

**Appendix F  
Sample SOW<sup>1</sup>**

(Encl. 1)

**SCOPE OF WORK  
GIS STUDY  
CITY OF VASSAR, MICHIGAN  
U.S. ARMY CORPS OF ENGINEERS, DETROIT DISTRICT  
CONTRACT DACW35-98-D-0003  
DELIVERY ORDER NO.**

**1. Description of Work:**

**31 March 1999**

The Contractor will provide the necessary labor, material, and equipment to develop a user attributed Geographic Information System (GIS) base map at a scale of 1"=100' with 2-foot contouring, 1"=200' Digital Orthophotos with 1-foot pixel resolution, and a user attributed GIS database adequate for parcel mapping, land use, floodplain delineation, and wetland delineation within the area outlined in attachment 1.

**2. Purpose of work:**

The work to be performed under this delivery task is to provide the City of Vassar, MI, with quantitative information and the development of a Geographic Information System (GIS) adequate for parcel mapping, planimetric features mapping, topographic contouring, land use, floodplain, and wetland delineation within the study boundaries.

**3. Work to be performed by the Contractor:**

**A. Aerial Photography**

1. The Contractor will design the layout of the photography, prepare the flight plans, establish the quality control, for natural color photography at a scale of 1:7920 (1"=660'). The photography shall cover the area as denoted on Attachment 1, in a north-south pattern. Prior to initiating the flight mission, the Contractor must submit this flight plan and a copy of the Camera Calibration Report for approval by the Government.

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<sup>1</sup> Appendix F contains several sample Photogrammetric Mapping Scopes of Work (SOW) from U.S. Army Engineer Districts. The Corps of Engineers obtains photogrammetric mapping data through the use of IDIQ A-E contracts. A Task Order for a specific data collection is issued against the overall IDIQ contract. In addition to the overall technical guide specification for a Photogrammetric Mapping IDIQ contract, a Task Order SOW is generally developed. A Task Order SOW is an appendix to the overall IDIQ contract. Therefore, the Task Order SOW provides the unique details about a specific data collection effort (project). Note that the level of technical detail in these sample Task Order SOWs is not complete without the overall IDIQ guide specification. The Guide Specification for the overall IDIQ contract includes many of the general technical details required for many projects. These samples are intended to provide assistance in the development of Task Order SOW only. Overall contract (detailed) specifications are generally contained in the guide specifications.

2. The Contractor will collect vertical, natural color photography in the Spring of 1999 to meet the following specifications.
  - a. **Scale:** 1:7920 (1"=660')
  - b. **Endlap and Sidelap:** The photographs will have 60 percent endlap and 30 percent sidelap coverage to ensure full stereo coverage of entire study area.
  - c. **Suitable conditions:** Photography collection shall take place when the sun is more than three (3) hours above the horizon or the sun angle is not less than 30 degrees before and after the true sun noon. Also, the Contractor must plan all flight schedules to ensure bright sun conditions with minimum haze, fog, and dust, < 5-percent cloud cover on each frame, and < 5-percent cloud shadow on each frame is required. This photography must be collected while the deciduous trees are without leaves, when there is no snow on the ground, nor ice on the lakes and beaches. All hydrological features must be within their normal banks. The photographs will not contain objectionable shadows caused by relief or low solar altitude.
  - d. **Aerial film type:** The aerial film will be furnished by the Contractor of a quality that is equal to or superior to 4-mil Kodak Aerocolor Negative Film 2445 (Estar Base) color film.
  - e. **Color Filter:** The Contractor is to use an "Antivignetting Light Yellow Filter," or equivalent, for all color aerial photography collection to provide uniform illumination distribution over each frame and to remove wavelengths shorter than 0.45 um.
  - f. **Contact Prints:** The Contractor shall provide six (6) sets of contact prints for each frame collected.
  - g. The Contractor will develop, print, and submit samples of the contact prints to the Government for review and comment on the contrast and color balance.
  - h. **Titling:** The Government requires the following format for frame titling.

Date	Project Name	Photography Scale	Roll #	Flight Line #	Frame #
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- i. **Flight Index:** The Government requires a digital photo index with vector file overlaying a U.S. Geological Survey (USGS) DRG of the area to be flown. The customer must be able to plot and view this file via ArcView 3.1.

**B. Field Survey & Control:**

1. **General:** The Contractor will establish the necessary ground control for the mapping project described in this scope of work as determined by the Contractor and approved by the Government. Prior to the acquisition of the photography, the Contractor is responsible for control targeting if control of the project is required. Photographic targets of an appropriate size will be used to establish horizontal and vertical control points for aerial triangulation and control of digital orthophotography and base map production. The Government requires the field control tied into National Geodetic Survey horizontal and vertical points.

**2. Project Control Datum:**

**Horizontal**

Datum of 1983 (NAD-83). HARN State Plane Coordinates. All project mapping and GIS will be based on North American Datum (NAD) 83, Michigan State Plane Coordinates, in the appropriate Zone, in U.S. Survey feet.

**Vertical**

All project control points will be referenced to the North American Vertical Datum, 1988 Adjustment in U.S. Survey Feet.

**3. Survey Deliverables:**

The Contractor shall provide to the Government two (2) copies of the following; survey schematic identifying the location of all horizontal and vertical control point locations, and a report documenting the survey mission, complete with GPS session notes, sketches, adjustments, etc.

**C. Digital Orthophotography:**

The Contractor will generate digital color orthophotos using the above flown photography. The maximum error tolerance of the digital orthophoto should not exceed American Society of Photogrammetry and Remote Sensing (ASPRS) Class 1 Map Accuracy Standards for Orthophoto Maps of the mapped scale. The Contractor will scan aerial photography sufficient to produce a ground resolution of 1 foot for production of 1:2400 or 1 inch = 200 foot scale DOPs. The orthophotography image will cover the total extent of the planimetric and topographic mapping. The delivery of the DOP file will be in four seamless Arc/Info TIFF w/TFW files. The Government expects the Contractor to generate Digital Terrain Models (DTMs) to produce the new natural color DOPs from the 1:7920 scale natural photography. The DTM will also be a deliverable.

**D. Mapping:**

The Contractor will perform analytical aerotriangulation and analytical stereocompilation procedures for digital planimetric and topographic mapping in three-dimensional vector files, to a scale of 1:1,200 (1"=100') meeting ASPRS Class 1 Map Accuracy Standards for Large Scale Maps. The location of the photo and mapping control points shall be precisely placed by coordinates in the planimetric map. Only points which fall within the area to be mapped (sheet layout) should be entered. The Contractor shall generate planimetric and topographic digital vector mapping linework linked with appropriate feature and annotation attribute tables in both Arc/Info Version 8 export files and ArcView Version 3.1 shape files.

- Planimetric and topographic features shall include, but are not limited to:
- Paved Road Edges
- Unpaved Road Edges
- Paved Parking
- Unpaved Parking
- Public Sidewalks
- Driveways
- Hydrology Boundaries

- Hydrology Center lines
- Building Footprints
- Road Center lines
- Utility Poles
- Light Poles
- Manholes
- Fire Hydrants
- Headwall
- Catch Basins
- Inlets
- 2-Foot Contours

### **E. GIS Responsibilities:**

The Contractor will process and deliver all mapping and GIS related data for use with Arc/Info Version 8 and ArcView Version 3.1 software. All data themes will be delivered in both Arc/Info Version 8 export files and ArcView shape files with appropriate attribute tables. Polygon features (buildings, roads, rivers, parking lots, sidewalks, zoning, and flood plain) will be delivered annotated, with appropriate attribute tables and mathematically closed linework. The data shown on the source maps described in each section below will be digitized within the project area as defined on the attached map.

#### **1. Translate Mapping Data and Process for use with Arc/View**

The Contractor will translate the mapping data collected from the aerial photography (see feature list in section D) to Arc/Info Format and process the roads and buildings to ensure that the linework forms mathematically closed polygons. The Contractor will digitize road centerlines and will add text to the Arc/View files for road names and major points of interest. The Contractor will also create annotation attribute tables linked to appropriate features. The data will then be exported to shape files for use with Arc/View software.

#### **2. Digitize and Process Approximately 1,000 Parcels**

The Contractor will scan the existing 16 City of Vassar Assessment Maps covering the project area. The resulting images will be rubber sheeted to match the new mapping. The Contractor will first construct the right-of-way network using right-of-way widths provided by the City of Vassar. After the right-of-way network has been established, the Contractor will digitize the parcel boundaries on a block-by-block basis. The digitizing will cover all of the parcel related features shown on the City of Vassar Assessment Maps including right of way boundaries, parcel boundaries, parcel numbers, block numbers, lot lines, lot numbers, and subdivision names.

Right-of-way boundaries and subdivision boundaries will be processed to ensure mathematically closed polygons. The Contractor will deliver a set of parcel plots on paper at scale of 1" = 200'.

### **3. Digitize and Process Water System Map**

The Contractor will use the scale of 1" = 400'. citywide water system map as the source for the water system layer. The existing water mains, proposed water mains, and pipes sizes, shown on the source map will be digitized and plotted on a single map sheet at scale of 1" = 400'. The water main size will be linked to the water main as an attribute.

### **4. Digitize and Process Sewer System Map**

The Contractor will use the scale of 1" = 400' city-wide sewer system map as the source for the sanitary sewer system layer. The existing manhole pipes, existing manholes, pipe sizes and proposed pipes will be digitized and plotted on a single sheet at 1" = 400' scale. The sewer pipe size will be linked to the sewer main as an attribute.

### **5. Digitize and Process Zoning Map and City Limits**

The Contractor will digitize the color-coded zoning polygons and city limit line shown on the City of Vassar Zoning District map. The zoning polygons will form mathematically closed polygons and will be plotted on a single map sheet at 1" = 400' scale using similar colors that are shown on the source map. The zoning classification as defined on the zoning district map will be linked to each zoning polygon as an attribute.

### **6. Digitize Flood Plain Data**

The source for the flood plain data will be the FEMA Flood Insurance Study dated June 19, 1989. As part of the base mapping, the Contractor will generate 2-foot contours for the project area. The Contractor will deliver the 2-foot contours to the Government. The Government will transfer the flood data shown in the FEMA flood profiles to the new base mapping. The Contractor will then digitize the flood plain boundaries as mathematically closed polygons. After the digitizing is complete, the Contractor will prepare a color plot of the flood plain data at a scale of 1" = 400'.

### **7. Digitize and Process Land Use/Land Cover and Wetlands Map**

The Government will determine land use/cover and wetlands classifications for the project area using a 1-acre polygon system. The Contractor will digitize the 1-acre polygon and will load the land use/cover and wetlands classification as defined by the Government into the Arc/View database for each polygon cell. A color-coded plot of the 1-acre wetlands data polygons for the project area will be developed at a scale of 1" = 400'.

### **8. GIS Demonstration and 2 Days Onsite Technical Support**

At the conclusion of the project, The Contractor and the Government will provide an onsite GIS demonstration to the Vassar City Council. The Contractor will also provide an experienced Arc/View technician for 2 days of onsite technical support at the City of Vassar. The technical support is intended to assist the City in loading, viewing, querying, and plotting the City of Vassar Arc/View data.

**E. Optional Items:**

1. Six sets of four (4) oblique color photographs of the following; Downtown, Industrial Park, Cemetery, Fairgrounds.
2. Two (2) photo mosaics indexes of 660' scale photography.
3. 1" = 200' scale color orthos with 1' pixel resolution in MrSID format.
4. Color photo mosaic (titled, mounted, and framed) from Digital Orthos (photographic quality) of 5 square mile area – Approximately 60" H 48" in size.

**F. Metadata:**

The Contractor will generate metadata files using a copy of "CORPSMET 95," a metadata file generator. This metadata file generator is available at the Corps Homepage <http://corpsgeo1.usace.army.mil>. The Contractor will deliver the metadata in a .gen file format.

**G. Items to be furnished by the Government:**

1. The Government will provide land-use/land cover classification delineations of the entire area to be mapped.
2. The Government will provide wetland classification delineation of the entire area to be mapped.
3. The Government will provide the 100-year floodplain of the Cass River.

**H. Items to be furnished by the Contractor:**

1. Six (6) sets of contact prints.
2. Flight index, a digital file compatible to ArcView 3.1, and 2 hardcopy prints on a mylar base.
3. Paper plot as specified under the Section E. GIS Responsibilities.
4. Two (2) copies of the survey schematic identifying the location of all horizontal and vertical control point locations, and a formal report documenting the survey mission in narrative form complete with GPS session notes, sketches, adjustments, etc.
5. Three (3) sets of four 1"=200' DOPs in Arc/Info Tiff w/ TFW files, labeled and delivered on CD.
6. Three (3) sets of the planimetric, topographic, and GIS Data in both Arc/Info export files and ArcView Shape files, on CD.
7. GIS Demo and 2 days of onsite technical support.
8. A Metadata file generated by "CorpsMet95" and delivered in a .gen file.

**I. Schedule and submittal:**

1. The Contractor will deliver products by December 1, 1999.
2. All materials to be furnished by the Contractor shall be delivered at the Contractor's expense to:

U.S. ARMY CORPS OF ENGINEERS - DETROIT DISTRICT  
GREAT LAKES HYDRAULIC AND HYDROLOGY BRANCH, 6<sup>th</sup> FLOOR  
ATTN: DAVID M. GERCZAK  
477 MICHIGAN AVENUE  
DETROIT, MI 48226

**DEPARTMENT OF THE ARMY  
U.S. Army Corps of Engineers  
Washington, DC 20314-1000**

**ETL 1110-X-XX**

**CECW-XX**

Technical Letter  
No. 1110-X-XXX

xx August 2000

1. Purpose. The purpose of this ETL is to provide guidance on procuring geospatial data to ensure data are collected consistently throughout the Corps in concert with Federal regulations and activities. The guidance outlined in this ETL is consistent with Federal Geographic Data Committee (FGDC) standards and activities.
2. Applicability. While the topics/concepts outlined here apply to all geospatial data, language provided is meant only as example verbiage. The Contracting Office Technical Representative (COTR) needs to consider the purpose of the data collection and tailor the example language to reflect the specific data collection activity. The examples provided are meant to augment the contract verbiage and are not comprehensive. Geospatial data collection contracts should always reflect the purpose of the data collection activity. Geospatial data is defined as data referenced, either directly or indirectly, to a location on the earth. Because of its broad definition, not all geospatial data collection activities are equal. Geospatial data procurement can entail all or part of imagery acquisition, mapping, feature extraction, geospatial analysis, etc.

While Hydrographic Survey data are considered geospatial data, because of the extensive guidance that already exists (see Chapter 16 of Hydro Manual), it will not be specifically addressed.

3. Distribution Statement. Approved for public release; distribution is unlimited.
4. References
5. Background

*a. Introduction.* Over the past few years, there have been many changes in the way the Federal Government procures technology. Many of these changes affected and continue to affect the procurement of geospatial information and geospatial processing capabilities. The following forces have driven these changes:

- (1) The need to move away from expensive and difficult-to-maintain unique solutions toward Commercial-Off-The-Shelf (COTS) and Standards-based COTS (SCOTS) for reasons of lower life cycle costs and upward compatibility with future generations of software in the commercial mainstream.
- (2) The need to share information between components of the Government, corresponding needs to conform to existing and emerging standards for the discovery and access of geospatial information, and standards for the representation and labeling of geospatial features and relationships.

- (3) The need to enable the U.S. information-based economy, grounded on geospatial information and services, by providing an information technology infrastructure that supports such an economy.
- (4) The need to eliminate the necessity for development or maintenance of separate Government-unique standards.
- (5) The need to implement the recommendations of the National Performance Review
- (6) The need to advance the goals of the National Information Infrastructure.
- (7) The need to avoid wasteful duplication of effort and to promote effective economic management of resources by Federal and state Governments, along with local and tribal governments.

*b. U.S. Policy on Information Systems and Spatial Data.* The U.S. policy on spatial data is set forth in three Office of Management and Budget Circulars (OMB A16, OMB A119 and OMB A130) and by presidential Executive Order 12906.

(1) OMB Circular A16

OMB Circular A16 describes the responsibilities of Federal agencies with respect to coordination of those Federal surveying, mapping, and related spatial data activities described below. Spatial data are geographically referenced features that are described by geographic positions and attributes in an analog and/or computer-readable (digital) form.

A major objective of this Circular is the eventual development of a national digital spatial information resource, with the involvement of Federal, state, and local governments, and the private sector. This national information resource, linked by criteria and standards, will enable sharing and efficient transfer of spatial data between producers and users. Enhanced coordination will build information partnerships among Government institutions and the public and private sectors, avoiding wasteful duplication of effort and ensuring effective and economical management of information resources in meeting essential user requirements.

The coordinating procedures established by this Circular extend to all activities financed in whole or in part by Federal funds.

(2) OMB Circular A119

OMB Circular A119 concerns Federal participation in the development and use of voluntary consensus standards and in conformity assessment activities. This Circular establishes policies to improve the internal management of the Executive Branch. This Circular directs agencies to use voluntary consensus standards in lieu of unique Government standards except where inconsistent with law or otherwise impractical. It also provides guidance for agencies participating in voluntary consensus standards bodies and describes procedures for satisfying the reporting requirements in the Act. The policies in this Circular are intended to reduce to a minimum the reliance by agencies on Government standards that are unique.

Many voluntary consensus standards are appropriate or adaptable for the Government's purposes. The use of such standards, whenever practicable and appropriate, is intended to achieve the following goals:

- (a) Eliminate the cost to the Government of developing its own standards and decrease the cost of goods procured and the burden of complying with agency regulation.
- (b) Provide incentives and opportunities to establish standards that serve national needs.
- (c) Encourage long-term growth for U.S. enterprises and promote efficiency and economic competition through harmonization of standards.
- (d) Further the policy of reliance upon the private sector to supply Government needs for goods and services.

Agencies must consult with voluntary consensus standards bodies, both domestic and international, and must participate with such bodies in the development of voluntary consensus standards when consultation and participation is in the public interest and is compatible with their missions, authorities, priorities, and budget resources.

### (3) Circular No. A-130

Circular No. A-130 provides uniform government-wide information resources management policies. This Circular establishes policy for the management of Federal information resources. Procedural and analytic guidelines for implementing specific aspects of these policies are provided, and these essentially mandate prudent and proper behavior in the acquisition, capturing, and generation of information of all types. The policies in the Circular apply to the information activities of all agencies of the executive branch of the Federal Government.

The Paperwork Reduction Act establishes a broad mandate for agencies to perform their information resources management activities in an efficient, effective, and economical manner.

### (4) Executive Order 12906\_Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure

This Executive Order states that geographic data are critical to promote economic development, improve stewardship of natural resources, and protect the environment. Modern technology now permits improved acquisition, distribution, and utilization of geographic (or geospatial) data and mapping. The National Performance Review has recommended that the executive branch develop, in cooperation with state, local, and tribal governments and the private sector, a coordinated National Spatial Data Infrastructure (NSDI) to support public and private sector applications of geospatial data in such areas as transportation, community development, agriculture, emergency response, environmental management, and information technology.

The Executive order establishes a Federal Geographic Data Committee to undertake data standards activities and to develop standards for implementing the NSDI, consistent with OMB Circular No. A-119. The FGDC is authorized under OMB Circular A16 to coordinate the development of geographic data standards within the United States engaging both Federal and Non-Federal participation. Standards for spatial data exchange and documentation (metadata) have been developed and approved through the FGDC. The FGDC has Thematic Subcommittees that are defining information content for more than a dozen categories of spatial information.

### 6. Description/Specifications/Statement of Work

*a. General.* The Contractor, operating as an independent Contractor and not as an agent of the Government, shall furnish all facilities, labor, material, and equipment necessary to provide goods and services in accordance with the terms, conditions, and specifications set forth below. The Contractor shall plan, schedule, and coordinate performance of all work associated with task orders in accordance with the requirements described in Section C. This shall include performing the professional photogrammetric mapping, related surveying work and photointerpretation required to furnish the Government with hardcopy and softcopy imagery or maps, digital datasets of land features, digital terrain data, change analysis, reports, and other data together with supporting material developed during the field data acquisition process, as may be required for various projects requested by USACE.

Example Language: The Contractor will provide complete Geospatial data to include a spatial component, content information, and metadata. These data shall be in compliance with EM-1110-1-1000 for Photogrammetric Mapping, EM-1110-1-1002 for Survey Markers and Monumentation, EM-1110-1-1003 for NAVSTAR Global Positioning System Surveying, EM-1110-1-1004 for Deformation Monitoring and Control Surveying, EM-1110-1-1005 for Topographic Surveying, EM-1110-2-1003 for Hydrographic Surveying, EM-1110-1-2909 for Geospatial Data and System, and Spatial Data Standards for Facilities, Infrastructure and Environment (SDS for FIE).

*b. Content.* Obviously, if the contract is to procure imagery or elevation information, content portion of the contract should reflect specifics on resolution of these data. If the contract is to collect feature data (building footprints, roads, etc), it must specify compliance with SDS for FIE.

A Data Content Standard provides semantic definitions for a set of real world geographic objects of significance to a community. This is often difficult to standardize because each community defines different significant objects. The Spatial Data Standards for Facility Infrastructure and Environment (SDS for FIE) provides a dictionary of standard feature and attribute definitions as well as a physical data model. The SDS for FIE is compliant with FGDC content standards.

Example Language: The Contractor will provide data compliant with the Spatial Data Standards for Facility Infrastructure and Environment (SDS for FIE), formally the Tri-Service Spatial Data Standard (TSSDS). The SDS for FIE provides a physical data model for FGDC content standards.

*c. Documentation/Metadata* Metadata or "data about data" describe the content, quality, condition, and other characteristics of data. The major uses of metadata are:

- To help organize and maintain an organization's internal investment in spatial data,
- To provide information about an organization's data holdings to data catalogues, clearinghouses, and brokerages, and
- To provide information to process and interpret data received through a transfer from an external source.

Generally, FGDC compliant metadata files need to be generated for "data sets." It may be reasonable for a Contractor to generate one metadata file for an entire data collection

effort. If the collection is completed in a short time and is uniform, such as with a small aerial photography effort, one metadata file can be generated that adequately describes these data. On the other hand, a large complex data collection effort over different geographic areas, probably needs multiple metadata files to adequately describe the data. The Government should work with the Contractor to determine a logical definition of "data set."

Example Language: Any data, database(s) and/or information products (reports, etc.) produced through this procurement must be documented through the preparation of standard metadata (data about data) descriptions. Proposals shall clearly describe how this will be accomplished.

Example Language: The Recipient/Contractor shall ensure that the metadata delivered are compliant with the Federal Geographic Data Committee Standard "Content Standard for Digital Geospatial Metadata", FGDC-STD-001-1998. A free copy of FGDC-STD-001-1998 is available at <<http://www.fgdc.gov/metadata/contstan.html>>. {Note: Reference appropriate endorsed Metadata Profile Standard, i.e., Biological Data Profile of the Content Standard for Digital Geospatial Metadata FGDC-STD-001.1-1999 in place of FGDC-STD-001-1998 when applicable}. The <Gov't> will provide the Recipient/Contractor with example metadata content text.

[Option 1] The <Gov't> requires that the Recipient/Contractor use Corpsmet95 for the collection/generation of the metadata. Corpsmet95 is available for download at <http://corpsgeol.usace.army.mil>.

[Option 2] Metadata received from the Recipient/Contractor must be able to be imported and processed by the (metadata-parser (mp) software (see web site <http://geology.usgs.gov/tools/metadata/tools/doc/mp.html> for a free copy of the mp software), or equivalent, free of errors.

*d. Accuracy is dependent upon the purpose and resolution of the data collection. FGDC has five parts to its accuracy standard. Whichever part of the standard is applicable, the collection effort shall be referenced in the contract. All standards are available at <http://www.fgdc.gov>. Geospatial Positioning Accuracy Standard, Part 4: Architecture, Engineering, Construction, and Facilities Management is consistent with accuracy information described in EM 1110-1-2909.*

Example Language: The Contractor will provide data consistent with FGDC:

Geospatial Positioning Accuracy Standard, Part 1, Reporting Methodology  
FGDC-STD-007.1-1998

Geospatial Positioning Accuracy Standard, Part 2, Geodetic Control Networks

FGDC-STD-007.2-1998

Geospatial Positioning Accuracy Standard, Part 3, National Spatial Data Accuracy Standard FGDC-STD-007.3-1998

Geospatial Positioning Accuracy Standard, Part 4: Architecture, Engineering, Construction, and Facilities Management (Draft Standard)

Geospatial Positioning Accuracy Standard, Part 5: Navigation Charts and Hydrographic Surveys (Draft Standard)

*Accuracy statements reported by the Contractor shall be completely and thoroughly substantiated by Metadata. The National Standard for Spatial Data Accuracy provides guidelines in Section 3.2.3, Accuracy Reporting, for reporting positional accuracy in Metadata. The <Contractor> shall ensure that the metadata are compliant with the Federal Geographic Data Committee Standard Content Standard for Digital Geospatial Metadata, FGDC-STD-001-1998, which is downloadable from <http://www.fgdc.gov/metadata/constan.html>.*

*e. Transfer/Format* Contract should indicate the format the data are to be delivered in is consistent with local platform/software.

Example Language: All data provided by the Contractor shall be in {DGN/ArcView} format.

Statement of Work  
Multiple Sites on Oregon Coast and Columbia River  
**Ground Control and Photogrammetric Mapping**  
**Contract DACW 57-00-D-0007**

**1.0 General:** This task order shall provide all resources and manpower necessary to generate ground control, new aerial photography and various mapping products for the Coos Bay Jetty System, as well as the North and South Jetties at Tillamook. All work and submittals shall conform to section "C" of the base contract. The technical point of contact for the Corps of Engineers is Mr. Scott Kool; phone 503-808-4849.

**2.0 Exhibits:** The following non-expendable exhibits are provided for your use:

Exhibit A: Site Maps showing jetties to be surveyed and mapped, as well as mapping limits for the land areas

Exhibit B: Control Diagram showing existing Corps survey control in the area.

Exhibit C: Monument Cards for control shown in Exhibit B

**3.0 Surveying and Mapping:** The following surveying and mapping tasks shall be produced:

**3.1 Flight Mission:**

**3.1.1 Jetties** Recommend negative scale 1" = 180' (1:2160) Airborne GPS/IMU controlled color aerial photographs for the production of spot elevations that are +/- 0<sup>33</sup> ft of actual elevation for Coos Bay North Jetty, and possibly the Tillamook Jetties as well. The intent is to produce this spot elevation accuracy. If that can be accomplished with a traditional flight mission and a somewhat higher flight, the technical POC will be willing to discuss. The approximate distance between the North and South Jetty at Coos Bay is 2,000 ft and the approximate distance between the North and South Jetty at Tillamook is 1,200 ft. Produce crossing flight-lines as necessary for the redundancy checks to produce the map accuracy.

**3.1.2 Schedule and Film Type::** All photography shall be completed during a 0 elevation or lower, **low tide** under clear and haze free skies between the hours of 8:00 am and 5:00 pm. High overcast would be acceptable, as the intent is to produce minimal shadows, however **low tide is mandatory**. The tide moves from south to north, and few tides are below zero this summer, , therefore flight mission planning is critical. Use high quality natural color film (AGFA 100 or equivalent).for jetty work, and high quality Color IR for the Rocky Creek work

**3.2 Survey Control:** Use Oregon State Plane South Zone (NAD83) and NAVD 88 for the Coos Bay mapping, and Oregon State Plane North Zone (NAD83) and NAVD 88 for the Tillamook mapping. Unit shall be the U.S. Survey Foot. If ABGPS/IMU aircraft is used, a minimum of two base stations shall be in operation during the flight.

**3.2.1 Permanent Jetty Control:** A minimum of 3 Permanent Inter-visible Jetty control

points shall be produced near each jetty. These control points may consist of existing monuments, and these points may be part of the panel points, however all monuments shall be resurveyed. Permanent control shall also be considered good GPS locations.

**3.2.2 Control Diagram:** Produce a Control diagram showing all monuments used or set. Show “published,” as well as surveyed coordinates, and show what control was held. Control Diagram shall be a Microstation compatible drawing file, plotted on Mylar. Sheet format, seed files, and other variable parameters will be provided by the technical POC as necessary.

**3.2.3 Monument Cards:** Produce standard monument cards (digital,) and digital photographs of immediate proximity for each permanent control monument.

**3.2.4 Ground Control:** Set ground control as necessary to produce the mapping. All mapping ground control shall be based on the newly established Permanent Jetty Control. Pre-marking will typically consist of monumenting, cleaning and painting jetty rock during low tide or calm seas. Jetty rock shall be clean and dry, and paint shall be long-lasting "Highway White." applied with a brush or roller. (not spray paint.) Pre-marks shall consist of brass plug with designation as per previously approved format.

**3.2.5 Map Checks:** In addition to mapping control requirements, a minimum of eight points per jetty shall be pre-marked and surveyed for checks on the final map. The permanent Jetty Control may be a part of these check points. These coordinates and elevations shall be in addition to and separated from any control required to produce the map. Again, if existing monumentation is recovered and used, it shall be re-surveyed.

**3.3 Photogrammetric Mapping:** Mapping of specified areas shall consist of the production of break-lines and spot elevations to depict the shape and size of the jetty for the calculation of rock quantities by others. These rock quantities will be based on original design data and this proposed mapping. Spot elevations shall be +/- 0.33 ft, in both horizontal and vertical. The majority of all models will contain mostly water, however the entire model shall be rectified for all models that show land areas. The limits of the mapping shall be the entire jetty and all land areas shown in Exhibit A.

Produce check plots on paper only, No formal sheets are required. Produce Microstation .DGN files for the line-work.

Produce an orthophoto (color) for all models. If sun-glare is apparent, use the best frame for orthophoto. Produce separate RGB file for each model, and “overview” file that contains full overview set, as per previous work.

**4.0 Logistics:** It is imperative the flight missions occur during low tide and preferably a minus tide. The tide moves from south to north, therefore it might be possible to complete Coos Bay and Tillamook in one day. If you use the IMU for both, you will need two field crews for the GPS base stations. It is imperative any mapping controlled with airborne GPS and IMU implement two base stations. The camera positioning system will be the discretion of the contractor, however the pre-marks shall be set and surveyed regardless. Coos Bay will require check in with Coast Guard and the BLM for access. Recommend advising coast guard of your

field schedule and flying schedule. Tillamook will require check in with resident office, ph. (503) 234-5598. Tillamook North Jetty has active rock removal contract at tip, so additional safety briefing and hard hats will be required as per main contract.

**5.0 Completion of Work:** Completion of work shall consist of delivery and accepting of the following items:

- 5.1 Original field notes and monument cards.
- 5.2 Camera calibration report.
- 5.3 Data produced during flight mission for stereo plotter orientation. (both panel and fiducial coordinates.)
- 5.4 Original film.
- 5.5 Diapositives.
- 5.6 Digital files (photogrammetric and survey control as specified in main contract).
- 5.7 Check plots
- 5.8 Survey Crew Daily Reports
- 5.9 Project surveying report as per main contract.
- 5.10 Control Diagram (digital and paper plot)

**6.0 Schedule:** Flight Mission shall be scheduled as soon as conditions can be met. All tasks shall be completed and relevant items delivered no later than 30 September 02.

End of scope

Statement of Work  
Multiple Sites on Columbia River  
**Ground Control and Photogrammetric Mapping**  
**Contract DACW 57-00-D-0010**

**1.0 General:** This task order shall provide all resources and manpower necessary to generate ground control, new aerial photography and various mapping products for the Washington side of The Dalles dam, as well as the Strawberry Island area near North Bonneville. All work and submittals shall conform to section "C" of the base contract. The technical point of contact for the Corps of Engineers is Mr. Scott Kool; phone 503-808-4849.

**2.0 Exhibits:** The following non-expendable exhibits are provided for your use:

Exhibit A: Rocky Creek Mapping Limits

Exhibit B: Jetty Mapping Limits

Exhibit C: The Dalles North Shore photogrammetric Mapping Limits

Exhibit C-1: The Dalles North Shore field topographic Mapping Limits

Exhibit D: Strawberry Island Mapping Limits for flight mission and optional mapping

Exhibit E: Strawberry Island, existing easement to be set

**3.0 DELETED**

**4.0 COLUMBIA RIVER SITES:** The following surveying and mapping products shall be produced for the Strawberry Island (North Bonneville site) and The Dalles site:

**4.1 Flight Mission:** Recommend negative scale near 1" = 400' (1:4800) conventionally controlled color aerial photographs for the production of 2 ft. contour mapping and spot elevations that are +/- 0.5 ft of actual elevation for both the Strawberry Island site as well as The Dalles North Shore.

**4.1.1 Schedule and Film Type:** All photography shall be completed as soon as possible upon successful negotiation of this contract, receipt of Notice to Proceed, and requisite ground control in place. Flight Mission shall occur under clear and haze free skies between the hours of 9:00am and 4:00pm. High overcast would be acceptable, as the intent is to produce minimal shadows.

Use high quality color film such as AGFA 100 color or equivalent.

**4.2 Survey Control:** Use Oregon State Plane North Zone (NAD 27) and NGVD 29/47 for both jobs. Unit shall be the U.S. Survey Foot.

Contractor is responsible for all permissions, flaggers and safety procedures as necessary.

**4.2.1 Permanent Control Monuments:** A minimum of 6 Permanent Inter-visible control points shall be established at both Strawberry Island, as well as The Dalles North Shore. These control points may consist of existing monuments, and these points may be part of the ground control panel points, however all monuments shall be resurveyed. Permanent control shall be considered good GPS locations, inter-visible and Second Order Class I. If GPS is used, it shall be a STATIC procedure, and involve a minimum of two geodetic receivers.

**4.2.2 Control Diagram:** Produce a Control diagram showing all monuments used or set. Show "published," as well as surveyed coordinates, and show what control was held. Control Diagram shall be a Microstation compatible drawing file, plotted on Mylar. Sheet format, seed files, and other variable parameters will be provided by the technical POC as necessary.

**4.2.3 Monument Cards:** Produce standard monument cards and digital photographs of immediate proximity for each permanent control monument.

**4.2.4 Ground Control:** Set ground control as necessary to produce the mapping. All mapping ground control shall be based on the newly established Permanent Survey Control. Pre-marking or post-flight ground control is considered acceptable. If temporary panels are used, the Corps will be responsible for retrieval. Monument designations shall conform to the previously established identification system.

**4.2.4.1 Map Checks:** In addition to mapping control requirements, a minimum of eight points per site shall be pre-marked and surveyed for checks on the final map. The permanent Survey Control may be a part of these check points. These coordinates and elevations shall be in addition to and separated from any control required to produce the map. Again, if existing monumentation is recovered and used, it shall be re-surveyed.

Comparison of the mapped coordinates to the higher accuracy field-surveyed coordinates shall be presented in tabular form and titled, "Quality Control Check-list." These 8 points shall be separate from any ground control required for the mapping, and may a part of your normal internal mapping quality control.

#### **4.2.5 Additional Field-work**

**Strawberry Island:** Set existing "Walking Trail" Easement held by the City of North Bonneville, as per Exhibit D. Set Angle point Center-line of Easement with 10" nails and flagging with guard stake set above ground and lath. In addition to angle points, set inter-visible guard stakes and lath on center-line with distance between points not to exceed 300 ft.

Establish coordinates and produce general description of the following "hook-up" points:

- a) Water from North Bonneville as shown on Exhibit XXX
- b) Electricity from newly constructed Fish Monitoring Facility just upstream.
- c) Sewer at existing North Bonneville Treatment facility

Assistance in locating these features will be provided by the COE Technical POC.

**4.2.5.1 The Dalles North Shore:** Produce topographic map of area shown on Exhibit C-1. Survey and mapping will be used for design and construction of proposed improvements consisting of “Visitor’s Center, parking lot, rest-rooms with power and running water.

Establish coordinates and produce general description of the following “hook-up” points:

- a) Water
- b) Electricity
- c) Vault toilet, so no sewer required.

Technical POC will provide assistance in locating proposed hook-up location, as well as existing survey control in the area.

Establish semi-permanent survey control as shown on Exhibits C and C-1. Monuments (approx. 8) shall consist of rebar with cap. Aluminum cap and monument designation will be provided by COE POC. Produce witness post and monument card showing “drive-to,” as well as coordinate and elevation.

These monuments shall also be used for panel points or check shots. They will be used for construction of improvements next summer.

### **4.3 Photogrammetric Mapping:**

**4.3.1 Scanning and Mapping:** Produce film diapositives as necessary to scan at a rate for the production of 0.5 ft or smaller pixels.

Strawberry Island is not a part of this mapping scope. Produce diapositives and scan files only. The Dalles North Shore mapping shall consist of the production of break-lines and spot elevations to support a 2 ft contour as well as depict the shape and size of the ground surface for design of improvements and the calculation of fill quantities in proposed stock-pile areas. These fill quantities will be based on this original mapping, and field surveys or another photogrammetric map upon completion of construction in 2 years. The future mapping or calculation of quantities is not a part of this scope.

Spot elevations shall be +/- 0.33 ft, in both horizontal and vertical. Autocorrelation is an option, not to exceed 2 ft postings. If Autocorrelation is used, it shall be supplemented with break-lines so that the mapping will meet or exceed ASPRS standards.

Produce orthophotos at a map scale of 1” = 50 ft (Color) for all models. Produce INTERGRAPH DGN and .RGB files, with overviews, as well as ARCINFO .GEN files for points and break-lines, and geo-referenced .TIFF files.

## 5.0 Optional Tasks

5.1 Mapping of Strawberry Island as per 4.3.1 requirements for The Dalles North Shore mapping.

5.2 Flight Mission at The Dalles for potential photogrammetric mapping at a later date. Additional photography will not be controlled, and flown at a height to produce 1" = 500' (1:6000) neg. scale. Film shall be the same natural COLOR used in the adjacent work, and shall be included in the same Flight Mission. Flight Mission will consist of approximately 5 Recreation areas at The Dalles Project, located at various points on both sides of the river. Each area will consist of approximately 5 exposures.

**6.0 Completion of Work:** Completion of work shall consist of delivery and accepting of the following items:

- 6.1 Original field notes and moument cards.
- 6.2 Camera calibration report.
- 6.3 Data produced during flight mission for stereo plotter orientation. (both panel and fiducial coordinates.)
- 6.4 Original film.
- 6.5 Diapositives.
- 6.6 Digital files (photogrammetric and survey control).
- 6.7 Check plots.
- 6.8 Project surveying report.
- 6.9 Control Diagram (digital and paper plot)

**7.0 Schedule:** All items shall be completed and relevant items delivered no later that 30 September 00. Completion date for optional items will be negotiated if exercised. Coastal flight mission should be accomplished during week of 31 July 02 if at all possible.

End of scope

STATEMENT OF WORK  
REVISED 16 APR. 1999  
Toutle River Mapping  
DACW57-99-D-0004

01. GENERAL: This task order shall provide all resources and manpower necessary to generate ground control, new aerial photography including negatives, prints, and diapositives; digital terrain model (DTM), digital orthophotography (optional), digital contours, and a coordinate grid, of a portion of the Toutle River near Mt. St. Helens in Washington. See Exhibit "A" for the limits of the mapping. All work and submittals shall conform to Section "C" of the Base Contract. Portland District, Corps of Engineers points of contact for project execution are Mr. Scott Kool [503-808-4849].

The following Exhibits are provided:

- Exhibit "A" Photography and Mapping Limits
- Exhibit "B" Metadata Format
- Exhibit "C" Survey Control Research File
- Exhibit "D" SRS Flight Map
- Exhibit "E" SRS Proposed Ground Control

02. GROUND CONTROL: The Contractor is expected to provide all surveyed ground control data necessary to map from the new aerial photography. Photo Control monuments will use Washington South Zone State Plane Coordinates (NAD 83). Use the same reference ellipsoid as the HARN station in the area. Elevation datum will be NAVD 88. All units will be in U.S. Survey feet.

This work includes production of ground control for 1-ft contour mapping on the Soil Retention Structure (SRS) spillway, as well as the ground control to support the 4-ft contour DTM. Recommend Airborne GPS for the 4-ft contour DTM, and conventional survey methods or Ground GPS for the SRS.

The panel points for the SRS shall be semipermanent points, as they will be recovered and re-used during the August flight mission.

In addition to setting control for new mapping, approximately 10 existing photo control points shall be recovered **and resurveyed**. The intent is to provide current data to compare with historic data for the purpose of validating the historic mapping.

The Corps will convert these points to NAD 83, NAVD 88.

The access for ground control shall be coordinated with the Corps POC. A key will be required to access the SRS. The U.S. Forest Service and the U.S. Fish and Wildlife Service must be notified also. Access by helicopter is recommended. Evergreen was used by the USACE for on-the-fly (OTF) GPS, in the same area in 1997. Although the field work is remote, the crew will not be allowed to camp in the area. The crew shall not retrieve any "shed antlers" or skulls, and every attempt shall be made to cause no disturbance to the elk. The winter kill was severe, and this particular spring is critical to the recovery of the general elk population. It is possible a State

Representative may ride along in the helicopter, not so much for vigilance, but as a guide for access to sensitive areas. The intent is to keep any herd from spooking into mass movement.

### 03. AERIAL PHOTOGRAPHY:

03.1 Format: The aerial photography shall be new and acquired using a 6-in. focal length USGS calibrated mapping camera. The latest copy of the camera calibration report for the camera used to acquire this imagery shall be furnished to the U.S. Army Engineer District, Portland, as part of the deliverables at the conclusion of the project. This photography should be suitable for generation of standard 9-in. H 9-in. color prints, negatives, and diapositives for production purposes and for deliverables.

03.2 The stereo photography shall have a minimum 60-percent forward over-lap and, where necessary, a minimum 30-percent side-lap. In the N. Toutle DTM area, the Contractor has the option of determining the flight line locations, flying height, and atmospheric conditions during time of acquisition, provided they are sufficient to generate all the deliverables required in this Task Order.

3.2.1 The areas flown for photography only shall have the same end-lap.

3.2.2 The SRS flight line shall have an end-lap of 80 percent, as specified in Exhibit "D."

03.3 Scale: The North Toutle mapping aerial photography negative scale shall be approximately 1:14,400 (1 in. = 1200 ft) and be sufficient to generate all the deliverables required in this Task Order. The intent of this photogrammetric work is to provide a DTM to support a 4-ft contour (Class 2), as well as the option for a 1-in. = 200-ft orthophoto. The remainder of the Toutle, as well as the South Toutle, shall have the same negative scale as the North Toutle mapping.

The SRS spillway negative scale shall be 1 in. = 250 ft (1:3000)

03.4 Aerial Photography Dates: This task order includes two separate flight dates. The B/W aerial photography shall be acquired as soon as practical, once the panels are in place, between the daytime hours of 1000 and 1400.

The Color IR shall be acquired during extreme low water levels, (July/August) which should allow the SRS spillway to be exposed.

The second flight mission (July/Aug. Color IR) will not include the South Fork for the Toutle, therefore the South Fork will only be photographed in April (B/W only) Each flight mission should hold the same scale, but with different film types, with the exception of the SRS.

All photography shall have be controlled by differential GPS, using the same techniques as in the mapping area. In addition to prints of all exposures, diapositives shall be produced and scanned. These scanned images shall be geo-referenced and delivered in both raw and compressed form.

The SRS August mapping flight used B/W film

03.5 Coordination: The flight mission shall be coordinated by the Contractor and comply to all relevant rules and regulations.

03.6 Aerial Photography Prints, Negatives, & Diapositives: All aerial photography prints, negatives and diapositives shall be annotated in accordance with the U.S. Army Engineer District, Portland, lettering standards in the Base Contract. Errors will require immediate correction at the Contractor's expense. A beginning number must be obtained from the GIS, Survey & Mapping Section [503-808-4849]. An ending number must be provided to the same office.

#### 04. PHOTOGRAMMETRY:

04.1 Orthophotography: Provide an option for orthorectification of the entire stereo model. This might cause the production of different data collection spacing to rectify the area of the model that falls outside of the 4-ft DTM area. The aerial photography shall be scanned at an approximate rate of 15 to 20 microns. The final orthophotograph map scale shall be 1 in. = 200 ft. A coordinate grid shall be digitally generated and geo-referenced to the ortho.

04.2 Scale: The optional digital orthophotography shall meet map standards for 1 in. = 200 ft (1:2400) mapping, and the DTM shall support a 4-ft contour in the Class 2 standards (spot elevation of well-defined point +/- 1.4 ft of surveyed elevation.)

04.3 Topography: Topographic contours shall be generated as a check for the DTM. Provide a paper plot.(no formal sheet is required.). Plot 4-ft contours with each fifth contour indexed. The 4-ft contours shall span the area shown in Exhibit A, and 5-ft contours shall be provided for the remainder of the ortho (outside of the 4-ft DTM area). Elevation data should be presented in terms of NAD 88. File size should be limited to 20 MEGABYTES and shall hold logical river-mile names. The DEM and DTM will be made available in .DGN files types.

05. PROJECT REPORT: Produce a report of equipment, software, and procedures used. This report shall include the origin of the ground control and basis of bearing. Note all assumptions made, and problems or comments relative to surveying, mapping, or hydraulic modeling of the area. This report shall include the surveyor's Daily Reports, and all items relative to this project that would be useful for documentation purposes in the future. This report is intended to be general in nature and compiled from information that is readily available to the Project Manager

06. DRAFTING:  
None required.

07. DELIVERABLES:

07.1 Photographic Products: All products listed under this item shall be delivered to the U.S. Army Engineer District, Portland; GIS, Survey & Mapping Section.

07.1.2 Aerial Photography Prints: Provide one (1) set of 9-in. by 9-in. annotated contact prints for each exposed frame.

07.1.3 Aerial Photography Negatives: Provide one roll of continuous strip negatives from the aerial flight containing 9-in. by 9-in. annotated images.

07.1.4 Other: Provide one hard copy of the aerial flight map used to acquire the imagery with specifications related to the acquisition and location of the imagery and flight lines. Provide one set of survey ground control data, including location sketches for the hypoints.

07.2 Photogrammetric Products:

07.2.1 Hard Copy Orthophotographs: Provide one check plot on paper, including the coordinate grid, at a scale of 1 in. = 200 ft.

07.2.2 Digital Files:

07.2.2.1 Provide digital orthophotography (option) as Intergraph NT compatible, uncompressed .cot files with overviews, DEM's as INROADS files, and the contour/grid digital data as .dgn files on different levels, with individual files for each orthophoto. All digital data shall be submitted on CDs.

08. METADATA:

Produce METADATA as per format in Exhibit "B." Submit digital and hard-copy file.

09. POC INFORMATION: Mailing addresses are as follows;

U.S. Army Corps of Engineers  
CENWP-PE-GM  
P.O. Box 2946  
Portland, OR 97208 – 2946  
ATTN: Scott Kool  
(503) 808-4849 office, x4845 FAX

**10. COMPLETION OF WORK:**

Completion of work shall consist of delivery and acceptance of the following items:

- a. One set of annotated aerial prints, one roll of annotated aerial negatives, and one set of control location marked diapositives.
- b. One copy of the annotated flight map, and one set of survey ground control data.
- c. One set of orthophotographic check plots with contours and coordinate grid(option).
- d. Digital topographic model (DTM) data, including spot elevations and break lines.
- e. Digital coordinate grid data.
- f. Field book and computations for ground control.
- g. Metadata files.
- h. Project Surveyor's Report.
- i. Diapositives or scanned images.

**11. COMPLETION DATE:**

Field work and first flight mission shall commence upon successful negotiation and receipt of Notice to Proceed. Submit this initial set of B/W contact prints. All mapping shall be completed by 30 Oct 99, and final flight mission shall be completed only after river flows have minimized. Monthly billing is encouraged for this work.

End of scope