

**STANDARD OPERATING PROCEDURE NO. 3****SURVEYING (GPS)**

<b>REVISION LOG</b>		
Revision Number	Description	Date
3.0	Original SOP (author=McLemore)	11/10/03
3.1	Revisions by McLemore	1/3/04
3.2	Revisions by PJP	1/5/04
3.3	Revisions by PJP	5/26/2004
3.4	Revisions by PJP	6/8/2004
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**1.0 PURPOSE AND SCOPE**

This Standard Operating Procedure (SOP) provides technical guidance and procedures that will be employed to conduct Global Positioning Survey (GPS) surveying.

Conventional land and GPS survey techniques will be used to survey monitoring well locations and elevations; surface water and sediment sampling locations; surface soil and biological sample locations; borehole locations and elevations; geophysical and sampling grid locations, elevations,

and orientations; utility clearance (as applicable); and other surface and subsurface features. Molycorp, Inc. will be responsible for all surveying other than GPS locations of samples and will use their own procedures. This SOP addresses only GPS locations for geophysical grid points and samples collected by the Characterization Team. “Conventional” GPS equipment is reasonably accurate for providing horizontal control; however, very sophisticated and expensive equipment is necessary for remotely accurate vertical control, which the Molycorp surveyors will be using.

## **2.0 RESPONSIBILITIES AND QUALIFICATIONS**

The Characterization Team Leader will have the overall responsibility for implementing this SOP. He/she will be responsible for assigning appropriate staff to implement this SOP and for ensuring that the procedures are followed accurately.

All personnel performing these procedures are required to have the appropriate health and safety training. In addition, all personnel are required to have a complete understanding of the procedures described within this SOP and to receive specific training regarding these procedures if necessary.

All staff are responsible for reporting deviations from this SOP to the Characterization Team Leader.

## **3.0 RELATED STANDARD OPERATING PROCEDURES**

The procedures set forth in this SOP are intended for use with the following SOPs:

- SOP 1 Data management (including verification and validation)
- SOP 2 Sample management (chain of custody)
- SOP 4 Taking photographs
- SOP 5 Sampling outcrops, rock piles, and drill core (solid)
- SOP 6 Drilling, logging, and sampling of subsurface materials (solid)
- SOP 9 Test pit excavation, logging, and sampling (solid)
- SOP 15 Surface water and seep sampling
- SOP 16 Ground-water sampling
- SOP 23 Geophysical surveys
- SOP 37 Microbe sampling
- Any other SOPs that require sample collection or surveying

## **4.0 EQUIPMENT LIST**

The following survey equipment may be needed for conducting GPS surveying for this project:

- Appropriate field sample forms from the database
- Weatherproof field logbook for any other observations not recorded on the forms
- Indelible black-ink pens
- GPS Instrument set to proper coordinate system
- Field map
- Measuring Tape
- Compass/Brunton
- Reference coordinates and datums

## 5.0 SURVEYING PROCEDURES

This section provides a general summary of GPS surveying procedures for surveying sample locations and geophysical survey grid points. These procedures shall be supplemented by the specific survey instrument manufacturer's recommendations and generally accepted surveying practices.

- Each operator will record the specific references (Universal Transverse Mercator -UTM coordinates and datums) used for their survey points. For surveying it is **imperative** to identify which coordinate system is used. A field labeled *coord\_system* is included on the data entry form to verify the system used. This SOP dictates that the horizontal datum used for this project will be NAD 27 CON (North American Datum 1927, This is at the request of Bruce Walker and will require recorded measurements to be **in feet** and not in meters). (Note: Some of the data from Molycorp could be referenced in mine coordinates, NAD 27, NAD 83, WGS 84, or be unknown. The coordinate system used for some of the legacy data is unknown. We have established this SOP to prevent unknown coordinate references and varied units for our project survey points. If you must use a different reference system for your GPS, RECORD IT so we can cross-reference it and your data won't be meaningless). UTM coordinates will be recorded as Easting and Northing. Land surveying control will be established from known National Geodetic Survey (NGS) benchmarks, using the New Mexico State Plane, Central Zone. The vertical datum will be the North American Vertical Datum of 1988. In addition, record the make, model, and unit number of the GPS used to measure the position. As a backup, all of this information can be recorded in the survey logbook.
- If the coordinates at a survey location cannot be determined due to the presence of tree cover or other interfering obstacles which prohibit adequate signal reception, coordinates will be obtained at a minimum of two alternate locations (offsets) close to the original survey location. The distance and bearing from each of the alternate locations to the original survey location will then be determined using a measuring tape and compass and recorded on the field sample form and in the field logbook.

## 6.0 QUALITY ASSURANCE/QUALITY CONTROL

Vertical elevations measured by GPS are suspect due to limited system accuracy and will be verified by Molycorp surveying or topographic maps.

## 7.0 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook or on field data forms as applicable.

The survey location identifier (i.e., sample identification number) and corresponding coordinates and elevation (include method used to determine elevation) will be recorded on the field sample forms. As a backup, this information will also be recorded in the survey logbook. Surveying

activities and field observations will also be recorded in the field logbook (Appendix 1). Information that will be documented in the logbook includes:

- Project name and number
- Date and Time
- Datum and UTM coordinates used
- Surveying personnel
- Weather conditions
- Equipment used
- Waypoint number in the GPS
- Daily field verification information (i.e., benchmark identification and coordinates)
- Survey location identification
- Survey location coordinates (northing and easting UTM coordinates)
- Elevation and how obtained (GPS, Topographic map, Molycorp survey, etc)
- Descriptions and coordinates of alternate survey locations (offsets)
- Measured distances from alternate survey locations to original survey locations
- A description of any conditions that may affect data integrity

## APPENDIX 1. FORMS

See Database for Field Sample Form, Hand Specimen Description Form, Field Photos Form, Reflectance Spectroscopy Form, Drill hole Form, and Gravimetric M C Form

An Example of the location portion of the Drill Hole Form:

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The screenshot shows a software window titled "Drillhole" with a form titled "Drill hole form". The form is divided into several sections:

- General Information:**
  - Hole\_id: 180099
  - Feature\_id: (empty)
  - Site\_Name: (empty)
  - Weather: (empty)
  - purpose: (empty)
  - Company: Molycorp
  - Owner: Molycorp
  - Type: Drill hole
- Location:**
  - UTM\_northing: 4060797
  - UTM\_easting: 452694.56
  - UTM\_zone: 13
  - Northing: 21798.02
  - Easting: 50990.88
  - Latitude: (empty)
  - Longitude: (empty)
  - Location\_assurance: reported
  - Point\_of\_location: field location
  - LocationNotes: (empty)
- Elevation:**
  - GroundElevation: 8164
  - CollarElevation: (empty)
  - BottomElevation: (empty)
  - Method\_of\_obtaining\_elevation: reported
  - HoleDepth: 1127
  - DepthSource: reported
  - Diameter: (empty)
  - hole\_path: linear