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| Identifier: **EP-ERSS-SOP-5028 (was SOP-03.11)** | Revision: **0.0** | Los Alamos NATIONAL LABORATORY EST.1943 |
| Effective Date: **02/09/07** | | |

# Environment & Remediation Support Services

# Standard Operating Procedure

for **COORDINATING AND EVALUATING GEODETIC SURVEYS**

**APPROVAL SIGNATURES:**

| **Subject Matter Expert:** | **Organization** | **Signature** | **Date** |
|---|---|---|---|
| Steve Koch | ERSS | | |
| **Quality Assurance Specialist:** | **Organization** | **Signature** | **Date** |
| Jackie Kolakowski | QA-IQ | | |
| **Responsible Line Manager:** | **Organization** | **Signature** | **Date** |
| Craig Eberhart | ERSS | | |

## 1.0 PURPOSE AND SCOPE

The purpose of this procedure is to describe the methodology for coordinating and evaluating geodetic surveys and establishing quality assurance (QA) and control for geodetic survey data. This procedure applies to all Los Alamos National Laboratory (LANL or Laboratory) Environment & Remediation Support Services (ERSS) Division activities that require geodetic survey.

## 2.0 BACKGROUND AND PRECAUTIONS

### 2.1 Background

To be acceptable, survey data must conform to Laboratory Information Architecture (IA) project standards IA-CB02, "GIS Horizontal Spatial Reference System," and IA-D802, "Geospatial Positioning Accuracy Standards for A/E/C and Facility Management." Survey data must also meet the following EP Directorate requirements:

- All survey coordinates must be expressed as SPCS 83, NM Central, US ft coordinates. All elevation data must be reported relative to the National Geodetic Vertical Datum of 1929.
- All surveys must originate from or be derivative of control monuments set in the 1992/1993 Laboratory Control Network (LCN).
- The PTL will inform survey personnel of accuracy requirements before surveying activities are undertaken.

[NOTE: The NMED Order on Consent requires sample locations to be within 0.1 ft. accuracy.]

### 2.2 Precautions

Recognizing that any survey method can return unacceptable survey data as a result of human error or other causes (e.g., imprecise GPS measurements), the EP Directorate should employ such survey methods and use such survey tools (e.g., Total Station, high-precision GPS) as are most suited to obtaining acceptable survey data.

## 3.0 EQUIPMENT AND TOOLS

See Attachment 1 for Equipment and Tools Checklist.

## 4.0 STEP-BY-STEP PROCESS DESCRIPTION

### 4.1 Evaluate Geodetic Survey Requirements

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| Project Team Leader | 1. | Determine the type of survey to be performed, the information that will be required by survey personnel, and the survey information to be reported (e.g., sample points, historical information, excavation boundaries). |
| | 2. | Determine whether the survey is for purposes of staking out previously defined locations (a stakeout survey) or to identify unknown locations (an unknown location survey). |
| | 3. | Gather the following information:<br>• Coordinate values for the stakeout points (or documents from which coordinate values can be calculated);<br>• Instructions for field identification of stakeout points (e.g., stakes, pin flags, whiskers, spray paint, ribbon); and<br>• The location identification numbers (IDs) to be assigned to the stakeout points. |

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| Project Team Leader (Continued) | 4. | Gather information that will assist survey personnel in location identification (e.g., a map on which pin flags mark existing sampling locations, documentation of the perimeter of an excavated trench, or an indication of the elevation of a well head). |
| | 5. | Ensure survey personnel meet the applicable requirements of the ERSS Division and the New Mexico Engineering and Surveying Practice Act for conducting the type of survey required, including the following:<br>• Survey personnel who perform control, property, easement, or boundary surveys must be registered professional land surveyors (New Mexico Engineering and Surveying Practice Act); and<br>• Survey personnel who perform surveys to determine the location and elevation of groundwater monitoring wells must be professional land surveyors registered in the State of New Mexico (ERSS Division requirement). |
| | 6. | Ensure survey personnel have sufficient experience in the application of survey methods and the use of surveying equipment to obtain data of acceptable quality for use by the ERSS Division. |

## 4.2 Prepare to Perform a Geodetic Survey

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| Project Team Leader | 1. | Provide survey personnel with a completed Geodetic Survey Work Request Form (see Attachment 2), which includes the following information:<br>• Date Requested;<br>• Name of Project Team Leader;<br>• Accuracy Needed:<br>• Brief Description of Survey (e.g., Technical Area, Location, Number of Points, Escort, etc.);<br>• Date QA Checked the Survey Points; and<br>• Date Submitted to the ER Database. |
| | 2. | For stakeout surveys, provide survey personnel with the following:<br>• the coordinates for the survey locations or documentation (e.g., as-built drawings, aerial photographs, or historical notes, from which the survey coordinates can be calculated;<br>• instructions for the method of marking points in the field (e.g., with stakes, pin flags, whiskers, spray paint, or ribbon);<br>• the location IDs to be assigned to the staked out points. |
| | 3. | For unknown location surveys, provide the survey personnel with the following:<br>• a clear statement of the locations to be surveyed; and<br>• a statement of the required accuracy for each point location. |
| | 4. | Before leaving for the field, ensure all equipment and tools listed in Section 3.0 of this procedure are obtained. |

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| **4.3** | **Perform Geodetic Survey Field Activities** | |
| Survey Personnel | 1. | Chronologically document the survey field activities by maintaining a handwritten field notebook and recording, at a minimum, the following information:<br>• the names of LCN control monuments used;<br>• intermediate traverse points;<br>• the sequence of measurements made; and<br>• brief descriptors of the points measured.<br>[NOTE: Angles and distances measured do not need to be recorded in the field notebook.] |
| | 2. | Mark and identify survey locations as instructed by the Project Team Leader and record the marker in the field notebook. |
| **4.4** | **Prepare Geodetic Survey Data for QA Review** | |
| Survey Personnel | 1. | After completing field survey activities, return to the office and prepare the survey data for QA review. |
| | 2. | Prepare a plot of the points located by the survey and identify each location point with the surveyor's point label. |
| | 3. | Prepare a Microsoft Excel spreadsheet that lists the following:<br>• the survey location points;<br>• GPS uncertainty values (as calculated by GPS);<br>• SPCS 83, NM Central coordinates (in US ft.); and<br>• surveyor's point labels.<br>[NOTE: Some survey data used during field investigations, such as traverse points, intermediate reference points, referenced attribute information, etc., do not need to be captured in the Microsoft Excel spreadsheet.] |
| **4.5** | **Perform QA Review of Geodetic Survey Data** | |
| Survey Personnel | 1. | Submit the survey plot, an electronic copy of the Microsoft Excel spreadsheet for survey location points, and the field notebook to the Project Team Leader. |
| Project Team Leader | 2. | Ensure all documentation (e.g., plats, coordinate values, and reports) of work performed by registered professional survey personnel for the ERSS Division bear the surveyor's seal and signature. |

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| Project Team Leader (Continued) | 3. | Assure that survey data are acceptable for use by the ERSS Division by verifying the following:<br>• survey personnel have used SPCS 83, NM Central coordinates expressed in US ft.;<br>• have assigned a surveyor's label to each survey point;<br>• have completed the field notebook; and<br>• have satisfied ERSS Division survey requirements for documentation of LCN control monuments, traverse points, etc. |
| | 4. | Assure the survey plot is both internally consistent (all surveyed points in correct location relative to each other) and the error of closure or the individual point uncertainty value associated with the derivative coordinate value (as statistically calculated by the GPS receiver) are sufficiently small. |
| | 5. | Notify survey personnel of any errors in the data that require resolution. |

## 4.6 Submit Geodetic Survey Data

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| Project Team Leader | 1. | When the survey data are determined to be acceptable, complete the Microsoft Excel Spreadsheet for the survey locations by assigning location ID labels to each of the surveyor's point labels within the spreadsheet. |
| | 2. | Ensure the spreadsheet contains the following information for each survey location:<br>• surveyor's point label;<br>• PTL-assigned location ID; and<br>• SPCS 83, NM Central coordinates. |
| | 3. | Open the survey location template (available at http://erinternal.lanl.gov/ from the "Service Request" menu). |
| | 4. | Perform a "Save As" operation from the survey location template to rename and save the template to a local disk or hard drive. |
| | 5. | Follow the instructions provided in the "Saved As" copy of the template to upload the contents of the Microsoft Excel spreadsheet and complete the template copy. |
| | 6. | After uploading the contents of the Microsoft Excel spreadsheet and completing the template, close and save all changes to the file. |
| | 7. | Attach the completed survey location file to an e-mail and send the e-mail and attachment to ERLocationUpload@lanl.gov.<br>[NOTE: By submitting the electronic copy of the survey location file to the above e-mail address, the Project Team Leader certifies the quality of the survey data.] |

### 4.7 Records

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| Project Team Leader | 1. | Submit the following records generated by this procedure to the Records Processing Facility:<br>• Field Notebook;<br>• Survey Location Map; and<br>• A copy of the approved procedure used by a subcontractor (if applicable). |

## 5.0 PROCESS FLOW CHART

Flow chart is to be included at a later date.

## 6.0 ATTACHMENTS

Attachment 1: 5028-1 Equipment and Tools Checklist (1 page)

Attachment 2: 5028-2 Geodetic Survey Work Request Form (1 page)

## 7.0 REVISION HISTORY

Author: Bill Kopp

| Revision No. *[Enter current revision number, beginning with Rev.0]* | Effective Date *[DCC inserts effective date for revision]* | Description of Changes *[List specific changes made since the previous revision]* | Type of Change *[Technical (T) or Editorial (E)]* |
|---|---|---|---|
| 0.0 | 02/09/07 | Reformatted and renumbered | E |
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## ATTACHMENT 1: EQUIPMENT AND TOOLS CHECKLIST

**5028-1**

**Equipment and Tools Checklist**

Records Use only

**GPS TRIMBLE 5700**

- ☐ Two (2) Tripods;
- ☐ GPS Controller;
- ☐ Two (2) GPS Receivers;
- ☐ Marine Base Battery;
- ☐ Base Antenna;
- ☐ Base Radio;
- ☐ Rover Backpack;
- ☐ Rover Pole;
- ☐ Rover Antenna;
- ☐ Charged Batteries;
- ☐ Five (5) Cables;
- ☐ Carrying Case;
- ☐ Pin Flags or Wooden Stakes;
- ☐ Felt Pen; and
- ☐ Notebook

## ATTACHMENT 2: GEODETIC SURVEY WORK REQUEST FORM

| **5028-2**<br><br>**Geodetic Survey Work Request Form** | Records Use only<br>  |
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| **Date Requested**: | **Project Team Leader**: | **Accuracy Needed**: |
|---|---|---|
| | | |

**Brief Description of Survey (e.g., Technical Area, Location, Number of Points, Escort, etc.)**:

| **Date QA Checked Survey Points**: | **Date Submitted to the ER Database**: |
|---|---|
| | |