Divide Creek Area Joint Study Summary

Report prepared by The Walter Group

(To be finalized the week of 9/5/2011)

COGCC Presentation prepared for

Landowners and Garfield County 9/7/2011

Background

- The "*PHASE I HYDROGEOLOGIC CHARACTERIZATION OF THE MAMM CREEK FIELD AREA IN GARFIELD COUNTY*" prepared by URS for Board of County Commissioners Garfield County, March 13, 2006
  - includes a lineament diagram which was generated using indirect methods:
    - aerial photographs,
    - aeromagnetic anomolies,
    - topographic maps
- The lineaments presented in the figure were not verified in the field.

- The Lineaments and Geologic Structures figure from the Phase I Hydrogeologic report, presented in the next slide, is sometimes considered as being a map showing faults connecting one location to another. Technically, only one symbol on this diagram represents faults, which is the red line with triangles attached to it at intervals. The diagram also includes the Divide Creek Anticline axis. The teal (blue-green) lines are lineaments interpreted from aerial and satellite imagery. Identification of lineaments from satellite imagery or aerial photographs is a subjective exercise; what one person may interpret as a lineament, another equally qualified person may not.

- The remainder of the lines (purple, green, and pink) represent lineaments discerned from aeromagnetic anomalies. By definition, a lineament is a linear topographical feature of regional extent that is believed to reflect crustal structure. "Aeromagnetic" pertains to observations made with an airborne magnetometer on a regional basis. An anomaly is a departure from the expected or normal. Thus, lineaments based on aeromagnetic anomalies are based on a change in the observations collected while flying over a wide area.

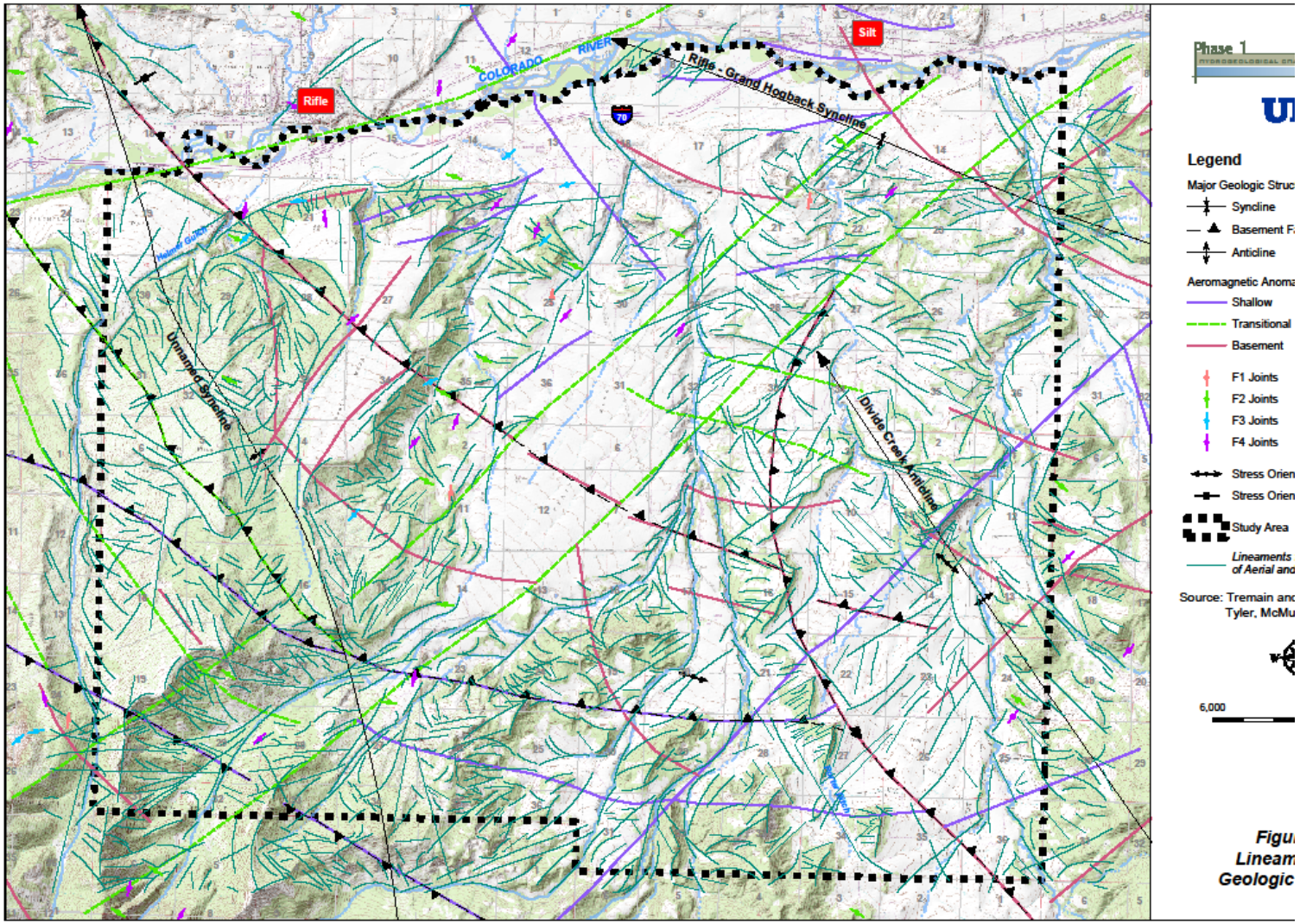
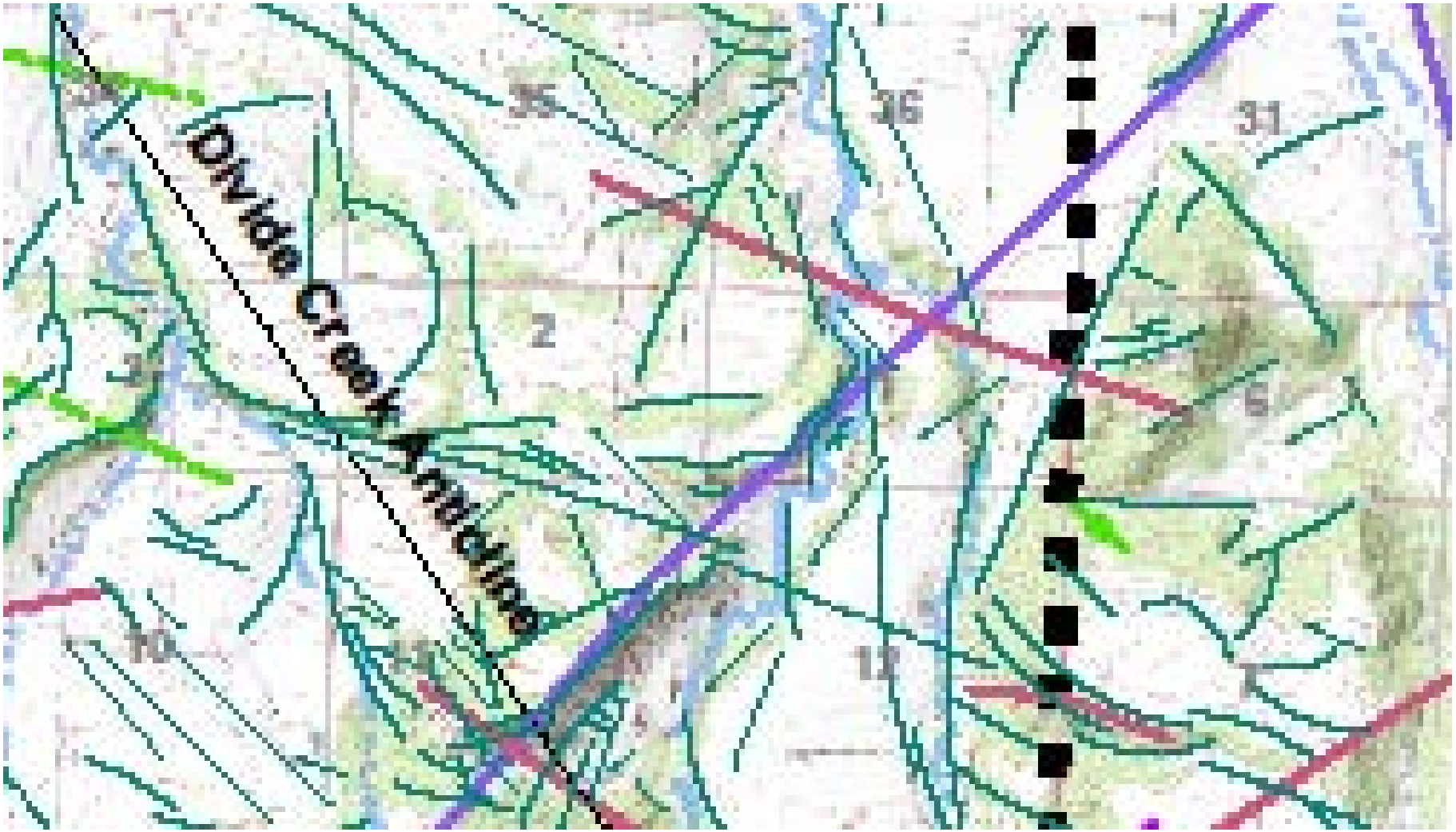


Figure from "PHASE I HYDROGEOLOGIC CHARACTERIZATION OF THE MAMM CREEK FIELD AREA IN GARFIELD COUNTY" prepared by URS for Board of County Commissioners Garfield County, March 13, 2006.

The next figure is an enlargement of the URS lineament diagram, covering the sections 34, 35, 36 of 6S92W, section 1, 2, 3, 10,11,12 of 7S92W, section 31 of 6S91W and sections 6 and 7 of 7S91W. This is generally the area surrounding and along the 6500 Road corridor.

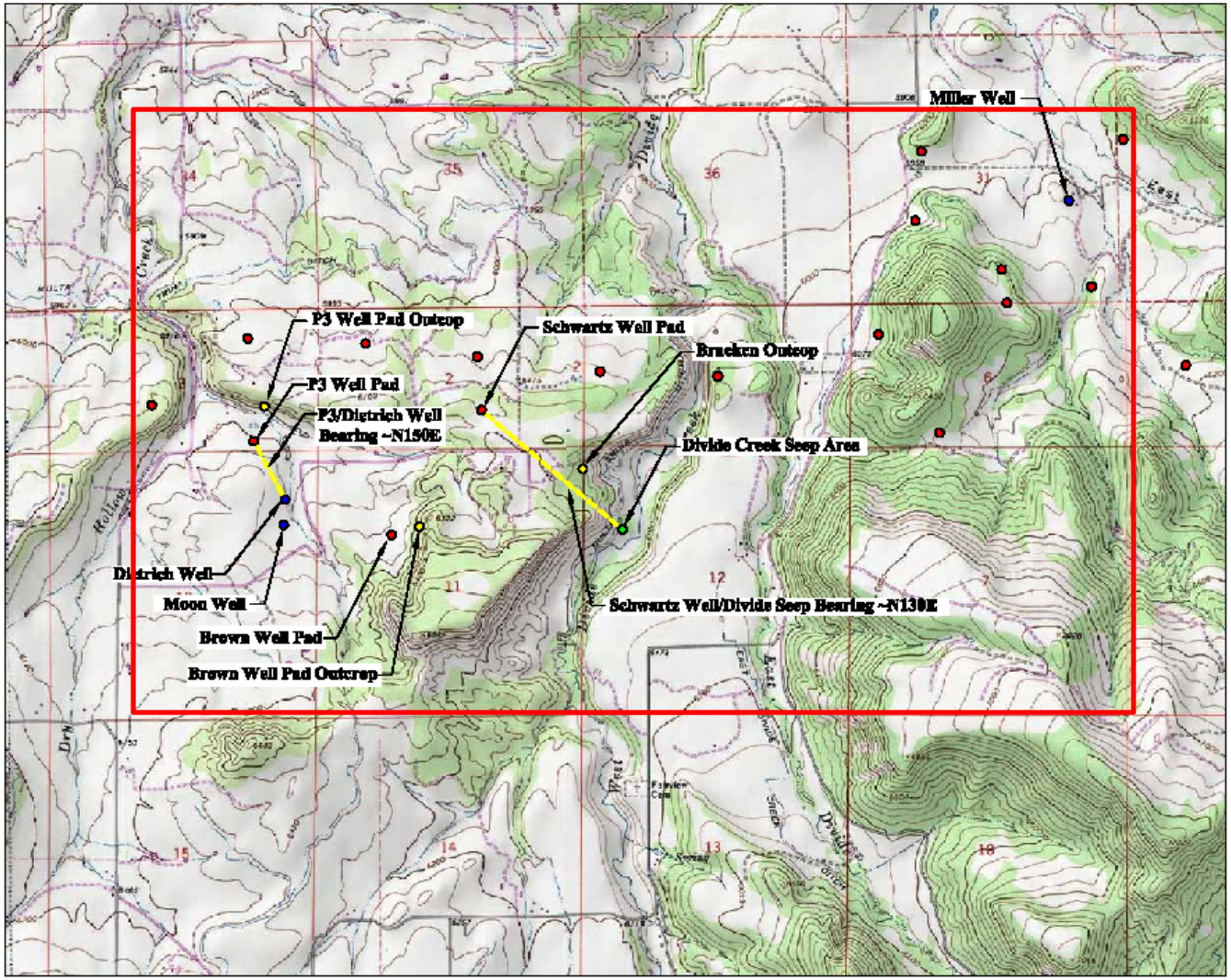
Note that none of the basement fault symbols fall within this area (the red lines with black triangles). This section does include aeromagnetic anomaly lines (purple, pink and blue) and the teal (blue-green) lineaments identified by URS from aerial and satellite imagery.



Enlargement of previous diagram in area of 6500 Road area

2010-2011 Walter Group Field Study:

- Was initiated in Fall/Winter 2010-2011
- Focused on the area, basically the area including and surrounding the 6500 Road Corridor. Well names are pointed out for reference in this figure.
- Report titled *"Divide Creek Area Joint Study Summary Report, South of Silt, Colorado"* by Walter Environmental Group, Inc. is being finalized
- Will be placed in COGCC Website "Library", under "Piceance Basin", "East Mamm Creek Area Investigation" by September 13th, 2011.



0 2,000

APPROXIMATE SCALE IN FEET

N

Explanation:

- Domestic Water Well Location
- Gas-Well Pad Location
- Gas Seep Location
- Outcrop Location

Data Sources:

USGS, Gibson Gulch Colo. Quadrangle; 1987.
USGS, Hunter Mesa Colo. Quadrangle; 1987.
COGCC Online Data; 2010.

WALTER ENVIRONMENTAL Group Inc.

P.O. Box 3967
Grand Junction, CO 81502
(970) 255-8017
(970) 255-8018 (fax)
www.TheWalterGroup.com

Study Area
Divide Creek Area Joint Study
South of Silt
Garfield County, Colorado

03/03/2011
Project No. 257-02-009

Figure 2

Walter Group Study

- The goal of this study were:
  - To measure rock outcrops in the field and identify the orientation of fractures and joint sets
  - To evaluate the orientation of these joint sets
    - Relative to lineaments
    - Relative to the spatial relationship between impacted domestic water wells and natural-gas wells in the study area

Procedure

- The Walter Group visited outcrops in the study area, and recorded strike and dip measurements of the visible joints (the surface of a fracture or parting in a rock without displacement) in undisturbed bedrock.

- The next photo shows a an outcrop with a Brunton compass oriented parallel to the face of a nearly-vertical joint. Brunton compasses are used to measure magnetic bearings of linear features.


11/11/2010

Outcrops

- Accessible, visible rock outcrops within the study area were measured in the same manner. The next photo is of an exposed joint face north of the Arbaney (P3) well pad.


11/11/2010

Joint sets

Next is a photo of joint sets. Note the brunton compass in the photo.

The gray housing of a Brunton compass is approximately 3 inches by 3 inches, for scale.

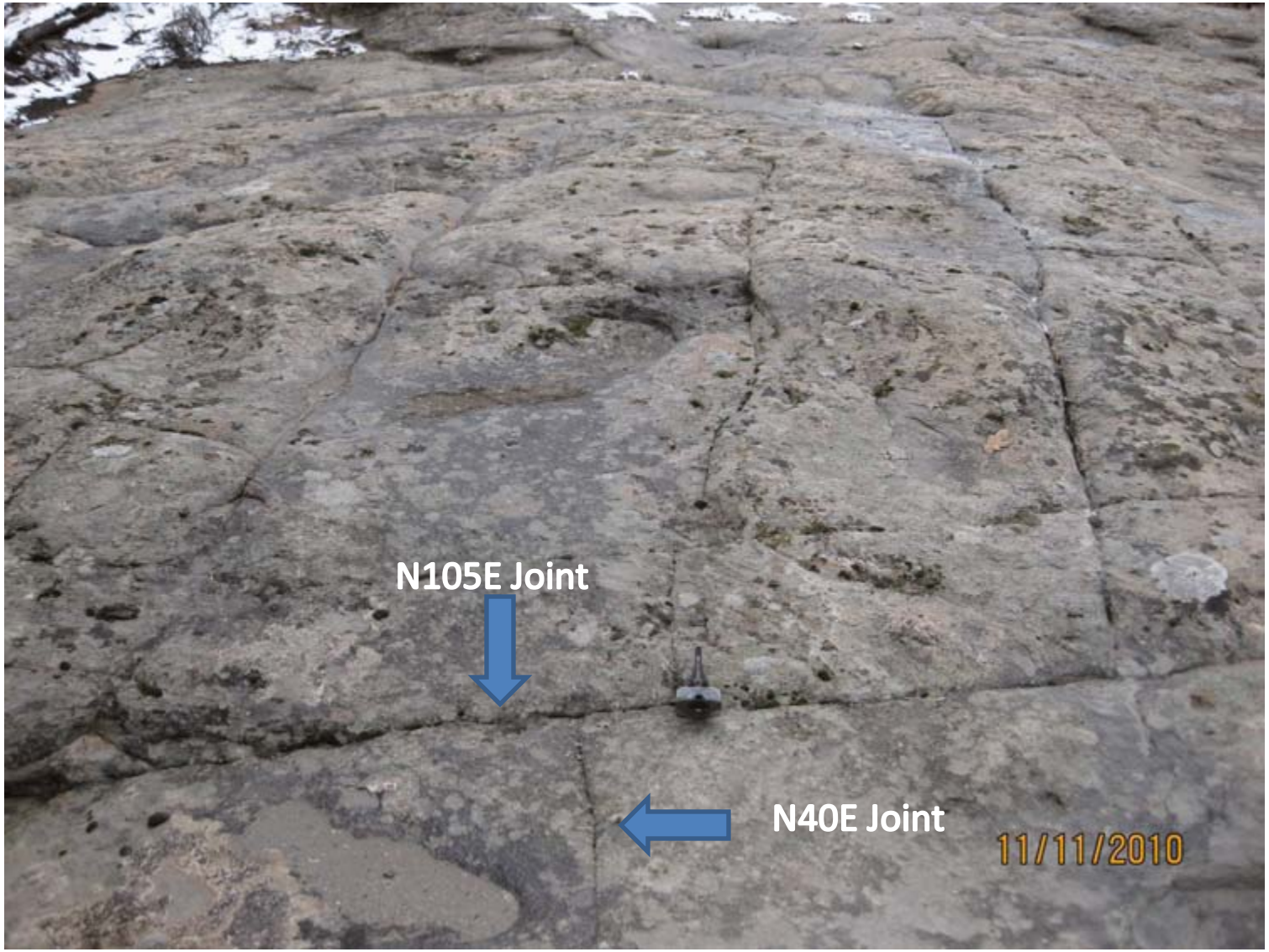
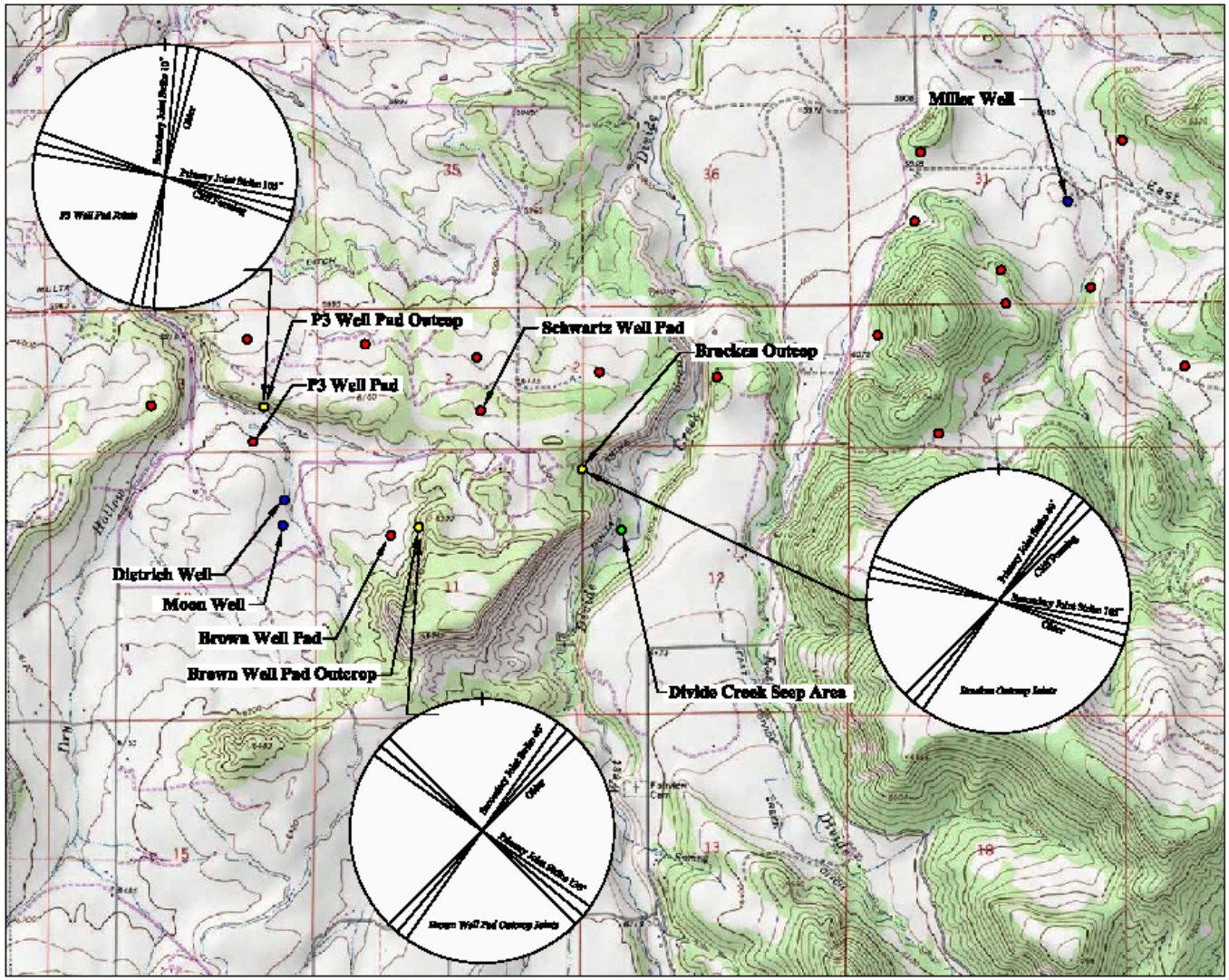

N105E Joint
N40E Joint
11/11/2010

Figure 3 (next slide)

- The next diagram shows the areas where Walter Group collected measurements at three exposed outcrops.
- The circular diagrams show the orientation of strikes and dips measured.
- There is a similarity in orientation of the measurements from all three outcrops.
- The similarity of the joint orientations to the exposed cliff faces in several instances indicates that the cliff faces are formed by erosion along the joint. Compare to the next figure.



0 2,000

APPROXIMATE SCALE IN FEET

Explanation:

- Domestic Water Well Location
- Gas-Well Pad Location
- Gas Seep Location
- Outcrop Location

Note:

Joint strikes are shown with 10 degrees of splay to enhance their appearance on the figure.

Data Sources:

USGS, Gibson Gulch Colo. Quadrangle; 1987.
USGS, Hunter Mesa Colo. Quadrangle; 1987.
COGCC Online Data; 2010.

WALTER ENVIRONMENTAL Group Inc.
P.O. Box 3967
Grand Junction, CO 81502
(970) 255-8017
(970) 255-8018 (fax)
www.TheWalterGroup.com

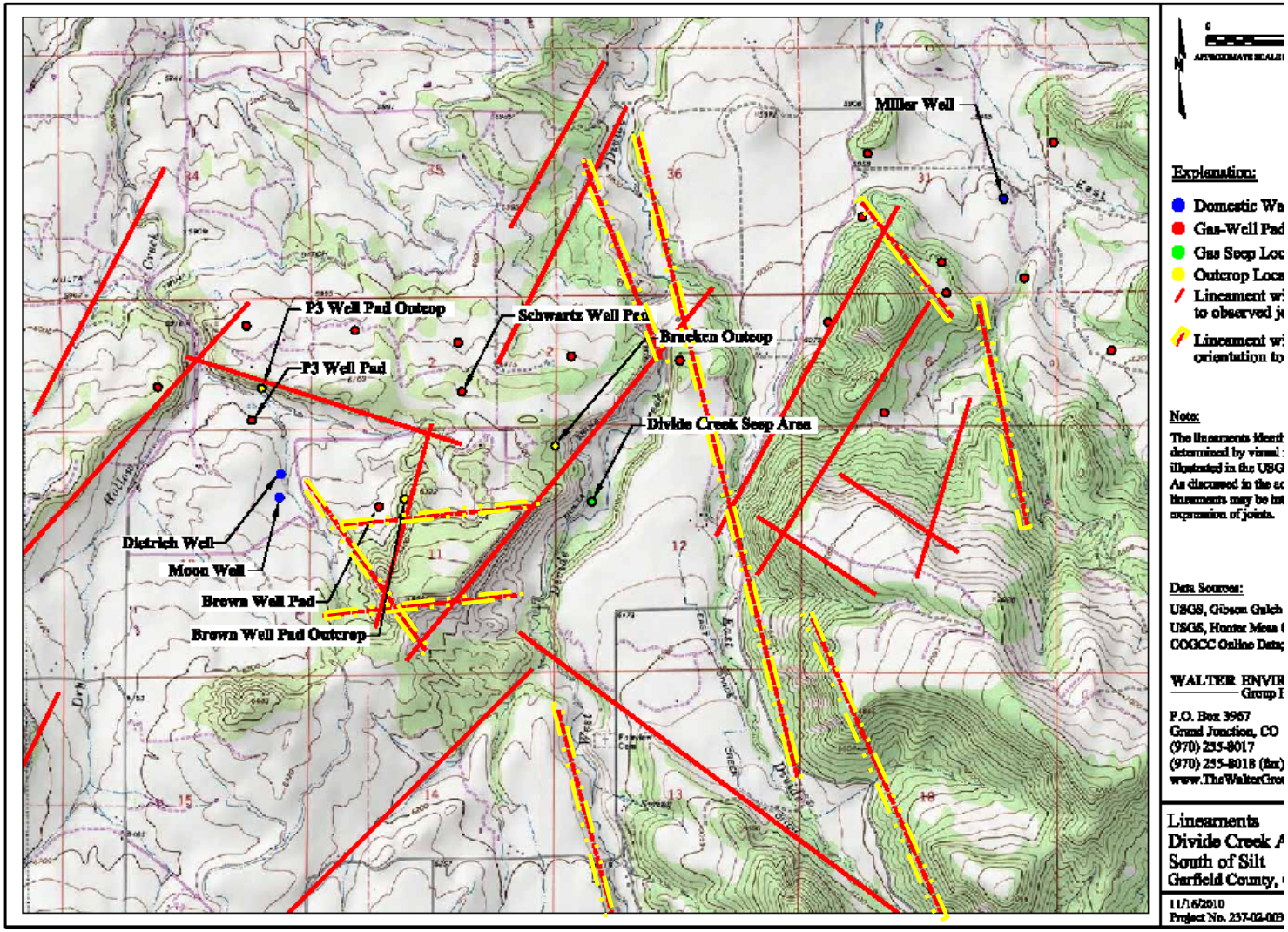
Joint Strike Measurements
Divide Creek Area Joint Study
South of Silt
Garfield County, Colorado

03/03/2011
Project No. 237-02-003

Figure 3

Figure 4 (next slide)

- The joint set orientations identified by the Walter Group Study were compared with lineaments identified by their review of aerial photos and topographical maps.
- Solid red lines in this diagram indicate lineaments that had a similar orientation to measured joint sets, and dashed red lines (outlined in yellow) indicate lineaments without similar orientation to measured joint sets.
- For the lineaments with similar orientation to a measured joint, this means that the lineament identifiable on a aerial photo or topographical map is likely the result of surface erosion along a joint.
- Non-associated lineaments may reflect subsurface changes in rock composition or other features.


Miller Well
P3 Well Pad Outcrop
Schwartz Well Pad
Bracken Outcrop
P3 Well Pad
Divide Creek Seep Area
Dietrich Well
Moon Well
Brown Well Pad
Brown Well Pad Outcrop
Explanation:
Domestic Wa
Gas-Well Pad
Gas Seep Loc
Outcrop Loca
Lineament wi
to observed j
Lineament wi
orientation to
Note:
The lineaments identi
determined by visual
illustrated in the USG
As discussed in the a
lineaments may be in
expression of joints.
Data Sources:
USGS, Gibson Gulch
USGS, Hunter Mesa
COGCC Online Data;
WALTER ENVIR
Group
P.O. Box 3967
Grand Junction, CO
(970) 255-8017
(970) 255-8018 (fax)
www.TheWalterGro
Lineaments
Divide Creek A
South of Silt
Garfield County,
11/16/2010
Project No. 257-02-00

Walter Group Conclusions

- The compass bearing between the Schwartz 2-15B Well and the West Divide Creek Seep is approximately N130E. This compass bearing coincides with the orientation of the secondary joint set observed in outcrop in the study area (N105E to N130E).
- The compass bearing between the P3 Pad wells and Dietrich (Moon area) water well is approximately N150E. This measurement does not coincide with the orientation of either joint sets observed in outcrop in the study area.

Overall Conclusions

- The overall conclusions of this study indicate:
  - that lineaments may or may not indicate or coincide with preferred pathways for gas migration in the subsurface.
  - aeromagnetic anomalies may or may not have a surface expression