National Geodetic Survey. This document is available as six separate Adobe Acrobat files at: <http://www.ngs.noaa.gov/AERO/Supinst.html>

D. INPUT FORMATS AND SPECIFICATIONS OF THE NATIONAL GEODETIC SURVEY DATA BASE, The "Bluebook", <http://www.ngs.noaa.gov/FGCS/BlueBook/>

E. DOT/FAA Advisory Circular No. 150/5340-1H, "STANDARDS FOR AIRPORT MARKINGS," 1999. This document is available as four separate Adobe Acrobat files at: http://www.faa.gov/arp/150acs.htm#Airport_Combpliance . Scroll down to "150/5340-1H"

F. DOT/FAA/AS-90-3, "A GUIDE TO GROUND VEHICLE OPERATIONS ON THE AIRPORT," 1990.

G. DOT/FAA Advisory Circular No. 150/5340-18C, "STANDARDS FOR AIRPORT SIGN SYSTEMS," 1991.

H. NGS ASP WWW Site: <http://www.ngs.noaa.gov/AERO/aero.html>

I. Exchange File Format Documentation is available on-line at: http://www.ngs.noaa.gov/PUBS_LIB/pub_index.html



J. FAA WWW site for location identifiers:

<http://www.FAA.GOV/ATPUBS/LID/LIDHME.HTM>

K. FAA WWW site for airport managers: <http://www.FAA.GOV/Arp/5010rpt.htm>

L. U.S. Terminal Procedures (source: FAA Aeronautical chart agents)

M. Airport/Facility Directory (source: FAA Aeronautical chart agents)

5.2 GLOSSARIES

A. GLOSSARY attached to FAA No. 405, NGS, 1996. Also see Appendix 6: CONTRACTIONS. Both in "Part 2" available at:

<http://www.ngs.noaa.gov/AERO/FAA405.htm>

B. GLOSSARY attached to GENERAL SPECIFICATIONS FOR AERONAUTICAL SURVEYS, VOLUME 1,, page 36, NGS, 2000. Available at:

<http://www.ngs.noaa.gov/AERO/Supinst.html>

C. GEODETIC GLOSSARY, NGS, 1986. (Not available on the WWW. For a printed copy call NGS (301) 713-324 or email: info_center@ngs.noaa.gov)

D. AERONAUTICAL INFORMATION MANUAL, esp. Appendix PILOT/CONTROLLER GLOSSARY (PCG), FAA, 2000. PCG available at:

<http://www.faa.gov/atpubs/pcg/pcgtoc.htm>

6. ACCURACY AND RELIABILITY

The data collected for the Aeronautical Survey Program is critical to the operation and safety of the National Airspace System. The data collected for this Project include runway end positions and runway vertical profiles, positions and elevations of navigational aids (NAVAIDS), positions and elevations of obstructions, and, if a Secondary Airport Control Station (SACS) replacement is required, accurately positioned airport geodetic control. The accuracy of this data must meet the standards published in FAA No. 405 and these General Specifications. The reliability of this data must be of the highest possible quality. This data is classified as critical by the International Civil Aviation Organization (ICAO), the United Nations organization formed in 1947 to help assure "that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically". ICAO defines data as critical when "there is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe."

Accuracy requirements are in FAA No. 405, Appendix 5.



7. QUALITY CONTROL

The Contractor must check all data to ensure that it is complete, reliable, and accurate. The Contractor's personnel will become thoroughly familiar with the General Specifications, with Attachments; the Supplemental Instructions; the FAA No. 405; the definitions of aeronautical and surveying terms; and with the material covered in the other references and publications, as required. See Section 5 for a list of References and Glossaries.

Prior to beginning survey work on this Project, the Contractor will submit a written Quality Control Plan covering all work, to include at least the following requirements: a check of all manual computations (including check marks and initials) , a check of all manual data computer entries, a check of file formats, and a check of all reports and data submitted. Also discuss how data will be backed-up and how it will be ensured that original data is not modified. See Section 12, Deliverables.

The Project Completion Report will include, at least, a written description and analysis of the quality control performed; tables showing check positions (e.g. Primary Airport Control Station (PACS) and SACS), a listing and analysis of all unusual circumstances, discrepancies, and deviations; and include the Quality Control Plan. See Attachment I for the Project Completion Report format.

8. DATA FORMATS

8.1 ORIGINAL DATA - Original, raw digital data will be submitted and their formats will be documented in the Project Completion Report. Original paper records will also be submitted, see Section 2.8. Observations for positioning marked points will be submitted in Blue Book format, see Section 8.3.

8.2 FINAL DATA - Final position and elevation data will be submitted in the Exchange File Format. Final runway profile data will also be in Exchange File format. Sketches, photos, reports, etc will not be in the Exchange File format, but both paper and digital copies will be submitted. The documentation for the Exchange File Format is a user's guide for preparing and submitting data for storage in the NGS Obstruction Chart Database (OCDB). It provides, in detail, the format and structure of every field allowable by the OCDB. Also included are dependencies, field widths, record order requirements, and field choice lists. The document is available on-line at: http://www.ngs.noaa.gov/PUBS_LIB/pub_index.html. See also Attachment E.

8.3 RUNWAY END POINTS, STOPWAY END POINTS, & DISPLACED THRESHOLDS - Observations for these points will be submitted in Blue Book format, and their positions will be submitted in Exchange File format. See Reference B.



8.4 SACS - If a SACS is replaced (see Section 11.7), its data and description will be submitted in Blue Book format, and the field adjusted position and elevation in Exchange File Format.

9. DATA MEDIUM, FILE NAMING CONVENTION & AIRPORT RECORDS

9.1 DATA MEDIUM:
CD-ROM

9.2 FILE NAMING CONVENTION
See Attachment C.

9.3 DATA LABELING - All data submitted by the Contractor must carry the following identifying information:

- A. Airport associated city
- B. Airport name
- C. Airport Location Identifier as listed in FAA Order 7350.7A (see the following www site: <http://www.FAA.GOV/ATPUBS/LID/LIDHME.HTM>)
- D. Airport AL number as listed in the U.S. Government Flight Information Publication - U.S. Terminal Procedures.

10. SURVEY METHODOLOGY

Ground surveying methods will be used for all work in these Airport Ground Surveys, General Specifications.

Prior to beginning any field work, the Contractor will submit a proposed Survey Plan to NGS. This Plan will describe proposed: surveying techniques, connections to existing control, survey instrumentation (models and specifications), observing plans, data collection methods, data processing methods, and quality control (including error analysis), see Section 7. Include a listing of all hardware and software that may be used. See Section 12, Deliverables.

Horizontal surveying accuracies required for this work vary from 1.2 in (3 cm) to 100 feet (30.5 m), and vertical accuracies vary from 1.6 in (4 cm) to 100 feet (30.5 m). Consequently, survey methods may vary considerably. Conventional techniques (traverse, triangulation, etc.) may be used and satellite positioning techniques (kinematic GPS, static GPS, etc.) may also be used as long as all methods meet the accuracy requirements listed in FAA No. 405. When not specified otherwise, standard surveying practices will be followed. Other new methodologies will be considered for approval if fully explained and justified in the Survey Plan.



11. SURVEY WORK

11.1 PURPOSE - The data collected for the Aeronautical Survey Program is critical to the operation and safety of the National Airspace System. The data is used to develop instrument approach and departure procedures, to certify airports for certain types of operations, to determine maximum takeoff weights, to update aeronautical publications, to provide geodetic control for engineering projects, to assist in airport planning and land use studies, and for other miscellaneous activities.

11.2 DATA - The data collected in the Project will include: accurate positions and elevations of specific points along runways, runway vertical profiles, positions and elevations of NAVAIDS, positions and elevations of obstructions, and, if SACS replacement is required, accurately positioned airport geodetic control. The accuracy of this data must meet the standards published in FAA No. 405 and these General Specifications.

11.3 REVIEW PRIOR SURVEY DATA - The Contractor will review the package of data from NGS containing records from previous airport surveys. A review of this data may provide information about future construction plans, problems encountered on past surveys and a general overview of the project. The Supplemental Instructions will state whether the airport will be surveyed with Airport Obstruction Chart (AOC) and/or Area Navigation Approach (ANA) requirements. See FAA No. 405, Section 2 for AOC information and Section 3 for ANA information.

Information about survey monuments on record with NGS is published in a Digital Survey DATA (DSDATA) format. A partial list of information contained on the NGS data sheets includes: designation, Permanent Identifier (PID), latitude, longitude, orthometric and ellipsoidal elevation, geoid height, horizontal and vertical order, stamping, stability, and station description. A complete list of the information contained on the Data Sheets and a detailed description of the DSDATA format can be obtained at the following website:

<http://www.ngs.noaa.gov/datasheet.html>. The Contractor will download current data sheets for PACS, SACS, and other stations in the vicinity of each airport.

11.4 CONTACT WITH AIRPORT AUTHORITIES - Before entry into any airport area not open to the general public, the Contractor shall discuss the project with appropriate airport authorities and obtain permission to operate on the airport. Close communication with airport management is critical. Appointments with airport management should be made well in advance to ensure a qualified airport representative is available to discuss the survey and the procedures for working on the airport. Proper clearances to work in the aircraft operations areas must be obtained before performing any work at an airport. A security and safety briefing may be required before field crews are allowed to work on the airfield. Follow standard safety procedures and equip all vehicles with flashing yellow lights and aircraft radios. Contact with the airport traffic control tower is mandatory during surveys at controlled airports unless an escort is provided. See also Section 2.3.



INTERVIEWS - The Contractor will conduct interviews with the following personnel, as possible: airport manager/operations, airport engineering, FAA air traffic control, and FAA airway facilities. Note, smaller airports will not have persons in all of these capacities. The contractor will complete the checklists in Attachment B and have them signed/dated by the airport official and the Contractor's employee.

During the survey, additional meetings may be required to discuss unusual circumstances, problems, or newly determined runway lengths that differ from published, see Section 11.11. Provide a summary of all such meetings in the Project Completion Report.

If it is determined that a replacement SACS(s) is required, discuss, with airport officials, optimal locations for the practical use and survivability of the SACS monument. Inquire about underground utilities and other hazards to setting monuments. Emphasize the importance of keeping the area surrounding the monuments clear of any future equipment installations or construction that may block intervisibility between the monuments, visibility to GPS satellites, or become a source of multipath interference.

After the survey is complete, meet again with the airport authorities. Turn in any badges, passes, or keys, discuss any significant and/or unusual findings, and notify them of your departure. Avoid discussing specific obstruction problems at this time since the data has not been verified. Especially avoid any statements about approaches being "clear" since the data is unverified and the requirements may vary.

11.5 RECONNAISSANCE - If the Airport Authority offers a "familiarization ride" around the airport with one of their employees, it is almost always a good idea to accept; both as a gesture of good faith and also to learn any shortcuts, trouble areas, or unique problems with the airport. The first independent recon should include recovering control stations, verifying navigational facilities, and generally watching for significant changes since the last survey. The field person should watch for new navigational facilities, new or changed taxiways and ramps, and obvious clearing of obstructions using the previous survey data (if available) and the current photographs for comparison to the actual conditions.

11.6 EXISTING SURVEY MARKS

A. PACS & SACS - The three main survey marks are: one Primary Airport Control Station (PACS) and two Secondary Airport Control Stations (SACS). The Contractor will recover the one PACS and two SACS at each airport. Each airport should have these three NGS survey marks in place, and may have other, older NOAA marks. A listing of airports with PACS and SACS and the dates that they were observed is available at: <http://www.ngs.noaa.gov/AERO/pacsacstat/pacsacstat.htm>. PACS are set to meet high-stability standards and are positioned to meet high accuracy standards using two 4+ hour static GPS sessions from the nearest NGS CORS. In addition, ties are required to two nearby NGS bench marks and to a HARN station. SACS have slightly less stringent stability and positioning specifications. For full requirements for PACS and SACS see



Reference C. The PACS and SACS at each airport will be used as starting control for all surveys at that airport. If a GPS fixed station is used, it should be centered over the PACS, if possible. Take photographs for PACS and SACS as required in Section 11.12.

B. OTHER SURVEY MARKS - Other NGS, NOS, and/or USC&GS survey control may also exist on the airport, see Attachment H for identification diagrams. For up to five of these marks per airport, recover them and submit digital recovery notes for them as described in Section 11.7 B. In addition, control set by other agencies may exist on airports. These marks will not be used unless the mark meets all site and stability requirements and no NOAA marks meet requirements. Contact NGS for approval.

11.7 UNUSABLE MARKS & NEW SITE SELECTION

A. PACS - If the PACS is not found, is destroyed, is damaged, or is not usable for some other reason, contact NGS immediately. NGS will review the situation and may reschedule the contract work at this airport.

B. SACS - If one or both SACS is not found, is destroyed, is damaged, or is not usable for some other reason, search the airport and vicinity for other NGS, NOS, or USC&GS marks that might be used as substitute SACS(s). Mark descriptions may be found by clicking on "data sheets" at the NGS Home Page <http://www.ngs.noaa.gov/> and clicking on "Radial Search". For SACS requirements see Reference C (Volume I), especially Sections 2 and 3; and Reference A (FAA No. 405, Appendix 3). Also consider setting new marks. Proposed sites for new marks should be discussed with airport management. Inquire about underground utilities and future construction that might affect mark longevity. For public and/or off-airport areas, "MISS UTILITY" type services should be contacted before driving rod or digging, and may be required by state or local regulation. A summary of SACS site selection considerations follows (for complete requirements see References A & C):

- i. Setting conditions effecting stability (dirt, bedrock, etc.),
- ii. Stability code of proposed new mark, see Attachment 8 of Reference C (Bronze disks set in rock outcrops, massive structures, or in concrete monuments will be used for new SACS),
- iii. Inter-visibility with other PACS and SACS,
- iv. Elevated site with visibility to airport features such as runways, NAVAIDS, and obstructions off the end of runways (ideally close to runway end),
- v. Distance from runway (old stations at least 15 m, new at least 60 m),
- vi. Accessibility,
- vii. Security for survey equipment left unattended,
- viii. Predicted survivability,
- ix Use by either conventional (optical) or satellite surveying equipment,
- x. Any previous high accuracy connection to the NSRS, and
- xi. Contractor mark setting capability.



After recovering additional marks and discussing potential new mark sites with airport officials, prepare a brief report considering the requirements in the References and listed above, and send the report to NGS via email with the following information: A list of all marks recovered on or near the airport (USC&GS, NOS, & NGS) and a recommendation as to which existing station(s) meet all SACS requirements and should be used as a replacement; and if a new mark(s) is recommended, list how each site meets the SACS considerations listed above. NGS will review the situation as quickly as possible and will make a determination as to how to proceed.

11.8 NEW SURVEY POINTS

A. SACS - If the Contractor recommends and NGS approves, a replacement SACS will be set, observed, adjusted, data submitted in Blue Book format, and field adjusted position submitted in the Exchange File. Complete specifications may be found in Reference C.

B. OTHER NEW POINTS - Additional temporary survey points may be set, if required.

11.9 DESCRIPTIONS OF NEW MARKS AND RECOVERY OF EXISTING SURVEY MARKS

NGS-style digital station descriptions or recovery notes shall be written for all marks set, searched for, recovered, or occupied during the survey (except for temporary points). The descriptions and recovery notes will be submitted in digital (D-file) format in accordance with chapter 3, Vol. I, of Input Formats and Specifications for the NGS Data Base (Blue book). (The Blue Book is available on the NGS web site: <http://www.ngs.noaa.gov/FGCS/BlueBook/> Hard Copy of the Blue Book can be obtained from NGS Information Services Branch (301) 713-3242. The latest version of NGS DDPROC software should be used to write the descriptions in the proper D-file format, see: http://www.ngs.noaa.gov/PC_PROD/Catalog/software.htm . Standard NGS format will be used for all descriptions.

Descriptions are one of the end products of surveying, along with the positions and the survey marks themselves. All three must be of highest quality. The descriptions must be complete, accurate, and in standardized format if the station is to be reliably recovered for use in the future.

Descriptions will be in the standard NGS format of three paragraphs. A "**description**" details the location of a new survey mark, or one not previously in the NGS digital database. A "**recovery note**" is an update and/or refinement to a description already in the NGS digital database, written upon a return visit to a survey mark. If an existing NGS horizontal or USC&GS triangulation station digital description is complete, accurate, and meets Blue Book requirements, the station may be recovered with a brief recovery note, such as "Recovered as Described." If minor changes or additions to the description are required, they may be added after the above phrase, such as "Recovered as described, except a new wooden fence is now 3 meters north of the station." Major changes require a complete, new, three-paragraph recovery note. General description requirements are given in Chapter 3 of the Blue Book, page 3-1. Descriptions and Recovery notes must be properly encoded into a D-file by using NGS DDPROC software.



Descriptions and recovery notes must be written by one person and checked by another. For example, a mark setter can draft a description immediately after setting the mark, and an observer can check a description during observations. Descriptions should be written immediately after visiting a station so that all details are fresh.

A complete, new, three-paragraph description is required for stations where:

- There is no NSRS digital description (not in NGS database)
- For all vertical stations (bench marks) unless a complete (usually three paragraph), accurate, up-to-date digital description exists in the NGS database.
- Where major changes have occurred, major inaccuracies found, or where required information is missing.
- Generally for stations other than NGS horizontal or USC&GS triangulation stations.

For full descriptions and recovery note requirements, see Section 2.8 and Attachment 5 of Reference C.

A recovery note is not required if a complete, accurate, digital description or recovery note was written within 1 year of the date of the new recovery.

11.10 VERIFICATION OF EXISTING SURVEY MARKS -

Observe two independent GPS sessions, at least 10-minutes long with a 5 second collection interval, between the PACS and each SACS, or measure the distance between the PACS and each SACS using a calibrated EDM, and compute an inverse distance. Using the NGS program INVERS3D (available on the NGS WWW site, under "Geodetic Tool Kit"), compute the inverse distance between the published positions of the PACS and each SACS. Then compare the newly measured distances or inverse distances (from new observations) against the distances determined from the published positions. Also obtain elevation checks either from GPS observations or from spirit levels.

To check, the distances must agree within 3 cm, the difference in ellipsoidal height must agree to +/- 4 cm, and the difference in orthometric height must agree to +/- 5 cm. If a distance or height does not agree, reobserve that SACS using GPS. Observe two, independent, 2 hour GPS sessions, see Reference C, Section 4.3.3 SACS, for complete specifications.

11.11 SURVEY WORK - GENERAL

The Supplemental Instructions for each airport will list the work required at each airport.

A. RUNWAYS - Runway lengths, widths, and profiles will be surveyed for all runways which have not been tied to the PACS and SACS, where changes have affected these measurements, and/or for runways not in the NGS database. These changes include: changes in the length of a runway, changes in the width of a runway, and/or re-surfacing of a runway (with any appreciable thickness). The Supplemental Instructions for each airport will list which runways must be surveyed. In addition, certain additional points along each runway must be surveyed, see below.



B. SPECIFIC POINTS - For all runways previously tied to the PACS and SACS , visually verify the survey nails and washers marking runway ends, displaced thresholds, and stopways by comparing current conditions to the runway sketches from previous surveys. If the survey nail and washer are in place and agree with the sketch, and there has been no other change that would now prohibit the point as defining the end, then this point does not need to be resurveyed. If a survey nail is missing, replace the point with a survey nail and washer, and position the new point. Use Reference B as a guide.

BLUE-BOOK SURVEY NAIL NAMING CONVENTION

Runway end points are named “AAA CL END RWY NNT” (where AAA = LID, CL = centerline, END = end, RWY = runway, “NN” is the runway number and “T” is the runway type (“L” for left, “C” for center, or “R” for right). Note, the LID is sometimes four rather than three characters. Samples: “LAX CL END RWY 12C” and “MSY CL END RWY 25”.

For the GPS four character abbreviation, use “RNNT”, where R = runway (note, for unpaved runways substitute “U” for “R”), NN as above, and “T” is the runway type (“1” for standard runways, “L” for left, “C” for center, or “R” for right). Note the addition of the “1” is for the GPS abbreviation only. Samples of GPS abbreviated designations for full designations above: “R12C” and “R251”.

Displaced thresholds are named “AAA DSPLCD THR NNT” (where AAA = LID, DSPLCD THR = displaced threshold, and NNT as above. For the GPS four character abbreviation use DNNT, where D = displaced threshold and NNT as above.

Stopways are named “AAA STOPWAY NNT” (where AAA = LID, STOPWAY = stopway, and NNT as above. For the GPS four character abbreviation use SNNT, where S = stopway and NNT as above.

In the Exchange File, the runway end point is designated solely by the runway number (NNT).

If a runway is unpaved, report this in the final report, and in the Exchange File, R-10 record, and on the Sketch.

Elevations and/or positions of specific points along runways, both marked runway points and “additional” runway points, will be determined as listed in FAA No. 405, Section 3, Table 3.1. If GPS is used, observe two independent GPS sessions at least 5-minutes long with a 5-second collection interval. Take photographs of all newly surveyed survey nails as required in Section 11.12.



C. LENGTHS - Runway lengths are determined from the positions of the runway end points using INVERS3D software as described in Section 11.10. The runway end point positions will be determined using GPS or by traditional survey methods (i.e., by means of angles and distances). Runway lengths will be computed while at the airport and compared to the lengths published in the Airport Facility Directory. If the computed length, rounded to the nearest foot, is shorter than the published length and the difference cannot be attributed to a runway change, review the points identified as the runway end points and contact NGS for further advice. This is especially important if the published length is a multiple of 500 feet.

D. WIDTHS - Measure runway widths with a tape measure to the nearest tenth of a foot (0.1 ft) and submit the actual dimension measured on the runway end sketch. For loading the width in the Exchange File format, use the following rounding convention: if the runway width is under 100 feet, round the width up to the nearest 5 feet. If the runway width is over 100 feet, round the width to the nearest 10 feet. If the rounded width is different from the published width, contact NGS for further advice.

E. PROFILES - Positions and elevations (on the runway centerline) are required at certain marked points, at certain points abeam various NAVAIDS, and at intermediate points to establish the elevation of the airport and to define the gradients of the runway. Note, the point abeam mentioned in FAA No. 405, Tables 2.1 and 3.1 is the point on the runway centerline where a perpendicular dropped from the NAVAID intersects the runway centerline. This point will be computed from the position of the object and the known centerline of the runway using plane geometry.

Runway profiles may be obtained from GPS observations or from spirit level/EDM observations. In either case, profiles must begin and end on the runway end points. Required profile point accuracies are listed in FAA No. 405, Appendix 5, Section 2.7. If GPS is used to determine runway profiles, data will be collected twice. If GPS is collected while in motion (e.g., kinematic GPS), collect one data set in each direction. All spirit level lines will be closed on known elevation points.

Three methods to collect profiles:

- i. Spirit levels - Collect elevations and positions at all points required by FAA No. 405, at other points spaced no greater than 600 feet, and at any points of apparent change in grade,
- ii. GPS (Option 1) - Collect elevations and positions at all points required by FAA NO. 405, at other points spaced no greater than 600 feet and at any points of apparent change in grade,
- iii. GPS (Option 2) - Collect elevations and positions every 50 feet along the runway, and interpolate the required intermediate points. See FAA No. 405, Tables 2.1 and 3.1.

F. BLASTPAD - Measure or determine the length and width of the blastpad to the nearest 1 foot.



11.12 PHOTOGRAPHS AND SKETCHES

PHOTOGRAPHS

A. PACS, SACS, and other NGS marks - Capture digital photographs #1, #2, and #3, as described below. NGS may add these photographs to the NGS on-line database.

B. SURVEY NAILS/WASHERS - Capture all five digital photographs, as described below, of all survey nail/ washers (those marking runway ends, thresholds, and stopways). See samples in Attachment K.

C. NAVAIDS - Take at least one photograph of all NAVAIDS surveyed, similar to #3, below. Show the survey tripod in place to indicate the exact point surveyed, or if positioned remotely, add arrows and labels to the photograph indicating the point(s) surveyed. For points that can't be occupied, submit a photograph with the horizontal and vertical survey points labeled. See samples on the NGS WWW site.

D. PHOTOGRAMMETRIC CONTROL POINTS - Take two photographs of all photogrammetric control points, similar to #3 below. The two photographs should be taken from two different directions, ideally 90 degrees apart (such as from the East and from the South).

Photograph #1 (Close-up) - This photograph will show the mark from directly above and cover an area about 6-12 inches in diameter. It will show the stamping clearly.

Photograph #2 (Eye-Level) - This photograph will show the mark from directly above and cover an area about 1 meter in diameter.

Photograph #3 (Horizontal View(s)) - This photograph will show the mark in the foreground, and the nearest identifiable feature in the background (paint markings, runway lights, satellite obstructions, etc.).

Photograph #4 (Approach View) - This photograph will show the mark in the foreground and have the runway approach in the background.

Photograph #5 (Side View) - This photograph will be taken from the side of the runway (and/or stopway) looking across the end of the runway (and/or stopway), with an arrow pointing to the runway end point (and/or stopway).

SIGN - Place a sign in photographs #2 through #5 containing the station designation (name) in large, clear, printed letters. For photograph #3 include the cardinal direction (N, NE, etc.) the photograph is looking.



DIGITAL PHOTOGRAPH FORMAT AND FILE NAMING - See Attachment M for format, file naming, and other photographic details.

CAPTION - The photographer will write a caption for each photograph. The format and file naming convention for the caption is described Attachment M. Note, for photographs of nails and washers, omit the “station type” from the later portion of the caption since the station type is included in the designation.

See Attachment K and (<http://www.ngs.noaa.gov>) for examples of the required photographs.

Submit both a color hardcopy and color digital copy of each photograph to NGS. The photographs shall be included in the Project Completion Report and may be published on the NGS web site.

SKETCHES - Make sketches of all points surveyed. See samples in Attachment L.

11.13 PHOTOGRAMMETRIC CONTROL POINTS - The Supplemental Instructions will provide general locations and type (horizontal and/or vertical) for the required control points. Generally, two horizontal and one vertical control points are required in each designated area (or box). The Contractor will identify points per recommendations in Attachment J, draw a sketch of each point, take two photographs of each point, and determine the position and/or elevation of the control points (as required by the Supplemental Instructions). A stereoscope should be used. The control points must be visible on all photographs of the area. Prick the positions of photograph control points on one photograph and label the points on the front side of the photograph. An annotation leader (line) may be used to lead to the text in congested areas on the photograph. See Attachment J for additional information on photogrammetric control points. The control point naming convention is described in Attachment E, Section 1.6. See sample photographs of acceptable photogrammetric control points in Attachment K.

11.14 NAVIGATION AIDS (NAVAIDS) - NAVAIDS required to be surveyed are listed in FAA No. 405. The Supplemental Instructions will list which NAVAIDS need to be surveyed at each airport, and this list will include all NAVAIDS that have not been tied to the PACS/SACS at that airport. Also survey any new NAVAIDS and any that have moved since the last survey. Ask airport officials for information about NAVAIDS. Determine the horizontal and/or vertical positions of NAVAIDS as specified in FAA No. 405, taking extra care to ensure that the correct point on each NAVAID is surveyed. For any NAVAIDS off the airfield, provide sketches, with dimensions, showing the NAVAID and its compound (area). Note, some NAVAIDS may be as much as 10 nautical miles away from the airport.

Plot all NAVAIDS on the aerial photography. If the NAVAID is beyond the coverage of the aerial photography, plot the NAVAID on the USGS quadrangle map. NAVAIDS are discussed in FAA No. 405, Section 2-5 and Section 3-5, and listed in Appendix 4. Accuracy requirements



are in FAA No. 405, Appendix 5. Include a list of all visual and all electronic NAVAIDS on the Facilities Abstract.

11.15 OBSTRUCTIONS - Determine the positions and elevations of all obstructions required by FAA No. 405, Section 2-6 and Section 3-6. The Supplemental Instructions for each airport will identify the type of survey (AOC and/or ANA) and the Obstruction Identification Surfaces (OIS) for that airport/runway. For obstructions in the Exchange File, make observations to verify that the obstruction being examined is the same as previously surveyed, and that the position and elevation are correct. If the obstruction's new position and top elevation agree with the published data within the FAA No. 405 accuracy tolerances, submit the data and the mis-closure, but do not update the position or top elevation in the Exchange File. If the obstruction can not be verified in position, mark it for deletion and survey a replacement obstruction. Enter the new position and top elevation into a new feature record in the Exchange File. If the obstruction can be verified in position but not in top elevation, submit the data and the size of the checks while retaining the published position and updating the top elevation in the Exchange File.

Determine if any new obstructions are present and determine positions and elevations as required. Determine obstructions for any new or changed OIS. Note, if the runway dimensions change, the OIS changes, and the obstructions and/or highest objects may change. If the height and/or position of an obstruction can not be adequately determined, notify NGS immediately. Complete the CHECK LIST, REQUIRED OBSTRUCTIONS FOR ANA SURVEYS provided in Attachment D. Also complete the newly developed AOC OBSTRUCTION CHECK LIST when applicable.

11.16 AIRPORT TRAFFIC CONTROL TOWER - Redetermine the Cab Floor elevation. The "Cab Floor" is usually the top floor in the tower. This is the level where the controllers use air/ground communications, visual signaling, and other devices to provide air traffic control services to aircraft operating in the vicinity of an airport or on the movement area. This elevation may be measured with vertical angles, tape measure, etc. to the nearest tenth of a foot (0.1 ft). Note, there is no marked spot.

11.17 AERIAL PHOTOGRAPHY ANNOTATIONS

A. PLANIMETRIC DETAIL - For AOC Surveys certain planimetric detail is required; refer to FAA No. 405, Section 2, Part 8 for complete listing of required data. Planimetric detail is not required for ANA Surveys. The following paragraphs provide additional guidance and clarification for the required planimetric detail but should not be construed as the only required planimetric detail for submission. See Attachment F for marking requirements. Annotate the following:

- i. Aircraft Movement Areas - including runways, taxiways, and aprons. Take care to indicate any runways, taxiways, or ramps completed since photography. Care should be taken to differentiate between aircraft movement areas and vehicle movement areas,



- ii. Obstructing Fences, and Transmission and Pole Lines,
- iii. Unpaved Tie Down Areas - if within 200 feet of a primary approach surface and if permanent Tie Down fixtures are present (See FAA 405),
- iv. Isolated Paved Helipads - (See FAA 405), and
- v. Sea Plane Landing Areas - (See FAA 405).

B. AERIAL PHOTOGRAPHY UPDATING - For AOC and ANA obstruction surveys, update the aerial photographs to the date of the survey. Changes will be annotated on the photography as outlined in Attachment F and discussed in the Project Completion Report.

- i. Obstructions - Any obstruction removal or obstruction clearing since the date of the photography must be determined for all obstruction surveys, (either AOC or ANA). The contractor should utilize either natural or cultural features as a point of reference for defining the limits, whenever possible. Frequently there are insufficient natural or cultural features available within the area in question to utilize as a reference. When the limits of obstruction clearing can not be adequately annotated on the photographs due to the lack of sufficient natural or cultural features, the contractor will be required to determine the limits by ground survey methods rather than by annotation on photography. Sufficient points must be determined so that the current limits of obstruction clearing can accurately be determined. A sketch must also be submitted when determining the limits of obstruction clearing by this method. If there are areas in which there has been selective cutting of trees, a statement must be made in the Project Completion Report that the obstructions determined represent the most significant remaining at the time of the survey,
- ii. Demolition - significant buildings torn down; roads or aircraft movement areas removed, and
- iii. Obstruction construction - completed new radio tower, etc.

For AOC surveys only, any change since the date of photography that would impact the accurate depiction of the planimetric detail required for submission on AOC surveys must be determined. The contractor must distinguish planimetric detail built and completed since the date of photography from planimetric detail new since the photography but currently under construction. The limits as of the date of survey must be provided.

- i. Construction - completed new buildings, hangars, terminal buildings, etc.,
- ii. Areas under construction (taxiways, movement areas, aprons, buildings) are annotated on the photos as under construction, and



iii. Roads - changes in the major road pattern around the airport including: new roads, roads that are closed. Roads with restricted public access that are intended for airport/facility maintenance are exempt as obstructions. These roads need to be distinguished from airport service roads (which are not for public use) associated with other airport operations such as food, fuel, and freight transportation which are not exempt as obstructions. See FAA 405 Section 2, 6.3.8 Obstruction Exemptions.

C. PHOTOGRAPHIC CONTROL POINTS - See Section 11.13.

12. DELIVERABLES TO NGS

12.1 - LABOR, EQUIPMENT, ETC. - The contractor will provide all labor, equipment, supplies and materials to produce and deliver the products as required under these General Specifications. Note, government supplied items are listed in Section 3.

12.2 - GOVERNMENT SUPPLIED ITEMS - The contractor will return to NGS all government supplied records (listed in Section 3), and all unused survey marks.

12.3 - QUALITY CONTROL PLAN - Before any field work begins, the Contractor will submit to NGS a Quality Control Plan covering all work (see Section 7). NGS will review this plan as soon as possible and respond with an approval or comment letter (or email) as soon as possible, normally within 5 working days.

12.4 - SURVEY PLAN - Before any field work begins, the Contractor will submit to NGS a Survey Plan (see Section 10). NGS will review this plan as soon as possible and respond with an approval or comment letter (or email) as soon as possible, normally within 5 working days. Field work will commence after the Contractor receives the approval letter (or email).

12.5 - PROJECT STATUS REPORTS - The Contractor will submit project status reports via email to the CO and NGS points-of-contact every week, until the work is complete. These reports will include a list of airports where work is underway and the airports where work is completed, with dates completed, and any unusual circumstances and/or deviations from these General Specifications.

12.6 - PROJECT COMPLETION REPORT - For each airport, the Contractor will submit a Project Completion Report summarizing the work performed under these General Specifications and the Supplemental Instructions including: the survey methodologies used to perform the work (section 10); description and analysis of the quality control performed (Section 7); discussion for each section listed in the Supplemental Instructions; description of the recovered/established geodetic control (section 11); and discussion of any unusual circumstances, discrepancies, and



deviations from these General Specifications or the Supplemental Instructions. See report format in Attachment I.

12.7 - HARD COPY MATERIAL - The Contractor will submit all original data. This will include the following hard copy material for the work performed under each specific Supplemental Instructions, including:

- A. All data collection forms (see Attachment D),
- B. Annotated photographs (see Attachment F),
- C. Annotated Field Plot Sheet (see Attachment G),
- D. All USGS quadrangle maps, with any annotations, and/or NAVAIDS,
- E. Field sketches, diagrams, and plans:
 - i. new SACS
 - ii. new runway end point; or new runway, displaced threshold or stopway
 - iii. new taxi area
 - iv. new ramp area
 - v. photogrammetric control
 - vi. all off-the-field electronic NAVAIDS
- F. If replacement SACS was set, all required hard copy.

12.8. DIGITAL FILES - The Contractor will submit all original and final digital files on CD-ROM, including:

- A. Final data set in Exchange File Format,
- B. Final data set for runway and stopway end points, and displaced thresholds in Blue Book format,
- C. If replacement SACS was set, final data set for SACS in Blue Book format,
- D. Original, digital data collection forms,
 - i. Raw Theodolite/EDM data,
 - ii. Raw GPS Observations Files,
 - original raw data files from receiver in RINEX II format,
 - broadcast ephemeris file from receiver,
 - ASCII message file from receiver, and
 - binary files containing ionosphere modeling information,
- E. Final processed data files, with format,
 - i. If GPS, include vector reduction and adjustment (a hard copy printout of the adjustment must also be submitted) and
 - ii. include all files necessary to recreate the project.

12.9 - TRANSMITTAL LETTER - In the data submission package, the Contractor will include a signed, transmittal letter listing all items submitted to NGS. A copy will be forwarded to NGS separately.



13. POINTS OF CONTACT

George E. Leigh
Contract Coordinator
National Geodetic Survey, NOAA
ATTN: N/NGS; SSMC3, Sta. 8613
1315 East-West Highway
Silver Spring, Maryland 20910
301-713-3167
email: gleigh@ngs.noaa.gov

David A. Hucks, Jr./H. Stewart Kuper Jr.
NGS Field Operations
Survey Section D
538 Front Street
Norfolk, VA 23510
757-441-6249
email: David.Hucks@noaa.gov

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ATTACHMENT A - EXPLANATIONS OF GOVERNMENT SUPPLIED MATERIALS

A.1 TRANSMITTAL LETTER

A letter containing a list of all items shipped to the contractor for a particular survey, the date the items were shipped, and the name and address of the individual who shipped them. The contractor is responsible for verifying the receipt of all items listed and returning a signed copy of the transmittal letter to the address listed.

A.2 SUPPLEMENTAL INSTRUCTIONS FOR GROUND SURVEYS

A set of instructions which is specific to a particular airport or survey. The Supplemental Instructions for Ground Surveys will typically contain the following sections:

- A. Project
 - i. AOC Number
 - ii. LID (Location Identifier)
 - iii. Airport Name
 - iv. Associated City
 - v. State
- B. Obstructions
 - i. Obstruction Identification Surfaces
- C. Previous Surveys
 - i. PACS and SACS information
 - ii. Information on runway profiles, if applicable
- D. Control
 - Information on required horizontal and vertical control points
- E. Runways
- F. Navigational Facilities
- G. Advisory Information

A.3. RUNWAY END SKETCH

A field sketch containing a schematic diagram of the runway end, surface markings, lights, connecting taxiways, stopways, blastpads, and other information. Runway end sketches are not drawn to scale, although all pertinent lengths and distances are clearly annotated. The contractor is responsible for verifying the information depicted, including all lengths and distances. If runway sketches are not available or not up-to-date, the contractor is responsible for providing the necessary sketches (See Section 11: Survey Work).

A.4. CONTACT PHOTOGRAPHS

9 x 9 inch prints of the aerial photography made with the transparencies in contact with the sensitized surface.



A.5. ENLARGED PHOTOGRAPHIC PRINTS

Prints of the aerial photography in which the scale has been changed to 1:12,000 (or as close to that scale as possible) through the process of projection printing. The OIS will be drawn on the enlarged photographic print designated as the airport “center shot.” Control boxes representing the designated areas for horizontal and vertical ground control points will also be drawn on the enlargements.

A.6. FIELD PLOT SHEET

A mylar (film) Computer Aided Drafting (CAD) plot at a scale of 1:12,000 for plane table work and/or general reference. The following items will be plotted for verification, using currently available data from the Obstruction Chart Database (OCDB):

- A. Runways
- B. Obstruction Identification Surfaces (OIS)
- C. Control (including PACS and SACS)
- D. Obstructions and other features
- E. NAVAIDS

The Field Plot Sheet will only be as accurate and up-to-date as the data in the OCDB; positions and elevations should not be assumed to be accurate until verified by field personnel.

A.7. QUADRANGLES

USGS topographic quadrangle maps with the following items plotted:

- A. OIS
- B. NAVAIDS (except those on the airport)
- C. Runways
- D. PACS and SACS
- E. Control boxes (for horizontal and vertical control)
- F. Obstructing ground (highlighted in red)
- G. Ground which comes within 50 feet of obstructing (highlighted in yellow)
- H. Penetrating elevations at 10,000-ft intervals for each 50,000-ft approach
- I. Flight lines and photocenters

The topographic maps are to be used as a reference tool only. While every effort will be made to ensure that objects are plotted correctly, no accuracy claims are made.

A.8. APPROPRIATE PAGES FROM U.S. TERMINAL PROCEDURES

U.S. Terminal Procedures are published in 20 looseleaf or perfect bound volumes covering the conterminous U.S., Puerto Rico, and the Virgin Islands. A Change Notice is published at the midpoint between revisions in bound volume format. The Terminal Procedures Publications include:

A. Instrument Approach Procedure (IAP) Charts: IAP charts portray the aeronautical data that is required to execute instrument approaches to airports. Each chart depicts the IAP, all related navigation data, communications information, and an airport sketch. Most procedures are designated for use with a specific electronic NAVAIDS, such as Instrument Landing System (ILS),



Very High Frequency Omnidirectional Range (VOR), Nondirectional Radio Beacon (NDB), etc.

B. Airport Diagrams: Full page airport diagrams are designed to assist in the movement of ground traffic at locations with complex runway/taxiway configurations and provide information for updating geodetic position navigational systems aboard aircraft. (Note: Airport Diagrams are not available for all airports.) The contractor will be supplied with pages from the U.S. Terminal Procedures which pertain to the survey to be conducted.

A.9. APPROPRIATE PAGES FROM AIRPORT/FACILITY DIRECTORY

The Airport/Facility Directory is a manual that contains data on public use and joint use airports, seaplane bases, heliports, VFR airport sketches, NAVAIDS, communications data, weather data sources, airspace, special notices, and operational procedures. The Airport/Facility Directory includes data that cannot be readily depicted in graphic form: e.g., airport hours of operation, types of fuel available, runway data, lighting codes, etc. The Airport/Facility Directory is published every 56 days by the National Aeronautical Charting Office, FAA (formerly Office of Aeronautical Charting & Cartography, NOS). The contractor will be supplied with the pages from the most-recent Airport/Facility Directory which pertain to the survey to be conducted.

A.10. FAA NATIONAL FLIGHT DATA DIGEST (NFDD)

A daily (except weekends and Federal holidays) publication of flight information appropriate to aeronautical charts, aeronautical publications, Notices to Airmen, or other media serving the purpose of providing operational flight data essential to safe and efficient aircraft operations. The contractor will be supplied with NFDDs pertaining to the survey to be conducted.

A.11. OBSTRUCTION SURFACE ANALYSIS (OSA)

The OSA is a listing which is generated from the OCDB. It contains, for each approach, a list of obstructions which fall within the various OIS, and the amount of penetration (positive or negative) relative to those OIS.

A.12. CD-ROM CONTAINING SCANNED IMAGES OF AIRPORT RED JACKET DATA

The following items from the NGS Airport Record Package will be scanned, if available:

- A. Field survey and Verification Report (76-111)
- B. Compilation Report (76-111A)
- C. Instrument Landing System Data (76-181)
- D. UDDF and/or 292, including any OCDB "Reports"
- E. Runway Data Sheet (76-115)
- F. Project Instructions
- G. Field Report
- H. Radio Facilities Abstract
- I. Field Sketches (76-195) of NAVAID Sites and Runway Ends
- J. Contact Photos Which Have NAVAIDS or Obstructions Photoidentified (Note: the NAVAIDS will be identified for reference only, and are intended as an aide in locating the sites.)



Only materials from the most recent AOC survey and the most recent ANA survey will be scanned, except as follows: the most recent Field Sketches (76-195s) which show local control schemes, NAVAID sites, runway ends, or photograph control points will all be scanned, regardless of the survey to which they pertain.

A.13. CD-ROM CONTAINING DIGITAL EXCHANGE FILE, PROJECT INSTRUCTIONS AND NGS DATA SHEETS FOR CONTROL STATIONS IN DSDATA FORMAT

The digital exchange file, project instructions, and NGS Data Sheets will be provided to the contractor on a CD-ROM. The Exchange File Format is the accepted format for preparing and submitting data for storage in the OCDB. This format supports the fields allowable by the OCDB. DSDATA is the traditional format of NGS data sheets. Information in this format can be manipulated by the NGS programs DSX, DSSELECT, etc.

A.14. FAA FORM 5010, AIRPORT MASTER RECORD

The FAA Form 5010 is prepared for all public-use airports. This master record contains comprehensive data on airports, including obstacles. Much of the information on FAA Form 5010 comes from unverified sources. Often, obstacle heights and positions are estimates which have not been measured and verified by instruments. For these reasons, the Airport Master Record is to be consulted for information purposes only.

A.15. BRASS DISKS

NGS will supply standard, pre-stamped disks with the NGS logo. These disks will be used by the Contractor for NGS projects only. See Attachment H for diagrams of various types of NOAA survey disks. The Contractor should notify NGS of the approximate quantity required.

A.16. SURVEY NAILS WITH WASHERS

NGS will supply commercial survey nails with washers. The washers will be pre-stamped with the letters "NGS". These nails and washers will be used by the Contractor for NGS projects only. The Contractor should notify NGS of the approximate quantity required.



ATTACHMENT B - AIRPORT INTERVIEW CHECKLISTS

Conduct interviews with the following personnel, if one is assigned to that particular airport:

B.1. AIRPORT MANAGER/ OPERATIONS: In this interview, obtain permission to enter the airfield for the survey. This interview can also provide valuable information about construction, both recent and ongoing, obstruction changes, and operational considerations (scheduled runway closures or special events, high-security areas on the field, etc.). The name of a person from this interview must be included on the Runway Data Sheet and in the Project Completion Report.

B.2. AIRPORT ENGINEERING: This interview will only be necessary or helpful on larger airports. The Engineering Department can provide specific information about runway dimensions, construction projects, and control stations. They can sometimes be helpful in scheduling runway work. It is helpful to include the name of a contact in this department in the Project Completion Report in case questions arise after the survey.

B.3. FAA AIR TRAFFIC CONTROL: If the field party is going to be allowed to operate on the airfield without an escort, it is always helpful to have a face-to-face interview with the Chief Control Tower Operator or his representative before starting. This can provide information on operational factors and also smooths the working relationship between the party and the controllers.

B.4. FAA AIRWAY FACILITIES: This interview is necessary on any airport with FAA Navigational Facilities. In some cases, the personnel who maintain the facilities for the airport being surveyed may be located at another site and portions of the interview may be done by telephone. The first purpose of the interview is to determine all pertinent changes to facilities (including NAVAIDS) since the previous survey. Following this, it may be necessary to schedule a technician to accompany the field party to certain facilities to let them through a gate or monitor an alarm while survey personnel are within critical areas of the site. It is helpful to include the name of a contact in this department in the Project Completion Report in case questions arise after the survey.



AIRPORT MANAGER CHECKLIST

- G 1. Deliver introductory letter and ASP Brochure & explain that you are a contractor for NGS,
- G 2. Explain survey procedures and schedule,
- G 3. Request permission to work on field,
 - G - Escort required?
 - G - Radio required?
 - G - Radio frequency,
 - G - Call sign,
- G 4. Runways; discuss any changes in length, width, or repaving,
- G 5. Runways; discuss any future plans for changes,
- G 6. Show current edition of AOC and ask for comments,
- G 7. Ask any questions listed in the Supplemental Instructions,
- G 8. Schedule any runway work,
- G 9. Discuss changes to planimetry/construction/facilities,
- G 10. Discuss obstructions,
 - G - Has any clearing been conducted?
 - G - If so, when, where, and by whom?
 - G - Are there plans for clearing?
 - G - If so, when, where, and by whom?
 - G - Are there any new obstructions,
 - G - If so, request drawings, plans, etc.,
- G 11. Verify the official name, address, and telephone number of the airport manager,
- G 12. Discuss field conditions for driving,
- G 13. Request keys to gates, as required,
- G 14. Request taxiway designation chart,
- G 15. Ask about survey control on the airport,
 - G - Discuss condition of PACS and SACS,
 - G - Stress the importance of the PACS and SACS,
 - G - Point out that the PACS should be used as starting control for all future surveys,
 - G - Discuss any other significant survey control,
 - G - Any future plans that might endanger survey marks?
- G 16. Request introduction to tower chief.

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Name	Signature, Contractor's Representative	Date
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Name	Signature, Airport Official	Date
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TOWER CHIEF/WATCH SUPERVISOR CHECKLIST

- G 1. Discuss radio procedures, call sign, procedures if radio communications fail,
- G 2. Discuss survey schedule, especially any runway work,
- G 3. Discuss taxiway designations,
- G 4. Ask about restricted areas,
- G 5. Verify the official name, address, and telephone number of the tower chief,
- G 6. Ask the location of FAA Facilities personnel.

Name	Signature, Contractor’s Representative	Date
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Name	Signature, Airport Official	Date
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FAA FACILITIES PERSONNEL CHECKLIST

- G 1. Discuss changes to NAVAID systems,
- G 2. Discuss any plans for NAVAID changes in the future,
- G 3. Schedule any required work at/near NAVAIDS that might interfere with their operation,
- G 4. Ask about location, accessibility, and directions to any outlying facilities.

Name	Signature, Contractor’s Representative	Date
------	--	------

Name	Signature, Airport Official	Date
------	-----------------------------	------



ATTACHMENT C - FILE NAMING CONVENTION

Submit a detailed directory tree listing, on paper, to be used as an index for locating all processing, adjustment, and supporting files that are submitted in digital format. Provide a summary explanation of the files to be found in individual directories.

Do not list the individual files within the PAGE-NT vector processing directory for each session or the files in the RAW and RINEX data directories.

If the RAW and RINEX data files are not named by their occupied station four character ID, submit an index of station name to RAW and RINEX file name.

Exchange File Format

- A. OC####.EXG Exchange file extracted from OCDB and sent to field.
- B. OC####.TXG Final Data set: a modified exchange file (EXG) reflecting the results of the survey. This file will include runway profile data. See 8.2 FINAL DATA.

is the Airport AL number as listed in the U.S. Government Flight Information Publication - U.S. Terminal Procedures.



ATTACHMENT D - DATA COLLECTION FORMS (WITH SAMPLES)

FORM NAME	BLANK	EXAMPLE
FACILITIES ABSTRACT	Y	Y
FACILITIES ABSTRACT Continuation Sheet		Y N
GENERAL CHECK LIST	Y	Y
AOC CHECKLIST	Y	Y
ANA CHECKLIST	Y	Y
RUNWAY DATA SHEET	Y	Y
FIELD SURVEY SKETCH	Y	See Attachment L
KINEMATIC GPS OBSERVATION LOG	Y	Y

(For the GPS log for static observations, see <http://www.ngs.noaa.gov/PROJECTS/GPSmanual/data.htm#obslog> , click on A-4. Observation Log: “Blank Form” or “Sample Entries”.

See NGS WWW site for PDF versions of the forms. WWW address TBD.

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ATTACHMENT E - EXPLANATION OF FEATURE DESCRIPTION FIELD IN THE EXCHANGE FILE FORMAT

The following describes the content and structure for feature descriptions entered in the Exchange File Format (Field 2 - Feature Identification record in the Exchange File).

The intention of this outline is to:

- Establish consistent feature labeling convention
- Describe the feature attributes embedded within the feature descriptions that result in the proper reporting on the deliverable (UDDF)
- Increase the integrity of the OCDB

E.1. GENERAL

Feature description labels will conform to the following structure:

[FEATURE NAME][!][COMMENT/embedded ATTRIBUTE]

The FEATURE NAME will describe the feature. If the feature was surveyed as an obstruction, this will identify the actual feature pointed at (i.e., OL, ANT, etc.). Feature names must conform to the “Standard Abbreviations and Contractions” specified in FAA No. 405.

Comments may be added after the exclamation mark that provides additional textual description of the feature itself. Comments are optional, will not be reported to the FAA, but can provide useful information (an obstruction number for example). Note that comments may not include select special characters and syntax (discussed below) that are reserved for identifying additional feature attributes embedded in the feature label.

Some features require an additional embedded ATTRIBUTE to be entered within special characters (reserved) after the exclamation point. The attribute information will be reported to the FAA.

Example:

Electronic NAVAIDS that are associated with a runway end must include the runway end number in parentheses () in the feature description. OL ON GS!(6)

Other reserved special characters include:

- [] Brackets
- "" Quotations

(See examples below showing when these special characters are used)

Some features require an additional embedded ATTRIBUTE to be entered with special pre-defined syntax after the exclamation point. The attribute information will be reported to the FAA.

Example:



- DME's must have an embedded mid-point elevation in the form:

MID PT=xxx

or

MP=xxx

where xxx is the mid-point elevation.

OL ON DME!(9) MID PT=756.00

(See examples below for when pre-defined syntax is used)

E.2. OBSTRUCTIONS

The following examples illustrate possible feature description labels for obstructions entered in the Exchange File.

NAME

TREE

NAME (TYPE)

RD(I)

Note: no space between the D and (

NAME (MODIFIER)

OL ON TWR (E OF 3)

NAME!COMMENT

TREE!50

OL BLDG! Q400741 #2217 BIH CUPOLA

ANT ON OL APBN!50 APBN 1989

AP STA A2 DCA!SAC

NAME (CONDITION)!COMMENT

ATCT (UNC)!50

Note: parentheses prior to the exclamation point are not considered reserved characters

NAME!COMMENT/ATTRIBUTE

ANT ON OL ATCT!50 ATCT FLOOR=128

Note: When more than one ATCT exist at an airport the floor elevation of the second ATCT shall be reported as above. The floor elevation of the primary ATCT should be reported in the A910 record of the Exchange File.

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Note: An ATCT is not considered a NAVAID. If a modifier is attached (such as Out of Service (OTS), Not CoMmissioned (NCM), or UNder Construction (UNC)) it should be part of the description name, for example: ATCT(UNC)!50

E.3. NAVAIDS

The proper NAVAID facility identifier, Airport location identifier, or runway designation must be entered after the exclamation point in the feature description label.

The following examples illustrate possible feature description labels for NAVAIDS entered in the OCDB.

NAVAIDS that are associated with a RUNWAY END must include the runway end number in parentheses.

OL ON LOC!(9)

NAVAIDS that are not associated with a specific runway, but are associated with the Airport surveyed must include the facility identifier in brackets.

ASR![EVR]

NAVAID facilities with an identifier other than the Airport facility identifier must include the NAVAID facilities Identifier in brackets.

ASR![WWD]

NAVAID facility with a two-letter facility identifier shall include the facility identifier followed by a space in the brackets.

NDB![SB]

NAVAIDS that are not associated with a specific runway or the Airport surveyed must include the letters NON in parentheses.

LDA!(NON)

DME!(NON) MID PT=1983.38

DEM Facilities must have an embedded mid-point elevation in the form:

MID PT=xxx

or

MP=xxx

Where xxx is the mid-point elevation.

OL ON DME!(9) MID PT=756.00

NOTE: A space must follow the elevation if any further comments are added.



MLSAZ's and MLSEL's must have an embedded phase center elevation in the form:

PC=xxx

Where xxx is the phase-center elevation

MLSEL!(9) PC=756.

In some cases two similar types of the NAVAID may serve the same runway end. For example, runway end 18 may have an ILS-DME as well as a MLS-DME. Each feature will be entered into the Exchange File separately. No differentiation will be discernable in the NAVAID section of the UDDF. Adding an "Additional Information" note is highly recommended. In this scenario, Both DME's will be reported on the UDDF as DME(18).

Note: When clearance array localizer is determined (for obstruction purposes), it should be labeled as an antenna or some other suitable name. Do not use clearance array localizer as the label. Do not attribute it as a localizer.

E.3.1. NAVAIDS THAT SERVE MORE THAN ONE RUNWAY

A NAVAID that serves more than one runway end should be shown with both runway end designations in one set of parentheses after the exclamation point.

OL ON DME!50 (9/27) MID PT=756.00

OM!(9L/9R)

NOTE: NAVAID feature descriptions entered in this fashion will be reported in the Exchange File in one record. (example: DME (9/27))

E.3.2. NAVAIDS WITH CONDITIONAL ATTRIBUTES

The description of Navigational Facilities that are not in service at the time of survey, will include a conditional description after the exclamation point. Accepted conditions include "OTS" (Out of Service), "NCM" (Not Commissioned), and "UNC" (Under Construction).

OL ON GS!50 (9) "OTS"

OL ON GS!(27) "NCM"

NOTE: The closing quotation is not necessary behind the condition description.

E.4.0 NAVAID AND OBSTRUCTIONS

The following examples illustrate possible feature labels for obstructions (that are also NAVAIDS):



NAME!COMMENT/ATTRIBUTE

- OL ON GS!50 (9)
- OL ON VORTAC!50 [EWR]
- OL ON DME!50 (9) MID PT=756.00
- OL ON ANT AT OL DME!50 (9) MID PT=756.00

E.5. VISUAL AIDS

A Runway designation number and a relative position indication for most Visual NAVAIDS must be entered after the exclamation point in the feature description label.

The following examples illustrate possible feature description labels for VISUAL NAVAIDS entered in the OCDB. A relative directional indicator shall be included when there are two or more aids serving one runway.

- REIL!(9)N (REIL = Runway End Identifier Lights)
- VASI!(22)NE
- !ALS(9)

APBN is the only Visual Aid that will have its position shown on the UDDF.

The first and last approach lights will be loaded following the example:

ALS!(9)FIRST

ALS!(9)LAST

OmniDirectional Approach Light System (ODALS) that serve as an approach light system should be attributed as an Approach Light System (ALS). ODALS that serve only as REILS should be attributed as REILS.

NOTE: Visual Aids will not be listed as (OTS) or (N.M.).

E.6. PHOTO-CONTROL POINTS

The number of a photo-control points should immediately follow the # in the feature description name. When a photo-control point is positioned from a permanent station, only the stations letter identifier is necessary.

- SS#1(TP-35)2000 (for conventional surveys)
- SS#1(GPS)2000 (For GPS surveys)

Explanation of naming convention:

“SS” is always part of the control point name



"#1" is the sequential number of the photograph control point

"TP-35" is the name of the control points started from, or use "GPS" if GPS was used

"2000" is the year

E.7. TEMPORARY CONTROL POINTS

Temporary horizontal control points and temporary traverse points should be entered with the following format:

!TP-01

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ATTACHMENT F - FIELD ANNOTATION PROCEDURES FOR PHOTOGRAPHY

F.1. Horizontal Control Stations of the National Network (PACS and SACS).	freehand dashed red circle (no prick mark) and label
F.2. Photograph Control Points (determined for horizontal control for photography)	prick mark centered in a 20 mm red square and label
F.3. Vertical Control Points (determined for vertical control for photography)	prick mark centered in a 20 mm blue square and label
F.4. Other objects photo-identified for positioning by aerotriangulation or photogrammetric plotting (including survey points used to locate new movement areas or buildings)	prick mark centered in 6 mm red circle and label
F.5. Approximate position of an obstruction or NAVAID (non photo-identified)	freehand dashed red circle (no prick mark) and number (approximately 4mm)
F.6. Areas cleared, topped, or graded since date of photography	Cleared area hashed through in green
F.7. Planimetry (aircraft movement areas)	Perimeter outlined in thin dashed red lines
F.8. Fence and Pole Lines	Route traced with thin red ink lines interrupted by small x's at approximately 1 inch intervals (x for Fence ; T for Transmission line)



ATTACHMENT G - FIELD ANNOTATION PROCEDURES FOR FIELD PLOT SHEET

G.1. Published obstructions field checked by valid survey methods

Label obstruction with feature number in red and strike through the previous top elevation in green

G.2. Obstructions on the existing chart that are to be carried forward to the new edition, but for which a new elevation has been determined

name and elevation (if any) underlined in red

G.3. Obstructions or other published objects (i.e., NAVAIDS, runway length and width) that are to be carried forward to the new chart, but were checked by inspection only

name and elevation (if any) underlined in green

G.4. Published object which still exists, but is recommended for deletion from the next edition of the OC

name and elevation (if any) strike-through in green

G.5. Published obstructions or other objects which no longer exist

explanatory notes in red

G.6. Changes in runways, taxiways, road locations, or areas requiring complete new survey

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small red check mark



ATTACHMENT H: SURVEY MARK DIAGRAM

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ATTACHMENT I: PROJECT COMPLETION REPORT CONTRACTOR FORMAT

I.1. INTRODUCTION

- A. Airport Obstruction Chart (AOC) number
- B. Location Identifier (LID)
- C. Name of airport
- D. City
- E. State
- F. Contractor point of contact - name, company name, address, telephone number, email
- G. Reference to Project Instructions
- H. Start and end dates of project.

I.2. CONDITIONS AFFECTING PROGRESS - Discuss any equipment failures, weather, scope of project, site accessibility, reconnaissance, and/or any other problems affecting progress.

I.3. FIELD WORK

- A. CHRONOLOGY - A brief description of the progression of the work.
- B. VISITS WITH AIRPORT OFFICIALS - Provide a brief summary of all meetings with airport officials.
- C. RECONNAISSANCE - Provide a listing of NOAA survey marks recovered and those not recovered. Provide a listing of any new marks set. Include descriptions of any airport changes found, for example a new NAVAID.
- D. INSTRUMENTATION - Provide a listing of equipment used in the survey, including model and serial numbers; EDM calibration reports, maintenance reports, and details of any changes from the Survey Plan. Include a copy of the Survey Plan as an attachment.
- E. SURVEY METHODOLOGY - Provide a brief summary and details of any changes from information included in the Survey Plan. List horizontal and vertical datums used and published dates of NGS survey control.
- F. SURVEY WORK - Provide general discussion and details of any problems
 1. List runways where obstructions were determined/evaluated
 2. Discuss PACS, SACS, and any other previous control used
 3. Discuss photo control surveyed
 4. Discuss runway profiling - include, at least, profile method, any problems with runway length and discussions with manager, any changes; make statement that authorities agreed (or disagreed) with runway dimensions surveyed,
 5. Discuss NAVAIDS - include, at least, statement that all NAVAIDS were surveyed, description of any new NAVAIDS
 6. Discuss Obstructions - state whether this was a new or revision survey, whether all obstruction included in the Exchange File were verified or marked for deletion, whether additional obstructions were determined in all specified surfaces as necessary, any changes.



G. ADVISORY INFORMATION - Identify photograph containing airport planimetry. Discuss changes to the airport since the date of photography and the photograph showing the change. Make a definitive statement that photography (with any annotations) is current and accurately depicts airport planimetry (when applicable) and that any clearing or topping of trees /grading of obstructing ground has occurred since the date of photography has been annotated.

I.4. DATA PROCESSING

A. HARDWARE

B. SOFTWARE

C. METHODOLOGIES

D. QUALITY REVIEWS - Provide a brief summary of methods used to help ensure high quality data and details of any changes from the Quality Control Plan. List all problems found and discuss corrective action taken.

E. FILE NAMING CONVENTION

F. FILE FORMATS AND MEDIUM

I.5. ANALYSIS OF RESULTS - Discuss the results, especially any unusual circumstances, problems, any deviation from the Instructions, and/or any results that exceed specifications, including those already reported in weekly email status reports.

I.6. COMMENTS ON GOVERNMENT SUPPLIED MATERIALS

A. INSTRUCTIONS

B. PHOTOGRAPHS

C. HISTORIC AIRPORT FILES

D. SURVEY DATA

E. NOAA AND FAA WWW SITES

I.7. RECOMMENDATIONS - Suggestions for improving future work.

I.8. SIGNATURE BLOCK - Signed by Contractor under statement as approved and meeting all requirements.

I.9. ANNEXES

Annex 1 - AIRPORT SURVEY DIAGRAMS - a map showing the outline of the runways and the survey network at the airport with GPS vectors, and angles and distances observed.

Annex 2 - Copy of the Quality Control Plan

Annex 3 - Copy of the Survey Plan



ATTACHMENT J: PHOTOGRAMMETRIC CONTROL POINT REQUIREMENTS

J.1. HORIZONTAL ACCURACY

A Standard - Normally two horizontal control points will be identified and positioned within each designated area with an accuracy of 0.3 meters. The Supplemental Instructions will provide additional guidance.

B. Specification - The observation times depend on the length of the base. The recommended minimum for static GPS observations is 15 minutes. If the base line length is more than 10 km, 30 minutes is recommended. Satellite geometry should also be considered.

J.2. VERTICAL ACCURACY

A Standard - Normally one vertical control point will be identified and the elevation determined within each designated area with an accuracy of 1.0 meter. The Supplemental Instructions will provide additional guidance.

B. Specification - The observation times depend on the length of the base. The recommended minimum for static GPS observations is 30 minutes. Satellite geometry should also be considered. The vertical point may be one of the horizontal points or a separate point. The ground area should be level or nearly level at the control point.

J.3. SELECTION OF HORIZONTAL CONTROL POINTS

The ideal type of point for control identification is one which produces a very small, recognizable, and symmetrical photographic image which has a distinct boundary of a relatively high to a lower contrast. Examples:

- A. A point at well defined junctions of intersecting features (sidewalks, abutments, and roads),
- B. Centers of low, small, symmetrical structures (a square shed, a circular platform, etc.),
- C. Corner points of any clear, well-defined feature (a parking lot, a tennis court, a road intersection),
- D. The center of a small isolated bush.

J.4. SELECTION OF VERTICAL CONTROL POINTS

Ideally, a level area should be selected. It is not essential that the ground be level completely around the vertical control point. It should be level or nearly so within a 90-degree arc from the control point for a radius of not less than 0.5mm on the photograph at contact scale. Examples of good points:

- A. Flat areas on a baseball field,
- B. Road intersections,
- C. Tennis courts, etc.



ATTACHMENT K: SAMPLE AIRPORT GROUND PHOTOGRAPHS

A. PACS and SACS - See the sample photos in Attachment 3 of Reference C, located at: <http://www.ngs.noaa.gov/AERO/Supinst.html>

B. SURVEY NAILS/WASHERS - See the four sample photographs below.

C. NAVAIDS - See the two sample photographs below, and for additional samples see the NGS WWW site: TBD.

D. PHOTO CONTROL POINTS - See the three sample photography below.

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ATTACHMENT L: SAMPLE AIRPORT SKETCHES

See also WWW site TBD.

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