PUBLIC JUSTICE
RIGHTING WRONGS

October 29, 2015

Via Certified Mail, Return Receipt Requested

Mr. Bob G. Alexander
President and Chief Executive Officer
Sandridge Exploration and Production, LLC
1601 Northwest Expressway
Suite 1600
Oklahoma City, OK 73118

Via Certified Mail, Return Receipt Requested

Mr. Kevin A. Easley
President and Chief Executive Officer
New Dominion, LLC
1307 South Boulder Ave W # 400
Tulsa, OK 74119

Via Certified Mail, Return Receipt Requested

Mr. Robert D. Lawler
President and Chief Executive Officer
Chesapeake Operating LLC
6100 N Western Ave
Oklahoma City, OK, 73118

Via Certified Mail, Return Receipt Requested

Mr. J. Larry Nichols
President and Chief Executive Officer
Devon Energy Production Co. LP
20 North Broadway
Suite 1500
Oklahoma City, OK 73102-8202

RE: ***Notice of Intent to Sue for Violations of the Resource Conservation and Recovery Act Involving Earthquakes Induced by the Injection and Disposal of Oil and Gas Production Wastes into the Ground***

Public Justice, P.C.
www.publicjustice.net

National Headquarters
1825 K Street NW, Suite 200
Washington, DC 20006
ph: 202-797-8600
fax: 202-232-7203

West Coast Office
555 12th Street, Suite 1230
Oakland, CA 94607
ph: 510-622-8150
fax: 510-622-8155

Dear Sirs:

We are writing on behalf of the Sierra Club[1] and its members ("Citizens") to provide you with notice of their intent to file suit against Sandridge Exploration And Production, LLC ("Sandridge"), New Dominion, LLC ("New Dominion"), Devon Energy Production Co. LP ("Devon") and Chesapeake Operating LLC ("Chesapeake") (collectively "Defendants") for ongoing violations of the Resource Conservation and Recovery Act ("RCRA")[2] resulting from the injection and disposal of waste fluids from the oil and fracking industries ("Production Wastes") into the ground via wells in Oklahoma. This injection has caused or contributed to a huge increase in the number and severity of earthquakes being experienced in Oklahoma and southern Kansas. These earthquakes have already caused injuries and property damage and are threatening much more damage that is potentially devastating. Therefore, as is more fully explained below, Defendants are violating RCRA as a result of past and present handling and disposal of Production Wastes in a manner that may present an imminent and substantial endangerment to health and the environment. Indeed, the threat caused poses a clear and present danger to the health of Oklahoma residents and their environment.

By failing to comply with RCRA, Defendants have injured or threatened to injure, and will continue to injure or threaten to injure, the health, environmental, aesthetic, and economic interests of Citizens. These injuries or risks are traceable to Defendants' violations discussed above and redressing these ongoing violations will redress the Citizens' injuries or risks.

After providing notice, Citizens are entitled to bring suit against "any person . . . who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment."[3] This citizen suit provision also allows the recovery of reasonable attorney and expert fees in addition to other costs by prevailing plaintiffs. Therefore, Citizens intend to bring suit to enjoin waste handling and disposal activities that present an imminent and substantial endangerment to health or the environment, to abate such endangerment by requiring Defendants to take at least the steps outlined below, to recover attorneys' fees and costs of litigation, and to obtain other appropriate relief. To abate the present endangerment, at minimum, Defendants must:

1) Immediately substantially reduce the amounts of Production Wastes they are injecting into the ground to levels that seismologists believe will not cause or contribute to increased earthquake frequency and severity. At minimum, the current rates of injection, particularly into the Arbuckle Formation, must be reduced substantially to cause a major reduction in the current unacceptable earthquake risks;
2) Reinforce vulnerable structures that current forecasts show could be hit by large magnitude earthquakes during the interim period;
3) Establish an independent earthquake monitoring and prediction center to analyze and forecast how much Production Wastes can be injected without inducing earthquakes and track how closely the ongoing earthquakes conform to predictions. This may involve further investigation and characterization of the underlying rock, including the Arbuckle Formation.

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1 85 Second Street, 2nd Floor San Francisco, CA 94105 USA Phone: 415-977-5500
2 42 U.S.C. § 6901, *et seq*.
3 42 U.S.C. § 6972(a)(1)(B).

In accordance with Section 7002(b)(2)(A) of RCRA,[4] this letter serves to notify Defendants that unless Defendants remedy the violations detailed in this letter, Citizens intend to file suit in federal district court at any time beginning ninety (90) days after the certified receipt of this letter.[5]

I. Earthquakes Induced By Defendants' Waste Injection are Causing Endangerment in Central Oklahoma and Southern Kansas

In recent years, it has been established that the injection of Production Wastes into the ground through high rate disposal wells causes earthquakes. After much local controversy, the the Oklahoma Geological Survey ("OGS") determined in the spring of 2015 that "the majority of recent earthquakes in central and north-central Oklahoma are very likely triggered by the injection of produced water in disposal wells" and that "seismologists have documented the relationship between wastewater disposal and triggered seismic activity.[6] The United States Geological Survey ("USGS") fully supports this conclusion. For example a New Yorker article recently quoted USGS geologist William Ellsworth in reporting that "[d]isposal wells trigger earthquakes when they are dug too deep, near or into basement rock, or when the wells impinge on a fault line. Ellsworth said, 'Scientifically, it's really quite clear.'"[7] Similar conclusions were reached by the authors of one of the first peer-reviewed papers on this issue, published in July 2014, titled "Sharp increase in central Oklahoma seismicity since 2008 induced by massive wastewater injection."[8] This phenomenon is not newly discovered. Well-known examples of water injection into wells causing earthquakes have occurred in Colorado, Texas, India, and China.[9] Most recently, in a year end review, EPA noted that many experts have concluded that a connection likely exists between disposal well location, injection volume and rates, and seismic activity.[10] EPA was concerned with the continued upward trend in earthquakes and recommended a reduction in the volumes of waste injected into the critical Arbuckle formation, which is the most critical stratum. *Id.* EPA further recommended more assessment and mapping of the Arbuckle formation and its connection to basement rock. *Id.*

Looking at the data, this conclusion is inescapable. Before 2009 the maximum number of earthquakes measured in a given year in Oklahoma was 167 in 1995. Figure 1. By 2014, the number of measured earthquakes soared to over 5,000, and in 2015 the number of earthquakes is predicted to be over 6,000. *Id.* The number of earthquakes that residents can feel has shown an even greater rate of increase. In 2014, Oklahoma had 585 earthquakes of magnitude-3 or greater compared to 109 magnitude-3 quakes in 2013.[11] Since late 2009, the rate of magnitude-3 or larger earthquakes in north-central Oklahoma has been nearly 300 times higher than in previous decades.[12] Of course, earthquakes do not respect state boundaries. The earthquake swarm in

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4 42 U.S.C. § 6972(b)(2)(A).

5 40 C.F.R. § 254.2.

6 http://earthquakes.ok.gov/what-we-know/ (visited on October 9, 2015)

7 http://www.newyorker.com/magazine/2015/04/13/weather-underground

8 Keranan et al., Sharp increase in central Oklahoma seismicity since 2008 induced by massive wastewater injection, 448-451, 451 (July 3, 2014)

9 William L. Ellsworth, Injection-Induced Earthquakes , Science 341, (2013) *available at http://www.gwpc.org/sites/default/files/files/Earthquakes%20and%20fracking(2).pdf*

10 EPA Region 6 End of Year Review of UIC Program for 2014 (transmitted on Sept 29, 2015)

11 http://www.usatoday.com/story/news/2015/03/05/oklahoma-quakes-fracking-oil-gas/24444581/

12 http://www.usatoday.com/story/news/nation/2015/03/10/oklahoma-earthquakes-fault-lines/24702741/

central and northern Oklahoma does not stop at the state boundary, but also extends to southern Kansas.[13] Figure 2 illustrates these trends and shows that the earthquakes are continuing to grow in number and to become stronger.

As discussed in a recent study, "this seismicity appears to be associated with increases in saltwater disposal that originates as 'flow-back' water after multistage hydraulic fracturing operations." [14] Since 2009, Defendants have injected huge amounts of Production Wastes via disposal wells. The total volume of Production Wastes injected has gone from 2 billion ("bn") barrels in 2009 to over 12 bn barrels in 2014. Figure 3. Focusing on the Arbuckle formation alone, which is the geologic stratum closest to the basement rock in which most of the earthquakes originate and into which large volume disposal wells discharge, Defendants account for over 60% of the total volume of Production Wastes injected in 2014. Figure 4. New Dominion has been injecting large volumes since 2011, but since then, the other three Defendants have matched or surpassed New Dominion's volumes. Figure 5.

Overlaying the locations of Defendants' wells onto the places where earthquakes above magnitude 3.5 have been felt shows that earthquakes are occurring in the vicinity of Defendants' wells and along faults that are close to the wells. Figure 6.[15] As more injection has occurred in the central and northern areas of Oklahoma, more and more earthquakes have occurred in those areas. *Id.* While not all wells cause earthquakes, studies have found that most high volume disposal wells are linked to earthquakes: "Even though quake-associated wells were only 10 percent of those studied, more than 60 percent of the high-rate wells — 12 million gallons or more — were linked to nearby earthquakes" and "of the 45 wells that pump the most saltwater [waste] at the fastest rate, 34 of them — more than three out of four — were linked to nearby quakes"[16] For example, just four wells owned by New Dominion have caused 20% of all the seismic activity in the central U.S. from 2008 to 2013.[17] Wells have been shown to induce earthquakes over 20 miles away.[18] The Disposal Study confirms that "the significant increases in SWD [Production Waste disposal] increase pore pressure in the Arbuckle Group, which spreads out away from the injection wells with time, eventually triggering slip on critically stressed faults in the basement." It also confirms that "[i]njection of large volumes of saltwater into the Arbuckle group appears to be triggering the release of already stored strain energy in crystalline basement." It is therefore scientifically beyond dispute that injection of Production Wastes

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[13] McNamara et al, Earthquake hypocenters …., Geophysical Research Letters (Jan 27, 2015) ("Future Hazards") at Figure 2.

[14] F. Rall Walsh III* and Mark D. Zoback, Oklahoma's recent earthquakes and saltwater disposal, Science Advances, 18 Jun 2015 available at http://advances.sciencemag.org/content/1/5/e1500195.full ("Disposal Study")

[15] The Figures attached to this notice letter are based on publicly available information, which are incomplete in some regards. We believe that Defendants have better information on their own wells. Therefore, we will refine the spatial analysis once we obtain better information from Defendants.

[16] http://www.nytimes.com/aponline/2015/06/18/science/ap-us-sci-manmade-quakes.html?smprod=nytcore-ipad&smid=nytcore-ipad-share&_r=0

[17] http://www.bloomberg.com/news/articles/2015-04-23/can-this-oklahoma-oilman-s-company-withstand-another-earthquake- stating "A July 2014 study published in Science found that four high-volume disposal wells owned by New Dominion on the outskirts of Oklahoma City may have accounted for 20 percent of all seismic activity in the central U.S. from 2008 to 2013."

[18] Sharp Increase at 448.

induces earthquakes and that Defendants are injecting the bulk of the Production Wastes that are causing the earthquakes about which Citizens complain.

Importantly, as mentioned above, the risk is not only that there are more frequent earthquakes, it is also that those earthquakes have been and will continue to be more severe. USGS scientists are warning that the smaller earthquakes induced by the injection of Production Wastes are reawakening long-dormant, 300-million-year-old fault lines across Oklahoma. The faults could trigger much higher-magnitude, and consequently more destructive, earthquakes than the smaller ones that have plagued the state in recent years.[19] According to USGS scientists, these reawakened faults in central Oklahoma could produce earthquakes as powerful as magnitude-5 and 6. *Id.* A USGS geologist stated "Many faults are reactivating, with as many as 17 magnitude-4 earthquakes in 2014." *Id.* In 2011, one even reached magnitude-5.4 in strength near Prague, Okla.

Recently, two earthquakes of greater-than-magnitude-4 occurred on the same day; further evidence of the higher frequency of more serious earthquakes in the areas of concern. A magnitude 4.4 quake hit northern Oklahoma on October 10, 2015, which a USGS said "had all the hallmarks of an induced quake" and "seems to be part of an ongoing swarm of induced quakes in the area."[20] On the same day, a magnitude 4.5 earthquake hit near the major oil storage area of Cushing about 100 miles southeast.[21] Cushing is the location of the world's largest and most important crude oil storage hub. The emergency manager reported that "the whole house shook." The oil tanks did not suffer significant damage, but it "shattered nerves." *Id.* Scientists reported in a paper published online in September that a large earthquake near the storage hub "could seriously damage storage tanks and pipelines." Dr. McNamara, the lead author of that study, stated that the recent earthquake continued a worrisome pattern of moderate quakes, suggesting that a large earthquake is more than a passing concern. "When we see these fault systems producing multiple magnitude 4s, we start to get concerned that it could knock into higher magnitudes," he said. "Given the number of magnitude 4s here, it's a high concern." *Id.*

The Cushing oil hub stores oil piped from across North America until it is dispatched to refineries. *Id.* As of last week, it held 53 million barrels of crude. *Id.* The earth beneath the tanks was comparatively stable until last October, when magnitude 4 and 4.3 earthquakes struck nearby in quick succession, revealing long-dormant faults beneath the complex. *Id.* Three more earthquakes with magnitudes 4 and over have occurred within a few miles of the tanks in the past month. *Id.* The Department of Homeland Security has gauged potential earthquake dangers to the hub and concluded that a quake equivalent to the record magnitude 5.7 could significantly damage the tanks. *Id.* Dr. McNamara's study concludes that recent earthquakes have increased stresses along two stretches of fault that could lead to earthquakes of that size. *Id.* Despite these risks, oil companies are challenging the right of the State of Oklahoma to reduce injection volumes. *Id.*

Further south, the Nemaha fault runs north-northwest between Oklahoma City and southern Kansas. Figure 6. In a peer-reviewed paper in Science magazine published in July

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[19] http://www.usatoday.com/story/news/nation/2015/03/10/oklahoma-earthquakes-fault-lines/24702741/

[20] Guardian, October 10, 2015, Oklahoma Earthquake likely caused by wastewater injection, seismologist says, available at http://www.theguardian.com/us-news/2015/oct/10/oklahoma-earthquake-fracking-us-geological-survey

[21] New York Times, October 14, 2015 New Concern Over Quakes in Oklahoma Near a Hub of U.S. Oil, *available at* http://www.nytimes.com/2015/10/15/us/new-concern-over-quakes-in-oklahoma-near-a-hub-of-us-oil.html

2014, seismologists found that a magnitude 7 earthquake is possible along that fault.[22] Furthermore, they stated that "the increasing proximity of the earthquake swarm to the Nemaha fault presents a potential hazard to the Oklahoma City metropolitan area." *Id.* USGS scientists have also said that a magnitude 7 quake cannot be ruled out.[23]

The Future Hazards study confirms that more severe earthquakes are likely as a result of ongoing injection of Production Wastes into the ground through high-rate disposal wells. It states that earthquake clusters associated with long fault structures could give rise to magnitude 5 to 6 earthquakes. Examples include earthquakes associated with the Nemaha fault near Jones, in the Medford and Stillwater regions, and between Langston and Guthrie. Another example is the area around Cushing. Future Hazards at Figure 2. The paper concludes that the increased seismicity poses an elevated hazard to infrastructure and the regional population. According a recent paper, the Cushing area earthquakes are associated with reactivated faults that cut into the Arbuckle formation and a subsidiary fault called the Wilzetta-Whitehall.[24] That paper noted that most of the earthquakes do not lie along known fault structures but there may be other fault structures that are being reawakened by the injection that are associated with these earthquakes. *Id* The most recent paper notes that earthquake activity in this area has been above forecast and that "[i]nclusion of all recent Oklahoma earthquakes in the NSHM [hazard model] significantly increases ground shaking estimates and earthquake hazard . . ., which would result in serious implications for infrastructure design standards.[25]

These earthquakes have already caused considerable physical damage and mental disquiet. The scale to classify earthquakes is logarithmic, meaning that a magnitude 4 earthquake is 10 times more powerful than a magnitude 3, and a magnitude 5 earthquake is 100 times more powerful than a magnitude 3. Earthquakes of magnitude 6 to 7 cause widespread damage and considerable loss of life. A series of shocks over magnitude 5 in 2011, the largest of which was magnitude 5.6 in the Prague area of Oklahoma, destroyed at least 16 houses and collapsed an historic spire at Benedictine Hall at St. Gregory's University.[26] Repairing the spire cost about $5M dollars. In addition to the property damage, in nearby Shawnee the quakes have not only caused property damage but have also caused harm to people. For example, Sandra Ladra was at home watching television in her home in Prague, Oklahoma in November of 2011 when an earthquake caused the rock facing on her fireplace to fall. The rocks struck Ms. Ladra causing her significant injury. Appendix A contains a few photographs of the harm done to visually illustrate the harm already done and the potential for future harm. Obviously, if much stronger earthquakes over 6 in magnitude struck, far greater numbers of people could be harmed. In addition, storage tanks for oil and other products could be ruptured, causing widespread

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[22] Keranan et al., Sharp increase in central Oklahoma seismicity since 2008 induced by massive wastewater injection, Science Vol. 345, 448-451, 451 (July 3, 2014) ("Sharp Increase")

[23] NYT – April 27, 2015 – U.S. Maps pinpoint earthquakes available at http://www.nytimes.com/2015/04/24/us/us-maps-areas-of-increased-earthquakes-from-human-activity.html

[24] McNamara et al., McNamara, D., at al., Efforts to monitor and characterize the recent increasing seismicity in central Oklahoma, The Leading Edge June 2015 *available at* https://profile.usgs.gov/myscience/upload_folder/ci2015Jun0413582855600McNamaraTLE.pdf

[25] McNamara et al., Reactivated faulting near Cushing, Oklahoma: Increased potential for a triggered earthquake in an area of United States strategic infrastructure, Geophysical Research Letters (October 23. 2015) available at http://onlinelibrary.wiley.com/doi/10.1002/2015GL064669/pdf

[26] http://www.newyorker.com/magazine/2015/04/13/weather-underground

environmental damage, in addition to property damage and personal injuries. In particular, if a large earthquake struck the massive oil storage area in Cushing, huge amounts of oil could be released, causing massive environmental damage. If a large earthquake hit the Oklahoma City area, it could cause thousands of injuries and even fatalities.

Thus, the injection of large volumes of Production Wastes into the ground in Oklahoma is causing large numbers of moderate strength earthquakes. The constant increase in the number of these size earthquakes, standing alone, causes an imminent and substantial endangerment. That endangerment is only exasperated by the increasing likelihood of a devastating earthquake that could kill large numbers of people and cause massive environmental devastation. This notice letter serves to warn the four leading companies that are making money from this practice that Citizens will sue in federal court to protect themselves and their environment unless these companies substantially reduce the volumes of Production Wastes that they are injecting and take the other measures outlined in this letter to abate the present endangerment.

II. Defendants Have Violated and Are Violating RCRA by Causing Earthquakes and/or Contributing to Their Cause

After providing notice, Citizens are entitled to bring suit against "any person . . . who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment."[27] To show such a potential endangerment, Plaintiffs must show that "there is some reasonable cause for concern that someone or something may be exposed to a risk of harm." *Interfaith Community Organization v. Honeywell International*, Inc, 399 F. 3d 248, 259 (3d Cir. 2005). As discussed above, and shown in even more detail below, Defendants have contributed and are contributing to past and present handling, storage, and disposal of Production Wastes which is causing earthquakes that may present an imminent and substantial endangerment to health or the environment. They are therefore jointly and severally liable for the abatement of this endangerment.

A. New Dominion Has Disposed of Production Wastes that Caused Earthquakes or Contributed to Their Occurrence and is Continuing to Do So

The Sharp Increase study describes the mechanism for how high volume waste disposal wells cause earthquakes. The rate of wastewater injection increased rapidly from 2004 onwards, doubling between 2004 and 2008. The need for Production Waste disposal increased as non-conventional "dewatering" oil production increased. Dewatering production wells produce as much as 200 times the Production Wastes as conventional oil wells. This led to a rapid increase in disposal via injection. At the same time, the rate of earthquakes went up, establishing a direct correlation between injection and earthquake frequency. The Sharp Increase study went beyond that and showed that the high rate of injection was causing the swarm of earthquakes around Jones, which lies close to Oklahoma City to the northeast. New Dominion started operating the first high rate injection well just south of Oklahoma City in 2004. This well and the other three in the same area that followed built up to an injection rate of 3 million barrels per month. This high rate of injection caused pressure to build up in the ground. Sharp Impact at Figure 3. The Jones earthquake swarm started concurrently with the reporting of positive pressure at the wells. The scientists who wrote Sharp Increase showed that the wells were

[27] 42 U.S.C. § 6972(a)(1)(B).

contributing to an expanding zone of high pressure moving northeast. *Id.* at Figure 4. As the high-pressure zone moved northeast so did the earthquakes. *Id.* The four high volume New Dominion wells were responsible for 85% of the increase in pressure in this area. Analysis of the ground conditions showed that higher pressures than were present in 2014 would be needed to cause an earthquake directly along the Nemaha fault. However, the Sharp Increase scientists warned that if pressure built up further it could cause an earthquake of magnitude 7.

The diagrams showing the spatial and temporal correlation confirm the Sharp Increase findings. From 2011 to 2014 New Dominion has been injecting large volumes of Production Wastes. Figure 5. In 2011, New Dominion disposed of higher volumes of waste than the other Defendants combined. *Id.* New Dominion's disposal mainly occurred through four wells close to Oklahoma City on the Nemaha fault and a number near the Wilzetta fault to the east. Figure 6. In 2014, and probably other years, the bulk of this injection was into the Arbuckle Formation.[28] Figure 8. Between 2009 and 2011, 53 of the 54 greater than 3.5 magnitude earthquakes in Oklahoma occurred close to New Dominion's wells. Figure 7. Since then, the earthquake swarm in the Jones area has continued and extended into the Guthrie area. Figure 6. New Dominion's disposal of Production Wastes is causing or contributing to the earthquake risks in these areas. In addition, it is likely that New Dominion is contributing to the earthquake risk in the Cushing area. Thus, New Dominion has contributed and is contributing to the past and present handling, storage, and disposal of Production Wastes which is causing earthquakes in Oklahoma and southern Kansas that may present an imminent and substantial endangerment to health and the environment.

B. Sandridge Has Disposed of Production Wastes that Caused Earthquakes or Contributed to Their Occurrence and is Continuing to Do So

Before 2011 Sandridge had not injected high volumes of Production Wastes into the ground. Figure 5. In 2011 it had one or two major wells in the north central part of Oklahoma, but no earthquakes occurred near them between 2009 and 2011. Figure 7. That changed dramatically in 2013 and 2014 when Sandridge started injecting huge volumes of Production Waste into the ground. Figure 5. Furthermore, all of these wells are in the north central part of Oklahoma close to the Kansas border. Figure 6. In 2014, and probably other years, the bulk of this injection was into the Arbuckle Formation.[29] Figure 8. Since late 2013 a swarm of greater than magnitude-3 earthquakes developed in this area. Figure 6. This swarm extends into southern Kansas. [30] These earthquakes are continuing in 2015 and, as detailed above, are becoming more severe. Therefore, it is almost certain that Sandridge's handling and disposal of Production Wastes has contributed and is contributing to the northern swarm of earthquakes. In addition, it is probable that Sandridge is contributing to the earthquake risk in the Cushing area.. Thus, Sandridge has contributed and is contributing to the past and present handling, storage, and disposal of Production Wastes which is causing earthquakes in Oklahoma and southern Kansas that may present an imminent and substantial endangerment to health and the environment.

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[28] The injection databases for other years do not state the formation into which injection occurs. Even in 2014, some of this data is missing.

[29] The injection databases for other years do not state the formation into which injection occurs. Even in 2014, some of this data is missing.

[30] Future Hazards at Figure 2.

C. Chesapeake Has Disposed of Production Wastes that Caused Earthquakes or Contributed to Their Occurrence and is Continuing to Do So

Chesapeake has been disposing of high volumes of Production Wastes into the ground since before 2011. Figure 5. In 2011 it had a few major wells in the north central part of Oklahoma, but no earthquakes occurred near them between 2009 and 2011. Figure 7. It doubled its disposal volume in 2012, tripled it in 2013 and then reduced it slightly from 2013 levels in 2014. Figure 5. Furthermore, most of these wells are in the north central part of Oklahoma close to the Kansas border. Figure 6. In 2014, and probably other years, the bulk of this injection was into the Arbuckle Formation.[31] Figure 8. Since late 2013 a swarm of greater than magnitude 3 earthquakes developed in this area. Figure 6. This swarm extends into southern Kansas. [32] These earthquakes are continuing in 2015 and, as detailed above, are becoming increasingly severe. Therefore, it is almost certain that Chesapeake's handling and disposal of the Production Wastes has contributed and is contributing to the northern swarm of earthquakes. In addition, it is probable that Chesapeake is contributing to the earthquake risk in the Cushing area. Thus, Chesapeake has contributed and is contributing to the past and present handling, storage, and disposal of Production Wastes which is causing earthquakes in Oklahoma and southern Kansas that may present an imminent and substantial endangerment to health and the environment.

D. Devon Has Disposed of Production Wastes that Caused Earthquakes or Contributed to Their Occurrence and is Continuing to Do So

Devon started to dispose of high volumes of Production Wastes into the ground in 2012, but then ramped up its volume rapidly. Figure 5. All but two of its wells are between the Sandridge and Chesapeake wells in the north and the New Dominion wells in the south. Figure 6. In 2014, and probably other years, the bulk of this injection was into the Arbuckle Formation.[33] Figure 8. Since 2013 a swarm of greater than magnitude 3.5 earthquakes developed in this area. Figure 6. This swarm extends into at least the Cushing area. *Id.* These earthquakes are continuing in 2015 and, as detailed above, are becoming more severe. Therefore, it is probable that Chesapeake is contributing to the earthquake risk in the Cushing area and it may also be contributing to the other earthquake swarms. Thus, Devon has contributed and is contributing to the past and present handling, storage, and disposal of Production Wastes which is causing earthquakes in Oklahoma and southern Kansas that may present an imminent and substantial endangerment to health and the environment.

III. Conclusion

Defendants have violated, are currently violating, and will likely continue to violate the Resource Conservation and Recovery Act by managing and disposing of Production Wastes in the current manner and failing to abate the endangerment to which their past and present injection of Production Wastes have contributed and continue to contribute. Accordingly, unless these violations are corrected, Citizens intend to file suit to enjoin and abate the violations described above, ensure future compliance with federal law, recover attorneys' fees and costs of litigation, and obtain other appropriate relief.

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[31] The injection databases for other years do not state the formation into which injection occurs. Even in 2014, some of this data is missing.

[32] Future Hazards at Figure 2.

[33] The injection databases for other years do not state the formation into which injection occurs. Even in 2014, some of this data is missing.

More specifically, Citizens seek reduction or abatement of the volumes of Production Wastes being injected into the ground so that earthquake risks subside to natural levels, the establishment of an independent forecasting body that could investigate, analyze and predict the cumulative effect of injecting Production Wastes, reinforcement of structures that could be vulnerable to the current elevated earthquake risks, and other appropriate relief.

If you have any questions regarding the allegations in this notice or believe any of the foregoing information may be in error, please contact Richard Webster at the number listed below. In the absence of any questions, we would also welcome an opportunity to discuss a resolution of this matter prior to the initiation of litigation if you are prepared to address the violations noticed above within a reasonable time.

Sincerely,

/s

Richard Webster, Esq.

Public Justice
1825 K Street, NW Suite 200
Washington, D.C. 20006
rwebster@publicjustice.net
(202) 797-8600

Robin Greenwald
Weitz & Luxenberg, PC
700 Broadway
New York, NY 10003
rgreenwald@weitzlux.com
(212) 558-5802

Scott Poynter
Poynter Law Group
400 W. Capitol Ave., Suite 2910
Little Rock, AR 72201
scott@poynterlawgroup.com
(501) 251-1587

Counsel for Citizens

Bill Federman
Federman & Sherwood
10205 N Pennsylvania Ave,
Oklahoma City, OK 73120
wbf@federmanlaw.com
(405) 239-2112

Local Counsel for Citizens

cc:

Via Certified Mail, Return Receipt Requested

Gina McCarthy
Administrator
U.S. Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Mail Code: 1101A
Washington, DC 20460

Via Certified Mail, Return Receipt Requested

Ron Curry
Regional Administrator
U.S. Environmental Protection Agency Region 6
1445 Ross Avenue, Suite 1200.
Dallas, Texas 75202

Via Certified Mail, Return Receipt Requested

Loretta E. Lynch,
U.S. Attorney General
U.S. Department of Justice
950 Pennsylvania Avenue N.W.
Washington, DC 20530-0001

Via Certified Mail, Return Receipt Requested

Mr. Gary Sherrer
Secretary
Oklahoma Departmentof Environmental Quality
P.O. Box 1677
Oklahoma City, OK 73101-1677

Via Certified Mail, Return Receipt Requested

Mr Tim Baker
Oil and Gas Conservation Division
Oklahoma Corporation Commission
P.O. Box 52000
Oklahoma City, OK 73152-2000

cc. to service agents

Via Certified Mail, Return Receipt Requested

Chesapeake Operating, L.L.C.
Registered Agent: The Corporation Company
1833 S. Morgan Road
Oklahoma City, OK 73128

Via Certified Mail, Return Receipt Requested

Devon Energy Production Company, L.P.
Registered Agent: The Corporation Company
1833 S. Morgan Road
Oklahoma City, OK 73128

Via Certified Mail, Return Receipt Requested

New Dominion, LLC
Registered Agent: Fred Buxton
1307 S. Boulder Ave., Suite 400
Tulsa, OK 74119

Via Certified Mail, Return Receipt Requested

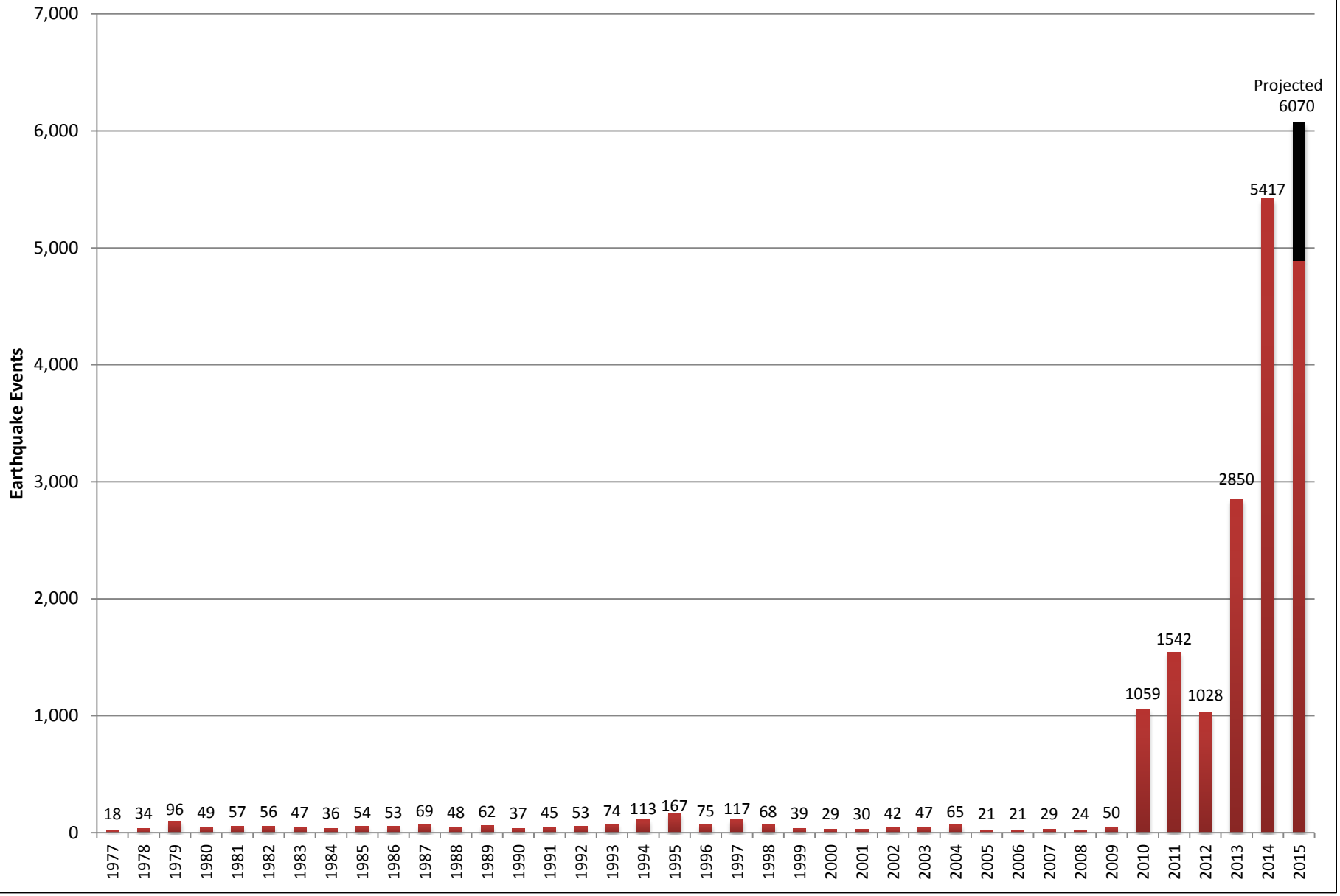
Sandridge Exploration and Production LLC
Registered Agent: The Corporation Company
1833 S. Morgan Road
Oklahoma City, OK 73128

Figures 1-8

Figure 1

Oklahoma Earthquakes

1977-2015 (through 10/21/15)

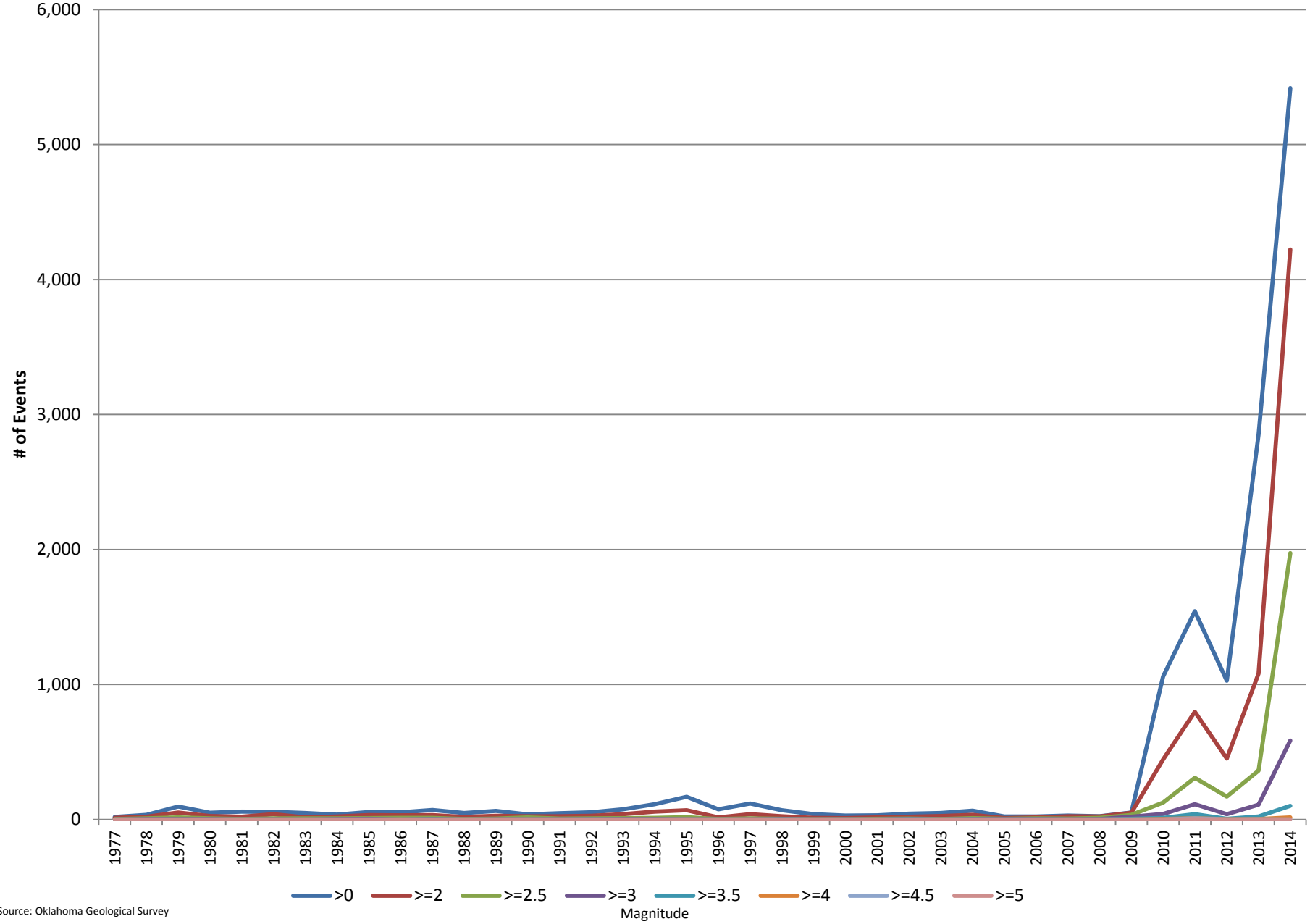


Source: Oklahoma Geological Survey

Projection based on average of 16.63 events/day as of 10/21/15

Figure 2

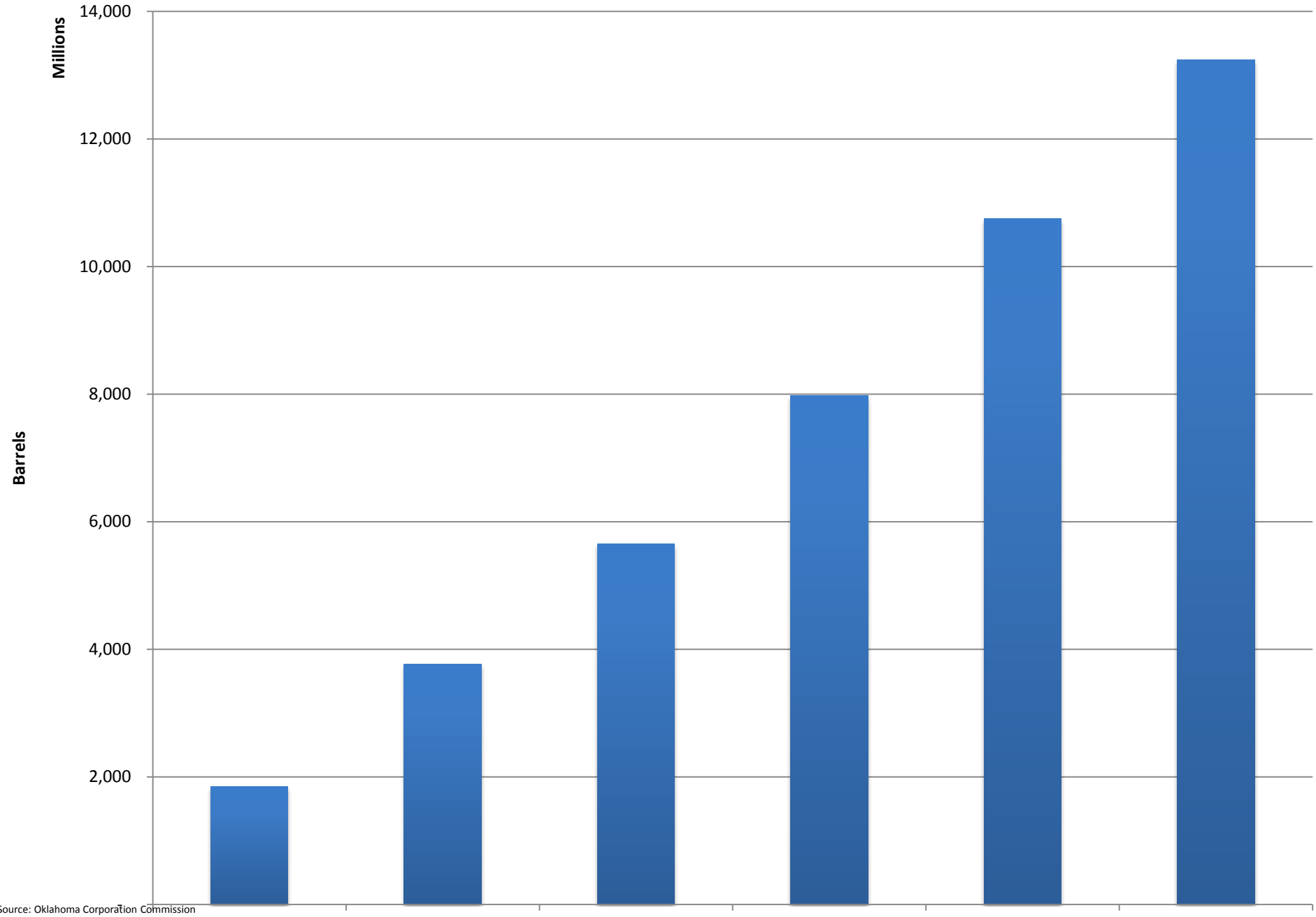
Number of Earthquake Events by Magnitude



Source: Oklahoma Geological Survey

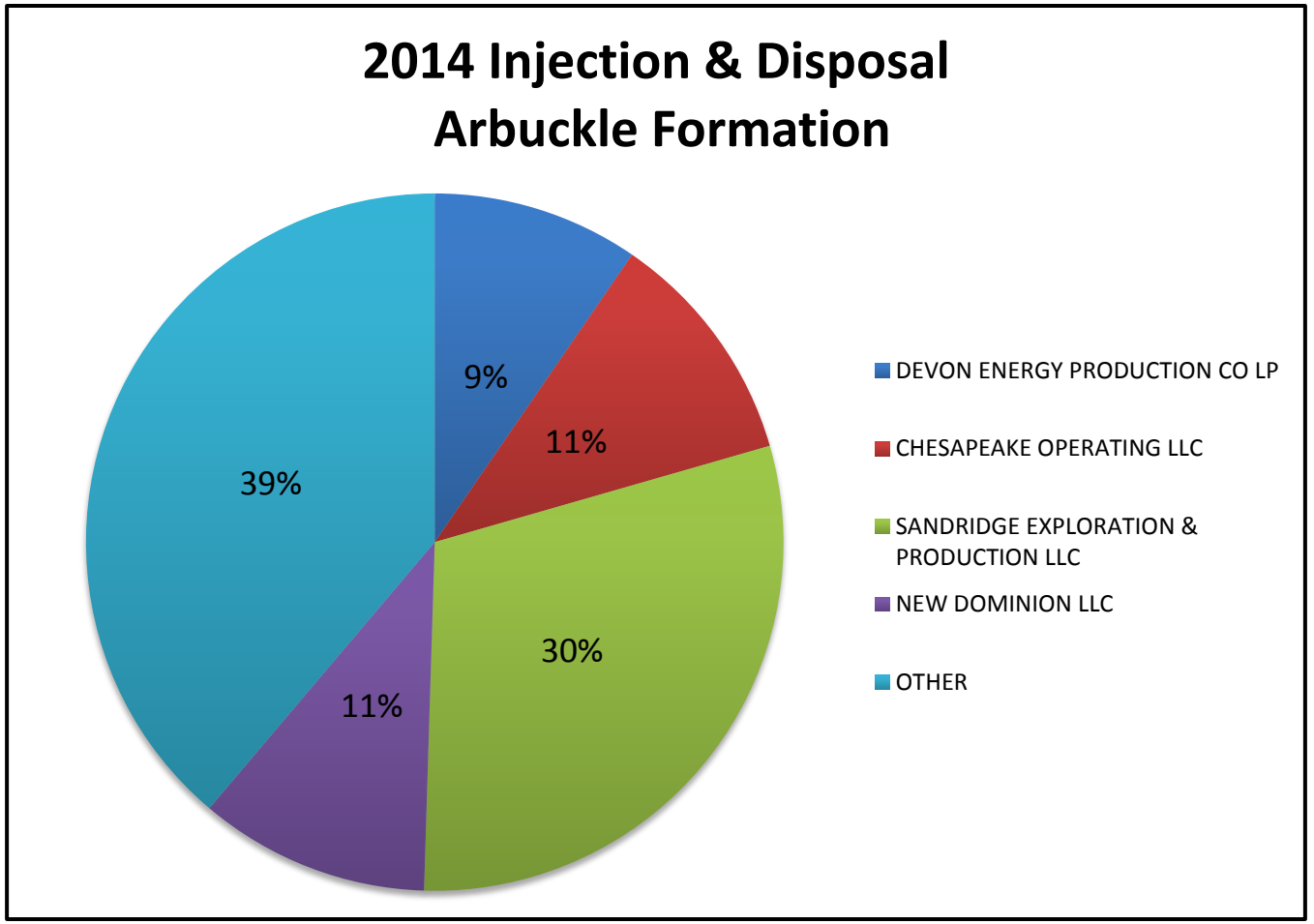
Figure 3

Oklahoma Cumulative Disposal & Injection Volume



Source: Oklahoma Corporation Commission

Figure 4



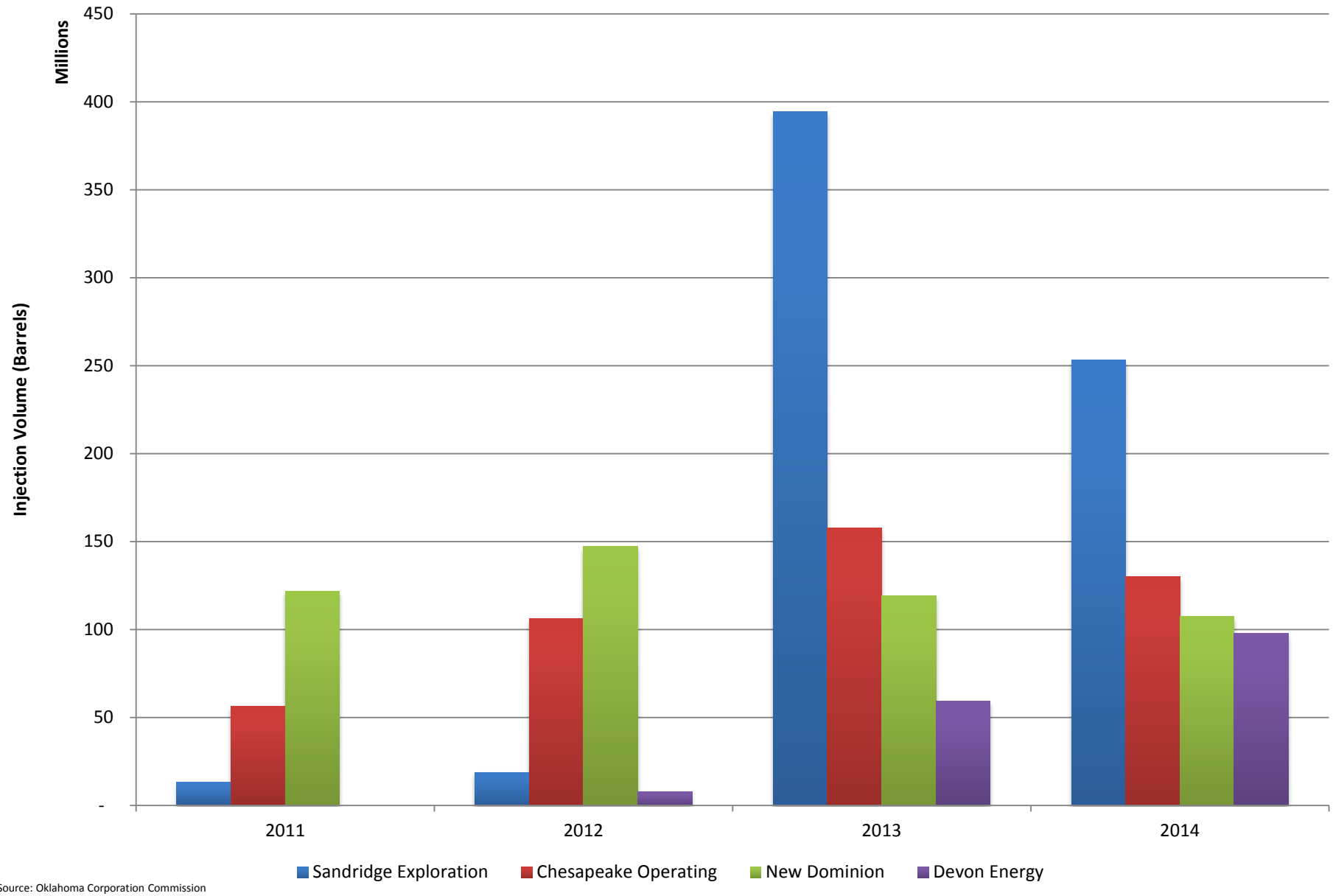
Operator	Injection Volume (bbls)
DEVON ENERGY PRODUCTION CO LP	64,555,296
CHESAPEAKE OPERATING LLC	73,885,836
SANDRIDGE EXPLORATION & PRODUCTION LLC	201,767,276
NEW DOMINION LLC	72,081,172
OTHER	261,551,899
TOTAL	**673,841,479**

Operator	# of Wells
DEVON ENERGY PRODUCTION CO LP	36
CHESAPEAKE OPERATING LLC	14
SANDRIDGE EXPLORATION & PRODUCTION LLC	91
NEW DOMINION LLC	6
OTHER	258

Source: Oklahoma Corporation Commission

Figure 5

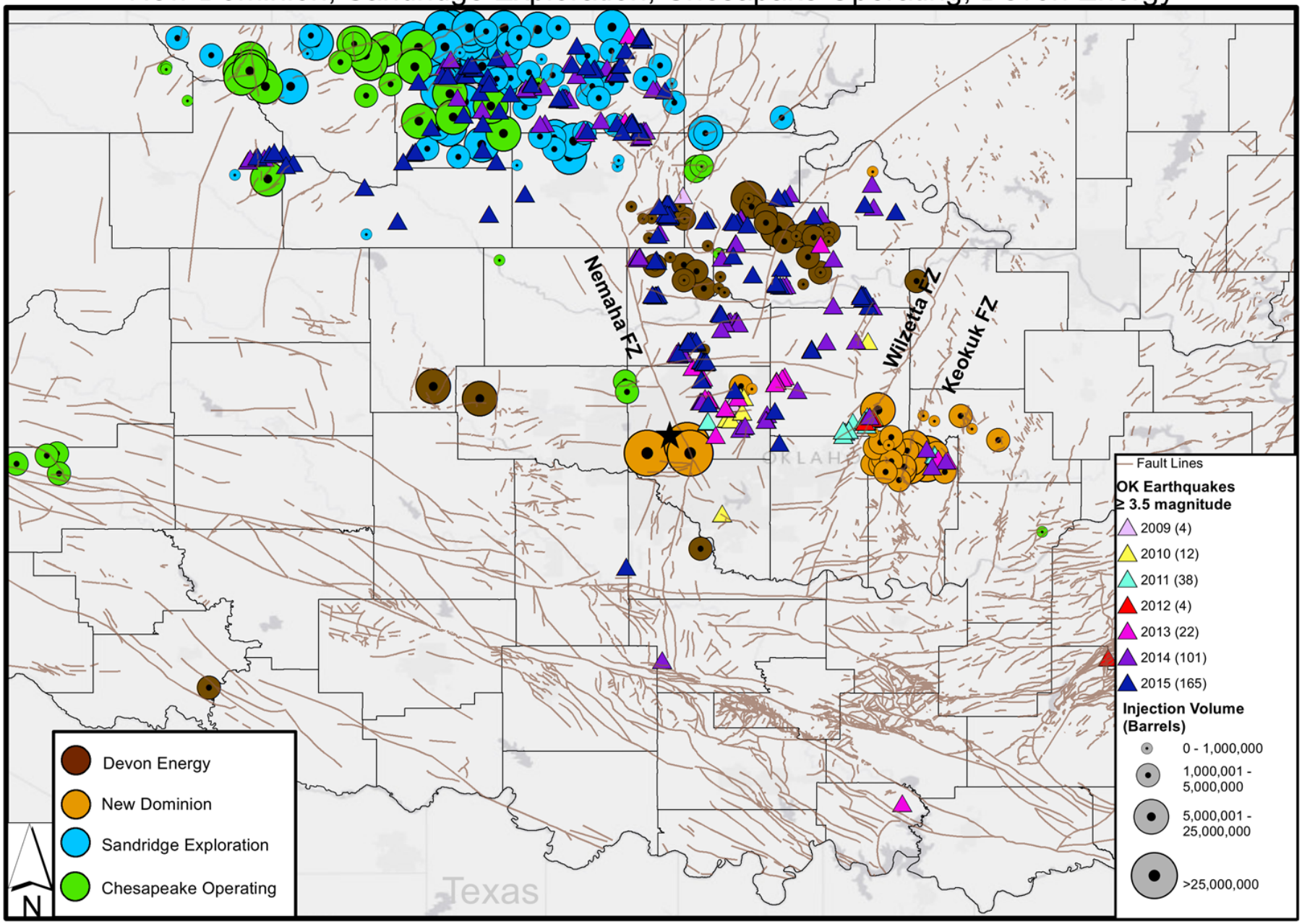
2011-2014
Injection & Disposal Volume



Source: Oklahoma Corporation Commission

Figure 6

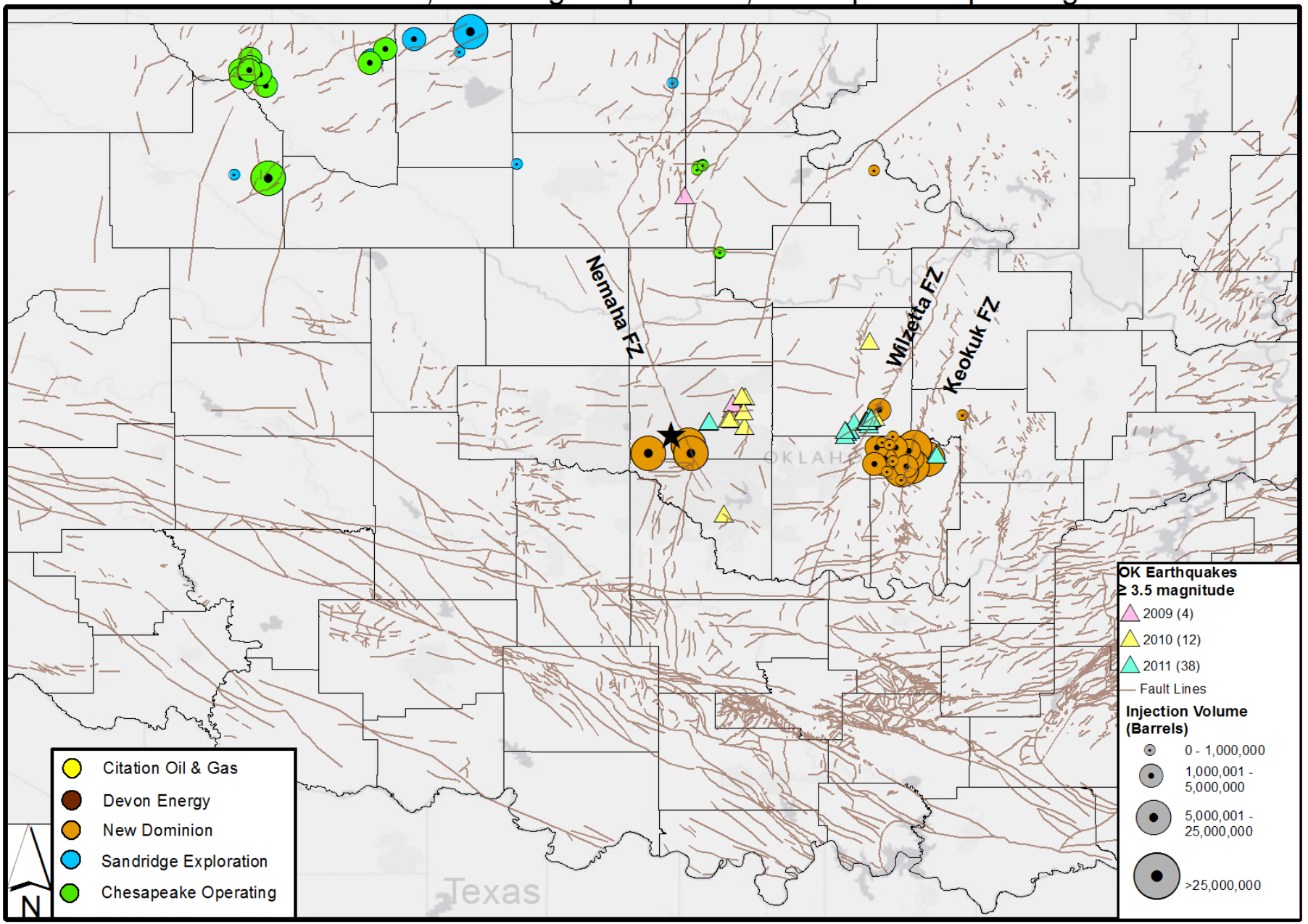
2011-2014 Cumulative Injection & Disposal
New Dominion, Sandridge Exploration, Chesapake Operating, Devon Energy



Fault Lines & Earthquakes - Oklahoma Geological Survey
Injection Well Locations & Volumes - Oklahoma Corporation Commission
Earthquakes Displayed ≥ 3.5 magnitude, 2015 earthquakes thru 10/12

Figure 7

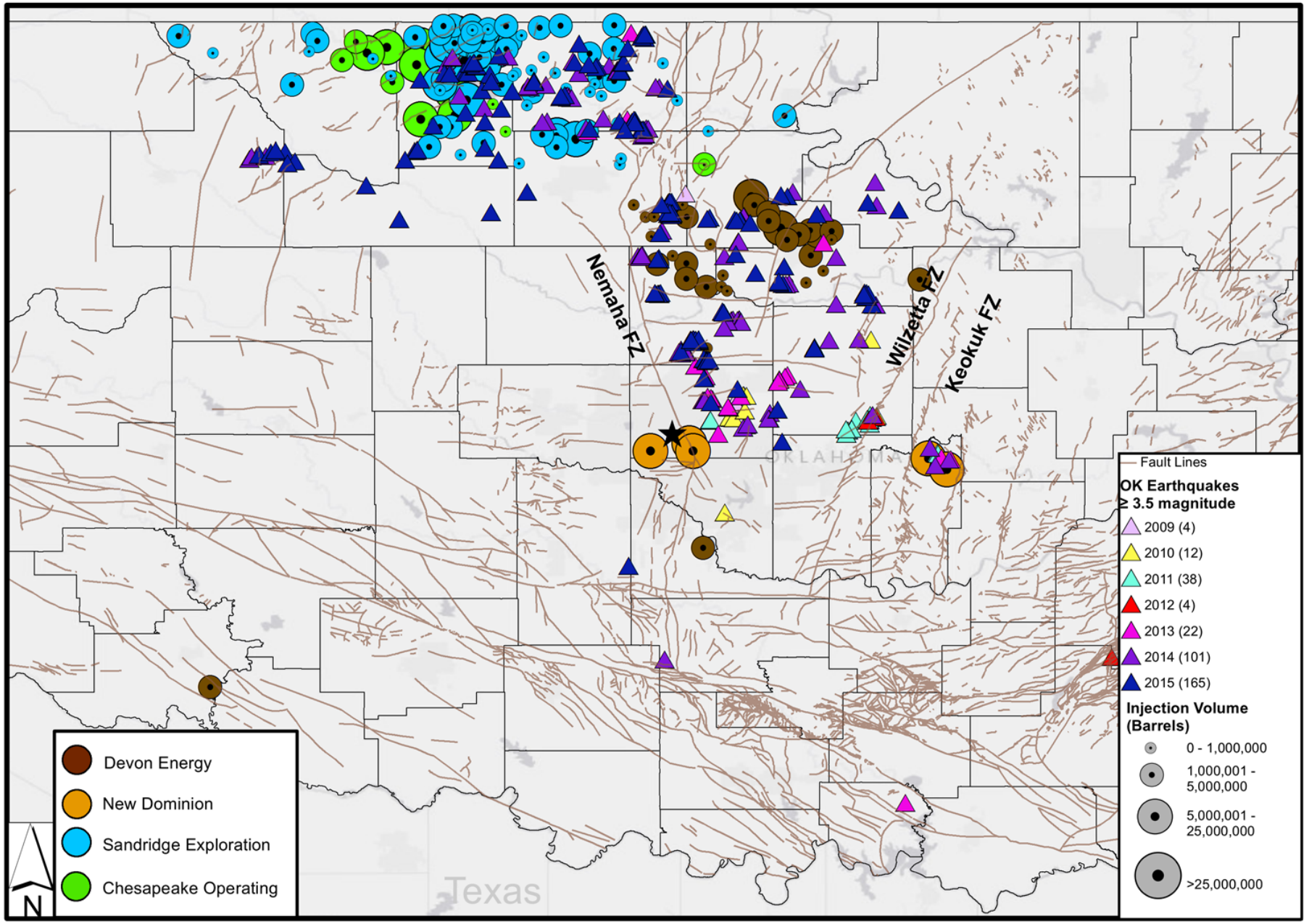
2011 Injection & Disposal
New Dominion, Sandridge Exploration, Chesapeake Operating



Fault Lines & Earthquakes - Oklahoma Geological Survey
Injection Well Locations & Volumes - Oklahoma Corporation Commission
Earthquakes Displayed ≥ 3.5 magnitude, 2015 earthquakes thru 10/12

Figure 8

2014 Injection & Disposal Volume
Arbuckle Formation



Fault Lines & Earthquakes - Oklahoma Geological Survey
Injection Well Locations & Volumes - Oklahoma Corporation Commission
Earthquakes Displayed ≥ 3.5 magnitude, 2015 earthquakes thru 10/12

Appendix A – Damage Already Caused By Earthquakes in Oklahoma