



## **REMARKS PREPARED BY SMU SEISMOLOGISTS FOR JAN. 15 IRVING CITY COUNCIL MEETING**

I would like to thank you, the Irving City Council, for the opportunity to appear tonight and discuss the recent seismic activity in the area. These earthquakes highlight the dynamic interplay of stresses and old faults within the earth's crust, even here in the flatlands of North Texas, and the need to understand how and when such stresses can give rise to earthquakes. To date, all of the North Texas earthquakes have been small, less than magnitude 4. The fact that they have been widely felt and have continued over months has naturally raised concerns.

The seismologists at SMU have been recording earthquakes in North Texas since 2008, but it is only with the close cooperation of local community governments, officials, organizations, and citizens willing to help deploy and host seismographs that such critical observations are possible. In this most recent case for example, Jason Carriere, the Emergency Management Coordinator for the Irving Police Department and his colleagues and peers have made possible the very rapid deployment of seismographs following the M3.5 and 3.6 earthquakes only 9 days ago.

I have prepared short remarks and then we are available for questions that you might have. My intention with these remarks is to highlight four points:

- First, I'll summarize the ongoing seismic activity in Irving-Dallas in the context of the rest of the seismicity that has occurred in the Fort Worth Basin since 2008;
- Second, I'll provide an overview of the current study of the Irving earthquake swarm and anticipated outcomes;

- Third, I'll list possible subsequent steps following the deployment of instruments designed to explore the cause of the activity; and
- Finally, I'll have some brief remarks concerning assessment of earthquake hazards and preparation going forward.

The overview of past and ongoing research related to possible linkages between human activities and earthquakes will not be explicitly covered tonight although you have been supplied the materials we presented to the Texas House Subcommittee on Seismicity on 12 May 2014 and it is also available at: [www.smu.edu/News/NewsIssues/EarthquakeStudy](http://www.smu.edu/News/NewsIssues/EarthquakeStudy).

The Irving earthquake sequence appears to have begun on 17 April 2014 with a magnitude 2.4 event and has been followed by thirty-seven additional events as identified by the United States Geological Survey (or USGS), including the magnitude 3.5 and 3.6 earthquakes last Tuesday. A number of these have been widely felt across the area with a total of four above magnitude 3. Because the two largest events are of almost equal magnitude and occurred close in time to one another, we and others have called this an earthquake swarm as opposed to a single main earthquake followed by aftershocks.

It is important to put this swarm into the context of the activity that has occurred across the DFW Metroplex since Halloween night 2008. Prior to 2008 there were no historic seismic events in the area and only one possible felt event reported in 1950. Of course the ability to detect and locate seismic events in the region has increased as a function of time, but with the substantial population in the region for well over 100 years, any felt reports associated with small events would have been made and those events would have been identified. As an aside, I would like to encourage everyone to file reports on the earthquakes they feel using the USGS "Did You Feel It" website ([earthquake.usgs.gov/earthquakes/eventpage/dyfi/](http://earthquake.usgs.gov/earthquakes/eventpage/dyfi/)). We have great technology, but reports from people who have felt earthquakes are quite useful in interpreting the location of an earthquake, its size and how seismic waves decrease

in amplitude as they move away from the earthquake source. Since October 31, 2008, the USGS has located over 120 earthquakes in our area. The Irving earthquakes represent the fourth sequence to be studied in our local area over the last six years. The first was an earthquake sequence centered near DFW airport in 2008 and 2009 with the largest magnitude of 3.3. A second sequence from 2009 into 2010 was near Cleburne, Texas with the largest magnitude of 2.8. A third set of events occurred near Azle, Texas beginning in the Fall of 2013 and continuing through 2014 with the largest magnitude of 3.6. In all of these cases earthquakes got smaller and further apart in time following the largest events. Additional focus areas of seismicity based on USGS locations exist NE of Cleburne, near Mineral Wells and in the Venus/Midlothian area but have not been well studied. Within the context of the increased seismicity in the area, the most recent swarm has similar characteristics to the others.

Turning to the recent Irving swarm, it is important to recognize that the USGS has primary responsibility in the US for locating earthquakes as well as providing earthquake hazard assessment. They complete this task with a high quality network of seismic stations deployed across the United States. In the case of the largest Irving earthquake, the existing USGS seismic stations used to first locate the event were as close as 40 miles and as far as 922 miles. As you can imagine, using seismic waves from such distant stations typically results in intrinsic errors in location estimates that can be as large as 3-6 miles. These errors are large enough that it can be difficult to assign an earthquake or swarm to a particular fault, which is critical to understanding the process. As a result, the deployment of additional seismic stations closer to initial earthquake location estimates provides the basis for refining these locations in order to attribute them to a fault. In areas such as California where earthquake activity is high, permanent seismic stations are already installed with spacing adequate to provide these types of refined earthquake locations. We in North Texas do not have such a network.

Before Tuesday, January 6, there were only three seismic stations within about 10 miles of the events, one of which was deployed on Monday afternoon, January 5. In order to improve our mapping of the fault causing these earthquakes, over the last week we have worked with the City of Irving and others to deploy additional seismometers designed to provide high precision locations. Today we have a total of 22 instruments fielded, although 14 of them are designed to record for only 10 days and will be recovered by the end of the week. Data from a number of these instruments is being shared with the USGS in order to enhance their real-time analysis of any subsequent earthquakes. We anticipate that within the next month as additional small events occur that these data will provide the basis for a refinement of our understanding of the responsible fault. This same approach proved to be successful for the earthquake sequences that occurred near DFW airport, Cleburne and Azle. The timing of this work is dependent on how much longer subsequent earthquakes occur in the coming weeks. Once the fault location is refined, the data provides a basis for improving the location estimates of the earthquakes that occurred before the local stations were deployed. Thanks to the support of City of Irving, this deployment subsequent to the largest events last Tuesday has been the most rapid of any of the sequences in the area and will provide one of the best data sets for assessing the swarm.

The third thing I want to discuss are the next steps in a study like this one. Once the locations have been completed, only *then* can we assess possible causes. We will consider a wide-range of possibilities, including whether the earthquakes are strictly natural or possibly associated with human activities. In either case, the waves released from the earthquake are associated with pre-existing stored energy along natural faults. Steps in this next stage of the study are the development of data on subsurface fault details, assessment of relative locations of any near-by commercial activities to the earthquakes, acquisition of data related to any identified commercial activities, and development of detailed subsurface geology and rock properties. If there are near-by commercial activities related to the injection or recovery of fluids, it might be that the impact of the associated fluids on near-by

faults will be important to explore and thus require additional supporting data. In the case of two of the previous earthquake sequences, those near DFW airport and Cleburne, we found that there is a *plausible* or *possible* linkage between waste water disposal and the earthquakes. I will add that there are other experts who point out that even in these two cases the sequences could be natural.

Finally, I want to touch briefly on the seismic activity and its possible hazard to our communities. It is important for you to understand that this area is beyond our specific expertise and an important area for continued cooperation with the USGS. All of the events since 2008 have been small and, although startling to all of us when we feel them - they have not been large enough to cause significant damage. The fact that the events appear to be shallow, 2-5 miles deep, means they are close to the surface where we live and thus well felt. The previous sequences have decayed away following the largest event with magnitudes similar to those experienced last Tuesday. I do not know whether this specific swarm will die out or whether it will continue. Experience shows that the majority of earthquake swarms do not result in damaging earthquakes. But at this time we cannot rule out the possibility of larger earthquakes, some possibly damaging. I believe these statements are consistent with guidance provided by the USGS. Recent earthquakes in West Texas, East Texas and South Texas have been large enough that they might cause some damage if they occurred in our area, and thus motivates the assessment of current seismicity in our local area and meetings like this one tonight. The USGS is an excellent resource for both hazard assessment and preparedness and therefore I encourage the local governments to work with these experts.

I close with thanks again for the leadership of the City of Irving, the support of the City of Dallas, the cooperation of the USGS, instrumentation from IRIS, and help provided by a number of individuals in the area over the last ten days. These events have led to cooperation and collaboration with a number of groups, governments and organizations. It is my opinion that these recent events - in the context of the increase in seismicity we've seen in our area since 2008 - are strong motivation for a

comprehensive assessment of the increased seismicity rate across North Texas. Communities need to be able to make informed decisions about preparation as well as improve hazard assessment. Such a comprehensive study will need to involve contributions from a diverse collection of individuals within government, industry and academia with expertise across a broad spectrum.

Dr. DeShon and I are now happy to entertain questions.

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