WORKING FILE

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Field Unit IV is using surface geophysical methods to investigate the vadose zone hydrology below canyons at Los Alamos National Laboratory (LANL). In 1996, the surface geophysical investigations will primarily be performed in Pueblo and Los Alamos Canyons. The surface geophysical investigations include the following objectives and geophysical methods.

1. Define areas within canyons where aquifers are present in sediments below canyon floors at shallow depths (10 feet to 70 feet).

This investigation of shallow aquifers is being performed with an integrated application of the following geophysical methods:
- Electromagnetic Frequency Domain (EMFD)
- Electrical Earth Resistivity (EER)
- Temperature
- Seismic Refraction

In December 1995 and January 1996 EMFD profiles and vertical soundings were collected on traverse lines in Pueblo Canyon. Temperature profiles (1 meter depth) have also been collected on these traverse lines. EER profiles and vertical soundings will be collected on these same traverse lines the week of January 22, 1996. In the same week, additional temperature profiles and diurnal vertical temperature gradients (depth of 0.1 meter to 2.0 meters) will be collected in Pueblo Canyon. Reversed seismic refraction profiles are scheduled for Pueblo Canyon in February, 1996.

The objective of this integrated application of surface geophysical methods is to define the location of shallow aquifers and define their dimensions (width, thickness, and depth to the top of the water table).

The pilot studies in Pueblo and Los Alamos Canyons will determine the ability of surface geophysical methods to characterize alluvial aquifers and will define the most efficient application of surface geophysical methods to accomplish this characterization. Results from the surface geophysical investigations will be used to select locations for monitor wells in the alluvial aquifers.

2. Define areas below canyons where perched aquifers are present and characterize the recharge relationship between shallow alluvial aquifers and the deeper perched aquifers.

The surface geophysical methods which will be used in an integrated application to meet these objectives are the following:

- Electromagnetic Frequency Domain (EMFD) deep vertical soundings
- Electromagnetic Time Domain (EMTD) deep vertical soundings
- Electrical Earth Resistivity (EER) deep vertical soundings
- Seismic Reflection (optional if warranted)

In December 1995 and January 1996, deep vertical soundings with the EMFD method were collected in Pueblo Canyon. Deep vertical soundings with the EER method will be collected in Pueblo Canyon starting in the week of Jan 22, 1996. Deep vertical soundings

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with the EMTD method are scheduled to start in Pueblo Canyon at the end of February 1996. Interpretation of vertical soundings with EMFD, EMTD, and EER methods and also seismic refraction method will be used in the decision to apply the seismic reflection method to image vertical fractures below alluvial aquifers which may be recharge pathways to perched aquifers.

Results from the surface geophysical investigations will be sued to guide the location of monitor wells completed in perched aquifers.

3. Characterize recharge relationships between perched aquifers and the deep main aquifers.

This study will be performed with the electromagnetic time domain method as this method will have the deepest penetration (to a depth of 800 -1000 feet depending on electrical properties of rock units) and the highest resolution of variations in the moisture regime in deep rock units. Identification of recharge relationships between perched aquifers and the underlying main aquifer is important, and the application of surface geophysics to accomplish this will be investigated.