

# Airports GIS

## AC 150/5300-16 Geodetic Control

Presented to | FAA Regions | Alaska  
By | Gil Neumann, APP 400 | Thomas Wade, ASW 611  
Date | October 19 20, 2011

1 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## Geodetic Control | Agenda

- Background (10 min)
- Requirements (10 min)
- Best Practices and Lessons Learned (10 min)



2 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## Why does FAA require Geodetic Control?

- To ensure a base level of survey data and mapping accuracy when collecting airport data for planning, engineering, and airspace-related projects



## Airports GIS data is a NextGen enabler

- The role and importance of airport and aeronautical data in meeting the safety, regularity, and efficiency of air navigation changed significantly with the implementation of area navigation (RNAV), required navigation performance (RNP) and airborne computer based navigation systems

3 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## What is Geodetic Control?

- Establishing and/or verifying defined points of reference by measurements of angles and distances, or by the Global Positioning System (GPS)

## Who defines Geodetic Control standards?

- The National Spatial Reference System (NSRS), under the control of the National Geodetic Survey (NGS) and managed by the Federal Geodetic Control Subcommittee (FGCS), is the standard in defining the latitude, longitude, elevation, scale, gravity, and orientation of control points throughout the United States
- Geodetic control surveys included in NSRS meet data recording, submittal, project review, and least squares adjustment requirements established by the FGCS

4 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## NGS | Continuous Operating Reference System

- CORS sites provide GPS carrier phase and code range measurements in support of three-dimensional positioning activities throughout the US and its territories
- Surveyors, GIS/LIS professionals, engineers, scientists, and others can apply CORS data to position points at which GPS data have been collected
- The CORS system enables positioning accuracies that approach a few centimeters relative to the National Spatial Reference System, both horizontally and vertically.



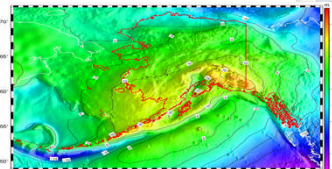
5 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## Standards: Datum and the GEOID Model

- Accuracy of GPS height measurements depends on several factors; the most crucial is "imperfection" of earth's shape
- Geodetic datums define the size and shape of the earth and the origin and orientation of the coordinate systems used to map the earth
- GEOID models are used to represent local variations in gravity that change the local definition of a level surface
- Datum required for Airports GIS:
  - Horizontal | **NAD83** (w/adjustments)
  - Vertical | **NAVD88**
- **GEOID09** is the current model (-16 needs to be updated)



GEOID09 is a refined hybrid model of the geoid in the United States and other territories, which supersedes the previous models GEOID06, GEOID03, GEOID99, GEOID96, GEOID93, and GEOID90.

6 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## ARP Policy on Permanent and Secondary Geodetic Control Stations (PACS/SACS)



- **AC150/5300-16 | Geodetic Control:** data is submitted through the Airports GIS website so that NGS can validate and verify the PACS/SACS identified for geodetic control used to establish mapping and data accuracy for FAA airport and airspace projects
- **Permanent Control:** FAA Regional Airports Divisions determine which airports require permanent geodetic control monumentation in the form of PACS or SACS based on the activity (operational or proposed future construction) at the airport
- For all airports in the National Plan of Integrated Airport Systems (NPIAS), we strongly **recommend** that at least PACS be established

7 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## PACS/SACS Stability Requirements

### PACS | Stability Code A or B

#### Stability Code A

- Expected to hold elevation
- Bedrock/outcrop, foundation in bedrock
- Sleeved, deep settings with galvanized stainless steel pipe

#### Stability Code B

- Probably hold an elevation
- Unsleeved, deep settings
- Massive retaining walls, abutments, piers, etc.



### SACS | may use Stability Code C, but prefer Stability Code A or B

- Stability Code C ▪ May hold an elevation but subject to ground movement

8 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## Considerations in Setting Monuments

- Permanency with appropriate geographic location and spacing
- Ease of recovery, location should allow efficient use by surveying community
- Accessible by public (public property should be utilized where feasible)
- Minimal multi-path
- No known potential conflict with future development
- Aerial-photo identifiable
- Adequate GPS satellite visibility (unrestricted at 15 degrees above the horizon). Minor obstructions are acceptable, but must be depicted on the Station Location Sketch and Visibility Diagram
- Accessible by vehicle (two-wheel drive preferred)
- Stability, bedrock being most preferred

***Protect the monuments: they are important and expensive!***



## PACS/SACS Requirements

- **Establish the PACS in a secure area on airport property**
  - A GPS-suitable site should be selected where surveying equipment may be left unattended at the mark with a minimum probability of disturbance
- **SACS should be established on airport property if practical**
  - If the siting requirements, such as, intervisibility and spacing cannot be met, one SACS may be set off the airport but no further than 1 km from the nearest airport boundary.
- **If establishing new PACS and SACS, the monuments should be set:**
  - No closer than 200 feet (60 meters) from a runway edge, or from the imaginary runway extension (not in the RSA)
  - If an existing control station is used, it should be at least 15 meters from a runway edge
  - In all cases, PACS and/or SACS should be at least 400 meters apart and intervisible



## PACS/SACS | Proximity to other Airport Features

- PACS/SACS should be located so a surveying tripod can be situated over the mark
  - If the mark could be in peril from snow removal, mowing, and other operations, it should be slightly recessed
- **NOTE: Consider the location of established PACS/SACS when planning new airport construction; if destroyed (or not exist) they should be replaced as part of a construction project**
- PACS/SACS must not be within 1000 feet (305 meters) of the critical side of an:
  - Instrument Landing System (ILS) Glideslope Antenna
  - Instrument Landing System (ILS) Localizer
  - Microwave Landing System Elevation Station
  - Microwave Landing System Azimuth Station
- PACS/SACS should be strategically located so as to provide maximum use for subsequent surveys yet situated where the chances of future disturbance will be minimal
  - An elevated site with runway end visibility is desirable. PACS and SACS should also be located where future station occupation will cause no interference to or from aircraft, including from prop and jet blast



## Existing PACS/SACS

AIRPORTS with PAC and SAC marks

This page is maintained by [NGS Software Requests](#)

Help

Re-Sort-By  LID  Airport\_Name  St  CITY

MFV	ACCOMACK COUNTY	VA	MELFA
LIT	ADAMS FIELD	AR	LITTLE ROCK
EKX	ADDINGTON FIELD	KY	ELIZABETHTOWN
ADS	ADDISON (ADS)	TX	DALLAS
SLK	ADIRONDACK REGIONAL	NV	SARANAC LAKE
AIK	AIKEN MUNICIPAL	SC	AIKEN
AIN	AINSWORTH MUNICIPAL	NE	AINSWORTH
ILN	AIRBORNE AIRPARK	OH	WILMINGTON
ARK	ARHOK AIRPORT	AK	ARHOK
AKO	ARRON-WASHINGTON COUNTY	CO	ARRON
ALM	ALAMOGORDO-WHITE SANDS REGIONAL	NM	ALAMOGORDO
ALB	ALBANY COUNTY	NY	ALBANY
S12	ALBANY MUNICIPAL	OR	ALBANY
T23	ALBANY MUNICIPAL	TX	ALBANY
OAJ	ALBERT J ELLIS	NC	JACKSONVILLE

Get Marks     <http://www.ngs.noaa.gov/cgi-bin/airports.pr?TYPE=PACSAC>

NOTE: Most Certificated Airports have/had PACS/SACS established by NGS



## Existing PACS/SACS (continued)

**AIRPORTS > MARKS**

This page is maintained by [NGS Software Requests](#)

[Help](#)

**Station List for Airport = ILN**

Pid	St	Cty	Designation	Type
AD8867	OH	027	A 01	SAC
JY1551	OH	027	AIRBORNE AZ MK	SAC
<b>JY1548</b>	<b>OH</b>	<b>027</b>	<b>AIRBORNE</b>	<b>PAC</b>
AB3467	OH	027	VOR/DME MXQ	

[Pid](#) Datasheet      **State**      **City**      **Designation**      **Type**

**JY1548**      **OH**      **027**      **AIRBORNE**      **PAC**



## Geodetic Control | Required Deliverables

- **Use the FAA Deliverable Checklist to guide the production and delivery or project deliverables**
- **Survey Work Plan**
  - prior to starting
- **Quality Control Plan**
  - prior to starting
- **Project Status Reports**
- **Project Sketch (Vector Diagram)**

**Contributing to the National Spatial Reference System**

NOAA's National Geodetic Survey defines and manages the National Spatial Reference System (NSRS) - a consistent coordinate system that defines latitude, longitude, height, scale, gravity, and orientation throughout the United States. NSRS comprises a consistent, accurate, and up-to-date national shoreline; a network of continuously operating reference stations (CORS) which supports 3-dimensional positioning activities; a network of permanently marked points; and a set of accurate models describing dynamic, geophysical processes that affect spatial measurements.

The accuracy and accessibility of NSRS is dependent on contribution of Global Positioning System or leveling observations by state, local, and private surveyors. Survey data must meet the following standards:

- Follow approved specifications for survey methodology.
- Achieve minimum accuracies of first-order horizontal or second-order vertical.
- Verify accuracies using NGS-approved software, and
- Format data in accordance with FGCS "blackbook" procedures.

Control point users can also now submit information on the location and condition of National Spatial Reference System (NSRS) survey markers using a form found at: [http://www.ngs.noaa.gov/FORMS\\_PROCESSING/cgi-bin/ncvy\\_entry\\_web.cgi](http://www.ngs.noaa.gov/FORMS_PROCESSING/cgi-bin/ncvy_entry_web.cgi)

For more information contact:  
Joe Evin  
Joe.Evin@noaa.gov  
301-713-3194

The U.S. Department of Commerce  
National Oceanic and Atmospheric Administration  
National Geodetic Survey

The National Geodetic Survey (NGS) defines and manages the National Spatial Reference System, which measures position, height, gravity, and orientation throughout the United States. Since 1993, NGS and its predecessor agencies have led the world in precise positioning and developed geospatial technologies for the public. NGS provides the expertise and a variety of free information, including direct access to its data base on the World Wide Web at: [www.ngs.noaa.gov](http://www.ngs.noaa.gov).



## Temporary Geodetic Control

- Utilize NGS Online User Positioning System (OPUS)
- Two independent, but intervisible marks
- Observe each mark in two continuous and independent sessions of at least 4 hours
- Submit data to NGS OPUS
- Follow other NGS requirements for OPUS
- Include results in project final report



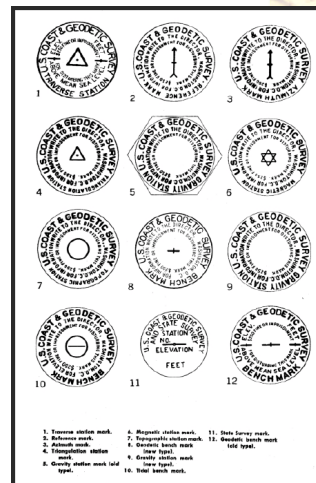
15 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration



## To PACS and SACS or not to PACS and SACS?

- **Consider: Value**
  - How often will they be used over the next five years? (construction activity)
- **Consider: Cost**
  - Basic airport establishment = \$5-15K+
- **Consider: Geologic Stability**
  - Permafrost
  - Subsidence
  - Tectonic plate movement
- **Consider: Timing**
  - Recommendation: if PACS/SACS are not available for the project, establish them on the next major development project (DO NOT include PACS/SACS installation on a project's critical path)
- **Consider: Validation/Verification Process**
  - Surveying requires significant QA/QC time and detailed documentation



16 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration





## PACS/SACS | Additional Considerations

- **Temporary Survey Marks (TSM) can provide an equivalent level of accuracy, however:**
  - They must be re-established with each project,
  - Use is subject to atmospheric and meteorological conditions,
  - Those with limited experience in establishing temporary control typically have more likelihood of causing an error in this scenario
- **If PACS/SACS are not available in planning project—establish on next major development project**
  - DO NOT include PACS/SACS installation on a project's critical path
  - Create separate Airports-GIS Project (Airside Construction)
- **Minimum requirements – 1 PACS, Preferably 1 SACS**
- **Large (acreage) airports could have 2 PACS/4 (or more) SACS**
- **State-plane coordinates need translation and transformation**
- **-16 requires significant surveying documentation; provides value**



## Questions

1. **Must you install PACS/SACS at NPIAS Airports?**
2. **Where can you find out if an airport has published PACS/SACS?**
3. **What is the current Geoid model for Alaska?**



**Gil Neumann**  
Senior Airport Planner | APP-400  
[gil.neumann@faa.gov](mailto:gil.neumann@faa.gov)  
Office: 202.267.5840

**G. Thomas Wade, P.E.**  
Senior Planner | ASW-610  
[thomas.wade@faa.gov](mailto:thomas.wade@faa.gov)  
Office: 817.222.5613

19 Regional Workshop - AAL  
October 19-20, 2011

Federal Aviation  
Administration

