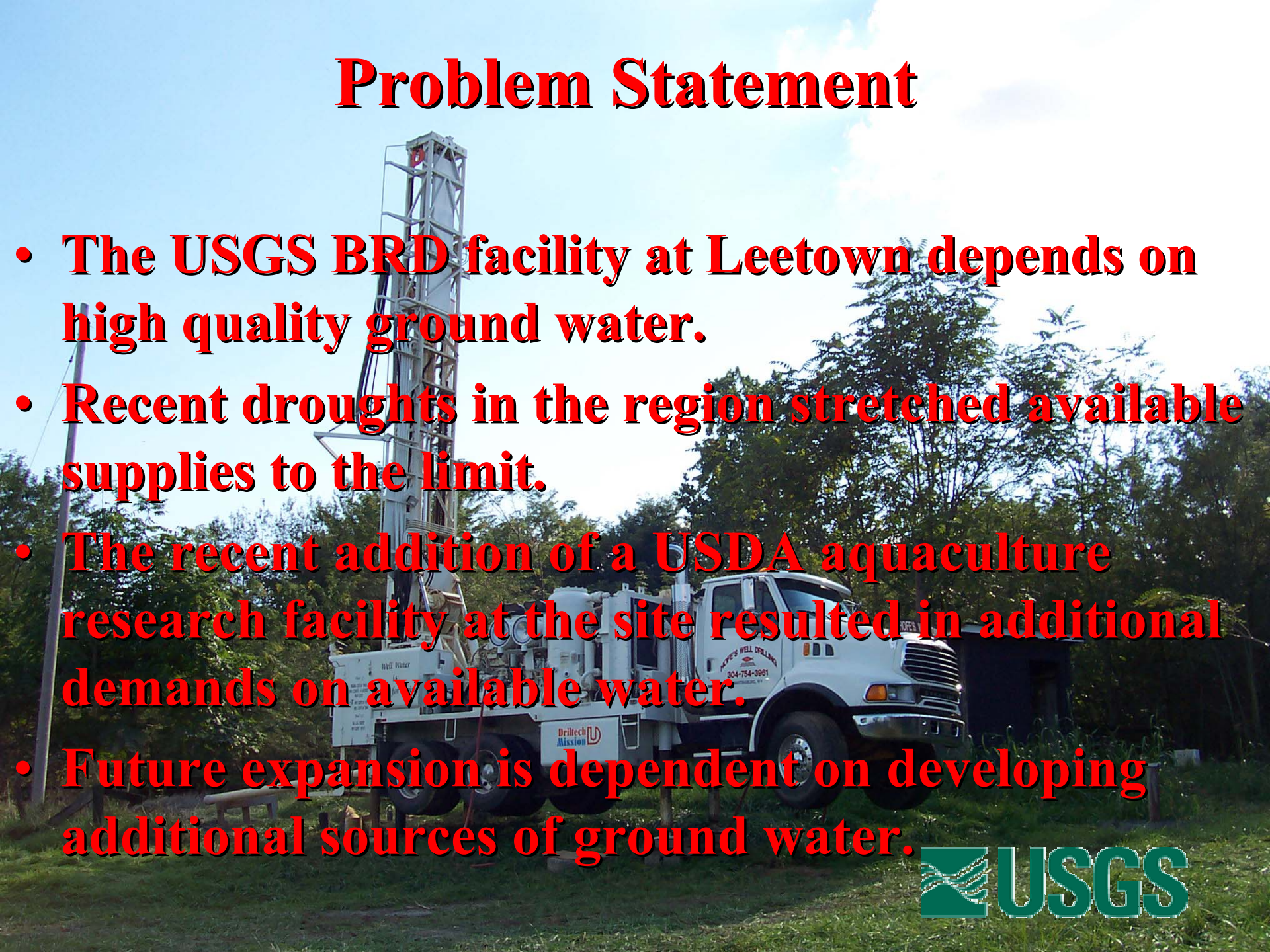
Current Status of the Leetown Hydrogeologic Assessment

- Funds needed to conduct the Leetown Hydrogeologic Assessment were allocated by Congress in February 2003.
- Preliminary work actually began at the site in November of 2002.
- Due to the nature of the project, the majority of field work for FY 03 was conducted by the geologic discipline.

USGS

Problem Statement



- The USGS BRD facility at Leetown depends on high quality ground water.
- Recent droughts in the region stretched available supplies to the limit.
- The recent addition of a USDA aquaculture research facility at the site resulted in additional demands on available water.
- Future expansion is dependent on developing additional sources of ground water.

USGS

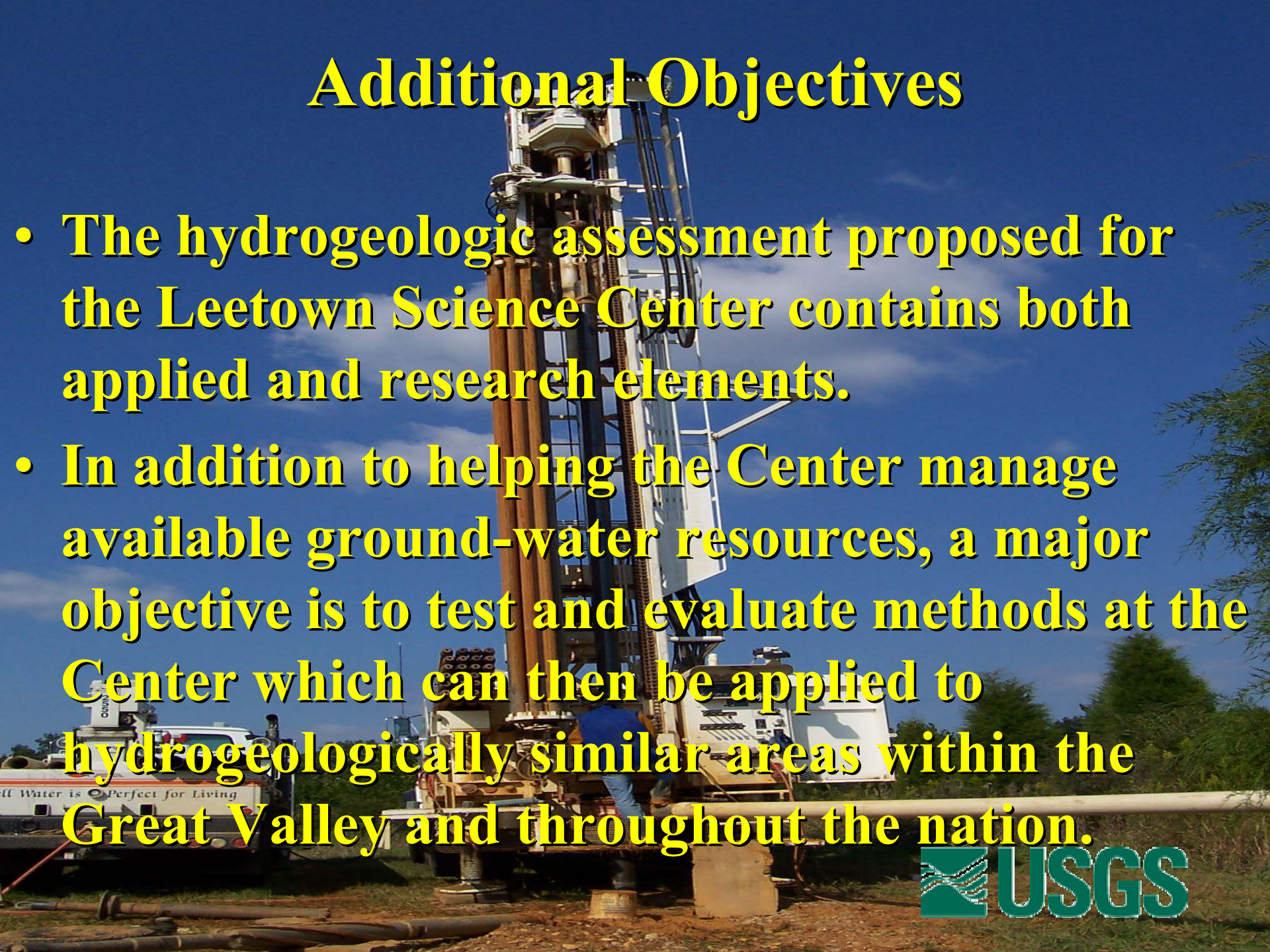
Objectives of Leetown Hydrogeologic Assessment

- 1) Develop a detailed understanding of the hydrogeologic setting/properties of the Karst aquifer in the Leetown area, 2) Document the availability and quality of ground water in the area, 3) Evaluate patterns of land and water use that might impact ground water, 4) establish a monitoring network to determine ground-water availability/quality, and 5) Assess water availability as a function of drought/changes in land use.

USGS

Additional Objectives

- The hydrogeologic assessment proposed for the Leetown Science Center contains both applied and research elements.
- In addition to helping the Center manage available ground-water resources, a major objective is to test and evaluate methods at the Center which can then be applied to hydrogeologically similar areas within the Great Valley and throughout the nation.



Tasks Scheduled for Completion in Fiscal Year 2003

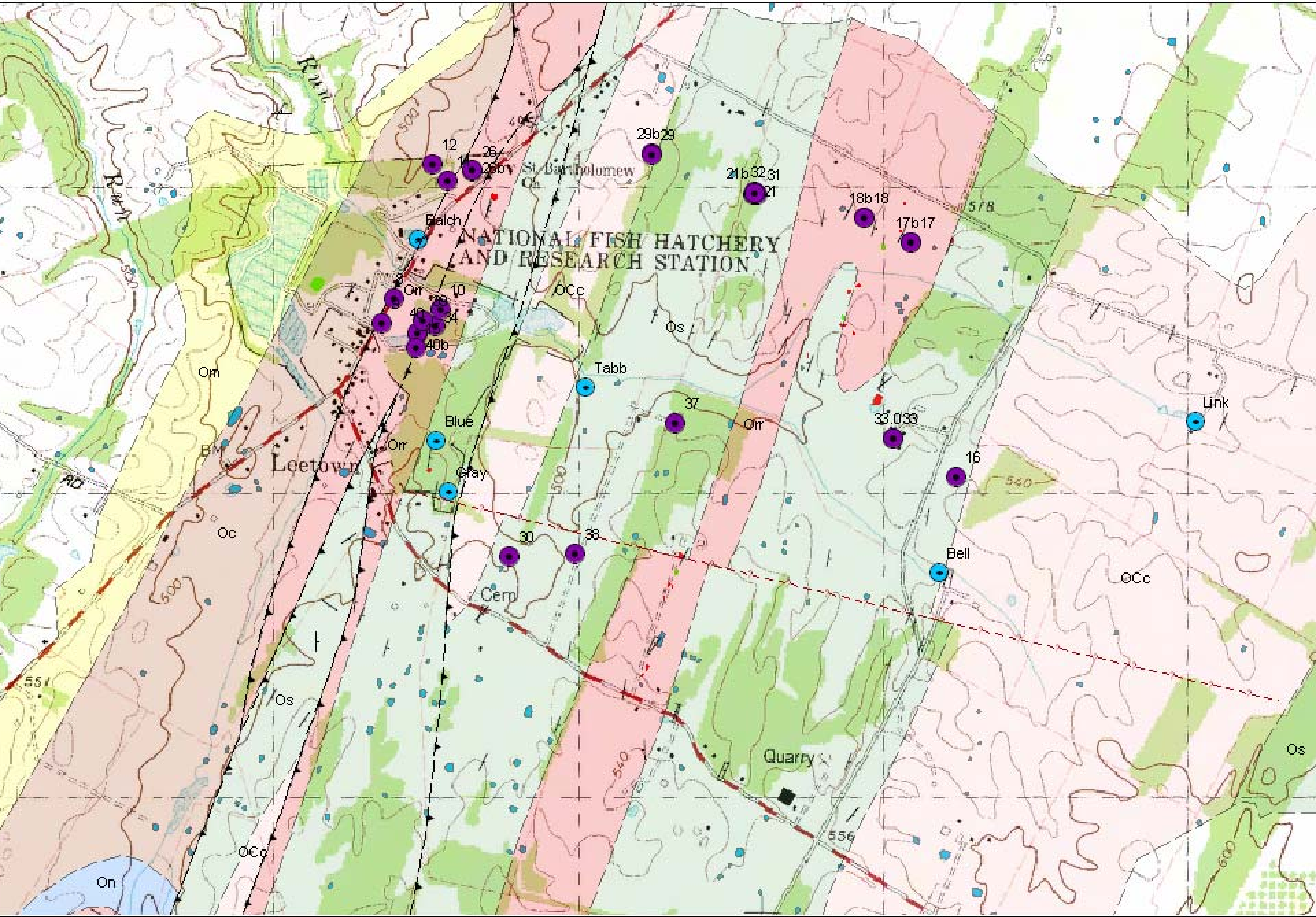
- Geologic, karst, and sinkhole mapping and geophysical surveys were conducted to help understand the fracture network.
- Nine bedrock wells and 8 shallow piezometers were drilled to document the type and degree of fracturing of the bedrock and to better understand the hydrogeologic setting over the entire site.
- A monthly monitoring well network was established for the Leetown area to assess temporal and spatial variation in water levels.

USGS

Tasks Scheduled for Completion in Fiscal Year 2003 - Continued

- Sensors to monitor levels at two springs, a stream gaging station, and two precipitation gages have been installed at the facility.
- Borehole geophysical logging of the monitoring wells was rescheduled for mid November and will employ several innovative methods.
- Analysis of the borehole geophysical data will be conducted over the winter followed by discrete zone monitoring tests in the Spring.

USGS



NATIONAL FISH HATCHERY
AND RESEARCH STATION
St. Bartholomew Ch
Leetown
Run
Balch
Tabb
Blue
Gray
Link
Bell
Cem
Quarry
Orr
OCc
Os
Om
Oc
On
12
26
29b29
21b32
31
21
18b18
17b17
10
40
40b
37
33.033
16
30
38
578
556
540
500
600
551

Preliminary Findings of Drilling Phase of Project

- Locating potential high yielding wells was easier than originally anticipated.
- There is good correlation between well yield and discharge areas, geologic structure, and locations of faults.
- Surface geophysical surveys show great promise as a potential prospecting tool and high conductivity zones correlate with geologic structure and faults

U. S. Geological Survey

12201 Sunrise Valley Drive
Reston, Virginia 20192

MT Data for: leetown

by

Herbert A. Pierce
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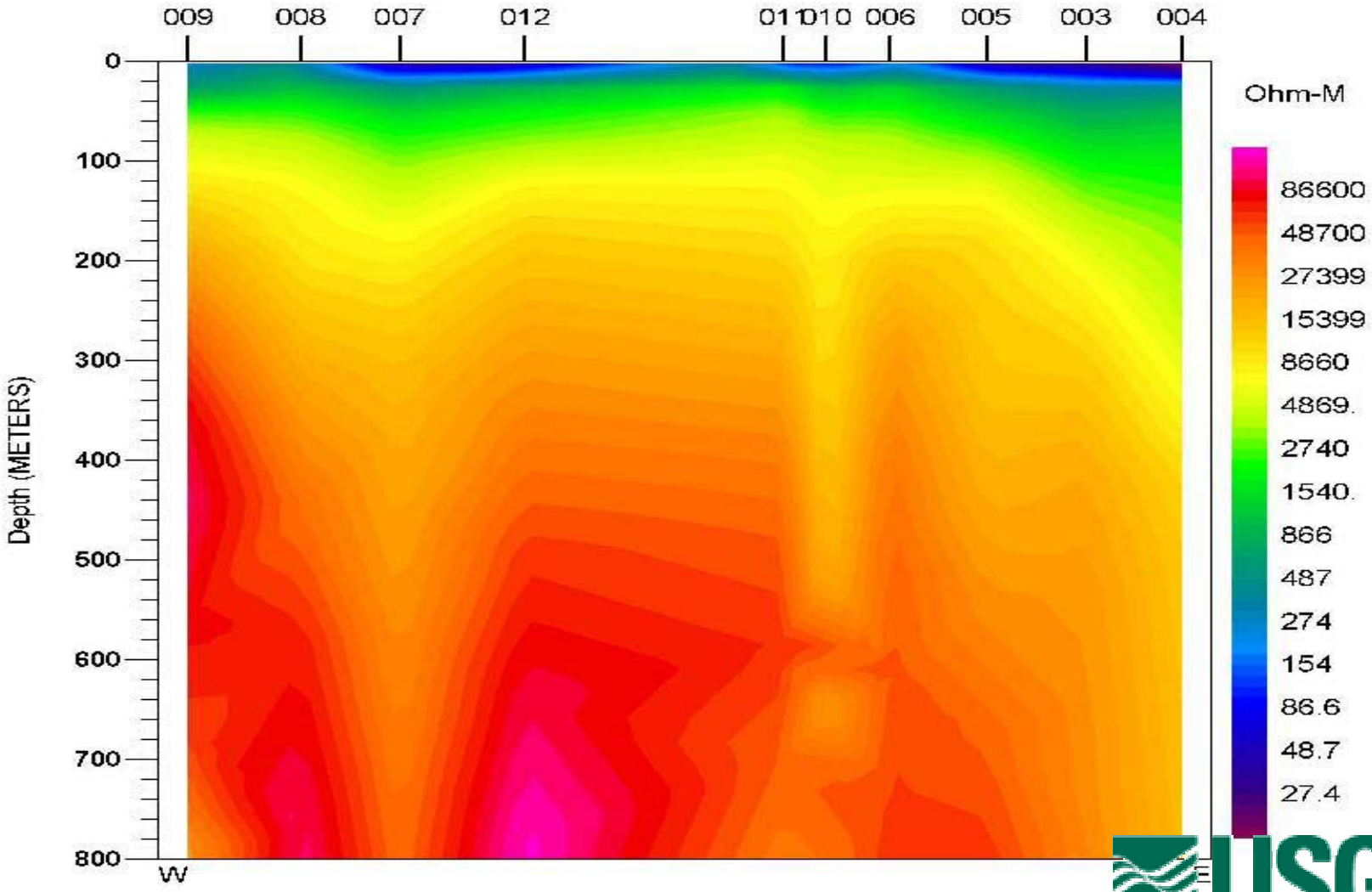


Preliminary Findings of Drilling Phase of Project - Continued

- Upper portion of aquifer is highly permeable, filled with solution voids, and has the capacity yield large quantities of water.
- This zone is characterized by large solution voids, many of which are clay filled.
- Water quality of these zones would likely be subject to contamination and may have problems with turbidity.

USGS

Preliminary Findings of Drilling Phase of Project - Continued

- Of 9 deep wells drilled, 2 could be expected to yield in excess of 100 gpm, 2 had estimated yields of 300 gpm, and 1 which was completed in a cave may yield in excess of 300 gpm.
- The remaining 4 wells drilled had yields of 6, 37, 20, and 18 gpm. These wells were drilled to characterize the typical setting and not the higher permeability conduit setting.

USGS

Preliminary Findings of Drilling Phase of Project - Continued

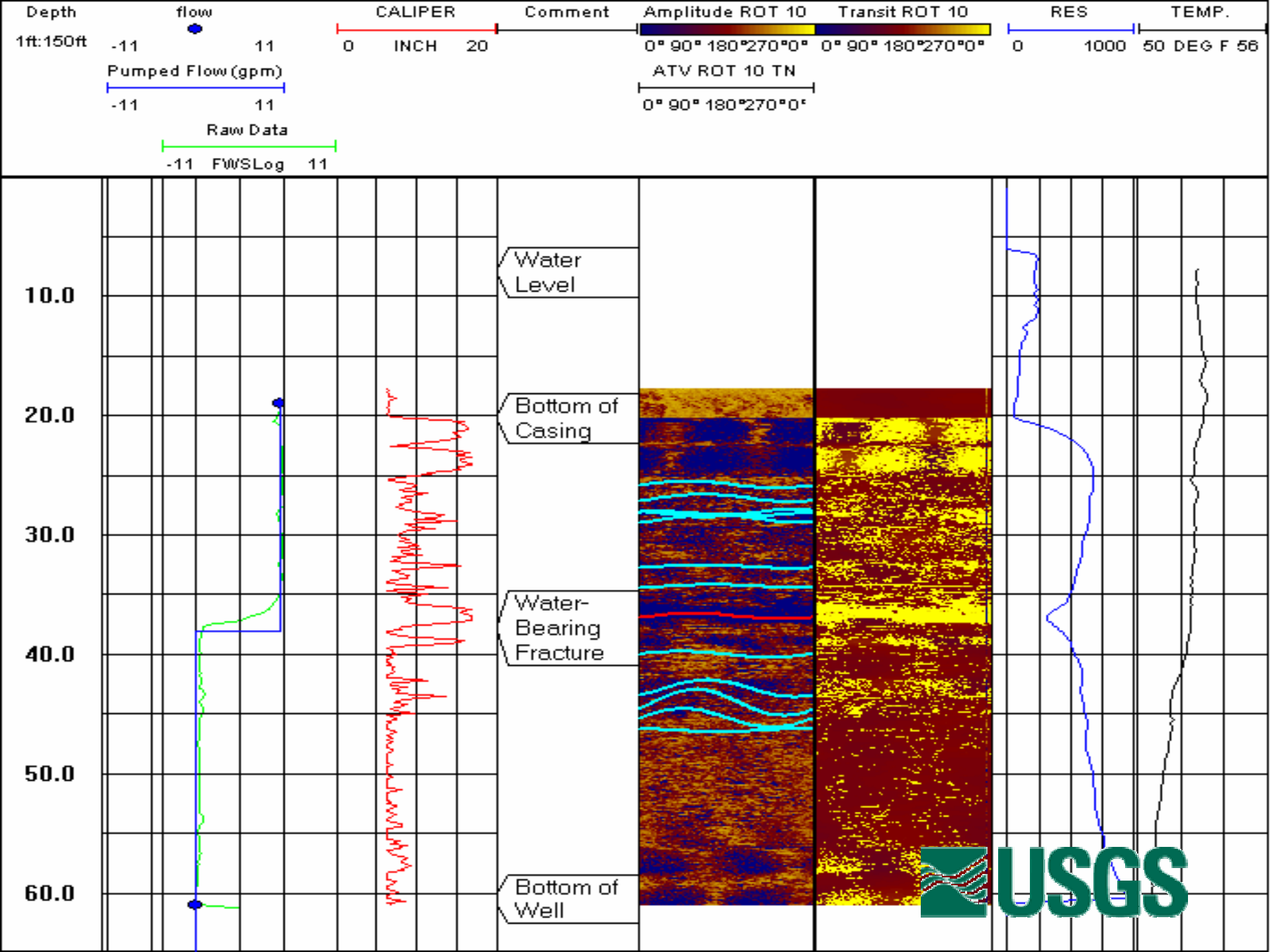
- As was expected, both conduit and diffuse aquifer settings were identified.
- The large synclinal structure in the upland area was intensely karstified and characterized by repeated solution voids to a depth of 160 feet + and appears to feed the wetland.
- The lowland area is also intensely karstified but is much more cavernous than the upland area. Water from this zone can be turbid.

USGS

Preliminary Findings of Drilling Phase of Project - Continued

- A well drilled on the fault at the USDA yielded up to 300 gpm of water as anticipated but did not have the turbidity problems that were common to the wells in the area. Unfortunately, bacterial contamination of the well is prevalent.
- A large 15 foot cavern was encountered when drilling the well at the softball field.
- Shallow piezometers drilled on the Tabb property had larger than average yields and may indicate a flow route to Gray Spring.

USGS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-11
11
Pumped Flow (gpm)
-11
11
Raw Data
-11 FWSLog 11
CALIPER
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Comment
Amplitude ROT 10
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Transit ROT 10
0° 90° 180° 270° 0°
ATV ROT 10 TN
0° 90° 180° 270° 0°
RES
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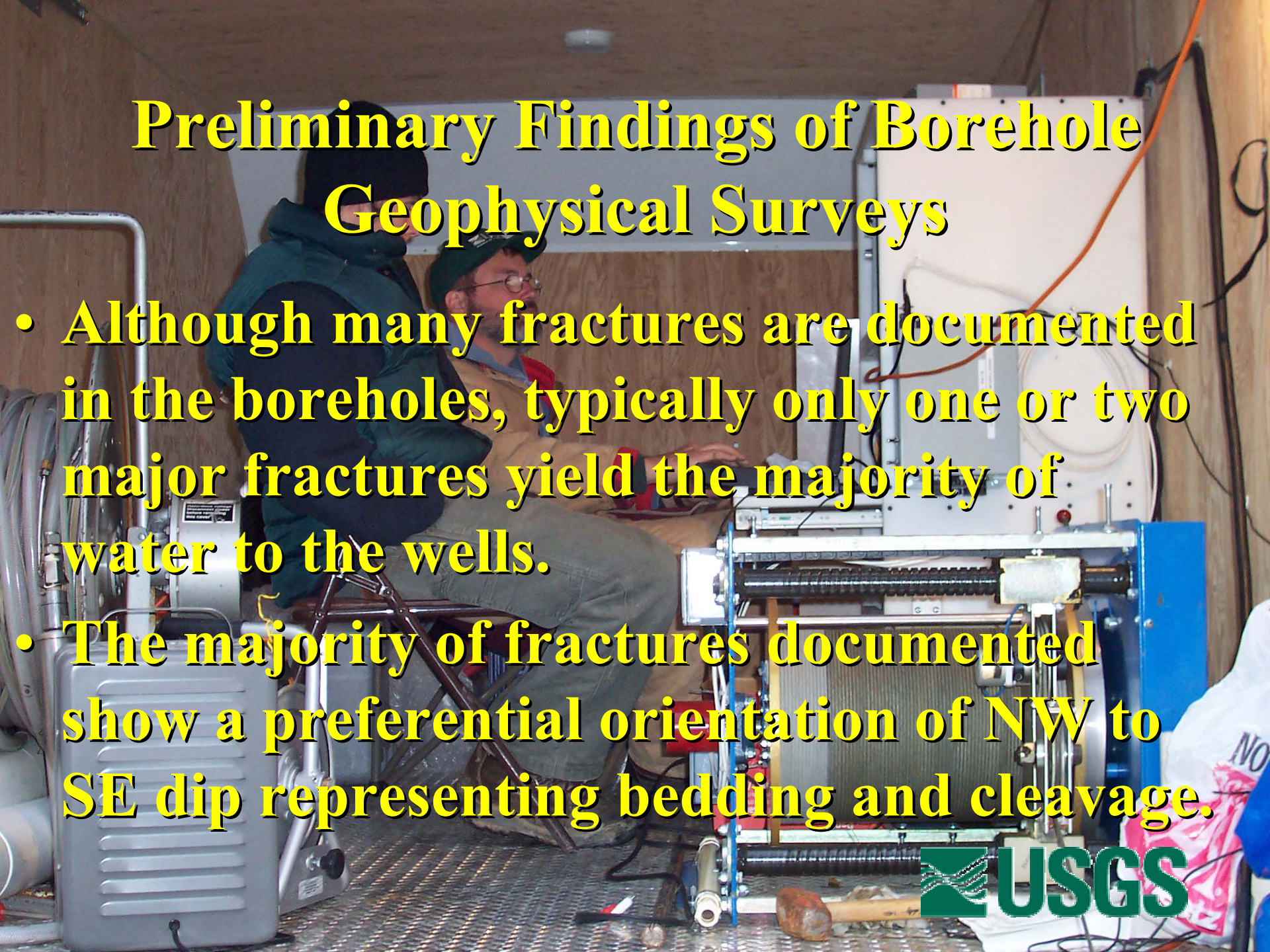
TEMP.
50 DEG F 56
10.0
20.0
30.0
40.0
50.0
60.0
Water Level
Bottom of Casing
Water-Bearing Fracture
Bottom of Well
USGS

Preliminary Findings of Borehole Geophysical Surveys

- Although many fractures are documented in the boreholes, typically only one or two major fractures yield the majority of water to the wells.
- The majority of fractures documented show a preferential orientation of NW to SE dip representing bedding and cleavage.



Preliminary Findings of Borehole Geophysical Surveys - Continued

- Dip of fractures typically range from 10^{O} to 75^{O} with a high density near 35^{O} to 65^{O}, a few vertical fractures also occur but are uncommon.
- Borehole deviation varies widely but NW to SE deviation is most common.
- The majority of water bearing fractures are in upper half of the borehole.

USGS

Preliminary Findings of Aquifer Tests

- Transmissivity ranges from less than 20 to 44,000 ft^2/day, median transmissivity is approximately 2,500 ft^2/day.
- Wells with higher transmissivity are located along faults or axes of synclines/anticlines.
- The highest transmissivity well was located at the intersection of a syncline and a cross fault.

USGS

Tasks Scheduled for FY 2004

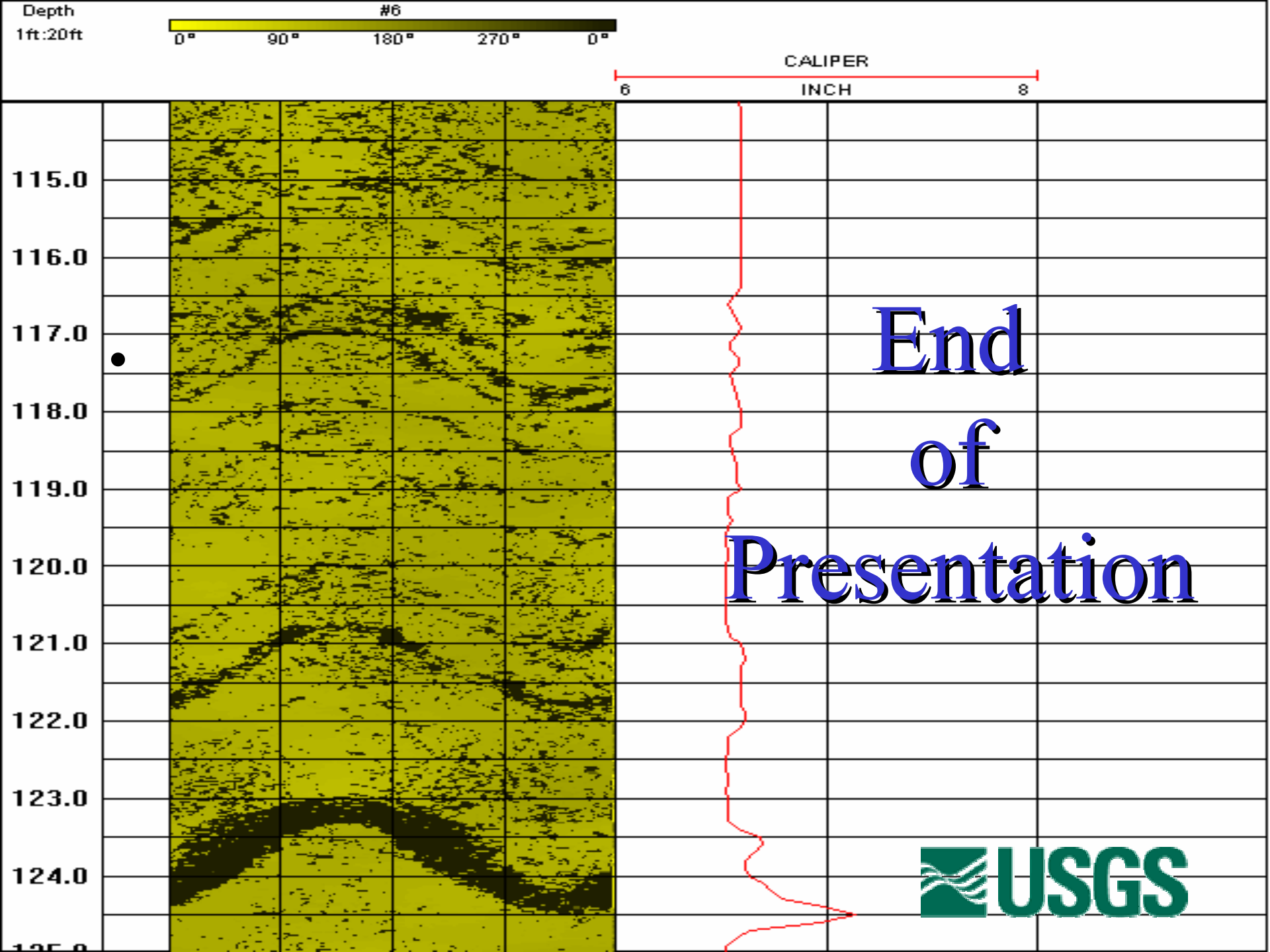
- Conduct additional surface geophysical and borehole geophysical surveys.
- Conduct short term and long term aquifer tests on Leetown wells to determine aquifer properties.
- Conduct an area wide well reconnaissance and measure water levels and conduct aquifer tests on selected wells in the Leetown area.
- Conduct water-quality sampling on selected wells and springs at the Leetown Science Center.
- Begin preparation of water-table map and ground-water flow model.

USGS

Tasks Scheduled for FY 2004 - Continued

- Begin short stream tracer tests to determine whether streams are losing water to the aquifer
- Begin ground-water tracer tests by injecting fluorescent dyes into sinkholes or fractures
- Conduct seepage runs to identify gaining and losing reaches of streams in the Leetown area

USGS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1ft:20ft
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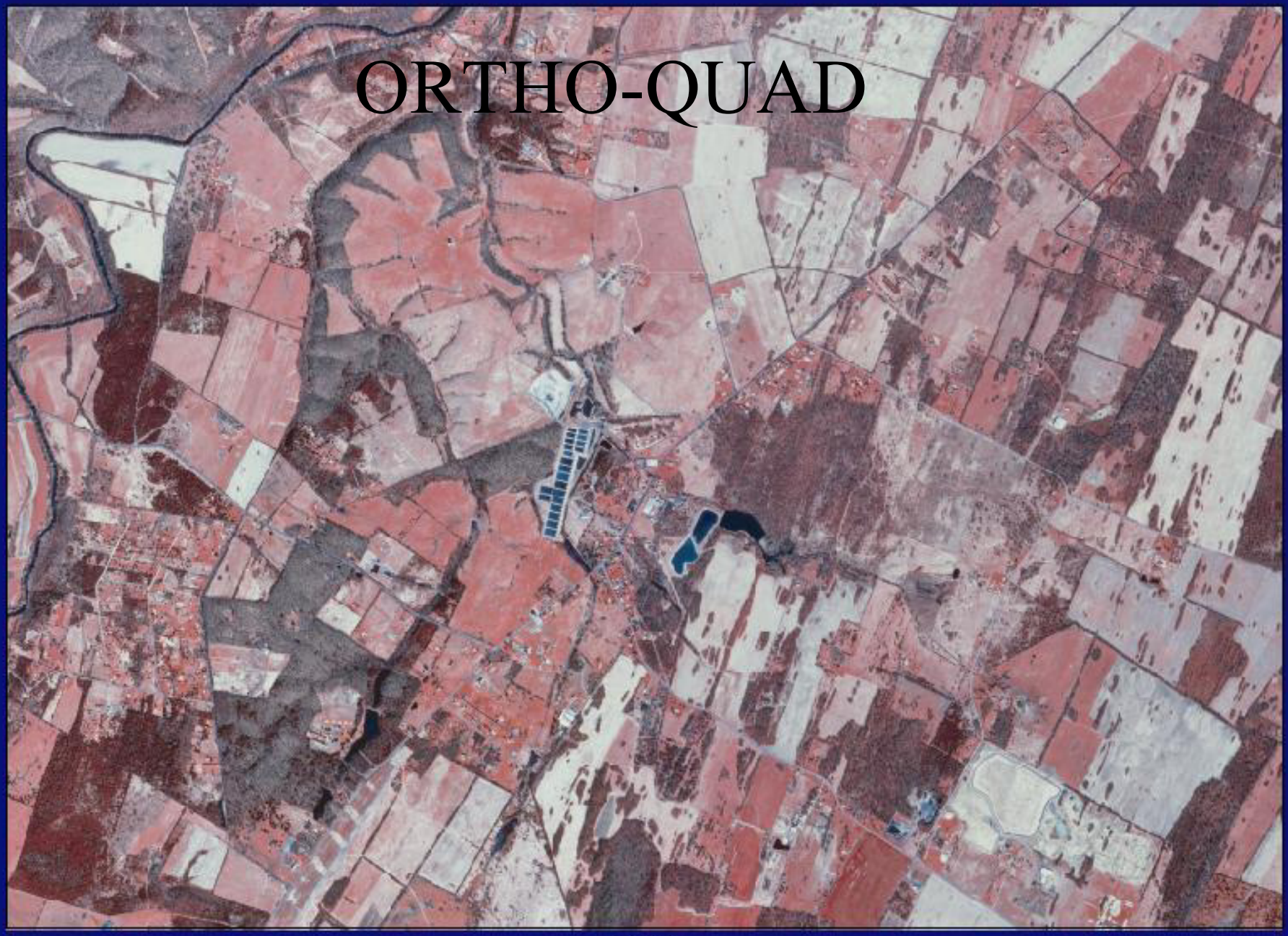
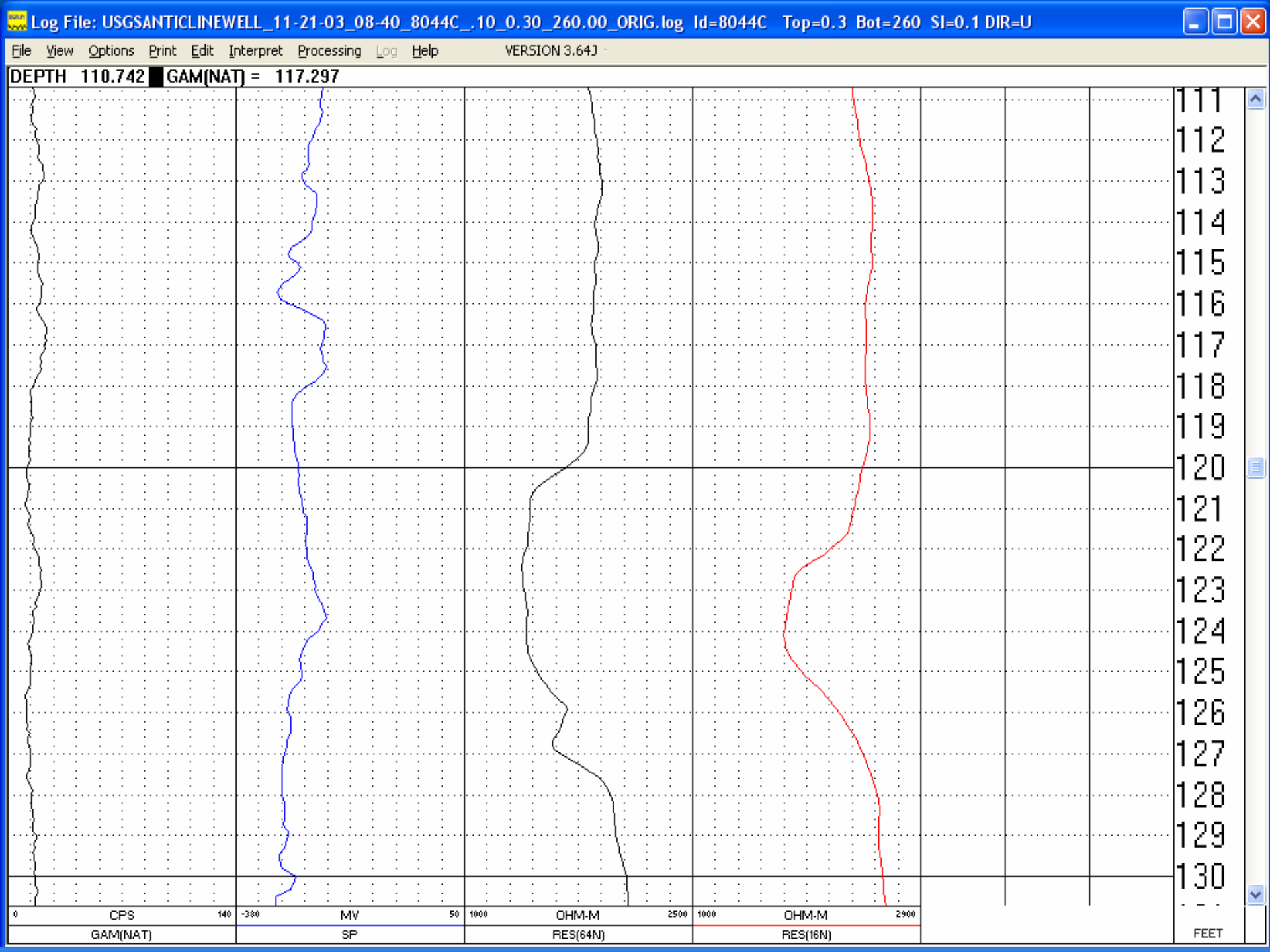
0°
90°
180°
270°
0°
CALIPER
6
INCH
8
115.0
116.0
117.0
118.0
119.0
120.0
121.0
122.0
123.0
124.0
End
of
Presentation
USGS

ORTHO-QUAD



1:24,000

Leetown Science Center and surrounding community- from 1:12,000 scale orthophoto quarter-quads, 1997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112
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SP
1000 OHM-M 2500
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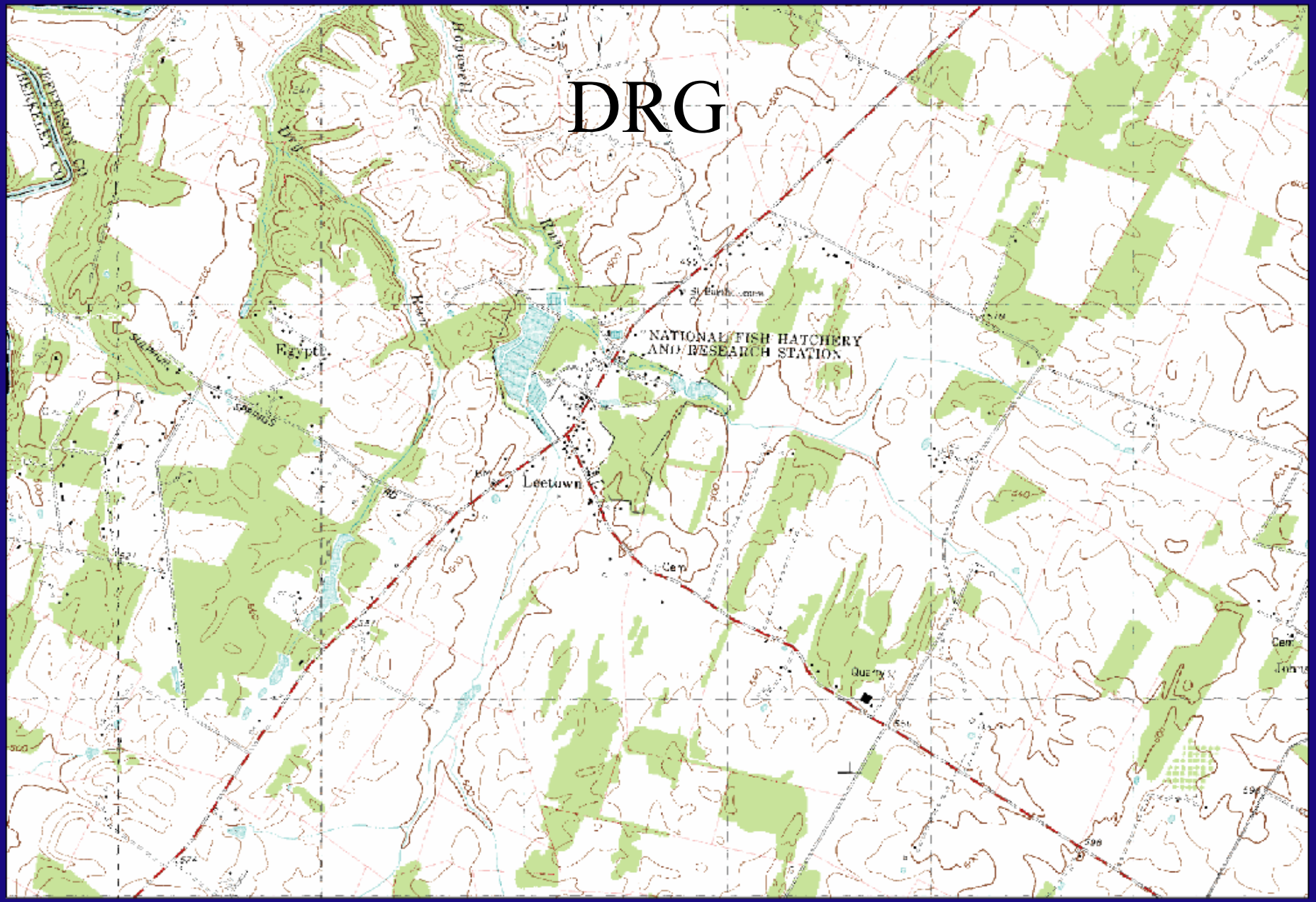
RES(16N)
FEET



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Leetown Science Center- quadrangle from 1978

Approach to Achieving Project Objectives

- FY 2003 – conduct Karst/geologic mapping, surface geophysical surveys, and install monitoring wells. FY 2004 – prepare geologic/Karst maps, conduct borehole geophysical surveys, analyze geophysical data, conduct short term/long term aquifer tests, conduct water sampling, FY2005 – Analyze water-quality/land use data, prepare water-table map/preliminary report. and develop ground-water flow model. FY 2006 – Prepare final report.

USGS