

# **MONITORING STANDARDS FOR BEACH EROSION CONTROL PROJECTS**

March 2004



Bureau of Beaches and Coastal Systems  
Division of Water Resource Management  
Department of Environmental Protection  
State of Florida

**MONITORING STANDARDS  
FOR  
BEACH EROSION CONTROL PROJECTS**

**TABLE OF CONTENTS**

|  |    |
|--|----|
| <a href="#">Foreword</a> .....   | 3  |
| <a href="#">Introduction</a> .....   | 4  |
| 01000 - <a href="#">Beach Profile Topographic Surveying</a> .....                    | 7  |
| 01100 - <a href="#">Offshore Profile Surveying</a> .....                             | 14 |
| 01200 - <a href="#">Borrow Site, Shoal and<br/>Other Bathymetric Surveying</a> ..... | 20 |
| 02000 - <a href="#">Aerial Photography</a> .....                                     | 25 |
| 02100 - <a href="#">Environmental Aerial Photography</a> .....                       | 32 |
| <a href="#">Appendix A – Monument Information Report</a> .....                       | 39 |

## Foreword

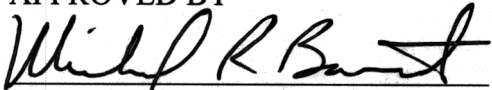
The Bureau of Beaches and Coastal Systems (BBCS) is responsible for programs for the protection and management of beaches and coastal systems of the State of Florida. This responsibility includes the accurate measurement and analysis of data to document the condition of the State's beaches and coastal systems, in particular the status of beach erosion and erosion control project performance for the purposes of managing coastal development and natural resources.

*Monitoring Standards For Beach Erosion Control Projects* was written to provide consistent project monitoring guidelines in the State of Florida and outlines the minimum data collection effort necessary to accomplish BBCS program goals. The focus is on work efforts contracted by local sponsors as required by FDEP permit or as necessitated by the planning and design process of beach erosion control projects.

This plan is a living document designed to be modified on an as-needed basis. It will require annual review in order to re-address issues such as methodology, and implementation of new technologies. This report does not include analysis aspects of coastal monitoring which is a significant component of the total monitoring effort. This report also does not include geotechnical or environmental components.

This report was prepared by Mark Leadon, P.E., Echo Gates, P.E., and Tom Watters, P.L.S. Editorial assistance was provided by Robert M. Brantly, P.E., Paden Woodruff, Emmett Foster, P.E., and Nhan Nguyen.

APPROVED BY



Michael R. Barnett, P.E., Chief  
Bureau of Beaches and Coastal Systems

3-03-04

Date Approved

# **MONITORING STANDARDS FOR BEACH EROSION CONTROL PROJECTS**

## **Introduction**

### **1.0 Background**

The Bureau of Beaches and Coastal Systems (BBCS) has an extensive history of coastal data acquisition along Florida's sandy coastal shores dating back to the early 1970's. Initial data acquisition was primarily to support the coastal construction control line program. Historic shoreline position data was subsequently assembled, documenting shoreline change back to the late 1800's. In more recent years, regional monitoring and erosion control project related data collection by BBCS has become an increasingly integral part of the State's Beach Management Program.

The predominant focus of BBCS data collection efforts has been beach and offshore profile survey data and aerial photography on a county-by-county basis. With the legislative commitment to a dedicated funding source for beach erosion control projects, emphasis on project-related data collection and its associated methods has increased due to the growth in the number of projects and increased funding to maintain existing projects.

This document establishes BBCS data collection and processing standards for erosion control projects. It is intended to provide local sponsors and contractors with standard procedures and specifications for project monitoring.

The BBCS continues to implement the Regional Coastal Monitoring Program initiated in 2001 in which one quadrant of the state is monitored comprehensively each year through profile surveys, aerial photography and aerial videography acquisition. Post-storm survey and photographic data will continue to be acquired by the BBCS on an as-needed basis. In cases in which project data collection is performed as a part of regional coastal monitoring, the technical specifications contained in the BBCS's *Statewide Regional Coastal Monitoring Plan* may apply.

### **2.0 Statement of Monitoring Policy**

It is the policy of the Bureau of Beaches and Coastal Systems (BBCS) to acquire, review, maintain, and make available to the BBCS staff and the general public high-quality, accurate coastal data for the purpose of monitoring Florida's beaches and coastal systems. These data are utilized in support of Florida's comprehensive beach management programs as defined in Chapter 161, F.S.

Project monitoring supports the needs of the public and the agency in a variety of ways. Data collected for specific projects is used to document and evaluate project

performance, to perform beach management planning, and to assist in conducting regulatory reviews related to the coastal construction control lines (CCCL) and joint coastal permitting (JCP). It is also used in the review and documentation of hurricane and other storm impacts to Florida's beaches and coastal systems.

### **3.0 Purpose of Data Collection and Processing Standards**

The purpose of this document is to define and compile technical standards and specifications for project-specific data acquisition and processing. The intent of this document is to provide a standard for systematic physical data collection monitoring of erosion control projects along Florida beaches for beach management and regulatory purposes. The products developed from use of this document will be consistent statewide, thereby facilitating efficient comparative analysis and dissemination to the public by the BBCS.

### **4.0 Data Components**

Data components contained in this document include the following:

- Topographic and Bathymetric Profile Surveys
- Bathymetric Surveys for Open Water Areas
- Aerial Photography
- Aerial Photography for Environmental Assessments

Associated technical specifications are included for all of the listed data components, including survey accuracy standards. The BBCS has opted for substitution of topographic LiDAR in place of conventional survey data in the Regional Coastal Monitoring Program, and will continue to consider incorporation of LiDAR technology into the project data collection effort on a project-by-project basis. Other alternative technologies will be considered as opportunities present themselves and specifications are developed accordingly.

This document contains an appendix illustrating the format of the information to be included in the Monument Information Report. Control and Range Monument information is available from the BBCS Internet web site at: <http://www.dep.state.fl.us/beaches/data/coastmon.htm>.

Other coastal resource monitoring standards important to the State's comprehensive beach management program effort, such as geologic/geotechnical, and environmental, have not been developed at this time.

### **5.0 Standards Document Accessing and Updating**

*Monitoring Standards for Beach Erosion Control Projects* will be available from the BBCS Internet web site. The address for the site is: <http://www.dep.state.fl.us/beaches/>

These technical specifications will be reviewed and updated on an annual basis. Revisions and updates will occur as new concepts and technologies become available and are implemented in beach erosion control projects. Input and involvement in development and updating of this document by the technical community and the general public is welcome and encouraged.

## SECTION 01000

### BEACH PROFILE TOPOGRAPHIC SURVEYING for BEACH EROSION CONTROL PROJECTS

#### PART I - GENERAL

This technical specification has been developed for application to beach erosion control project monitoring as required by the Bureau of Beaches and Coastal Systems (BBCS). In the event that project monitoring coincides with or is conducted as a part of the BBCS regional monitoring program, then the more extensive regional monitoring technical specifications developed by the BBCS shall apply.

#### A. DESCRIPTION OF WORK

1. Work described in this section includes the acquisition, horizontal and vertical control (either by conventional or Global Positioning System (GPS) methods), post processing, quality control/quality assurance, and deliverables of topographic survey data. Conventional topographic survey data shall be collected at BBCS reference points, which are approximately 1,000 feet apart alongshore, or other lines or areas as described in the contract Scope of Work.
2. Purpose – The purpose of the topographic survey is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

#### B. DEFINITIONS

1. Contractor – The Company that will provide topographic survey services to the BBCS.
2. HARN – The Florida High Accuracy Reference Network.
3. NAD 83/90 – The North American Datum 1983 adjustment of 1990.
4. NAVD 88 – The North American Vertical Datum of 1988.
5. TBM – Temporary bench mark.
6. Control Monument or Benchmark – BBCS 2<sup>nd</sup> order or higher control point, typically but not necessarily known as an “A” station.

7. Range Monuments – BBCS reference points, spaced approximately 1000 ft apart alongshore, typically known as “R” stations.
8. RTAB – A table of range monument locations (vertical and horizontal), elevations, and profile azimuths.
9. RMSE – Root mean square error

#### C. REFERENCE DOCUMENTS

1. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards, Parts 1, 2, and 3*, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.
2. Federal Geographic Data Committee, *Content Standard for Digital Geospatial Metadata*, FGDC-STD-001-1998, 1998.
3. Federal Geodetic Control Committee, *Standards and Specifications for Geodetic Control Networks*, September 1984.
4. Florida Minimum Technical Standards. Chapter 61G17-6, Florida Administrative Code.
5. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, *Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)*, November 1997.

### PART II - EXECUTION

#### A. DATA COLLECTION

1. Survey Control - Topographic surveys shall use BBCS “A” monuments (as recorded in the County public records) or other National Geodetic Survey (NGS) published 2<sup>nd</sup> order or higher marks for survey control. Tabular listings of all horizontal and vertical control on all existing "A" monuments shall be obtained through either the BBCS web site or directly from the BBCS office.

All GPS radio base station control or range/azimuth system control shall be established or recovered from BBCS control monuments (typically “A” stations) and shall meet or exceed Geospatial Positioning Accuracy Standards, Range VIII. Designation, stamping, description, horizontal position, horizontal RMSE, elevation (in NAVD 88) and elevation RMSE shall be provided to BBCS for all established base station control in the Monument Information Report as outlined in Part III.B.3.

2. Ground Support – The Contractor shall provide all manpower and equipment as needed to complete the required topographic work.
3. Range Monuments and Azimuths - All beach profile surveys shall be referenced to BBCS range monument locations and conducted along azimuths as defined in the latest edition of the BBCS RTAB listing. Alternate baseline coordinate locations and azimuths may be used upon approval by BBCS for consistency in project monitoring. Documentation and verification of the alternate locations shall be obtained by the contractor and provided to the BBCS as outlined below. The appropriate BBCS RTAB listing shall be obtained through either the BBCS web site or directly from the BBCS office.

The Contractor shall prepare a Monument Information Report as required in Part III.B.3 that describes the location of given, found, and used monuments and TBMs including identification, establishment date, coordinates, elevations, and profile azimuths. TBM identification shall include reference monument origin, identification, azimuth, distance down line, and TBM elevation. The Monument Information Report shall also include tables of differences between given and found values, given and used values, and found and used values. An example format for the report is provided in Appendix A.

4. Beach/Dune Profiles - All upland profiles including any intermediate profiles shall be collected on Florida State Plane Coordinate Systems and BBCS established grid bearings and shall be in accordance with accuracy specifications in Part II.A.7 below.
5. Horizontal Datum - The horizontal datum shall be the HARN NAD 83/90.
6. Vertical Datum - The vertical datum shall be the NAVD 88.
7. Accuracy – Reference monuments: The vertical accuracy of the data shall meet or exceed GPS-derived heights (5cm) standard and Chapter 61G17-6, F.A.C., minimum technical standards for a topographic survey (see Part I.C.4) and be verified by two (2) controlling benchmarks. Leveling instruments shall be “PEG” tested. The horizontal accuracy of the data shall meet or exceed Geospatial Positioning Accuracy Standards, Range VIII, (maximum of 0.66 ft.) (See Part I.C.1).

Profile Data: The vertical accuracy of the topographic profile data shall meet or exceed GPS-derived heights (5cm) standard and Chapter 61G17-6, F.A.C., minimum technical standards for a topographic survey (see Part I.C.4). Accuracy shall be verified by two (2) controlling benchmarks, and checked back into the reference monument at each profile line or checked into adjoining TBM, Benchmark, or reference point at each profile line.

The check back method must be described in the metadata as required in Part III.B.4 of this specification.

The horizontal accuracy of the data shall meet or exceed Geospatial Positioning Accuracy Standards, Range X, (maximum of 3 ft.). GPS observations, poly-chain, electronic distance measuring (EDM) device, or stadia observation shall be used to measure distances. Redundancy in horizontal measurement is required. Redundant methods must be described in the metadata as required in Part III.B.4 of this specification.

Survey accuracy shall comply with all standards contained in references in Part I.C.

8. Units of measure - All required data shall be collected in U.S. Survey Feet.
9. Data Resolution – The data shall be collected at intervals not to exceed 25 ft. and at all grade breaks and attributed items along the profile sufficient to accurately describe the topography at the profile locations. Attribute codes are to be as discussed in Part II.A.12, below. All rod readings shall be read and recorded to the nearest hundredth of a foot (2 decimal places).
10. Data Collection Area – The topographic data shall be collected seaward out to a depth sufficient to establish continuity with offshore data, and landward to the DEP monument location or approximately 150 feet landward of the vegetation line, whichever is more seaward. If a wading depth survey is performed of the beach and upland only without an offshore survey component, then the survey shall, at a minimum, extend to approximately 1 ft. below mean low water.

If the point 150 feet landward of the vegetation line cannot be reached because of an obstruction, such as a building, bay water, mangroves, or other impassable vegetation or obstacle, then the survey line may be stopped at the obstacle and shall be noted as such in the survey field book. Coastal armoring is generally not an impassable obstacle and is normally to be surveyed.

The BBCS range monument locations shall be established as the 0.0 locations for recording all horizontal distances along profiles. Horizontal distances along profile lines shall be recorded as positive seaward of the monument location and negative landward of the monument location.

11. Procedural Control – The Contractor shall outline and maintain a schedule for planned data collection and itemize all procedures including quality control and instrumentation to be followed during the completion of this work. Procedural standards are outlined in reference documents listed in Part I.C. All procedures and milestones achieved during completion of this

work shall be described in the metadata as required in Part III.B.4 of this specification.

12. Field book beach profile pages are to include the following information for each profile: Survey monument identification, stamping or TBM identification, the date of the survey, the profile azimuth (grid), the survey crewmembers, and attribute identification. Distance and elevation readings shall be recorded in a standard columnar arrangement on the field book pages.

In addition to the observation points required in Part II.A.9, features shall be attributed in the field book with associated location and elevation. Features to be attributed include but are not limited to the following:

- Buildings
- Centerlines of all roads, streets, trails
- Edges of dense vegetation
- Edges of water
- Edges of pavement
- Tops of escarpments
- Concrete monuments
- Iron pipes
- Iron rods
- Monuments on grade such as a cap on a seawall
- Monuments off grade
- Seaward limits of profile data collection
- Landward limits of profile data collection
- Revetments
- Peat or Mulch
- Naturally occurring rock such as coquina or worm rock
- Tops of seawalls
- Edges of vegetation
- Landward limits of wet sands

Single character codes shall be included in the DEP formatted data set as follows:

| <b>CODE</b> | <b>FEATURE</b>   |
|-------------|--|
| C           | Centerlines of all roads, streets, trails                                  |
| R           | Edges of hardened shoreline such as revetments or naturally occurring rock |
| S           | Tops of seawalls   |
| V           | Edges of vegetation  |
| W           | Landward limits of wet sands   |

## B. DATA PROCESSING

Topographic data collected by these methods shall have quality checks performed and verified by the surveyor in responsible charge and detailed in the metadata (see Part III.B.4).

## C. DATA SUBMITTALS

Survey data is to be provided in the datum in which the data is collected.

When submitting permit required monitoring information to the BBCS, the Contractor shall include a transmittal letter clearly labeled with the following at the top of each page: "This monitoring information is submitted in accordance with the approved Monitoring Plan for Permit No. [XXXXXX] for the monitoring period [XXXXXX]." If the monitoring is not required by permit, but cost-shared through the BBCS Beach Erosion Control Program, the transmittal letter shall be labeled, "This monitoring information is submitted in accordance with BBCS Project Agreement [XXXXXXXX]." In addition, the exterior of all digital products, such as floppy and compact disks, shall be labeled with the description of contents, Project Agreement Number, or Permit Number and monitoring period.

## PART III - PRODUCTS

### A. HARDCOPY PRODUCTS

Report from the surveyor certifying to the Department that the survey meets the BBCS technical specifications established herein (Part.II.A of this specification) and minimum technical standards of Chapter 61G17-6, F.A.C.

### B. DIGITAL PRODUCTS

1. ASCII file containing raw x, y, and z profile data points, if x,y,z data are collected.
2. ASCII files containing the profile data processed into the DEP distance and depth format. DEP format includes data as well as header records.
3. Monument Information Report (Given/Found/Used Report) with regard to monumentation described in Parts II.A.1 and II.A.3 above shall be submitted in Excel format (.xls) or equivalent spreadsheet format and provided on CD. Format shall be provided as shown in Appendix A of this document. Document templates are available from the BBCS web site or directly from the BBCS office.
4. Complete federally compliant metadata file including methodology of the data collection and processing procedures utilized in accordance with

standards set forth by the Federal Geographic Data Committee as referenced in Part I.C.2 of this specification. The metadata file shall be delivered on CD.

5. Copies of all checked, standard field books, computation and reduction files, and abstracted final positions shall be provided to the BBCS. Field books shall be scanned and pages amassed into a .pdf document for electronic submittal on CD.

END OF SECTION

## SECTION 01100

### OFFSHORE PROFILE SURVEYING for BEACH EROSION CONTROL PROJECTS

#### PART I - GENERAL

This technical specification has been developed for application to beach erosion control project monitoring as required by the Bureau of Beaches and Coastal Systems (BBCS). In the event that project monitoring coincides with or is conducted as a part of the BBCS regional monitoring program, then the more extensive regional monitoring technical specifications developed by the BBCS shall apply. A separate specification (Borrow Site, Shoal and Other Bathymetric Surveying) shall be used for bathymetric surveying not associated with beach profiles.

#### A. DESCRIPTION OF WORK

1. Work described in this section includes the acquisition, horizontal and vertical control (either by conventional or GPS methods), post processing, quality control/quality assurance, and deliverables of coastal bathymetric survey data. Bathymetric survey data shall be collected at BBCS reference points, which are approximately 1,000 feet apart alongshore, or other lines or areas as described in the contract Scope of Work. This specification is applicable to nearshore (referred to as “offshore” herein) profile surveying and does not include full consideration of surveying in areas such as inlets and offshore borrow areas.
2. Purpose – The purpose of the bathymetric survey data is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

#### B. DEFINITIONS

1. Contractor – The company providing bathymetric survey services to the local sponsor or consultant acting in behalf of the local sponsor.
2. HARN – The Florida High Accuracy Reference Network.
3. NAD 83/90 – The North American Datum 1983 adjustment of 1990.
4. NAVD 88 – The National American Vertical Datum of 1988.
5. TBM – Temporary bench mark.

6. Control Monument or Benchmark – BBCS 2<sup>nd</sup> order or higher control point, typically but not necessarily known as an “A” station.
7. Range Monuments – BBCS reference points, spaced approximately 1000 ft apart alongshore, typically known as “R” stations.
8. RTAB – A table of range monument locations (vertical and horizontal), elevations, and profile azimuths.
9. RMSE – Root Mean Square Error

#### C. REFERENCE DOCUMENTS

1. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards*, Parts 1, 2, and 3, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.
2. Federal Geographic Data Committee, *Content Standard for Digital Geospatial Metadata, FGDC-STD-001-1998*, 1998.
3. Federal Geodetic Control Committee, *Standards and Specifications for Geodetic Control Networks*, September 1984
4. Florida Minimum Technical Standards. Chapter 61G17-6, Florida Administrative Code.
5. US Army Corps of Engineers, *Hydrographic Surveying, Engineering and Design Manual, EM1110-2-1003*, 1999.
6. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, *Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)*, November 1997.

### PART II - EXECUTION

#### A. DATA COLLECTION

Bathymetric surveys have historically been conducted by the use of boat-mounted echo sounding equipment (fathometer). Accuracy of bathymetric surveying has historically been subject to water level (e.g., tidal elevation) variations and sea conditions and the subsequent successful establishment of tidal correction and filtering of sea conditions. The use of kinematic GPS, including “on-the-fly” methods, has greatly increased the capability of achieving acceptable accuracy levels. Accuracy standards set forth by BBCS in this document are based on the demonstrable accuracy of these improved technologies. All bathymetric surveying

shall meet or exceed accuracy levels achievable by these improved technologies. Generally these accuracy levels cannot be met using a tide gauge.

1. Survey Control

All control work shall be completed prior to performing any profile surveys for a given survey area, unless otherwise specified by BBCS.

- a. Ground Control - Bathymetric surveys shall use BBCS "A" monuments (as recorded in the County public records) or other National Geodetic Survey (NGS) published 2<sup>nd</sup> order or higher control for survey control. Tabular listings of all horizontal and vertical control on all existing "A" monuments shall be obtained through either the BBCS web site or directly from the BBCS office.

All GPS radio base station control or range/azimuth system control shall be established or recovered from BBCS control monuments (typically "A" stations) and shall meet or exceed Geospatial Positioning Accuracy Standards, Range VIII. Designation, stamping, description, horizontal position, horizontal RMSE, elevation (in NAVD 88) and elevation RMSE shall be provided to BBCS for all established base station control in the Monument Information Report as outlined in Part III.B.3.

- b. Ground Support – The Contractor shall provide all manpower and equipment as needed to complete the required bathymetric survey work.

2. Range Monuments and Azimuths - All offshore profile surveys shall be referenced to BBCS range monument coordinate locations and conducted along azimuths as defined in the latest edition of the BBCS RTAB listing. Alternate baseline coordinate locations and azimuths may be used upon approval by BBCS for consistency in project monitoring. Documentation and verification of the alternate locations shall be obtained by the contractor and provided to the BBCS as outlined below. The appropriate BBCS RTAB listing shall be obtained through either the BBCS web site or directly from the BBCS office.

The Contractor shall provide the following information concerning all given, found, and used monuments and TBMs in the Monument Information Report as required in Part III.B.3: identification, establishment dates, coordinates, elevations, and profile azimuths. TBM identification shall include reference monument origin, identification, azimuth, distance down line and TBM elevation. Accuracy standards shall be in accordance with Part II.A.8.d. The Monument Information Report

shall also include tables of differences between given and found values, given and used values and found and used values. An example format for the report is given in Appendix A.

3. Offshore Profiles – All offshore profiles including any intermediate profiles shall be collected on Florida State Plane Coordinate Systems and BBSC established grid bearings and shall be in accordance with accuracy specifications in Part II.A.8.d below.
4. Horizontal Datum - The horizontal datum shall be the HARN NAD 83/90.
5. Vertical Datum - The vertical datum shall be the NAVD 88.
6. Equipment and Calibration

All survey equipment shall be properly calibrated and operated as appropriate for specific work being performed in accordance with standards established in Part I.C.4 of this specification. All depth measurement equipment shall be verified for accuracy at the beginning and end of each survey day. A direct depth measurement check (e.g. via pole, lead line, etc.) shall be conducted and recorded at both shallow and maximum depths relative to the work area at the beginning and end of each survey day, and more frequently if necessary. Use of a velocity probe is acceptable for speed of sound calculations to calibrate depth-recording instruments.

If sea conditions preclude performing the depth check at the end of the day, sea conditions and indication of inability to perform the depth check shall be recorded and reported in the field book. At the beginning of each survey day, the last survey line of the previous day shall be repeated the following survey day to verify the measurement from the previous day. A similar check shall be performed whenever a change in conditions during a survey warrants a check, such as unforeseen circumstances (i.e., equipment problems which may temporarily suspend a survey day) to ensure that the survey work is properly grounded with depth checks.

7. Data Measurement
  - a. Bathymetric survey data collection shall be performed as close in time as possible with the upland topographic survey data collection. Difference in time between the onshore and offshore data shall be no greater than 14 days.
  - b. Bathymetric survey data collection shall be conducted in calm seas. Maximum wave heights during the data collection period shall not exceed 3 feet.

- c. Bathymetric survey data shall be acquired as close to time of high tide as possible, and shall extend landward to a depth sufficient to establish continuity with upland survey data. The offshore survey shall continue seaward, extending to a minimum of 3000 feet offshore (from the most landward offshore data point) or to -30 feet (NAVD 88), whichever is reached first.
- d. Accuracy – The vertical accuracy of the profile data shall meet or exceed GPS-derived heights (0.2-0.5 ft.) standard (see Part I.C.6). The allowable horizontal positioning system accuracy of the data shall be a maximum of 2.0 feet. The allowable off-line horizontal deviation shall be a maximum of 30 feet.
- e. Units of measure - All required data shall be collected in U.S. Survey Feet.
- f. Data Resolution – The data shall be collected at intervals not to exceed 25 ft. and at all grade breaks along the profile sufficient to accurately describe the bathymetry at the profile locations.
- g. Procedural Control – The Contractor shall itemize all procedures including quality control and instrumentation followed during the completion of this work. Procedural standards are outlined in reference documents listed in Part I.C. Any deviations from procedures and standards contained within this specification shall be identified and approved by BBCS prior to conducting the survey work. All survey methodologies, quality control/quality assurance procedures, and milestones achieved during completion of this work shall be described in the metadata as required in Part III.B.4. Any findings, corrections, and results of those procedures shall also be included in the submittal.

## B. DATA PROCESSING

All data processing shall be in accordance with National Geodetic Standards (as established by reference to Parts I.C.1 and I.C.6), Florida Minimum Technical Standards (reference Part I.C.4), requirements for a U.S. Army Corps of Engineers Class II Hydrographic Survey (with the exception that vertical accuracy shall conform to the BBCS specification in Part II.A.8.d above and referenced in Part I.C.5), accepted survey practice, and BBCS data standards and format requirements.

## C. DATA SUBMITTALS

Survey data is to be provided in the datum in which it was collected.

When submitting permit required monitoring information to the BBCS, the Contractor shall include a transmittal letter clearly labeled with the following at the top of each page: "This monitoring information is submitted in accordance with the approved Monitoring Plan for Permit No. [XXXXXX] for the monitoring period [XXXXXX]." If the monitoring is not required by permit, but cost-shared through the BBCS Beach Erosion Control Program, the transmittal letter shall be labeled, "This monitoring information is submitted in accordance with BBCS Project Agreement [XXXXXXX]." In addition, the exterior of all digital products, such as floppy and compact disks, shall be labeled with the description of contents, Project Agreement Number, or Permit Number and monitoring period.

### PART III - PRODUCTS

#### A. HARDCOPY PRODUCTS

Report from the surveyor certifying that the survey meets the BBCS Technical Standards established herein (Part II.A of this specification) and minimum technical standards of Chapter 61G17-6, Florida Administrative Code.

#### B. DIGITAL PRODUCTS

1. ASCII file containing raw x, y, and z profile data points.
2. ASCII files containing the profile data processed into the DEP distance and depth format. DEP format includes data as well as header records.
3. Monument Information Report (Given/Found/Used Report) with regard to monumentation described in Parts II.A.2.a and II.A.3. above. Information shall be submitted in Excel format (.xls) or equivalent spreadsheet format and provided on CD. Format shall be provided as shown in Appendix A of this document. Document templates are available from the BBCS web site or directly from the BBCS office.
4. Complete federally-compliant metadata file including data collection and processing methods utilized in this work in accordance with standards set forth by the Federal Geographic Data Committee as referenced in Part I.C.2 of this specification. Metadata shall be delivered on CD.
5. Copies of all standard field books, all computation and reduction files, and abstracted final position depths and distances from reference points shall be provided to the BBCS. Field books shall be scanned and pages amassed into .pdf format for electronic submittal on CD.

END OF SECTION

## SECTION 01200

### BORROW SITE, SHOAL AND OTHER BATHYMETRIC SURVEYING for BEACH EROSION CONTROL PROJECTS

#### PART I - GENERAL

This technical specification has been developed for application to beach erosion control projects as required by the Bureau of Beaches and Coastal Systems (BBCS). The surveys specified herein are not associated with the Statewide Regional Monitoring Program.

This specification is applicable to offshore areas, giving full consideration to surveying in areas such as ebb and flood shoals, borrow sites and borrow site development. A separate specification, Offshore Profile Surveying, shall be used for all bathymetric surveying associated with beach profiles.

#### A. DESCRIPTION OF WORK

1. Work described in this section includes the acquisition, horizontal and vertical control (either by conventional or GPS methods), post processing, quality control/quality assurance, and deliverables of coastal bathymetric survey data.
2. Purpose – The purpose of the bathymetric survey data is to provide data and other products for coastal regulatory and management activities along the coast of Florida.

#### B. DEFINITIONS

1. Contractor – The company providing bathymetric survey services to the local sponsor or consultant acting on behalf of the local sponsor.
2. HARN – The Florida High Accuracy Reference Network.
3. NAD 83/90 – The North American Datum 1983 adjustment of 1990.
4. NAVD 88 – The National American Vertical Datum of 1988.
5. TBM – Temporary bench mark.
6. Control Monument or Benchmark – BBCS 2nd order or higher control point, typically but not necessarily known as an “A” station.
7. RMSE – Root Mean Square Error.

## C. REFERENCE DOCUMENTS

1. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards, Parts 1, 2, and 3*, Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.
2. Federal Geographic Data Committee, *Content Standard for Digital Geospatial Metadata*, FGDC-STD-001-1998, 1998.
3. Federal Geodetic Control Committee, “*Standards and Specifications for Geodetic Control Networks*,” September 1984.
4. Florida Minimum Technical Standards. Chapter 61G17-6, Florida Administrative Code.
5. US Army Corps of Engineers, *Hydrographic Surveying*, Engineering and Design Manual, EM1110-2-1003, 1999.
6. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, “*Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)*,” November 1997.

## PART II - EXECUTION

### A. DATA COLLECTION

Bathymetric surveys have historically been conducted by the use of boat-mounted echo sounding equipment (fathometer). Accuracy of bathymetric surveying has historically been subject to water level (e.g., tidal elevation) variations and sea conditions and the subsequent successful establishment of tidal correction and filtering of sea conditions. The use of kinematic GPS, including “on-the-fly” methods, has greatly increased the capability of achieving acceptable accuracy levels. Accuracy standards set forth by BBCS in this document are based on the demonstrable accuracy of these improved technologies. All bathymetric surveying shall meet or exceed accuracy levels achievable by these improved technologies. Generally these accuracy levels cannot be met using a tide gauge.

#### 1. Survey Control

All control work shall be completed prior to surveying a given area, unless otherwise specified by BBCS.

- a. Ground Control - Bathymetric surveys shall use BBCS “A” monuments (as recorded in the County public records) or other National Geodetic Survey (NGS) published 2nd order or higher

control for survey control. Tabular listings of all horizontal and vertical control on all existing "A" monuments listing shall be obtained through either the BBCS web site or directly from the BBCS office.

All GPS radio base station control shall be established or recovered from BBCS control monuments (typically "A" stations) and shall meet or exceed Geospatial Positioning Accuracy Standards, Range VIII. Designation, stamping, description, horizontal position, horizontal RMSE, elevation (in NAVD 88) and elevation RMSE shall be provided to BBCS for all established base station control in the Monument Information Report as outlined in Part III.B.4. The Monument Information Report shall also include tables of differences between given and found values, given and used values and found and used values. An example format for the report is given in Appendix A.

- b. Ground Support – The Contractor shall provide all manpower and equipment as needed to complete the required bathymetric survey work.
2. Horizontal Datum - The horizontal datum shall be the HARN NAD 83/90.
3. Vertical Datum - The vertical datum shall be the NAVD 88.
4. Equipment and Calibration

All survey equipment shall be properly calibrated and operated as appropriate for specific work being performed in accordance with standards established in Part I.C.4 of this specification. All depth measurement equipment shall be verified for accuracy at the beginning and end of each survey day. A direct depth measurement check (e.g. via pole, lead line, etc.) shall be conducted and recorded at both shallow and maximum depths relative to the work area at the beginning and end of each survey day, and more frequently if necessary. Use of a velocity probe is acceptable for speed of sound calculations to calibrate depth-recording instruments.

If sea conditions preclude performing the depth check at the end of the day, sea conditions and indication of inability to perform the depth check shall be recorded and reported in the field book. At the beginning of each survey day, the last survey line of the previous day shall be repeated the following survey day to verify the measurement from the previous day. A similar check shall be performed whenever a change in conditions during a survey warrants a check, such as unforeseen circumstances (i.e., equipment problems which may temporarily suspend a survey day) to ensure that the survey work is properly grounded with depth checks.

## 5. Data Measurement

- a. Bathymetric survey data collection shall be conducted in calm seas. Maximum wave heights during the data collection period shall not exceed 3 feet.
- b. Accuracy – The vertical accuracy of the data shall meet or exceed GPS-derived heights (0.2-0.5 ft.) standard (see Part I.C.6). The allowable horizontal positioning system accuracy of the data shall be a maximum of 2.0 feet. The allowable off-line horizontal deviation shall be a maximum of 30 feet.
- c. Data Resolution – The data shall be collected at intervals not to exceed 25 ft. and in sufficient density to accurately describe the bathymetry of the subject area.
- d. Procedural Control – The Contractor shall itemize all procedures including quality control and instrumentation followed during the completion of this work. Procedural standards are outlined in reference documents listed in Part I.C. Any deviations from procedures and standards contained within this specification shall be identified and approved by BBCS prior to conducting the survey work. All survey methodologies, quality control/quality assurance procedures, and milestones achieved during completion of this work shall be described in the metadata as required in Part III.B.3. Any findings, corrections, and results of those procedures shall also be included in this submittal.

## B. DATA PROCESSING

All data processing shall be in accordance with National Geodetic Standards (as established by references Parts I.C.1 and I.C.6), Florida Minimum Technical Standards (reference Part I.C.4), requirements for a U.S. Army Corps of Engineers Class II Hydrographic Survey (with the exception that vertical accuracy shall conform to the BBCS specification in Part II.A.6.b, above and referenced in Part I.C.5), accepted survey practice, and BBCS data standards and format requirements.

## C. DATA SUBMITTALS

Survey data is to be provided in the datum in which it was collected.

When submitting permit required monitoring information to the BBCS, the Contractor shall include a transmittal letter clearly labeled with the following at the top of each page: "This monitoring information is submitted in accordance with the approved Monitoring Plan for Permit No. [XXXXXX] for the monitoring

period [XXXXXX]." If the monitoring is not required by permit, but cost-shared through the BBCS Beach Erosion Control Program, the transmittal letter shall be labeled, "This monitoring information is submitted in accordance with BBCS Project Agreement [XXXXXX]." In addition, the exterior of all digital products, such as floppy and compact disks, shall be labeled with the description of contents, Project Agreement Number, or Permit Number and monitoring period.

### PART III - PRODUCTS

#### A. HARDCOPY PRODUCTS

Report from the surveyor certifying that the survey meets the BBCS Technical Standards and Florida minimum technical standards, Chapter 61G17-6, Florida Administrative Code.

#### B. DIGITAL PRODUCTS

1. ASCII file containing raw x, y, and z data points.
2. .DWG or .DXF of the borrow area with information provided on the following layers:
  - a. Point drawing of "A" monuments used to control the survey with a listing of monument coordinates (x,y, and z) and description.
  - b. Line drawing of survey extents with points of intersection listed on the drawing.
  - c. Line drawing of transects surveyed.
  - d. Point drawing of all data points collected, with elevation.
3. Complete federally-compliant metadata file including data collection and processing methods utilized in this work in accordance with standards set forth by the Federal Geographic Data Committee as referenced in Part I.C.2 of this specification. Metadata shall be delivered on CD.
4. Monument Information Report (Given/Found/Used Report) with regard to all ground control monument information described in Part II.A.2.a., above. Information to be included in the report is outlined in Part II.A.2.a.
5. Copies of all standard field books, all computation and reduction files, and abstracted final position depths and distances from reference points shall be provided to the BBCS, if used. When possible, field books shall be scanned and pages amassed into .pdf document for electronic submittal on CD.

END OF SECTION

## SECTION 02000

### AERIAL PHOTOGRAPHY ACQUISITION for BEACH EROSION CONTROL PROJECTS

#### PART I - GENERAL

This technical specification has been developed for application to beach erosion control project monitoring as required by the BBCS. This technical specification is specific for use of conventional photographic equipment and processing. If a digital camera is used, then the Contractor shall demonstrate to the project sponsor that required spatial resolution and photo coverage (equivalent to conventional 9x9 negative) is to be achieved and provided. In the event that project monitoring coincides and is conducted as a part of the BBCS regional monitoring program, then the more extensive regional monitoring technical specifications developed by the BBCS shall apply.

#### A. DEFINITIONS

1. Aerial Photography System - An airborne aerial photography system shall consist of a precision aerial camera, airborne Global Positioning System (GPS) with attendant GPS base station(s), and an Inertial Measuring Unit (IMU).
2. CORS - Continuously Operating Reference Stations.
3. Camera Focal Length – The distance measured along the optical axis from the rear nodal point on the lens to the plane of critical focus of a very distant object.
4. Contact Prints – Prints produced directly from negatives or the equivalent prints from digital photography, 9”x 9”.
5. Contractor – The aerial survey or photogrammetric company that will provide aerial survey and/or photogrammetric services.
6. Crab – The condition caused by incorrect orientation of the camera with respect to the track of the aircraft. Any turning of an airplane which causes its longitudinal axis to vary from the track of the plane.
7. HARN - The Florida High Accuracy Reference Network.
8. NAD83/90 - The North American Datum of 1983 adjustment of 1990.
9. NAVD 88 – North American Vertical Datum of 1988.

10. Pixel – The smallest cell size with a uniform value of an image. This digital image grain is produced in varying sizes, usually referred to in ground units such as 6 inches, 1 foot, or 3 meters. Pixels are created during the scanning of the aerial imagery and are key to establishing the resolution of the photograph/image.
11. Scale – The relationship between a given distance on the ground and the corresponding distance on a photograph or image. Scale can be expressed in two different ways, both as ratios. The first method uses common measuring systems to relate the distance on the photo to the actual distance on the earth (e.g., 1" = 200'). The second method uses a ratio where the unit of measure is arbitrary (e.g., 1:1200). For this method meters, feet, miles, etc. can all be used as the measuring unit to relate distance on a photo or image with distance on the earth.
12. Scanning – The process of converting analog photographs or hard copy maps into digital form.

## B. REFERENCE DOCUMENTS

1. Florida Department of Transportation, *Specifications for Aerial Photography Topic No.: 550-020-002-f.* Effective: December 30, 1997.
2. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards, Parts 1, 2, and 3.* Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.
3. Federal Geographic Data Committee, *Content Standard for Digital Geospatial Metadata.* FGDC-STD-001-1998, 1998.
4. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, *Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm).* November 1997.
5. U.S. Army Corps of Engineers, *Photogrammetric Mapping.* Engineering Design Manual EM1110-1-1000, March 31, 1993.
6. U.S. Geological Survey, *USGS Aerial Camera Specifications.* January 1, 2003

## PART II - EXECUTION

### A. PRE-FLIGHT

The Contractor shall submit the most recent camera calibration report for the camera utilized for photo acquisition according to the standards of Part I.B.6 of

this specification. The date of calibration shall not exceed the proposed flight date by more than three years.

B. FLIGHT

1. Scale – The negatives shall be at scale of 1" = 500' (1:6000).
2. Flight Altitude – The altitude of the aircraft used to obtain the photography shall be 3,000 feet. It is the responsibility of the contractor to coordinate the flight with the appropriate authority when operating in restricted air space.
3. Ground Control - Ground control includes all necessary ground support and GPS receivers (base stations) for the required number of ground control points to be occupied during the flight. All ground control will be based on the Florida State Plane Coordinate System, NAD83/90 adjustment and tied to the HARN.

Where possible, GPS base stations shall have ellipsoid heights to an accuracy of 2 centimeters relative to the CORS or the HARN.

A ground control report shall be prepared and must include all pertinent base station information and mission notes, including information on GPS station monument names, descriptions, coordinates, visibility diagrams, and stability.

4. Ground Control Base-Station Spacing – Ground control base stations shall be 7 miles to a maximum of 12 miles apart.
5. Camera Focal Length – The aerial photography shall be acquired with a single lens, precision aerial camera having a nominal focal length of 6 inches (152 – 154 mm) that is capable of producing negatives of high-resolution quality or approved equivalent.
6. Overlap – The aerial photography shall have a minimum of 30% forward overlap.
7. Sidelap – Generally, the aerial photography shall be acquired on a single flight line. However, areas that require more than one flight line shall have a minimum of 30% side overlap.
8. Tilt - Care shall be used to reduce tilt to a minimum of less than 5 degrees for any one photograph, 2 degrees for any 10 or more consecutive photographs, or one degree for the entire flightline.

9. Crab - Crab shall not exceed 10 degrees as measured from the flightline, as indicated, by two or more consecutive photographs.
10. Film Type - The Contractor shall use aerial film of a quality that is equal or superior to 4 mil Kodak Double-X Aerographic 2405 (Estar Base) panchromatic for all black and white photography and 2444 for all color photography. Only fresh, fine grain, dimensional stable, and safety base aerial film shall be used. Outdated film shall not be used.
11. Obscurations – Photography shall not be acquired when haze, smoke, or dust obscure the ground, or when clouds or cloud shadows will appear on any photograph.
12. Shadows/Reflection – Photography shall minimize shadows caused by trees or topographic relief. Photography shall not be taken when the sun’s inclination is less than thirty (30) degrees above the horizon. Use of an anti-vignetting filter is required.
13. Flight Log – A flight log representing aircraft flight time shall be maintained on an hourly basis. The time of takeoff, start of photograph, end of photograph, and landing shall be recorded to the nearest of 0.1 of an hour.
14. Weather Log – A weather log shall be maintained to substantiate any delays due to inclement weather. The weather log shall include date, location, weather report, and weather forecast from the U.S. Weather Bureau. This information may be supplemented by direct observation.
15. Tide Log – The Contractor shall maintain a tide log to substantiate any delay due to incorrect or unacceptable tides. The tide log shall include the date, time, location of the nearest NOAA tide station(s) being reported, and the tide elevation at the beginning, middle, and end of data collection as calculated for photo collection location (through interpolation between adjacent tide stations). All reported tide elevations shall be referenced to NAVD 1988.
16. Flight Time – The entire flight shall occur between one (1) hour before and one (1) hour after mean low tide in the region to be photographed, unless otherwise authorized by BBCS.
17. Procedural Control – The Contractor shall outline and maintain a schedule for planned data collection and itemize all procedures including quality control and instrumentation to be followed during the completion of this work. Procedural standards are outlined in reference documents listed in Part I.B. All procedures and milestones achieved during completion of this

work shall be described in the metadata as required in Part III.B.2 of this specification.

C. POST-FLIGHT

Flight Report – The Contractor shall submit a copy of a flight report signed by the pilot or the aerial photographer. The flight report shall contain the flight, tide, and weather logs.

D. FILM PROCESSING

C-41 processing is required as per Kodak specifications. Each exposure shall be numbered just within the exposed area, in consecutive order throughout the entire project, starting with exposure number one on roll number one and continuing the numbering in consecutive order through all rolls exposed on the project. The approximate time and scale of the photographs shall appear on the first and last exposure of each flightline; and the month, day, and year shall appear on each exposure, just within the exposed area. The exposures shall show the roll number (R-1), date (5-6-96, etc.), scale of photography, project identification, altimeter reading, flight line number, and the photo number, as read from left to right on each photograph and be located on the landwardmost edge of the photograph.

The contact prints shall be of uniform density and such a degree of contrast that all details of the negatives will show clearly both in the shadows and the highlights as well as in the half tones between shadows and the highlights. An adequate variety of grades of contrast paper (medium weight RC paper) shall be used in making prints to accomplish this purpose. All prints shall be clean and free from chemicals, stains, blemishes, uneven spots, air bells, light fog or streaks, static marks and other blemishes which would interfere with their intended purposes, and shall be delivered in a smooth and flat condition.

E. SCANNING

The digitization of the photo (diapositive) or negative (i.e., the pixel-by-pixel recording of the halftones converting black-and-white photos into digital gray levels, or color photos into digital spectral levels) with high geometric and radiometric accuracy camera shall be used. The scanner shall produce a geometric resolution for black and white photos of 1 micron and a radiometric resolution of 256 gray levels and selectable pixel sizes of 5.5 micron to 120 micron. The scanner shall produce a geometric resolution for color photos of 1 micron and a radiometric resolution of 256 color levels and selectable pixel sizes of 7.5 micron to 120 micron. The scan rate shall be 21 micron with a pixel size of .40 feet for both black and white and color photography.

Digitized images shall have a full radiometric range of values, representing the full radiometric range of values of and in the same proportion as the source

image. Areas that are black or approaching black shall have radiometric values that are zero or approaching zero, and areas that are white or approaching white shall have values at or approaching 255. Likewise, areas that are dark colors shall have radiometric values approaching zero, and areas that are light colors shall have radiometric values approaching 255.

The scanning technician shall match the dynamic range of the source imagery to accurately reproduce the full data in the available radiometric range, and special effort shall be made not to lose data by compressing it anywhere along the curve.

Any scanning system must scan a precise photogrammetric grid plate at the desired scanning resolution for the project to test for geometric quality of the scanner.

The pictorial quality of the digital image shall consist of a low contrast, overall even tone and low grain content.

Scanning procedures and quality of the final images, including pixel resolution, shall be provided in the metadata as required in Part III.B.2 of this specification.

#### F. DATA SUBMITTALS

When submitting permit required monitoring information, the Contractor shall include a transmittal letter clearly labeled with the following at the top of each page: "This monitoring information is submitted in accordance with the approved Monitoring Plan for Permit No. [XXXXXX] for the monitoring period [XXXXXX]." If the monitoring is not required by permit, but cost-shared through the BBCS Beach Erosion Control Program, the transmittal letter shall be labeled, "This monitoring information is submitted in accordance with BBCS Project Agreement [XXXXXXXX]." In addition, the exterior of all digital products, such as floppy and compact disks, shall be labeled with the description of contents, Project Agreement Number, or Permit Number and monitoring period.

### PART III - PRODUCTS

#### A. HARD COPY PRODUCTS

##### Pre-Flight

Camera Calibration Report - The camera calibration report shall be submitted in accordance with Part II.A.1 of this specification.

##### Post-Flight

1. Flight Report – The flight report shall be submitted in accordance with Part II.C.1 of this specification. The following reports will be submitted as

sections of this report: Flight Log (Part II.B.12), Weather Log (Part II.B.13), and the Tide Log (Part II.B.14).

2. Contact Prints - One set of 9"x9" contact prints shall be submitted in accordance with Part II of this specification.

B. DIGITAL PRODUCTS

1. Scanning Report - A report on the final images, including pixel resolution shall be submitted in accordance with Part II.E of this specification. Report shall be delivered on CD.
2. Scanned images in TIF format (uncompressed). The digital images shall be delivered on CD.
3. Complete federally compliant metadata file for each image in accordance with standards set forth by the Federal Geographic Data Committee as referenced in Part I.B.3 of this specification. The metadata files shall be delivered on CD.

END OF SECTION

## SECTION 02100

### ENVIRONMENTAL AERIAL PHOTOGRAPHY ACQUISITION for BEACH EROSION CONTROL PROJECTS

#### PART I - GENERAL

This technical specification has been developed for application to beach erosion control project monitoring associated with the Beach Erosion Control Program and Joint Coast Permits of the BBCS. This specification is intended for assessments of nearshore hardbottom coverage and spreading of beach nourishment fill placement. This technical specification is specific for use of conventional photographic equipment and processing. If a digital camera is used, then the Contractor shall demonstrate to the project sponsor that required spatial resolution and photo coverage (equivalent to conventional 9x9 negative) is to be achieved and provided. Environmental aerial photography acquisition is independent of requirements of the Statewide Regional Monitoring Plan.

#### A. DEFINITIONS

1. Aerial Photography System - An airborne aerial photography system shall consist of a precision aerial camera, airborne Global Positioning System (GPS) with attendant GPS base station(s), and an Inertial Measuring Unit (IMU).
2. CORS - Continuously Operating Reference Stations.
3. Camera Focal Length – The distance measured along the optical axis from the rear nodal point on the lens to the plane of critical focus of a very distant object.
4. Contact Prints – Prints produced directly from negatives or the equivalent prints from digital photography, 9”x 9”.
5. Contractor – The aerial survey or photogrammetric company that will provide aerial survey and/or photogrammetric services.
6. Crab – The condition caused by incorrect orientation of the camera with respect to the track of the aircraft. Any turning of an airplane, which causes its longitudinal axis to vary from the track of the plane.
7. HARN - Florida High Accuracy Reference Network.
8. NAD 83/90 - North American Datum of 1983 adjustment of 1990.

9. NAVD 88 – North American Vertical Datum of 1988.
10. Pixel – The smallest cell size with a uniform value of an image. This digital image grain is produced in varying sizes, usually referred to in ground units such as 6 inches, 1 foot, or 3 meters. Pixels are created during the scanning of the aerial imagery and are key to establishing the resolution of the photograph/image.
11. Scale – The relationship between a given distance on the ground and the corresponding distance on a photograph or image. Scale can be expressed in two different ways, both as ratios. The first method uses common measuring systems to relate the distance on the photo to the actual distance on the earth (e.g., 1" = 200'). The second method uses a ratio where the unit of measure is arbitrary (e.g., 1:1200). For this method meters, feet, miles, etc. can all be used as the measuring unit to relate distance on a photo or image with distance on the earth.
12. Scanning – The process of converting analog photographs or hard copy maps into digital form.

## B. REFERENCE DOCUMENTS

1. Florida Department of Transportation, *Specifications for Aerial Photography*. Topic No.: 550-020-002-f. Effective: December 30, 1997.
2. Federal Geographic Data Committee, *Geospatial Positioning Accuracy Standards, Parts 1, 2, and 3*. Final Draft, U.S. Geological Survey, Reston, Virginia, 1998.
3. Federal Geographic Data Committee, *Content Standard for Digital Geospatial Metadata*, FGDC-STD-001-1998, 1998.
4. National Oceanic and Atmospheric Administration, NOAA Technical Memorandum NOS NGS-58, *Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2 cm and 5 cm)*. November 1997.
5. U.S. Army Corps of Engineers, *Photogrammetric Mapping*. Engineering Design Manual EM1110-1-1000, March 31, 1993.
6. U.S. Geological Survey, *USGS Aerial Camera Specifications*, January 1, 2003

## PART II - EXECUTION

### A. PRE-FLIGHT

1. The Contractor shall submit the most recent camera calibration report for the camera utilized for photo acquisition according to the standards of Part I.B.6. The date of calibration shall not exceed the proposed flight date by more than three years.
2. Sea conditions in the project area shall be checked each morning to identify an appropriate flight window which shall comply with the following:
  - a. Seas have been calm for a minimum of 24 hours preceding flight.
  - b. Water clarity is such that an aerial image of submerged hardbottom may be successfully obtained.
  - c. Tides are incoming during morning hours with cloud cover at less than 10%. In order to minimize glint, the flight window shall occur when the sun angle is between 15 to 30 degrees to the horizon.
3. The project sponsor shall identify and concur with the Contractor on an intended flight week window. During the designated flight week, the Contractor shall be notified by telephone by the project sponsor or authorized designee on the morning of an appropriate day in which acceptable weather and water conditions exist. The Contractor shall be prepared to conduct the aerial photography work the same morning that the notice to proceed is provided.

## B. FLIGHT

1. Scale – The negatives shall be at scale of 1" = 660' (1:7920).
2. Flight Altitude – The altitude of the aircraft used to obtain the photography shall be 3,960 feet. It is the responsibility of the contractor to coordinate the flight with the appropriate authority when operating in restricted air space.
3. Ground Control - Ground control includes all necessary ground support and GPS receivers (base stations) for the required number of ground control points to be occupied during the flight. All ground control will be based on the Florida State Plane Coordinate System, NAD83/90 adjustment and tied to the Florida High Accuracy Reference Network (HARN).

Where possible, GPS base stations shall have ellipsoid heights to an accuracy of 2 centimeters relative to the Continuously Operating Reference Stations (CORS) or the HARN.

A ground control report shall be prepared and must include all pertinent base station information and mission notes, including information on GPS

station monument names, descriptions, coordinates, visibility diagrams, and stability.

4. Ground Control Base-Station Spacing – Ground control base stations shall be approximately 7 miles (preferred) to 12 miles (maximum) apart.
5. Camera Focal Length – The aerial photography shall be acquired with a single lens, precision aerial camera having a nominal focal length of 6 inches (152 – 154 mm) that is capable of producing negatives of high-resolution quality or approved equivalent.
6. Overlap – The aerial photography shall have a minimum of 30% forward overlap.
7. Sidelap – Generally, the aerial photography shall be acquired on a single flight line. However, areas that require more than one flight line shall have a minimum of 30% side overlap.
8. Tilt - Care shall be used to reduce tilt to a minimum of less than 5 degrees for any one photograph or 2 degrees for any 10 or more consecutive photographs, or one degree for the entire flightline.
9. Crab - Crab shall not exceed 10 degrees as measured from the flightline, as indicated, by two or more consecutive photographs.
10. Film Type - The Contractor shall use aerial film of a quality that is equal or superior to 4 mil Kodak Double-X Aerographic 2405 (Estar Base) panchromatic for all black and white photography and 2444 for all color photography. Only fresh, fine grain, dimensional stable, and safety base aerial film shall be used. Outdated film shall not be used.
11. Obscurations – Photography shall not be acquired when haze, smoke, or dust obscures the ground, or when clouds or cloud shadows will appear on any photograph. The image will be clear and sharp in detail, free from clouds, shadows or any other blemishes that would render the image as uncertain for mapping rock and reef features to –15 feet NAVD.
12. Shadows/Reflection – Photography shall minimize water reflection in order to decrease uncertainties in the mapping of submerged rock, reef and vegetation features. Photography shall be taken in the early morning when the sun's inclination is between 15 degrees and 30 degrees above the horizon. Use of an anti-vignetting filter is required.
13. Flight Log – A flight log representing aircraft flight time shall be maintained on an hourly basis. The time of takeoff, start of photograph,

end of photograph, and landing shall be recorded to the nearest of 0.1 of an hour.

14. Weather Log – A weather log shall be maintained to substantiate any delays due to inclement weather. The weather log shall include date, location, weather report, and weather forecast from the U.S. Weather Bureau. This information may be supplemented by direct observation.
15. Tide Log – The Contractor shall maintain a tide log to substantiate any delay due to incorrect or unacceptable tides. The tide log shall include the date, time, the location of the nearest NOAA tide station(s) being reported, and the tide elevation at the beginning, middle, and end of data collection as calculated for photo collection location (through interpolation between adjacent tide stations). All reported tide elevations shall be referenced to NAVD 1988.
16. Flight Time – The flight shall be at such time that the midpoint of the flight occurs at mean low tide in the region to be photographed.
17. Procedural Control – The Contractor shall outline and maintain a schedule for planned data collection and itemize all procedures including quality control and instrumentation to be followed during the completion of this work. Procedural standards are outlined in reference documents listed in Part I.B. All procedures and milestones achieved during completion of this work shall be described in the metadata as required in Part III.B.2 of this specification.

#### C. POST-FLIGHT

Flight Report – The Contractor shall submit a copy of a flight report signed by the pilot or the aerial photographer. The flight report shall contain the flight, tide, and weather logs.

#### D. FILM PROCESSING

C-41 processing is required as per Kodak specifications. Each exposure shall be numbered just within the exposed area, in consecutive order throughout the entire project, starting with exposure number one on roll number one and continuing the numbering in consecutive order through all rolls exposed on the project. The approximate time and scale of the photographs shall appear on the first and last exposure of each flightline; and the month, day, and year shall appear on each exposure, just within the exposed area. The exposures shall show the roll number (R-1), date (5-6-96, etc.), scale of photography, project identification, altimeter reading, flight line number, and the photo number, as read from left to right on each photograph and be located on the landwardmost edge of the photograph.

The contact prints shall be of uniform density and such a degree of contrast that all details of the negatives will show clearly both in the shadows and the highlights as well as in the half tones between shadows and the highlights. An adequate variety of grades of contrast paper (medium weight RC paper) shall be used in making prints to accomplish this purpose. All prints shall be clean and free from chemicals, stains, blemishes, uneven spots, air bells, light fog or streaks, static marks and other blemishes which would interfere with their intended purposes, and shall be delivered in a smooth and flat condition.

#### E. SCANNING

The digitization of the photo (diapositive) or negative (i.e., the pixel-by-pixel recording of the halftones converting black-and-white photos into digital gray levels, or color photos into digital spectral levels) with high geometric and radiometric accuracy camera shall be used. The scanner shall produce a geometric resolution for black and white photos of 1 micron and a radiometric resolution of 256 gray levels and selectable pixel sizes of 5.5 micron to 120 micron. The scanner shall produce a geometric resolution for color photos of 1 micron and a radiometric resolution of 256 color levels and selectable pixel sizes of 7.5 micron to 120 micron. The scan rate shall be 21 micron with a pixel size of .40 feet for both black and white and color photography.

Digitized images shall have a full radiometric range of values representing the full radiometric range of values of and in the same proportion as the source image. Areas that are black or approaching black shall have radiometric values that are zero or approaching zero, and areas that are white or approaching white shall have values at or approaching 255. Likewise, areas that are dark colors shall have radiometric values approaching zero, and areas that are light colors shall have radiometric values approaching 255.

The scanning technician shall match the dynamic range of the source imagery to accurately reproduce the full data in the available radiometric range, and special effort shall be made not to lose data by compressing it anywhere along the curve.

Any scanning system must scan a precise photogrammetric grid plate at the desired scanning resolution for the project to test for geometric quality of the scanner.

The pictorial quality of the digital image shall consist of a low contrast, overall even tone and a low grain content.

Scanning procedures and quality of the final images, including pixel resolution, shall be provided in the metadata as required in Part III.B.2.

#### F. DATA SUBMITTALS

When submitting permit required monitoring information to the BBCS, the Contractor shall include a transmittal letter clearly labeled with the following at the top of each page: "This monitoring information is submitted in accordance with the approved Monitoring Plan for Permit No. [XXXXXX] for the monitoring period [XXXXXX]." If the monitoring is not required by permit, but cost-shared through the BBCS Beach Erosion Control Program, the transmittal letter shall be labeled, "This monitoring information is submitted in accordance with BBCS Project Agreement [XXXXXXXX]." In addition, the exterior of all digital products, such as floppy and compact disks, shall be labeled with the description of contents, Project Agreement Number, or Permit Number and monitoring period.

### PART III - PRODUCTS

#### A. HARD COPY PRODUCTS

##### Pre-Flight

1. Camera Calibration Report - The camera calibration report shall be submitted in accordance with Part II.A.1 of this specification.

##### Post-Flight

2. Flight Report – The flight report shall be submitted in accordance with Part II.C.1 of this specification. The following reports will be submitted as sections of this report: Flight Log (Part II.B.12), Weather Log (Part II.B.13), and the Tide Log (Part II.B.14).
3. Contact Prints - One set of 9”x9” contact prints shall be submitted in accordance with Part II of this specification.

#### B. DIGITAL PRODUCTS

1. Scanning Report - A report on the final images, including pixel resolution shall be submitted in accordance with Part II.E of this specification. Report shall be delivered on CD.
2. Scanned images at 20% overlap in TIF format (uncompressed). The digital images shall be delivered on CD.
3. Complete federally compliant metadata file for each image in accordance with standards set forth by the Federal Geographic Data Committee as referenced in Part I.B.3 of this specification. The metadata files shall be delivered on CD.

END OF SECTION

**MONITORING STANDARDS  
FOR  
BEACH EROSION CONTROL PROJECTS**

APPENDIX A

MONUMENT INFORMATION REPORT

---

Figure 1: Control Monument Information Report Format

Figures 2 - 7: Range Monument Information Report Format

## APPENDIX A

### MONUMENT INFORMATION REPORT

The following figures are examples of the format for submission of control and range monument information used in the data collection and processing phases of project-related surveys. Two distinct sets of information are required: control monument and range monument.

Control monument information shall be provided as shown in Figure 1 below. One table for each control monument used is to be provided to the BBCS. All control monuments must be 2<sup>nd</sup> order marks or higher to achieve the horizontal and vertical accuracy required by these monitoring standards.

| <b>CONTROL MONUMENT USED BY [Contractor]<br/>for [Survey Project Name]<br/>[Date of Survey]</b> |  |
|---|--|
| <b>DATUMS: NAD83/90 / NAVD1988</b>  |  |
| <b>DESIGNATION</b>  | 0041   |
| <b>STAMPING</b>   | 17-84-A23  |
| <b>NORTHING</b>   | 1111111.11   |
| <b>EASTING</b>  | 999999.99  |
| <b>HORIZONTAL RMSE</b>  | .01  |
| <b>ELEVATION</b>  | 9.99   |
| <b>VERTICAL RMSE</b>  | .10  |
| <b>DESCRIPTION</b>  | The mark is located at the intersection of U.S. Highway 19 and State Road 453. The mark bears 35.0 feet north of a stop sign 65.3 feet south of the SE corner of a metal building 3.0 feet north of a metal witness post. The mark is a standard DEP brass cap glued into a concrete sidewalk stamped 17-84-A23. |

**Figure 1: Control Monument Information Report Format**

Range monument information used as a profile reference location is to be reported in the formats depicted below. The information as shown in Figure 2 is the reference locations from the RTABS distributed by the BBCS. Range monuments that are located during the course of the field survey are tabulated as shown in Figure 3. Figure 4 depicts the format of the monument information used to reduce and process the data into the DEP data format.

| <b>EXAMPLE COUNTY MONUMENT COMPARISON 2002</b> |                |                 |                |           |                 |
|--|----------------|-----------------|----------------|-----------|-----------------|
| <b>DATUMS: NAD83/90 / NAVD1988</b>             |                |                 |                |           |                 |
| <b>DEP GIVEN MONUMENTS</b>                     |                |                 |                |           |                 |
| <b>MON ID</b>                                  | <b>M. DATE</b> | <b>NORTHING</b> | <b>EASTING</b> | <b>AZ</b> | <b>M. ELEV.</b> |
| R001   | MMM1980        | 1481070.240     | 787346.470     | 90.00     | 7.23            |
| R002   | MMM1972        | 1480231.740     | 787295.480     | 90.00     | 9.36            |
| R003   | MMM1972        | 1479170.250     | 786910.980     | 90.00     | 8.30            |
| R004   | MMM1995        | 1478243.100     | 786645.050     | 90.00     | 7.51            |
| R005   | MMM1972        | 1477340.250     | 786340.980     | 90.00     | 8.89            |
| R006   | MMM1985        | 1476402.770     | 786076.100     | 90.00     | 8.06            |
| R007   | MMM1980        | 1475489.760     | 785758.980     | 90.00     | 7.58            |
| R008   | MMM1979        | 1474610.260     | 785520.480     | 90.00     | 6.99            |
| R009   | MMM1972        | 1473671.770     | 785405.480     | 90.00     | 9.03            |
| R010   | MMM1986        | 1472764.770     | 785228.480     | 90.00     | 9.71            |

**Figure 2: Monument Information Provided by FDEP.**

| <b>EXAMPLE COUNTY MONUMENT COMPARISON 2002</b> |                |                 |                |           |                 |
|--|----------------|-----------------|----------------|-----------|-----------------|
| <b>DATUMS: NAD83/90 / NAVD1988</b>             |                |                 |                |           |                 |
| <b>MONUMENTS FOUND BY CONTRACTOR 2002</b>      |                |                 |                |           |                 |
| <b>MON ID</b>                                  | <b>M. DATE</b> | <b>NORTHING</b> | <b>EASTING</b> | <b>AZ</b> | <b>M. ELEV.</b> |
| R-1-T  | 80             | 1481070.163     | 787346.934     | 90.00     | 7.10            |
| R-2  | 72             | 1480231.455     | 787294.435     | 90.00     | 9.33            |
| R-3  | 72             | 1479170.198     | 786910.287     | 90.00     | 8.30            |
| T-4  | 95             | 1478242.711     | 786644.778     | 90.00     | 7.41            |
| R-5  | 72             | 1477339.664     | 786341.179     | 90.00     | 8.81            |
| R-6  | RESET          | 1476402.887     | 786150.950     | 90.00     | 9.07            |
| R-7-T  | 80             | 1475489.691     | 785758.501     | 90.00     | 7.09            |
| R-8  | 79             | 1474610.283     | 785521.752     | 90.00     | 6.60            |
| R-9  | 72             | 1473671.826     | 785405.312     | 90.00     | 8.73            |
| T-10   | 86             | 1472764.519     | 785228.533     | 90.00     | 9.73            |

**Figure 3: Monument Information Found During Field Investigation by Surveyor.**

| EXAMPLE COUNTY MONUMENT COMPARISON 2002<br>DATUMS: NAD83/90 / NAVD1988 |         |             |            |       |          |
|--|---------|-------------|------------|-------|----------|
| MONUMENTS USED BY CONTRACTOR 2002 SURVEY                               |         |             |            |       |          |
| MON ID   | M. DATE | NORTHING    | EASTING    | AZ    | M. ELEV. |
| R-1-T  | Jan-80  | 1481070.240 | 787346.470 | 90.00 | 7.23     |
| R-2  | Aug-72  | 1480231.740 | 787295.480 | 90.00 | 9.36     |
| R-3  | Aug-72  | 1479170.250 | 786910.980 | 90.00 | 8.30     |
| T-4  | COE1995 | 1478243.100 | 786645.050 | 90.00 | 7.51     |
| R-5  | Aug-72  | 1477340.250 | 786340.980 | 90.00 | 8.89     |
| R-6  | RESET02 | 1476402.887 | 786150.950 | 90.00 | 9.07     |
| R-7  | Jan-80  | 1475489.760 | 785758.980 | 90.00 | 7.09     |
| R-8  | COE1979 | 1474610.260 | 785520.480 | 90.00 | 6.60     |
| R-9  | Aug-72  | 1473671.770 | 785405.480 | 90.00 | 8.73     |
| T-10   | Jan-86  | 1472764.770 | 785228.480 | 90.00 | 9.71     |

**FIGURE 4: Monument Information Used to Process Data.**

A comparison of the northing, easting, azimuth, and elevation values of the given and found range monuments is shown in Figure 5, where  $\Delta N$ ,  $\Delta E$ ,  $\Delta AZ$  and  $\Delta Z$  are the differences in northing, easting, azimuth and elevation values, respectively. Differences in the northing and easting values greater than 5 feet should be clearly designated, such as the easting value below highlighted in yellow. Differences in the azimuth values greater than  $1^\circ$  and in the elevation values greater than 0.3 feet shall be designated in a similar manner. Figures 6 and 7 are similar comparisons between given and used values, and found and used values respectively.

| EXAMPLE COUNTY MONUMENT COMPARISON 2002<br>DATUMS: NAD83/90 / NAVD1988 |            |            |             |            |
|--|------------|------------|-------------|------------|
| GIVEN -VS-FOUND  |            |            |             |            |
| MON ID   | $\Delta N$ | $\Delta E$ | $\Delta AZ$ | $\Delta Z$ |
| R-1-T  | 0.077      | -0.464     | 0.000       | 0.130      |
| R-2  | 0.285      | 1.045      | 0.000       | 0.030      |
| R-3  | 0.052      | 0.693      | 0.000       | 0.000      |
| T-4  | 0.389      | 0.272      | 0.000       | 0.100      |
| R-5  | 0.586      | -0.199     | 0.000       | 0.080      |
| R-6  | -0.117     | -74.850    | 0.000       | -1.010     |
| R-7  | 0.069      | 0.479      | 0.000       | 0.490      |
| R-8  | -0.023     | -1.272     | 0.000       | 0.390      |
| R-9  | -0.056     | 0.168      | 0.000       | 0.300      |
| T-10   | 0.251      | -0.053     | 0.000       | -0.020     |

**Figure 5: Comparison of Found Monuments to Those Given by FDEP.**

| <b>EXAMPLE COUNTY MONUMENT COMPARISON 2002</b> |           |           |            |           |
|--|-----------|-----------|------------|-----------|
| <b>DATUMS: NAD83/90 / NAVD1988</b>             |           |           |            |           |
| <b>GIVEN -VS-USED</b>                          |           |           |            |           |
| <b>MON ID</b>                                  | <b>ΔN</b> | <b>ΔE</b> | <b>ΔAZ</b> | <b>ΔZ</b> |
| R-1-T  | 0.000     | 0.000     | 0.000      | 0.000     |
| R-2  | 0.000     | 0.000     | 0.000      | 0.000     |
| R-3  | 0.000     | 0.000     | 0.000      | 0.000     |
| T-4  | 0.000     | 0.000     | 0.000      | 0.000     |
| R-5  | 0.000     | 0.000     | 0.000      | 0.000     |
| R-6  | -0.117    | -74.850   | 0.000      | -1.010    |
| R-7  | 0.000     | 0.000     | 0.000      | 0.490     |
| R-8  | 0.000     | 0.000     | 0.000      | 0.390     |
| R-9  | 0.000     | 0.000     | 0.000      | 0.300     |
| T-10   | 0.000     | 0.000     | 0.000      | 0.000     |

**Figure 6: Comparison of Monuments Used to Process Survey Data to Those Given by FDEP.**

| <b>EXAMPLE COUNTY MONUMENT COMPARISON 2002</b> |           |           |            |           |
|--|-----------|-----------|------------|-----------|
| <b>DATUMS: NAD83/90 / NAVD1988</b>             |           |           |            |           |
| <b>FOUND-VS-USED</b>                           |           |           |            |           |
| <b>MON ID</b>                                  | <b>ΔN</b> | <b>ΔE</b> | <b>ΔAZ</b> | <b>ΔZ</b> |
| R-1-T  | -0.077    | 0.464     | 0.000      | -0.130    |
| R-2  | -0.285    | -1.045    | 0.000      | -0.030    |
| R-3  | -0.052    | -0.693    | 0.000      | 0.000     |
| T-4  | -0.389    | -0.272    | 0.000      | -0.100    |
| R-5  | -0.586    | 0.199     | 0.000      | -0.080    |
| R-6  | 0.000     | 0.000     | 0.000      | 0.000     |
| R-7  | -0.069    | -0.479    | 0.000      | 0.000     |
| R-8  | 0.023     | 1.272     | 0.000      | 0.000     |
| R-9  | 0.056     | -0.168    | 0.000      | 0.000     |
| T-10   | -0.251    | 0.053     | 0.000      | 0.020     |

**Figure 7: Comparison of Monuments Used in a Survey to Those Found During Field Investigation.**