

*Petroleum Exploration and Prospect
Generation, Geohazard Studies, Southwest US
Geology Courses and Field Trips*

P. O. Box 1470
Durango, Colorado 81302
Phone/fax (970) 259-1505
E-mail geostar20@aol.com

La Plata County 4M Monitoring Well Location Project

**Amended summary report of consulting work originally performed by Brame
GeoScience, LLC for the Colorado Oil and Gas Conservation Commission in
August, 2008 and amended in March, 2009**

Submitted to the Colorado Oil and Gas Conservation Commission March 19, 2009

Introduction

The 4M Project conducted by the Colorado Oil and Gas Conservation Commission (COGCC) is a continuation of the older 3M Project in the northern San Juan Basin of La Plata County, Colorado. These projects represent a continuous, decades-long effort to achieve a more comprehensive understanding of coal bed methane (CBM) and water production from the Fruitland Formation and the potential long term impacts of this production at the updip Fruitland Formation outcrop. This information is used to determine and regulate the proper density of Fruitland CBM wells downdip from the Fruitland outcrop.

The COGCC has proposed to drill five new monitoring wells at or near the Fruitland Formation outcrop in the latest phase of the 4M Project. These proposed well sites extend approximately fifteen miles along the Fruitland outcrop trend from south Durango, Colorado to the north and east (Fig. 1). The COGCC needed the following pre-drill geologic characterizations and estimates for each of these wells: 1) the estimated drill depth to the contact between the Fruitland Formation and the underlying Pictured Cliffs Sandstone, and 2) a geological cross section through this contact perpendicular to the Fruitland outcrop. Jeff Brame of Brame Geoscience, LLC was contracted to conduct a brief study of the area to provide this pre-drill geological information. This report presents the results of this study.

Project scope

The objective of this study is to provide certain pre-drill geological information pertaining to the five proposed 4M Project wells. This objective was accomplished through an integrated analysis of various geological data across the area with particular focus on COGCC website data and geological displays from COGCC hearing files. The results of this study will advise the COGCC in operations planning prior to the drilling of the wells.

Data sources

- 1) COGCC website
- 2) COGCC hearing files of Cause 112, Order 157
- 3) Colorado Geological Survey Open File report 00-18
- 4) 7.5" quadrangle geologic maps Durango East, Rules Hill and Ludwig Mountain
- 5) Geologic map of northern La Plata County, CO provided by COGCC
- 6) Previous work by Brame GeoScience, LLC

Displays

Figure 1: Project location map with proposed 4M well locations and project cross sections

Figure 2: Structure map top Pictured Cliffs Sandstone in northern San Juan Basin, La Plata Co., CO

Figure 3: Topographic location of proposed well 34-9-4-1

- Figure 4: Cross section A-A' through proposed well 34-9-4-1
Figure 5: Topographic location of proposed well 35-8-19-1
Figure 6: Cross section B-B' through proposed well 35-8-19-1
Figure 7: Topographic location of proposed well 35-8-15-1
Figure 8: Cross section C-C' through proposed well 35-8-15-1
Figure 9: Topographic location of proposed well 35-7-8-3
Figure 10: Cross section D-D' through proposed well 35-7-8-3
Figure 11: Topographic location of proposed well 35-7-15-1
Figure 12: Cross section E-E' through proposed well 35-7-15-1
Table 1: Proposed La Plata County 4M monitoring well locations

Methodology

The approximate latitude and longitude location for each well was provided by the COGCC. Using the map system on the COGCC website, these locations were plotted as accurately as possible in section, township and range on the base map. The Fruitland Formation-Pictured Cliffs Sandstone contact layer was added to the map and cross sections through each well were laid out perpendicular to this contact. Each cross section extended 4-5 miles downdip from this contact and included four wells (Fig. 1). The cross sections were scaled and stick versions of each well were placed on the cross sections with vertical placement reference coming from the ground level elevation of each well. Then the top Fruitland horizon and Fruitland-Pictured Cliffs contact were determined and placed on each well.

The elevation of the Fruitland-Pictured Cliffs contact at each proposed 4M well location was estimated by placing the well locations on the top Pictured Cliffs structure map from the COGCC hearing files (Fig 2). These elevation values are only approximate because the locations were placed on the map by hand measurement and the contours across this steeply dipping Pictured Cliffs are very close together. Then the ground level elevation for each proposed 4M well location was estimated after applying the topography layer to the base map. The topographic setting of each well location is shown in Figs. 3, 5, 7, 9, 11. Next the proposed project well bores were placed on the cross sections using as vertical reference the estimated elevations for ground level and Fruitland-Pictured Cliffs contact. The proposed well bores are shown with a projected total depth just into the Pictured Cliffs below the Fruitland.

Generalized surface topography was drawn on each cross section. Then the outcrop locations of both top Fruitland and Fruitland-Pictured Cliffs contact as determined from geologic maps were placed on the topographic profiles. Next the top Fruitland and Fruitland-Pictured Cliffs contact horizons were drawn on the cross sections from updip outcrop to downdip subsurface. Time did not allow delineation of the Kirtland Formation, Animas Formation or Quaternary alluvium stratigraphic units above the Fruitland, so these units are combined on the cross sections as Kirtland Formation-Cenozoic.

The described work flow allowed for the construction of reliable geologic cross sections (Figs 4, 6, 8, 10, 12) and for the estimation of drill depths to Fruitland-Pictured Cliffs contact (Table 1) for each proposed 4M well.

Discussion of Results

Surface locations, ground elevations and drill depths to the Fruitland-Pictured Cliffs contact were determined for each proposed 4M well (table 1). Dip oriented geological cross sections were constructed through each proposed well location (Figs 4, 6, 8, 10, 12). Pre-drill characterization results for each proposed 4M well location are briefly discussed below. All proposed wells will penetrate a steeply dipping section of Fruitland Formation, so the drilled thickness will be greater than the actual stratigraphic thickness of the formation.

34-9-4-1 well

Cross section A-A' (Fig. 4)

Location: SW ¼, section 4, T34N, R9W

Ground elevation: +6550'

Drill depth to Fruitland-PC contact: 550'

This well is located just updip of the Kirtland-Fruitland contact outcrop. It will start in the upper part of the Fruitland and should encounter all significant Fruitland coals.

35-8-19-1 well

Cross section B-B' (Fig. 6)

Location: NW ¼, section 19, T35N, R8W

Ground elevation: +7070'

Drill depth to Fruitland-PC contact: 770'

This well is located downdip of the Kirtland-Fruitland contact outcrop. It will drill a moderate thickness of Kirtland-Cenozoic and will penetrate a full thinner Fruitland section.

35-8-15-1 well

Cross section C-C' (Figure 8)

Location: NW ¼, section 15, T35N, R8W

Ground elevation: +7880'

Drill depth to Fruitland-PC contact: 980'

This well is located just downdip of the Kirtland-Fruitland contact outcrop. It will drill a thin Kirtland section and penetrate a full Fruitland section.

35-7-8-3 well

Cross section D-D' (Fig. 10)

Location: SW ¼, section 8, T35N, R7W

Ground elevation: +7520'

Drill depth to Fruitland-PC contact: 420'

This well is located just updip of the Kirtland-Fruitland contact outcrop. It will start in the upper part of the Fruitland and should encounter all significant Fruitland coals

35-7-15-1 well

Cross section E-E' (Fig. 12)

Location: NW ¼, section 15, T35N, R7W

Ground elevation: +7600'

Drill depth to Fruitland-PC contact: 400'

This well is located just updip of the Kirtland-Fruitland contact outcrop. It will start in the upper part of the Fruitland and should encounter all significant Fruitland coals

Limitations

This study was authorized by Karen Spray of the Colorado Oil and Gas Conservation Commission and the amended version was authorized by Steve Lindblom of the Colorado Oil and Gas Conservation Commission. The geologic work was performed in a scientific and competent manner. The findings and conclusions in this report represent the best reasoning and judgment of Brame GeoScience LLC personnel. No warranty or guarantee, expressed or implied, is included or intended in this report. Please contact us if you wish to discuss any aspect of this report or if we can be of further assistance.

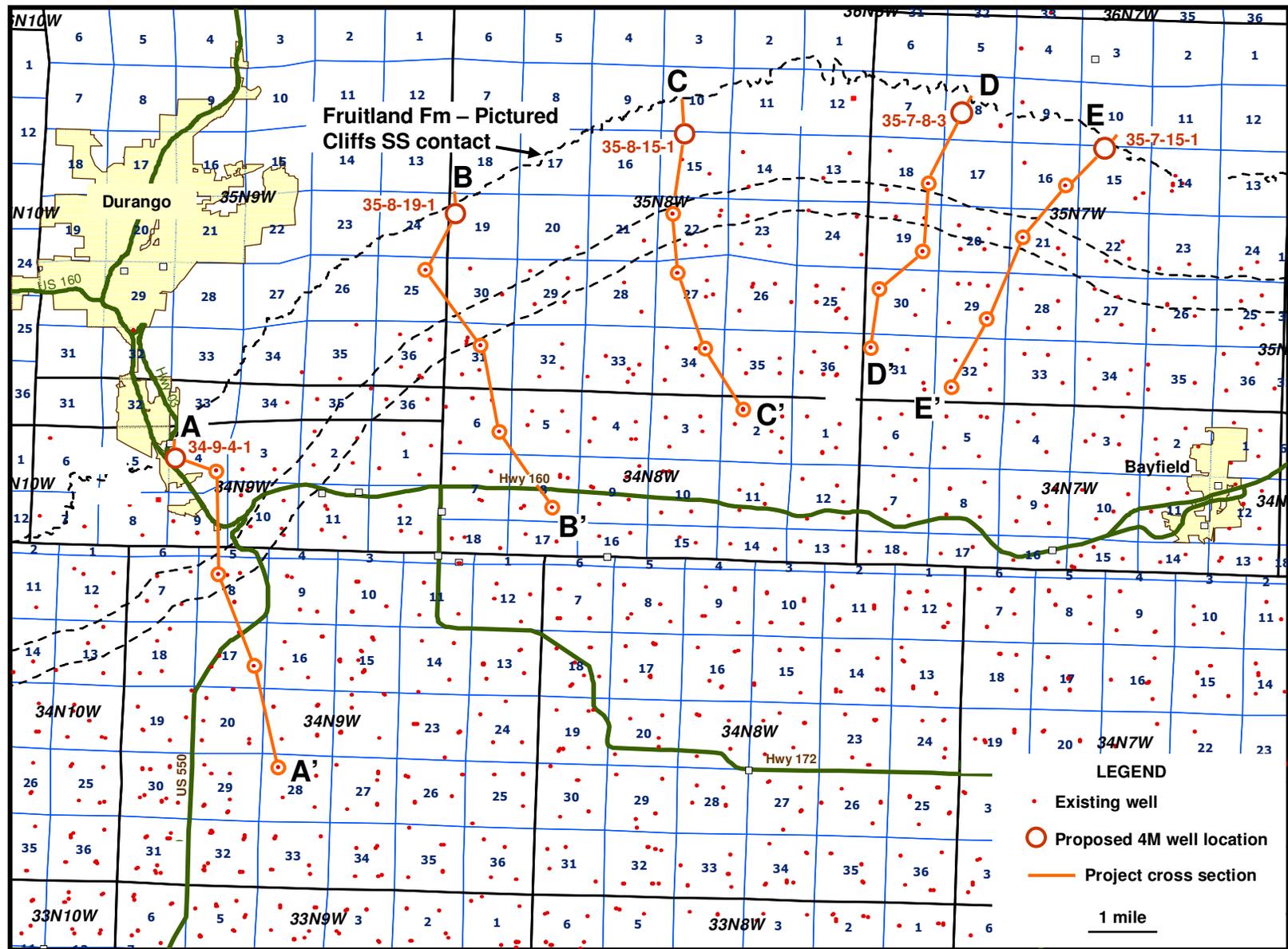


Figure 1: Project location map showing proposed 4M monitoring well locations and project cross sections

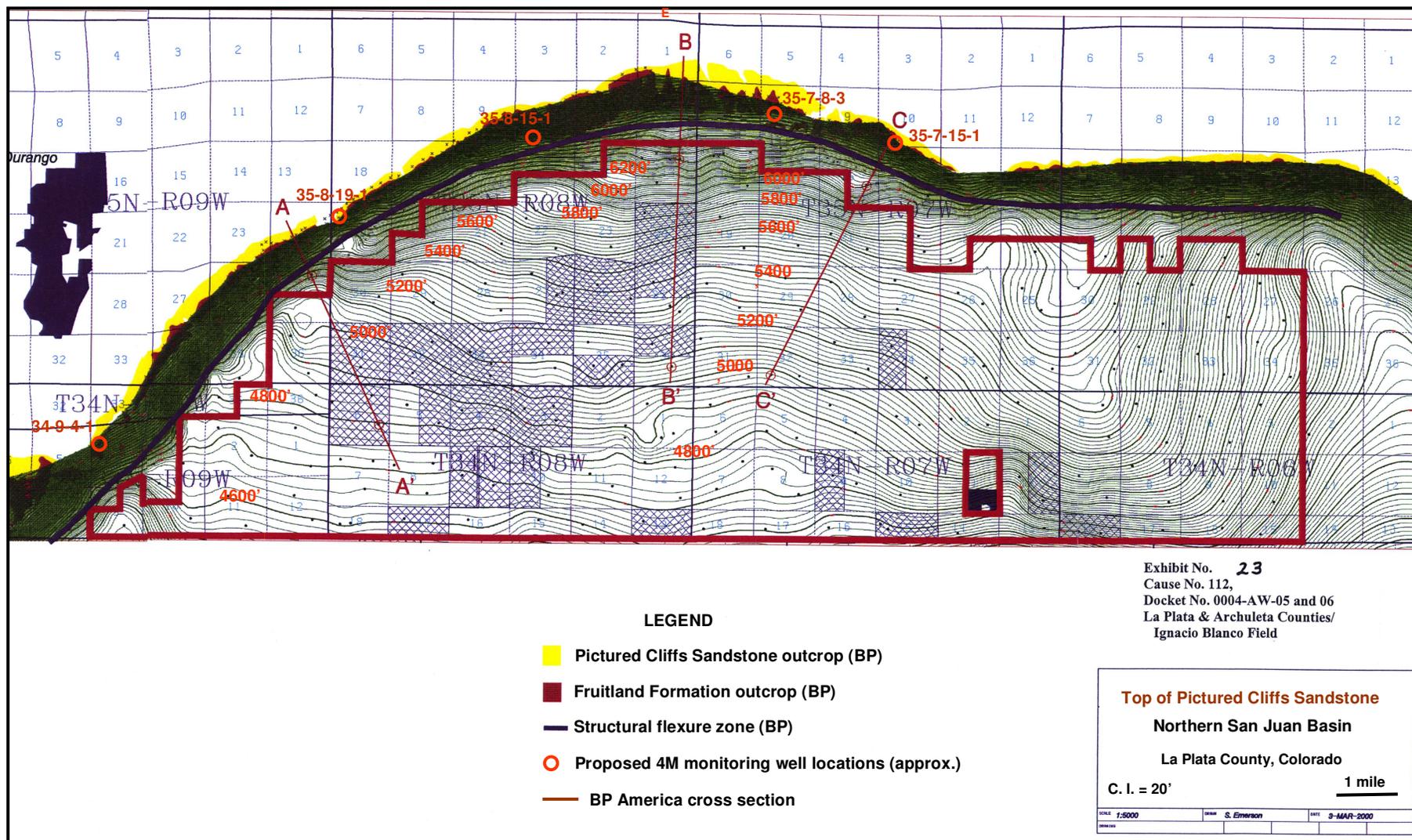


Figure. 2: Structure map on top of Pictured Cliffs Sandstone in northern San Juan Basin, La Plata County, Colorado with superimposed locations of proposed 4M monitoring wells. Modified from BP America map contained in the COGCC hearing files of Cause 112, Order 157

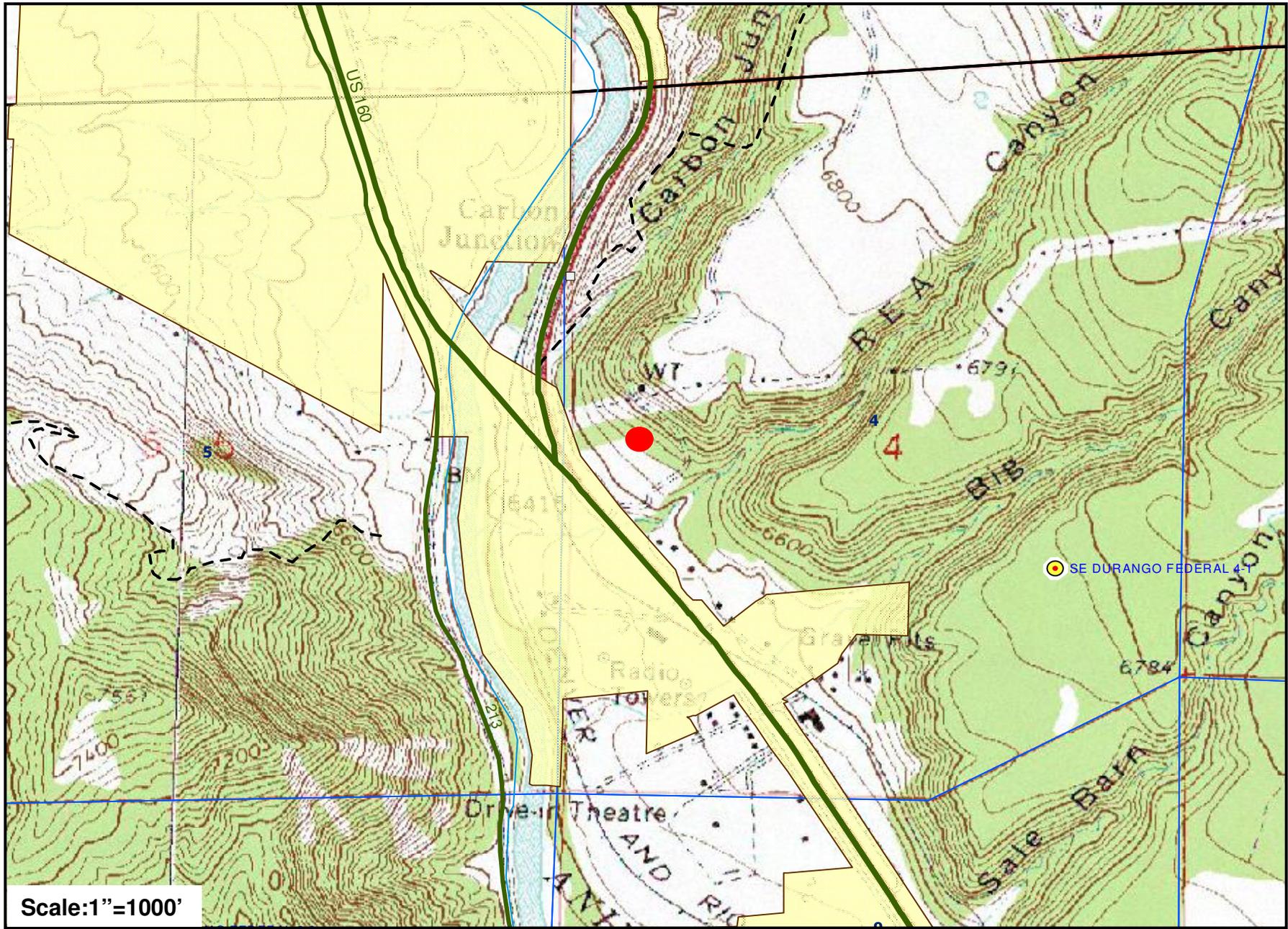
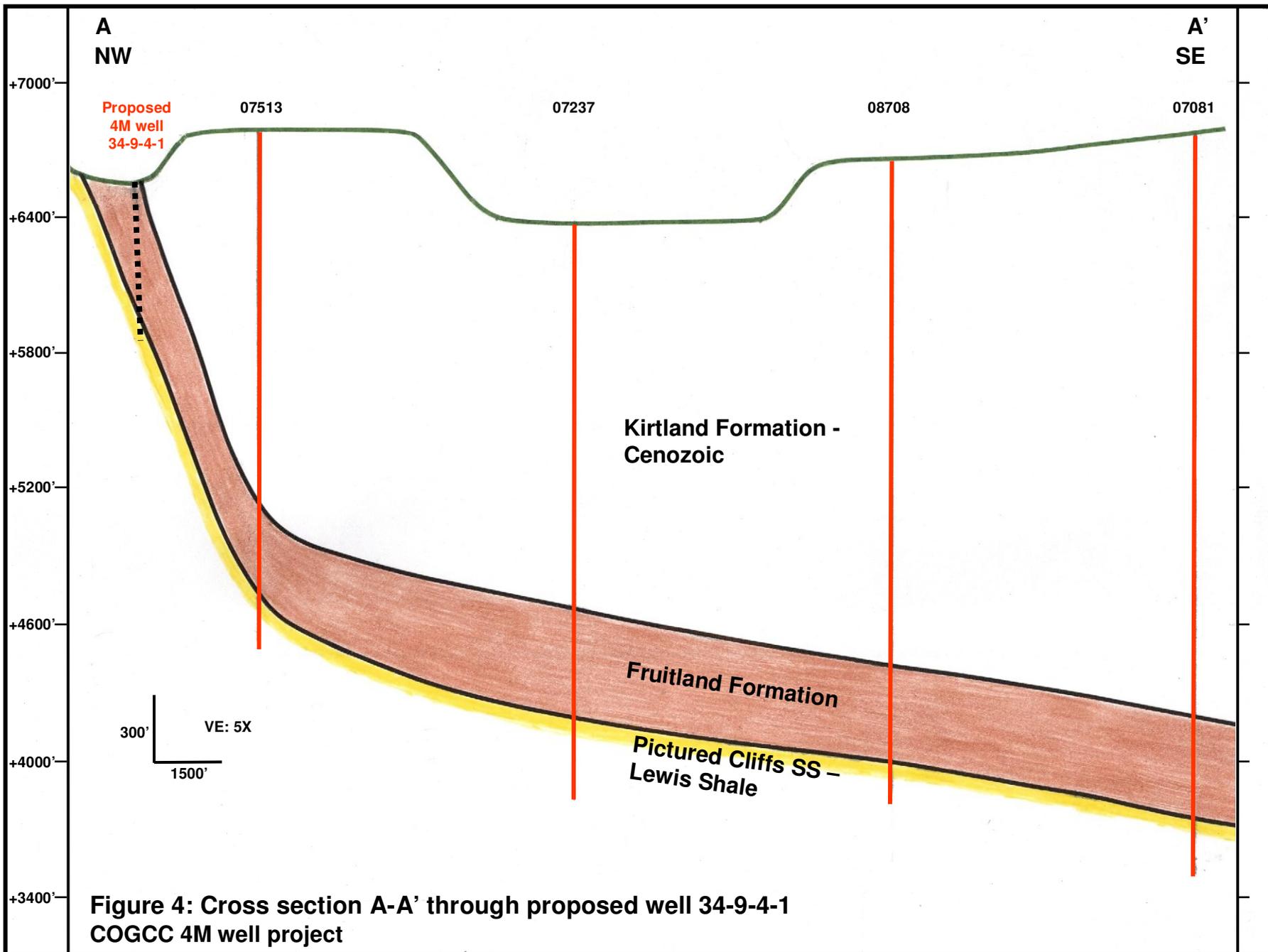


Figure 3: Topographic location of proposed well 34-9-4-1 (cross section A-A')



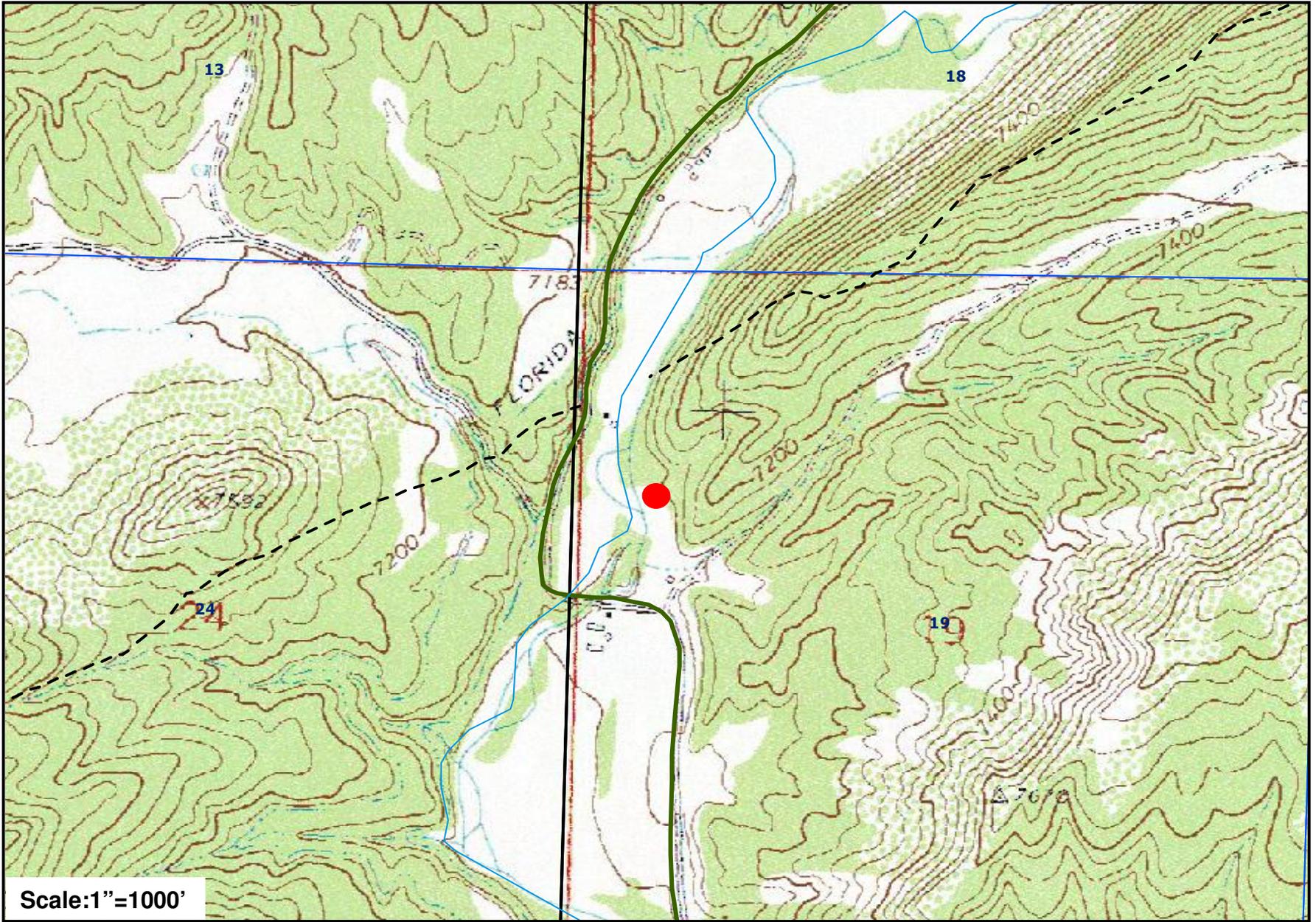
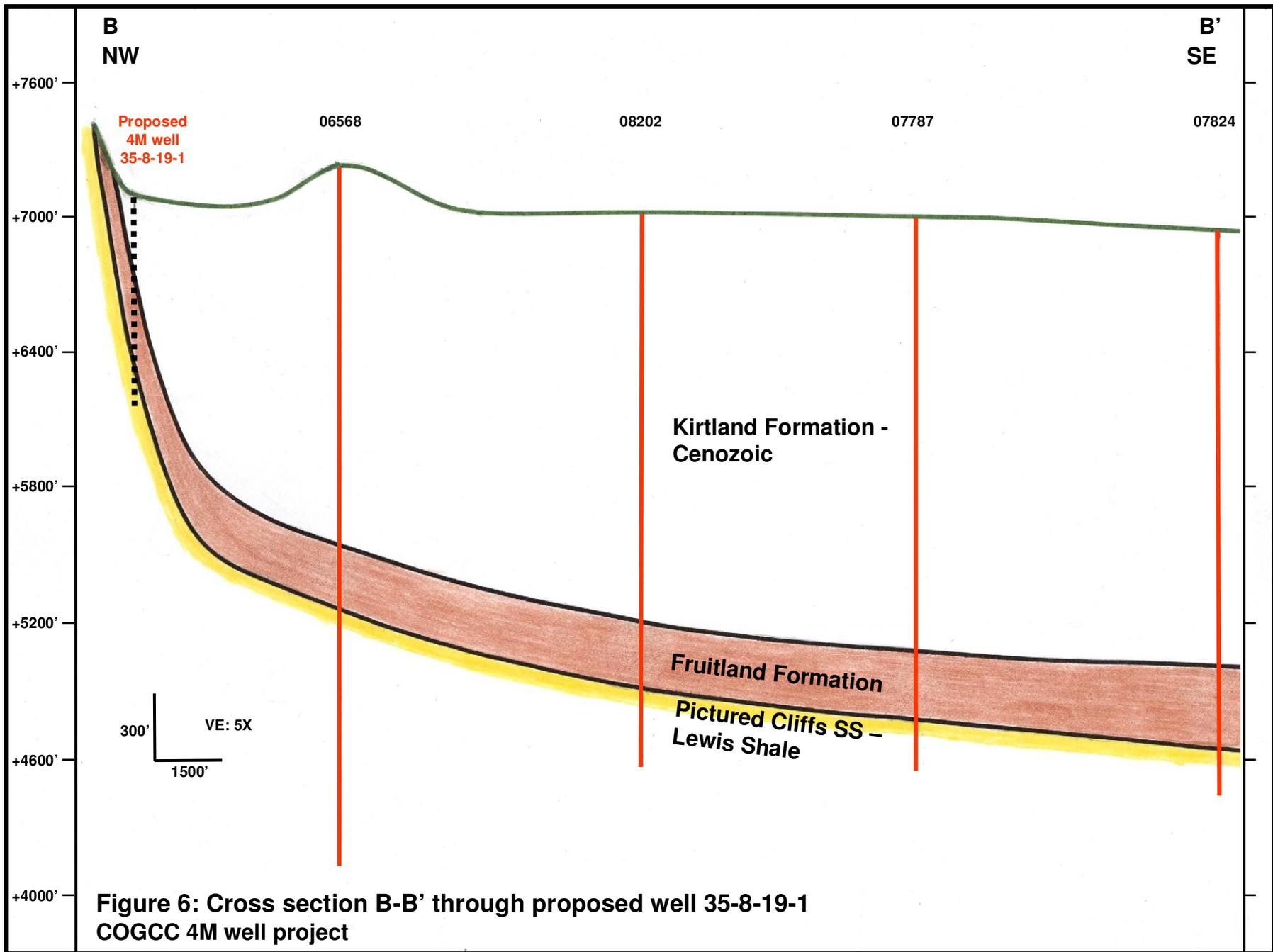


Figure 5: Topographic location of proposed well 35-8-19-1 (cross section B-B')



**Figure 6: Cross section B-B' through proposed well 35-8-19-1
COGCC 4M well project**

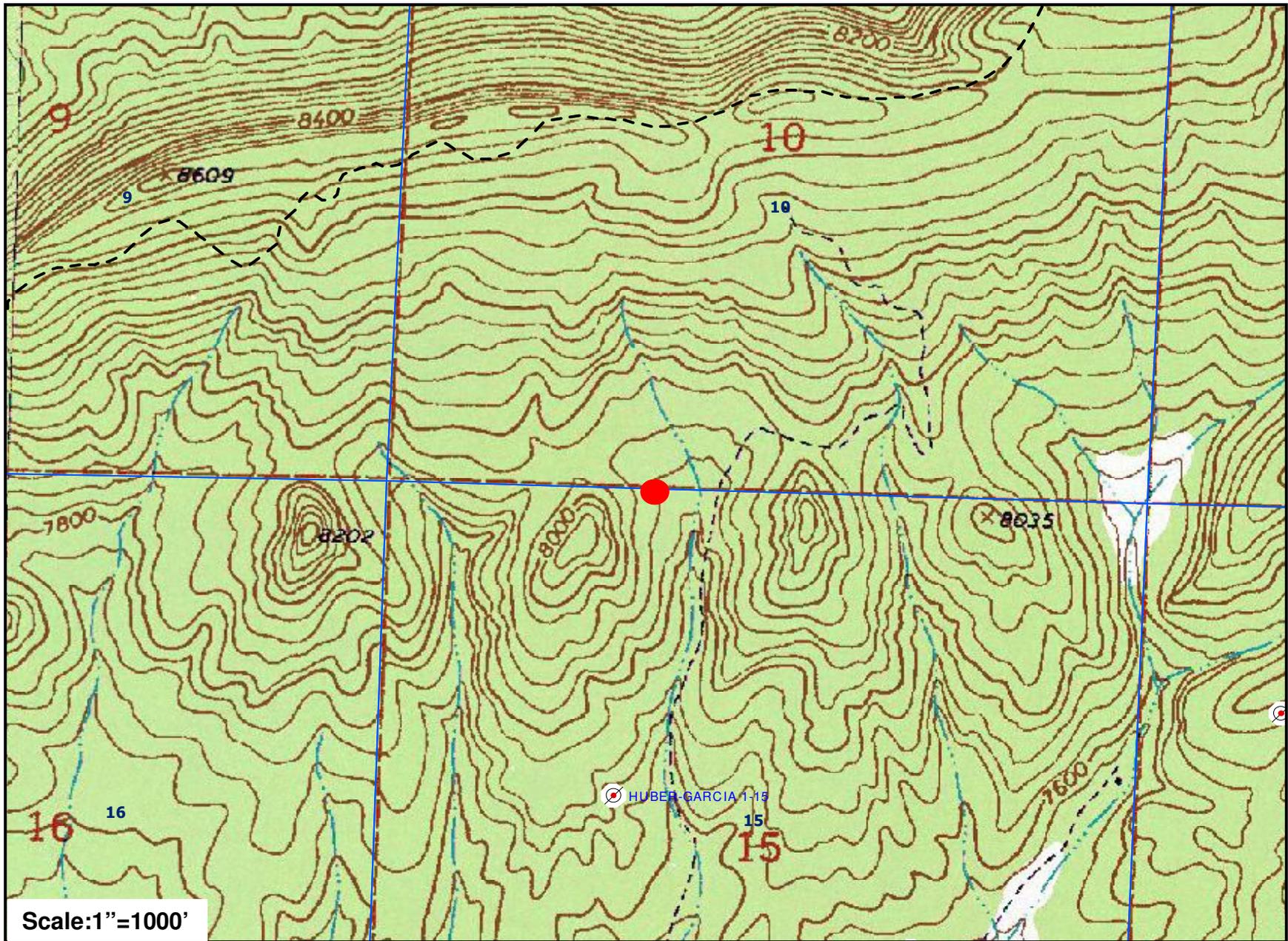
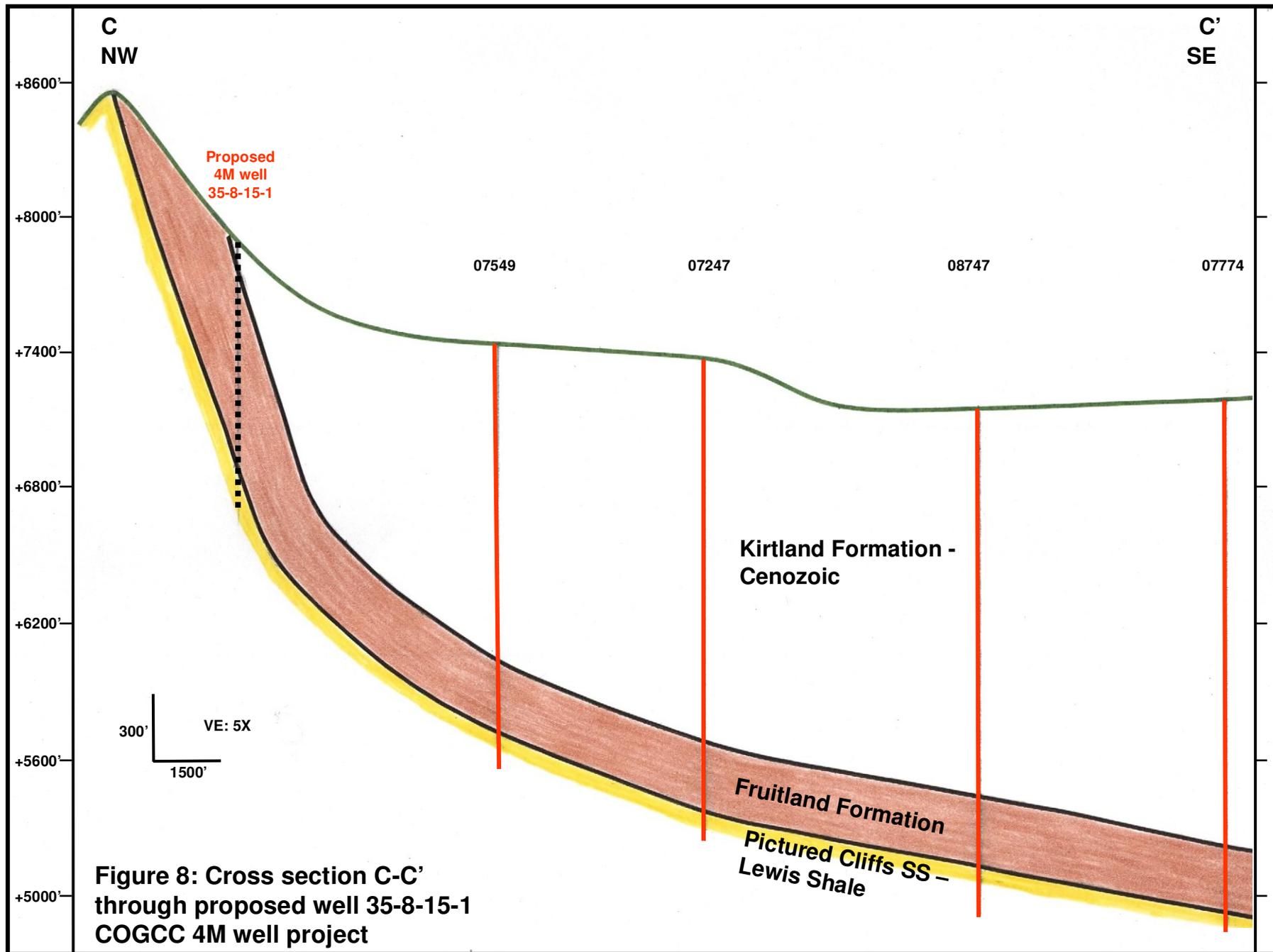


Figure 7: Topographic location of proposed well 35-8-15-1 (cross section C-C')



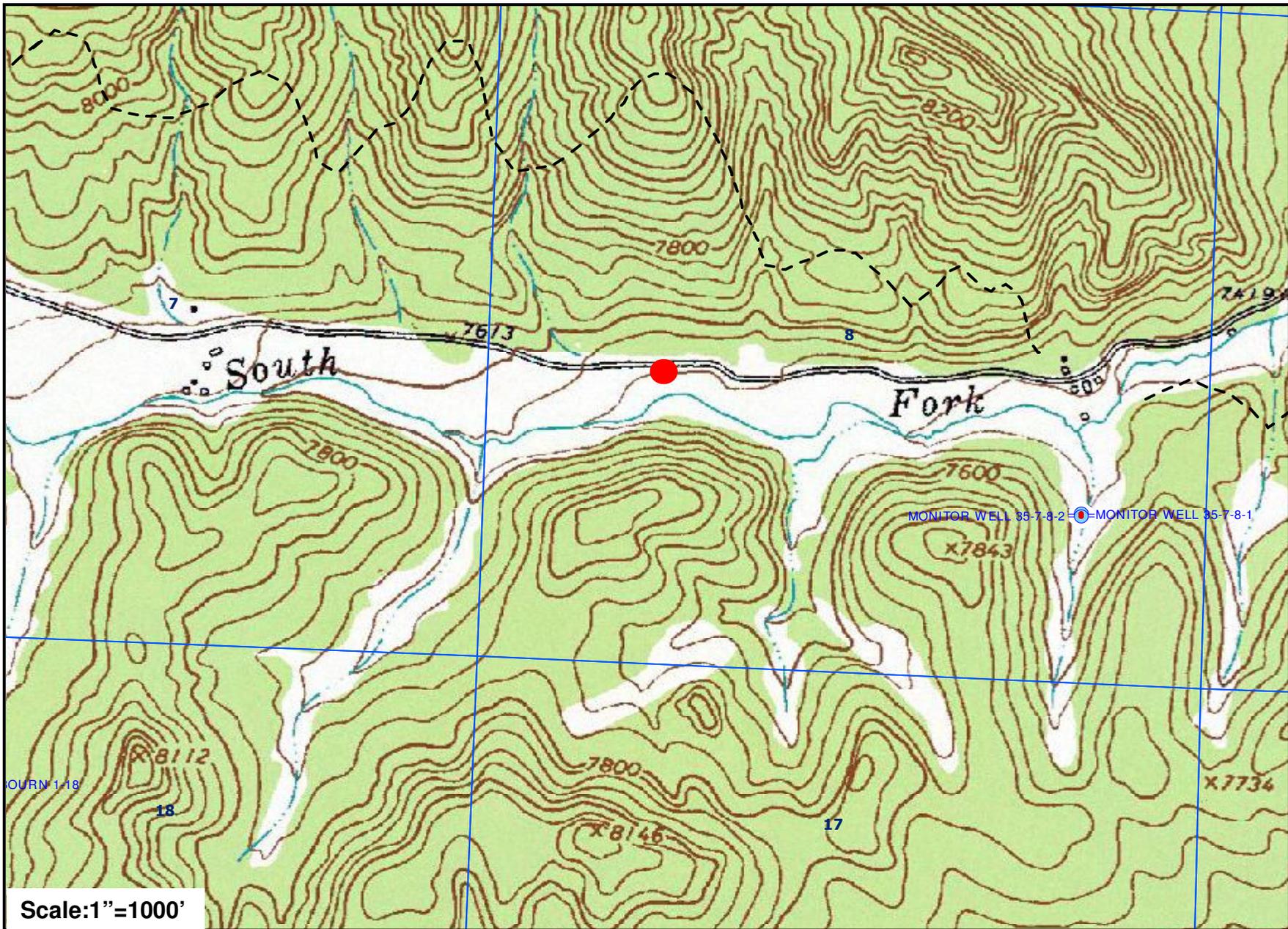
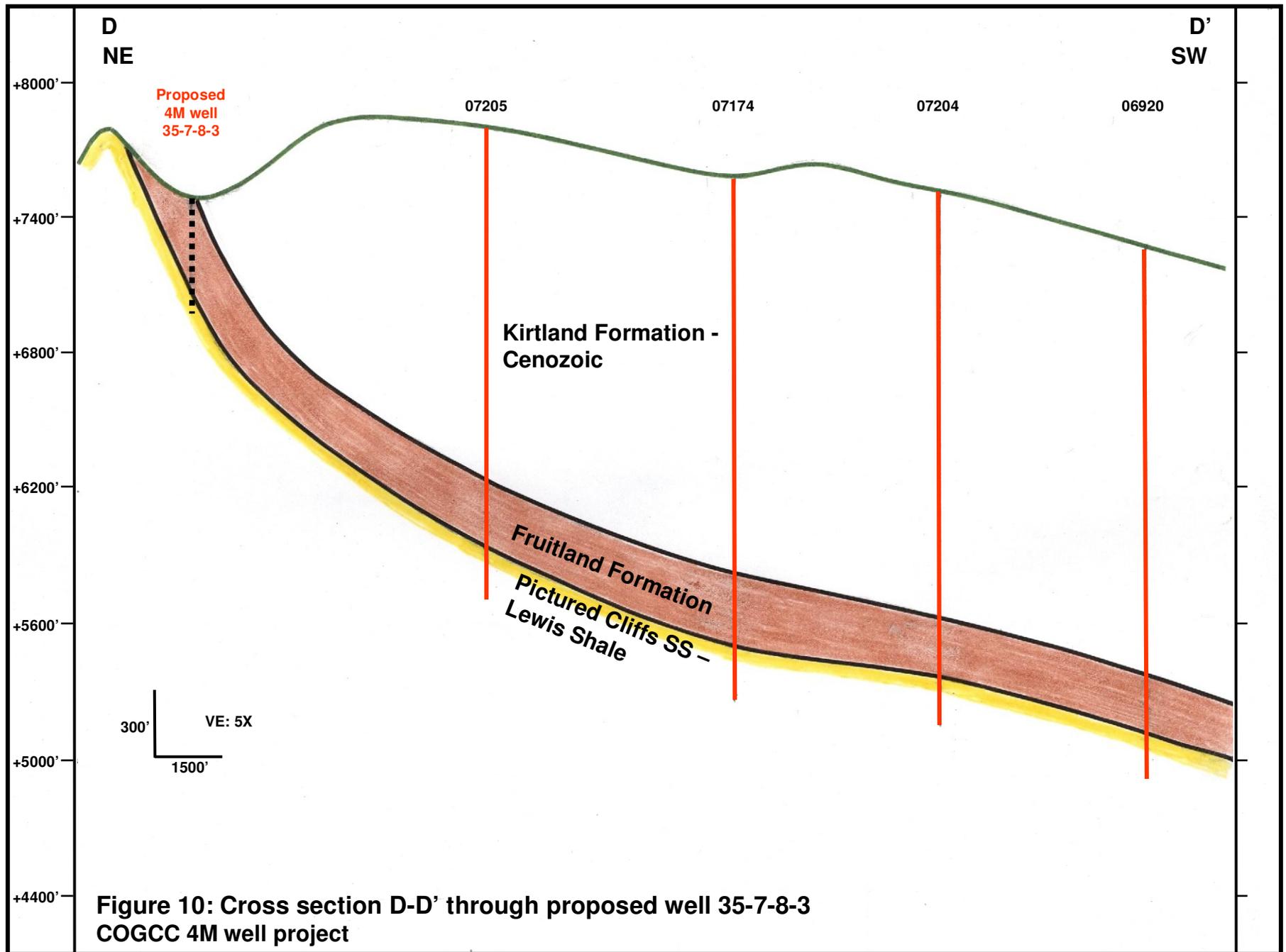


Figure 9: Topographic location of proposed well 35-7-8-3 (cross section D-D')



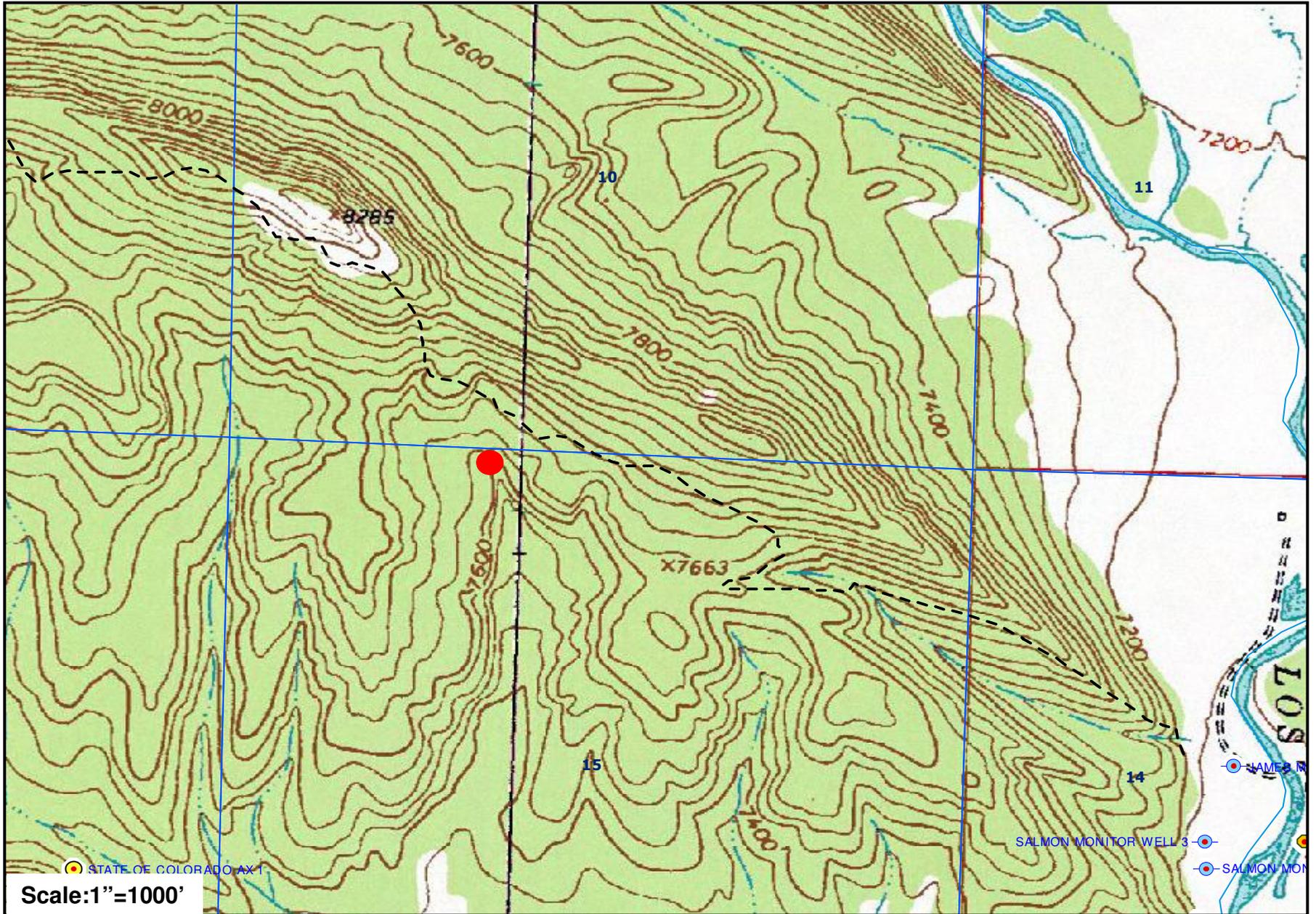
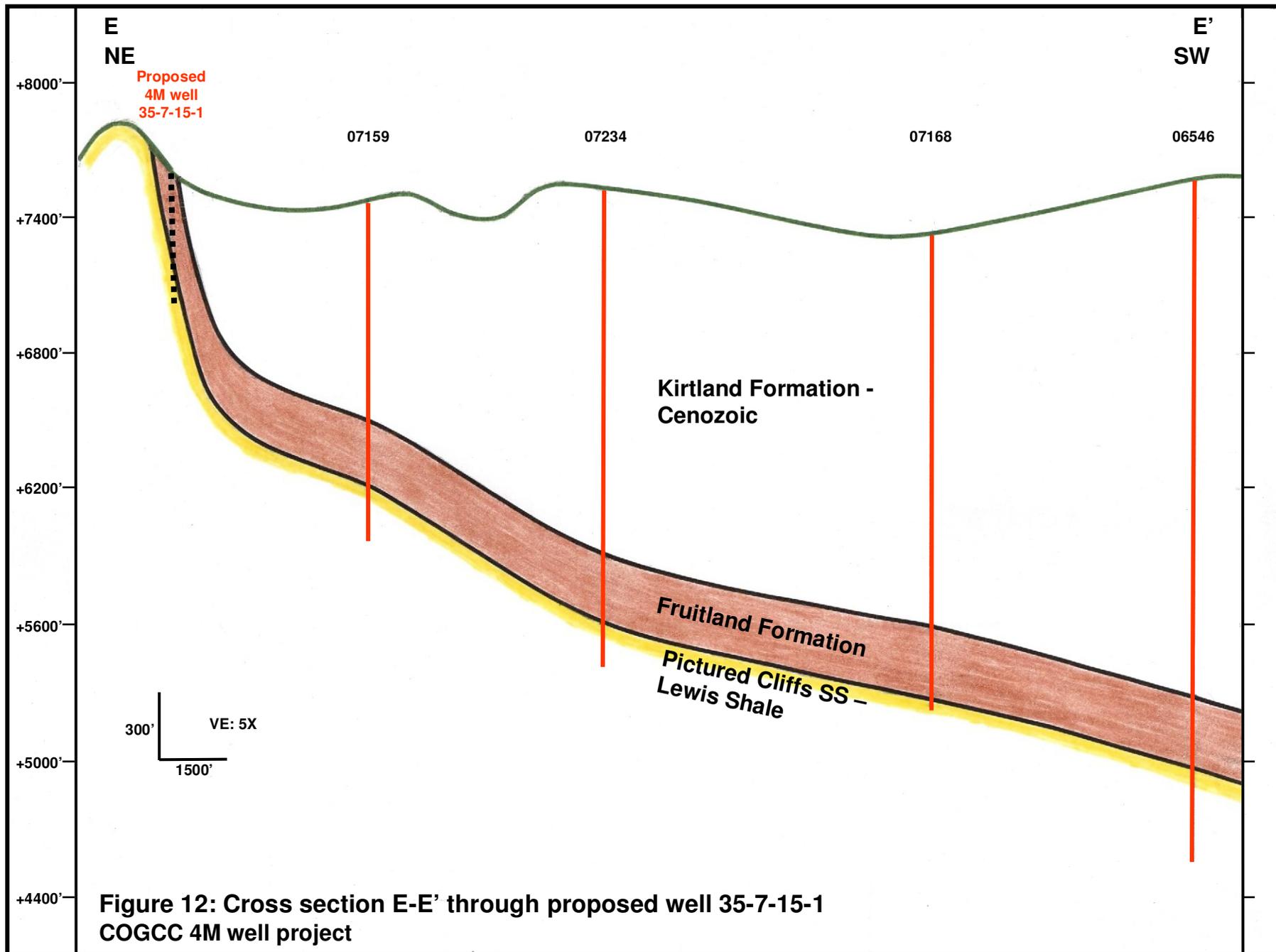


Figure 11: Topographic location of proposed well 35-7-15-1 (cross section E-E')



**Figure 12: Cross section E-E' through proposed well 35-7-15-1
COGCC 4M well project**

Table 1: Proposed La Plata County 4M Monitoring Well Locations

Well Name	Nickname	Location (approximate)	Latitude	Longitude	X - Section	Ground Elevation (est.)	Drill Depth to PC-Fruitland Contact (est.)
34-9-4-1	Basin Towing	550' FWL, 2700' FSL, 4, 34N, 9W	37.234099	-107.864418	A-A'	6550'	550'
35-8-19-1	Palmer	550' FWL, 1700' FNL, 19, 35N, 8W	37.28983	-107.793846	B-B'	7070'	770'
35-8-15-1	Nichols	1850' FWL, 50' FNL, 15, 35N, 8W	37.30925	-107.735011	C-C'	7880'	980'
35-7-8-3	Tulloch	1250' FWL, 2200' FSL, 8, 35N, 7W	37.315239	-107.663755	D-D'	7520'	420'
35-7-15-1	Hoier	1850' FWL, 150' FNL, 15, 35N, 7W	37.308381	-107.626353	E-E'	7600'	400'