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From: Bill Leith <wleith@usgs.gov>
Sent: Thursday, September 25, 2014 1:04 PM
To: rulescoordinator
Cc: Stacie Fowler
Subject: USGS Comments on RRC-proposed amendments 3.9 and 3.46 relating to Disposal Wells
Attachments: USGS comments to TX RRC 9.25.14.pdf; ATT00001.htm

Comments from the U. S. Geological Survey
Submitted to the Railroad Commission of Texas, Oil and Gas Division,
Regarding amendments 3.9 and 3.46 relating to Disposal Wells
and Fluid Injection into Productive Reservoirs,
To incorporate requirements related to seismic events for disposal wells.

September 25, 2014

The U.S. Geological Survey (USGS) welcomes the opportunity to provide comments to the Texas Railroad Commission (RRC) as it undertakes the challenging task of mitigating the hazards posed by induced seismicity and wastewater injection wells. Scientific understanding of induced earthquakes is rapidly evolving, and it is clear that the RRC is striving to consider the best and most recent scientific advances in our understanding of induced earthquakes in their proposed regulations. We are also pleased that USGS research has proven helpful in the development of these regulations and that our data products may assist in decision making.

The draft Disposal Well Rule Amendments would require the applicant to utilize the publicly available USGS earthquake catalog to identify prior earthquake activity dating back to 1973 within a region of influence around the site. In general, the USGS agrees that occurrence of prior seismicity may be a risk factor for injection-induced seismicity. The specifics of the proposed rules, however, incorrectly overstate the present and historic capabilities of the USGS for monitoring earthquakes in the State of Texas. There are two points that we wish to bring to your attention.

First, the amendment states, "The USGS has the ability to detect and locate all seismic events larger than magnitude 2.0 throughout the continental United States." This statement is incorrect. The USGS detection threshold varies considerably in different areas of the United States, and USGS earthquake catalog completeness to magnitude 2.0 is attained only in a limited number of regions that lie within dense seismic networks. The USGS catalog completeness also degrades further back in time because fewer seismic stations were in operation.

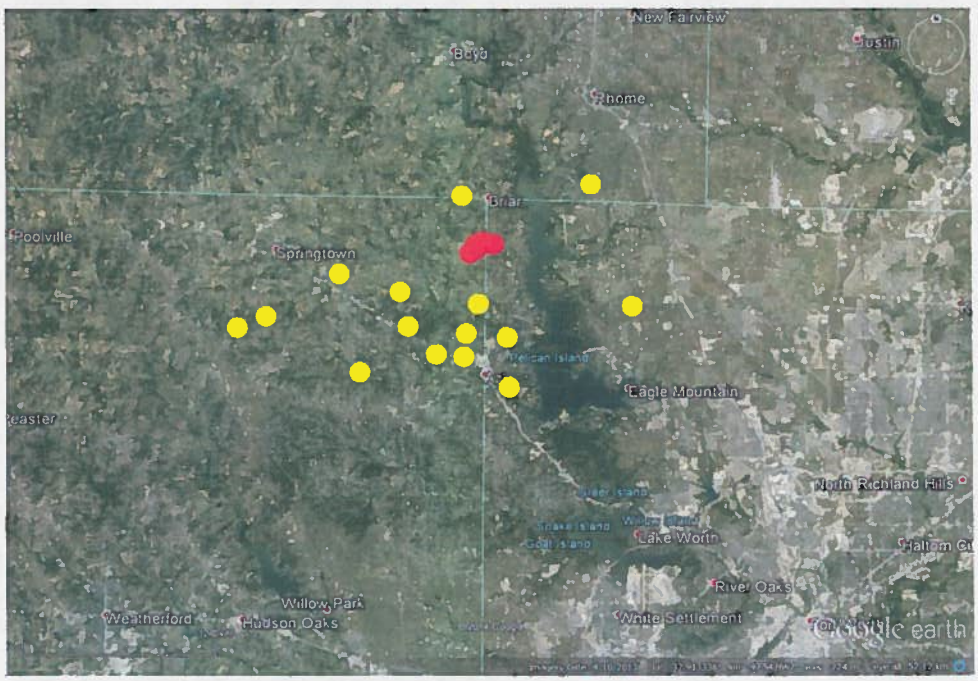
Texas has relatively sparse spacing of seismic stations compared to states with higher earthquake hazard. An accurate statement for Texas would be, "The USGS's ability to detect earthquakes varies throughout the State of Texas. The USGS is currently capable of detecting and locating all Texas earthquakes with magnitudes of about 3.0 and larger and can detect smaller earthquakes in regions with better seismic station coverage. Earthquakes smaller than magnitude 2.5 are not included in the catalog unless they are reported to the USGS as having been felt."

Second, the accuracy of USGS earthquake locations is overstated implicitly in the amendment. The amendment uses proximity of a disposal well to earthquakes in the USGS catalog as a possible trigger for requesting more information. The amendment states, "Applicants for a disposal well permit ... would be required to

access the USGS search tool at ... in order to retrieve data regarding the locations of historical seismic events within the estimated 10-year, five psi pressure front boundary."

Unfortunately, the USGS earthquake locations in Texas are not of sufficient accuracy to be used for this purpose. The USGS location uncertainties are currently 10 to 20 km in many parts of Texas. For earthquakes from 1970-1999, location uncertainties could be as large as 40-50 km. These uncertainties are far greater than 3.2 km, which is the distance of the 10-year, five psi pressure front boundary quoted as an example in the amendment (page 2 line 7), and thus routine USGS locations are not precise enough for this application.

The earthquakes that occurred northwest of Fort Worth near the City of Azle in November and December 2013 illustrate the limited accuracy of routine USGS locations in Texas, as well as how accuracy can be improved with a denser spacing of seismometers. In the map below, routine USGS epicenters processed by the USGS National Earthquake Information Center are shown in yellow. They span a distance range of more than 20 km in the east-west direction. In response to a request for assistance, the USGS, in partnership with Southern Methodist University, installed several temporary seismograph stations in the area that were used to improve the locations of these earthquakes. The improved locations for these same earthquakes are shown by the red symbols. Note that the relocated epicenters lie within about one kilometer of each other, whereas the apparent 20 km spread of the routine epicenters was an artifact resulting from the limited location accuracy.



The USGS has continuing interest in injection-induced earthquakes in Texas. USGS scientists are collaborating with researchers at Southern Methodist University on the study of the Azle earthquakes, and the USGS has funded research on induced earthquakes in Texas by Dr. Cliff Frohlich at the University of Texas at Austin.

The USGS would be happy to work with the Texas RRC to address our technical comments. We would also be happy to engage the RRC in research that will lead to better understanding of the hazard posed by injection-induced earthquakes in Texas, and in identifying the risk factors for inducing earthquakes.

For further information or discussion of these matters, please contact Dr. William Leith, Senior Science Advisor for Earthquake and Geologic Hazards, U.S. Geological Survey, 905 National Center, Reston VA 20192 (tel. 703-648-6786; email: *wleith@usgs.gov*).