



DEPARTMENT OF NATURAL RESOURCES

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September 6, 2013

Virginia Turley
16423 WCR 20
Ft. Lupton, CO 80621

RE: Response to Complaint Report – Water Well Damage Due To Seismic Survey
Complaint No. 200381764
Division of Water Resources Well Permit No. 36205
SESW Section 14– Township 2 North – Range 66 West
Weld County, Colorado

Dear Ms. Turley:

In response to your concerns regarding alleged damage to your water well due to seismic survey activities, the Colorado Oil and Gas Conservation Commission (COGCC) staff has conducted an investigation using all available resources, to determine if the seismic survey actions may be responsible for any water well damage. As part of the investigation the staff interviewed representatives from all the parties involved including Noble Energy, Anadarko Petroleum Company (APC), Geokenitics USA, and Urban Seismic Services, Inc. (USS), and Mr. Dale Turley. Based on an earlier complaint regarding your concerns on the quality of the water from your water, the COGCC sampled the subject well (sample date September 23, 2012) and issued you a summary letter discussing the COGCC sample results and results from a sample collected by Noble Energy (sample date February 7, 2012). The COGCC has recently collected a third sample from your water well (August 9, 2013), which is currently under analysis by the laboratory.

The following are facts pertinent to this complaint investigation.

January 3, 2001 – Turley Water Well drilled and constructed by Dreiling Drilling. The well was installed at a depth of 805 feet below ground surface. The well draws water from the Laramie Fox Hills Aquifer.

July 2011 – Turley's sign agreement with Cougar Land Services to allow seismic studies to be conducted on their property. As part of the agreement, the Turley's showed Cougar Land Services the location of the water well and were told that any seismic operations would be conducted a minimum of 200 feet from their water well.

October 11, 2011 - The COGCC director approved a COGCC Form 20 – Notice of Intent to Conduct Seismic Operations for Geokinetics USA, Inc. ("Crescent 3D" survey) for areas in Weld

county including the Turley property. This notice was assigned COGCC seismic survey permit number 5888. The client for the survey is Anadarko Petroleum Company (APC).

December 30, 2011 – Geokenitics USA conducted seismic operations using vibrosis buggies on property directly north of both the Turley water well and the Turley residence. Based on seismic data locations, vibrosis source points (points 54631621, 54631622, and 54631623) were conducted north of both the Turley water well and the Turley residence. This seismic survey line is the most southern seismic source points for the Crescent 3D survey. Figure 1 shows part of the southern portion of the Crescent 3D survey adjacent to the Turley Property. Review of the data array shows that the seismic source point locations were collected along paths approximately North 50° East and seismic receiver location along paths approximately North-South. In areas where preexisting property restrictions for locating the seismic source point locations were indentified, the source point locations were adjusted to accommodate these restrictions. Review of the Turley investigation area shows that the vibrosis source point locations collected on their property shows that Geokenitics modified the source point locations to accommodate the Turley's concerns for their water well.

December 30, 2011 – Urban Seismic Services, Inc. (USS), a third party observer, was present during the vibrosis operations conducted as part of the Crescent 3D survey, including the Turley property. Real-time monitoring data was collected by USS at locations shown on Figure 2 to record vibration or ground motion results from the Geokenitics vibrosis source points.

February 7, 2012 – LT Environmental sampled the Turley water well for Noble Energy in response to a request from Mrs. Turley. Samples were submitted to Accutest Mountain States (Accutest) and Isotech Laboratories (Isotech). According to Noble Energy, the sampling was conducted because of landowner concerns regarding water quality as the result of new oil & gas well drilling in their area.

February 29, 2012 – Noble Energy submitted the sample results in letter to Mrs. Turley. All analytical data reports were included. Accutest noted on the analytical summary table that the Turley well had nitrite exceeding the CDPHE human health level (result 11.2 mg/l; maximum drinking water standard is 10 mg/l). Included with the letter was a diagram of the stable isotope results for the well showing methane gas in the water well to be biogenic in origin. No "oil" or other hydrocarbons were observed in the water well or any evidence of hydrocarbons present in the analytical results.

Week of August 5th, 2012 - Arthur Koepsell (COGCC) took a phone call from Mrs. Turley. On the call she stated that she thought her well had oil present, that she was having water delivered, and she would like the COGCC to figure out what was going on with her water well.

September 23, 2012 – Turley water well was sampled by Terracon Consultants under the direction of the COGCC. Terracon noted in the field notes that the water from the well was clear in appearance, was not effervescencing, did not produce any sediment during the well presample purging, and did not have any odors or visual evidence of bacterial fouling. The samples from the water well were submitted to Test America. An Isotech sample for determination of the stable

isotopes of methane was also collected. Bacterial Activity Reactivity Test (BART) samples were also collected.

November 15, 2012 – COGCC submitted a summary letter to Mrs. Turley presenting the analytical sample results for the September 23, 2012 sample and a comparison of the earlier February 7, 2013 Noble sample results to the COGCC results. No evidence of any O&G impact (gas, organics or oil) was present in either the Noble or the COGCC sample results. The methane gas present in the well was identified by both Nobel and the COGCC as biogenic in origin. The results of the (BART) analysis indicated that the water well was positive for nuisance bacteria. The presence of elevated nitrate exceeding the CDPHE health standard was also noted (February 7, 2012 sampling results). The letter also noted that the nitrate results indicated that there is likely a surface connection to the water wellbore resulting in a possible impact from surface activities.

June 8, 2013 – Mrs. Turley filed a formal complaint with the COGCC alleging damage to her water well from the Geokenitics Crescent 3D seismic survey. The COGCC assigned complaint number #200381764 to this complaint.

July 18, 2013 – Bob Chesson, COGCC NE Colorado EPS and Jim Milne, COGCC Environmental Manager conducted a visit to the Turley residence, meet with Mr. Dale Turley, visited the water well location, and discussed the allegations of seismic issues. Mr. Turley stated that he observed seismic trucks on the Turley property between the water well and the house on the morning of the survey (December 2011); however, he did not stop to inquire why the trucks were in an area previously identified with the seismic company as off-limits based on discussions with Mrs. Turley (July 2011).

Observations by staff showed that it was unlikely that any vibrosis buggies had accessed the Turley property from the south off Weld County Road 20 because that access would have required crossing a road ditch and over a road cut to access the property, and would have resulted in damage to the southern property fence on the Turley property. No evidence of prior access was observed along County Road 20 and the property fence appeared to be several years old, with no obvious visual evidence of any damaged or recent repairs or replacement.

August 9, 2013 – Terracon Consultants, under the direction of the COGCC, collected a third sample of Mrs. Turley water well for general water quality laboratory analysis and also collected a sample from Mr. Dale Turley's water well.

DISCUSSION OF COGCC COMPLAINT FINDINGS

Seismic Survey Operations

The Turley complaint alleges that the seismic buggies conducted testing at a location between the water well and the residence and were stopped from further access on the property adjacent to the water well at the date of the survey. The complaint also alleged that the seismic testing caused

damage to the water well resulting in the poor water quality observed in the sampling results. A map provided by complainant alleges that the survey trucks accessed the property along a north-south line to travel past the residence and the water well.

The COGCC received the latitude and longitude coordinates for all of the seismic vibrosis source points along with a map of the survey. The mapped locations of the seismic source points are shown on Crescent 3D survey (Figure 2) The data show the closest vibrosis source point to the water well was source point 54631622, approximately 400 feet north of the water well. The closest vibrosis source point to the Turley residence was point 54631623, approximately 400 feet north of the residence.

Based on the post-survey data locations and observations by the USS monitoring personnel, no seismic operations involving vibrosis source points were conducted south of these locations and no active seismic operations were conducted adjacent to the water well or the Turley residence.

Site observations and mapped seismic survey data show no evidence that the vibrosis buggies for the Crescent 3D survey accessed the Turley property from Weld County Road 20 directly south of the water well location. The Turley property has several easily accessed points including the Turley residence driveway and an oil & gas lease road directly east of the Turley property without resorting to a damaging cross-county access from Weld County Road 20.

Statements by Ms. Turley and Mr. Dale Turley identify seismic vehicles between the water well and the Turley residence on December 30, 2011. The staff does not dispute this allegation, but can find no documentation that any seismic operations were actually conducted adjacent to the water well or between the water well and the Turley residence. Damage to the water well from seismic ground vibration is unlikely due to the distances between the seismic vibrosis source point and the water well (approximately 400- and 440-feet). Additionally, ground motion measurements by USS real-time monitoring show no recorded structure or water well damaging vibration equaling or exceeding the peak particle velocity of 2 inches per second (in/sec) damage threshold established by the US Bureau of Mines (1971 and 1980) for safe seismic operations around structure and water wells. Peak particle velocity reading provided by USS for the two monitoring locations on the Turley properties were 0.060 in/sec and 0.225 in/sec (USS, 2013).

Degradation of Water Quality

No water quality data exists for the Turley water prior to February 7, 2012, 40 days after the December 30, 2011 seismic survey date. Laboratory analyses of the February 7, 2012 sample and the September 23, 2012 sample are similar, indicating relatively stable water quality for the water well; no evidence of oil or any other oil & gas related compounds have been identified in the sample results for the water well.

During both sampling events, no evidence of sediment, mud, or dirt, or distinctive odors reported by the sampling crews. Both samplings of the water well were the direct result of concerns expressed by Ms. Turley of oil in her water well as the result of oil & gas drilling in her area. At no time has the COGCC staff or, based on our investigation, Noble Energy, stated that the water in the Turley well was "unsafe to drink". Both sampling reports identified the issue with high nitrate in the water sample results, and the COGCC letter emphasized that the nitrate concentration in the

February 2012 sample exceeded the CDPHE drinking water health standard. Both sample results also identified elevated TDS concentrations exceeding the CDPHE SMCL.

CONCLUSIONS

Based on all reviewed information the COGCC staff has made the following findings:

1 – Review of all seismic survey documentation identifies that two vibrosis source point locations on the Turley property proximal to both the water well and the residence; source point 54631622, located approximately 400 feet north of the water well and source point 54631623, located approximately 440 feet northeast of the water well and approximately 400 feet north of the Turley residence. No seismic operations involving vibrosis source points were conducted south of these locations.

2 - Ground motion measurements by USS real-time monitoring show no recorded structure or water well damaging vibration equaling or exceeding the peak particle velocity of 2 in/sec damage threshold established by the US Bureau of Mines for safe seismic operations around structure and water wells.

3 - No seismic vibrosis source point operations were conducted adjacent to or between the water well and the Turley residence.

4 - No evidence was discovered indicating that the Geokenitics seismic vibrosis buggies accessed the Turley property north off of Weld County Road 20, over the road ditch, road cut, through the Turley property fence, and proceeded cross-county on the north-south path between the water well and the residence as shown on at accompanying figure to the June 8, 2013 complaint.

5 - The first water quality sample was collected from the Turley water well 40 days after the December 30, 2011 seismic operations.

6 – Water quality sample results from the Turley water well for the February 2012 and September 2012 sampling show no significant differences between the two sampling events. Sampling results show that the Turley water well has elevated total dissolved solids (TDS) which can result in mineral deposit accumulations where large volumes of water are allowed to evaporate (such as a swamp cooler filters).

Based on the information available and investigation conducted, staff does have sufficient evidence to indicate that the December 30, 2011 seismic operations conducted by Geokenitics USA for the Crescent 3D survey caused any structural damage to the Turley water well resulting in degradation of existing water quality. We, therefore, cannot file a Notice of Alleged Violation against Geokenitics USA, pursuant to Rule 522.a.(4) of the Commission Rules and Regulations. COGCC staff considers this complaint resolved. However, you have the right to file an application to the Commission pursuant to Rule 522.a. (4) and Rule 503.b. (4), requesting the Commission enter

an Order Finding Violation (OFV), which would result in an OFV hearing. For additional information you can contact COGCC Hearings Manager, Mr. Robert Frick at 303-894-2100 ext. 5152. These Rules are found on our website: <http://cogcc.state.co.us>.

Respectfully,

Robert H. Chesson, CPG, PG
Environmental Protection Specialist

Colorado Oil and Gas Conservation Commission

cc: James Milne, COGCC Environmental Manager
Matt Sura (via e-mail)

References

Urban Seismic Services, Inc. (USS), March 13, 2013, *Damage Investigation Crescent 3D, Turley Water Well, 16423 CR 20, Ft. Lupton, Colorado*.

U.S. Bureau of Mines, 1971, *Blasting Vibrations and Their Effects on Structures*. Bulletin 656, 105 pgs.

U.S. Bureau of Mines, 1980, *Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting*. Report of Investigations (RI) 8507.

FIGURES

Figure 1

Southern Portion of the Crescent 3D Seismic Survey

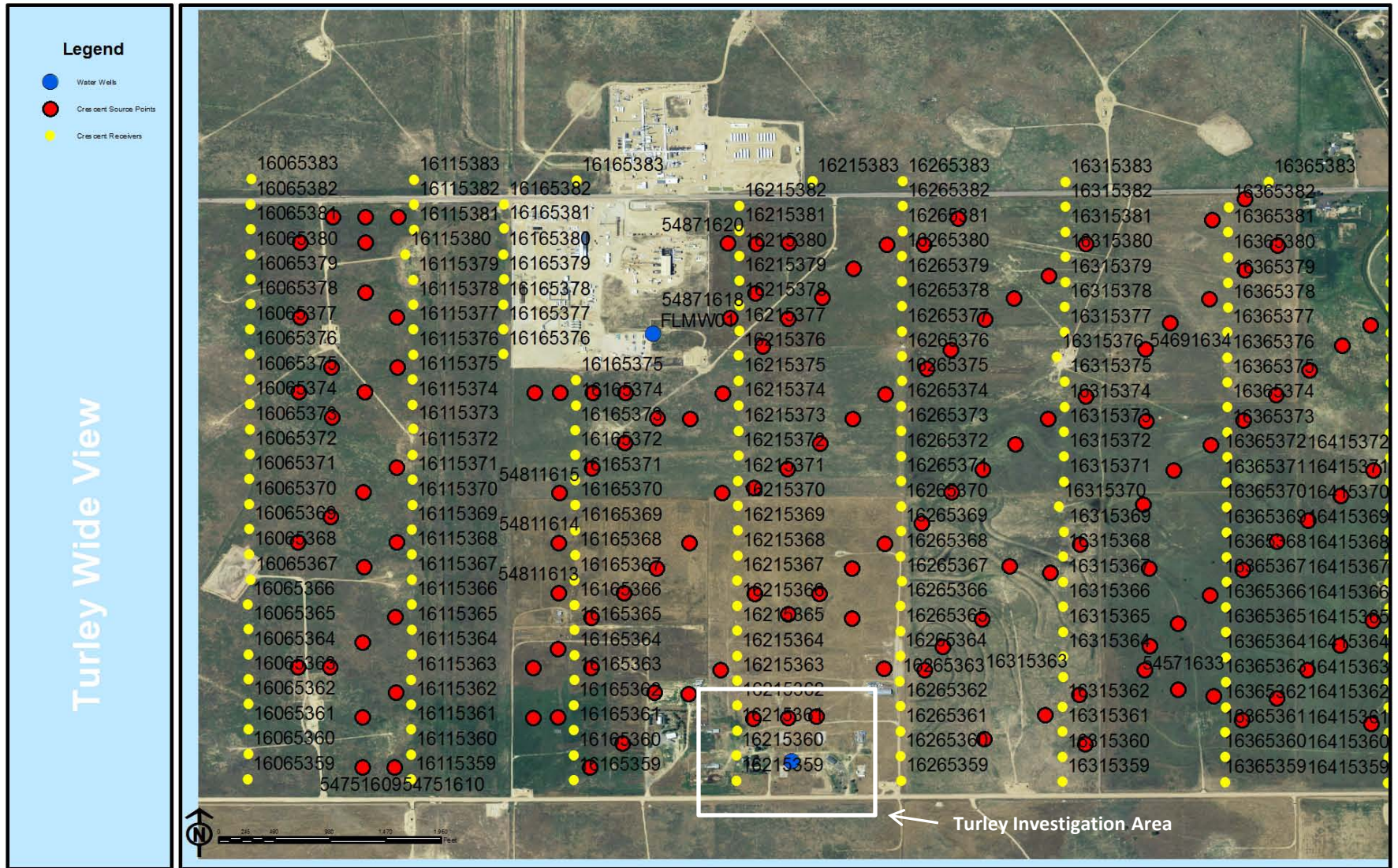


Figure 2
Crescent 3D Seismic Survey Detail – Turley Residence Area

- Seismic Source Point location
- Seismic Receiver location
- Turley Water Well
- ▲ USS real-time monitoring location

