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What's Shakin'? *Ladra v. New Dominion, LLC*: A Case of Consequence for the Hydraulic Fracturing Industry and Those Affected by Induced Seismicity

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COMMENT

What's Shakin'?

Ladra v. New Dominion, LLC: A Case of Consequence for the Hydraulic Fracturing Industry and Those Affected by Induced Seismicity

JAMES PATRICK LOGAN*

I. INTRODUCTION

Few topics in the field of environmental law have been so vigorously contested in recent years as the extraction of natural gas via the hydraulic fracturing of subterranean rock formations. This process, known colloquially as “fracking,” has generated significant controversy and numerous debates over its apparent economic benefits and supposed environmental harms.¹ Proponents of the practice espouse beliefs that it will lower energy costs, provide jobs, and increase the United States’ level of energy independence.² Opponents, however, cite fears of water contamination, destruction of

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1. See, e.g., Juliette Kayyem, Op-Ed., *Re-thinking the Fracking Debate*, BOS. GLOBE (Aug. 22, 2011), http://belfercenter.hks.harvard.edu/publication/21261/re-thinking_the_fracking_debate.html [https://perma.cc/9GC8-ZG3S].

2. Nick Novak, *Fracking to Lower Energy Costs, Raise Disposable Income \$2,700 in 2020*, MACIVER INSTITUTE (Sept. 10, 2013), <http://www.maciverinstitute.com/2013/09/fracking-to-lower-energy-costs-raise-disposable-income-2700->

local ecosystems, contribution to climate change, and induced seismic activity.³ This case note discusses potential legal remedies for those affected by the latter; that is, whether those affected by anthropogenically induced seismic activity have a cause of action against those who induced earthquakes via hydraulic fracturing and its related activities.

This analysis will be accompanied by a study of a 2015 ruling of the Supreme Court of Oklahoma, *Ladra v. New Dominion, LLC*.⁴ The case considered the possibility of a private tort action by homeowners against the operators of injection wells proceeding within the state's judicial system, rather than simply being subject to review by a state regulatory agency. The court ultimately decided that the case would be allowed to continue within the judicial system instead of in front of a regulatory agency. This case, while not providing a "silver bullet" precedent with which future claimants can automatically win their cases against parties involved in fracking and waste disposal, does demonstrate that these claims are viable and ought to be dealt with in proper courts of law, rather than through administrative agencies.⁵

Section II of this case note contains a brief overview of the hydraulic fracturing process and the state of fracking in Oklahoma, the site of this note's principal case (*Ladra v. New Dominion*). Section III provides a history of the case and its central issues. Section IV discusses the ruling given, as well as the validity of the arguments made before the court. Section V examines the likelihood of success for the plaintiff *Ladra* and other homeowners seeking damages from the operators of injection wells due to earthquake-related harm done to their property or person. This section primarily assesses whether a preponderance of the evidence standard can be

in-2020 [<https://perma.cc/VM6M-SZBD>]; IHS, AMERICA'S NEW ENERGY FUTURE: THE UNCONVENTIONAL OIL & GAS REVOLUTION AND THE U.S. ECONOMY (2013), http://www.energyxxi.org/sites/default/files/pdf/Americas_New_Energy_Future_Phase3.pdf [<https://perma.cc/B8Y6-HWJG>]; Mark Thompson, *U.S. to Become Biggest Oil Producer*, CNNMONEY (Nov. 12, 2012), <http://www.money.cnn.com/2012/11/12/news/economy/us-oil-production-energy/index.html> [<https://perma.cc/V3DN-QQTK>].

3. See, e.g., MICHELLE BAMBERGER & ROBERT OSWALD, THE REAL COST OF FRACKING 1-18 (2014).

4. *Ladra v. New Dominion, LLC*, 353 P.3d 529 (Okla. 2015).

5. *Id.* at 532.

achieved when alleging that fracking activities caused earthquakes that resulted in property damage, and uses the arguments presented in the lower court during *Ladra v. New Dominion* as an example. Section VI considers the significance of the decision and what effect it may have on the hydraulic fracturing industry.

II. A BRIEF HISTORY OF FRACKING

Though Oklahoma is not as well known for its natural gas deposits as are Pennsylvania and Texas with the Marcellus and Barnett Shales, respectively, the state contains numerous shale formations that yield substantial quantities of natural gas.⁶ In fact, the first instances of massive hydraulic fracturing in the United States occurred in southern Oklahoma in 1968.⁷

The primary means of extracting natural gas from these shale formations is the unconventional drilling method of hydraulic fracturing. The process of fracking consists of drilling a wellbore vertically down into a shale formation, then turning and drilling horizontally through the rock.⁸ The wellbore is then filled with a pressurized fluid that creates, or expands existing, fissures within the rock to release natural gas, which is then recovered for use as an energy resource.⁹ Massive amounts of wastewater are left over from the fracking process,¹⁰ often containing salts, chemicals,

6. ALEX PRUD'HOMME, HYDROFRACKING: WHAT EVERYONE NEEDS TO KNOW 40-45 (2013).

7. Carl T. Montgomery & Michael B. Smith, *Hydraulic Fracturing: History of an Enduring Technology*, 62 J. PETROLEUM TECH. 26, 27 (2010).

8. See generally NAT'L ENERGY TECH. LAB. STRATEGIC CTR. FOR NAT. GAS & OIL, U.S. DEP'T OF ENERGY, MODERN SHALE GAS DEVELOPMENT IN THE UNITED STATES: AN UPDATE 47-51 (2013), <https://www.netl.doe.gov/File%20Library/Research/Oil-Gas/shale-gas-primer-update-2013.pdf> [<https://perma.cc/NL86-SR87>].

9. *Id.*

10. *Class II Oil and Gas Related Injection Wells*, EPA, <http://www.epa.gov/ui/class-ii-oil-and-gas-related-injection-wells> [<https://perma.cc/R4DZ-Y3CV>] (last updated Sept. 6, 2016) (an estimated 2 billion gallons of such wastewater are injected in the United States every day, mostly in Texas, California, Oklahoma, and Kansas). Much of this water is not solely leftover from liquid that was actually injected. Rather, a large amount of this leftover wastewater was already underground and is retrieved along with oil and natural gas. The product is then "de-watered" and captured, leaving as much as ten times as much residual water left over, which is then disposed of via injection wells. Rivka Galchen, *Weather Underground: The Arrival of Man-Made Earthquakes*, NEW YORKER, (Apr. 13, 2015), <http://www.newyorker.com/magazine/2015/04/13/weather-underground> [<https://perma.cc/34UZ-6FLT>].

heavy metals, and radioactive material.¹¹ Though some of this wastewater can be reused, much of it must be disposed, and injecting the waste back into rock formations deep underground is frequently the primary means of said disposal.¹²

Fracking elicits controversy due to its pollution risk at multiple points throughout the extraction and disposal processes, which could lead to serious harm to the environment and public health. There are multiple areas of concern, including possible atmospheric emissions from the wells and equipment, contamination of local groundwater via the fracturing of permeable rock formations, surface water pollution, and induced seismicity from the fracturing and injection processes.¹³ The precise relationship between fracking activities and earthquakes is unresolved, and explanations remain theoretical, but numerous geologists and geological organizations contend that added pore pressure from the injected fluid, in conjunction with the corresponding rock fracturing caused by that fluid, can “reduce forces acting to keep faults locked and trigger [earthquakes].”¹⁴

Currently, three rock formations form the basis for the fracking industry in Oklahoma: the Anadarko, Granite Walsh, and Woodford.¹⁵ Combined, these lie beneath the majority of the state of Oklahoma, subjecting much of the state to natural gas exploration in the last decade or so.¹⁶ Since the inception of this activity,

11. Valeria J. Brown, *Radionuclides in Fracking Wastewater: Managing a Toxic Blend*, 122 ENVTL. HEALTH PERSP. A50, A50-A51 (2014); REBECCA HAMMER & JEANNE VAN BRIESEN, NAT. RESOURCES DEF. COUNCIL, IN FRACKING’S WAKE: NEW RULES ARE NEEDED TO PROTECT OUR HEALTH AND ENVIRONMENT FROM CONTAMINATED WASTEWATER 23 (2012), <https://www.nrdc.org/sites/default/files/Fracking-Wastewater-FullReport.pdf> [<https://perma.cc/88S2-AAPK>].

12. Kelly O. Maloney & David A. Yoxtheimer, *Production and Disposal of Waste Materials from Gas and Oil Extraction from the Marcellus Shale Play in Pennsylvania*, 14 ENVTL. PRAC. 278, 278 (2012).

13. Valerie J. Brown, *Industry Issues: Putting the Heat on Gas*, 115 ENVTL. HEALTH PERSP. A76, A76 (2007).

14. Eric Hand, *Injection Wells Blamed in Oklahoma Earthquakes*, 345 SCI. 13, 13 (2014); *see also Induced Earthquakes*, USGS, <http://earthquake.usgs.gov/research/induced> [<https://perma.cc/H473-6LQ3>].

15. PRUD’HOMME, *supra* note 6, at 42 -46.

16. *See Gas Production in Conventional Fields, Lower 48 States*, ENERGY INFO. ADMIN. (Apr. 8, 2009), http://www.eia.gov/oil_gas/rpd/conventional_gas.pdf [<https://perma.cc/M7FM-ETS9>].

large parts of the state, once considered geologically stable,¹⁷ now experience far more, and far stronger, earthquakes than they have in the past.¹⁸

III. LADRA V. NEW DOMINION

A. Facts of the Case¹⁹

On November 5, 2011, Sandra Ladra was in her home in Prague, Oklahoma, with her family when the walls and floor began to shake.²⁰ A 5.0 magnitude earthquake had struck nearby, with aftershocks and subsequent earthquakes up to magnitude 5.7 (i.e., the Prague earthquake).²¹ The earthquake severely damaged several buildings, injured people, and buckled pavement.²² The Ladra family was not spared. The earthquake caused serious fractures in their home's two-story chimney.²³ As the chimney broke apart,

17. A. McGarr et al., *Coping with Earthquakes Induced by Fluid Injection*, 347 SCI. 830, 830 (2015).

18. Justin L. Rubinstein & Alireza Babaie Mahani, *Myths and Facts on Wastewater Injection, Hydraulic Fracturing, Enhanced Oil Recovery, and Induced Seismicity*, 86 SEISMOLOGICAL RES. LETTERS 1060, 1061 (2015). Up until 2008, Oklahoma experienced roughly one to two earthquakes of magnitude 3.0 or greater each year. Galchen, *supra* note 10. That number increased dramatically over the next several years, with Oklahoma experiencing 890 such earthquakes in 2015. *Oklahoma Earthquakes of Magnitude 3.0 or Greater*, USGS (Sept. 24, 2016), <http://earthquake.usgs.gov/earthquakes/byregion/oklahoma/OKeq-graph.gif> [<https://perma.cc/F5RV-APPS>].

19. *Ladra v. New Dominion, LLC*, 353 P.3d 529, 530 (Okla. 2015).

20. *Id.*

21. *See Magnitude 5.7 – Oklahoma: Earthquake Summary*, USGS, <http://earthquake.usgs.gov/earthquakes/eventpage/usp000jadn#executive> [<https://perma.cc/L2Y2-FU9X>] (last updated Sept. 6, 2016) (providing additional information on the earthquake central to this case. The discrepancy between magnitudes provided is due to the relative strength of the earthquake at difference distances from its epicenter, as well as whether the reported measurement is of an aftershock or the initial earthquake. All measured seismic events exceed 4.8, however).

22. *Id.*

23. *Ladra*, 353 P.3d at 530.

large chunks of rock fell to the floor. The falling rock struck Sandra's legs, seriously injuring her lower body.²⁴ She needed immediate medical treatment, and now claims personal injury damages exceeding \$75,000.²⁵

Ladra filed the suit in the District Court of Lincoln County.²⁶ In her action, Ladra claimed that hydraulic fracturing and the use of injection wells to dispose wastewater caused the earthquake that resulted in her injuries.²⁷ She asserted that the New Dominion, Spess Oil Company, and various John Doe defendants were liable for her injuries because their operation of injection wells was the proximate cause of the earthquake that caused those injuries.²⁸ The defendants moved to dismiss the case, objecting to Ladra's claim and contesting jurisdiction.²⁹

On October 16, 2014, the District Court dismissed the case, stating that exclusive jurisdiction on matters concerning oil and gas operations belonged not to trial courts, but to the Oklahoma Corporation Commission ("OCC").³⁰ Ladra filed a Petition in Error with the Supreme Court of Oklahoma, seeking review of the District Court's order.³¹

B. Case on Appeal

Aside from procedural matters, the primary issue before the court on appeal was whether jurisdiction with the district court was proper for the case. That is, should a private tort action concerning harm related to the effects of fracking and wastewater disposal be brought before a judge and jury or a state regulatory agency?³²

24. *Id.*

25. *Id.*

26. *Id.*

27. *Id.*

28. *Id.*

29. *Ladra*, 353 P.3d at 530.

30. *Id.*

31. *Id.*

32. *See generally* OKLA. STAT. tit. 17, § 52 (2016), for an overview of the structure of the OCC, a state-sanctioned regulatory agency, as well as the authority granted to it.

1. Appellant's Arguments

Ladra claimed that New Dominion and the District Court misinterpreted the jurisdictional authority granted to the OCC by Oklahoma statutes. Ladra first asserted that she has a legitimate private cause of action between her and the operators of the injection wells. She went on to argue that because her tort claim is between two private entities, the OCC had no authority to intervene and attempt to resolve it. Rather, she claimed the OCC only has the authority to adjudge matters concerning public rights as they relate to “the exploration, drilling, development, production and operation of wells used in connection with the recovery, injection or disposal of mineral brines.”³³ In addition, Ladra asserted that the Supreme Court of Oklahoma has jurisdiction to review actions by the OCC.³⁴

2. Appellees' Arguments

The Appellees (New Dominion and others) refuted Ladra's claims. Their argument focused primarily on the authorizing statute for the OCC, which states “[e]xcept as otherwise provided by this section, the Corporation Commission is hereby vested with *exclusive* jurisdiction, power and authority with reference to,” *inter alia*, field operations for oil and gas, exploration and drilling, and injection wells.³⁵ Given the limiting language, “except as otherwise provided by this section,” it seems that the OCC's jurisdiction is constrained to an extent. However, the only sections of the statute that provide jurisdiction to entities other than the OCC concern the pollution of water or transportation of waste.³⁶ Furthermore, nowhere does the statute assert that it applies only to public rights.³⁷ Accordingly, the plain-text reading of the statute endorsed by the Appellees produces the conclusion that the OCC does, in fact, have jurisdiction over this case, as the instant matter is in reference to several of the categories listed under section 52(A)(1) (such as exploration for oil and gas).³⁸

33. *Ladra*, 353 P.3d at 531.

34. *Id.*

35. Tit. 17, § 52(A)(1)(b) (emphasis added).

36. *See, e.g., id.* § 52(A)(6)-(7).

37. *See id.* § 52.

38. *See id.* § 52(A)(1).

IV. RULING

The Oklahoma Supreme Court found in favor of Ladra. The argument that this is a private cause of action, to which the OCC has no jurisdiction, succeeded.³⁹ In addressing the jurisdictional issues (whether the original case was properly filed, and whether the current court had the authority to review OCC recommendations) the court stated:

Appellees confuse the statutory grant of exclusive jurisdiction to the OCC to regulate oil and gas exploration and production activities in Oklahoma, with the jurisdiction to afford a remedy to those whose common law rights have been infringed by either the violation of these regulations or otherwise. Because this case does not seek to reverse, review, or modify an OCC order, but simply seeks to recover damages, jurisdiction is proper in the district court.⁴⁰

Given the pertinent Oklahoma case law on the matter, this is the correct outcome; even though the OCC's enabling statute provides it with jurisdiction over issues relating to many aspects of oil and gas development, and ultimately vests in the Commission many "powers of a court of record, [it] is without the authority to entertain a suit for damages."⁴¹ Accordingly, private tort actions, such as the one brought by Ladra, do not fall within the jurisdiction of Oklahoma state regulatory agencies. Instead, they fall "particularly within the jurisdiction of district courts," despite the fact that such matters may be related subject matter that state agencies typically regulate.⁴²

Finally, the Appellees' last argument, that the courts subject to this case do not have the authority to defeat a final judgment on a matter by the OCC, fails. While the Supreme Court of Oklahoma does grant that a "district court may not . . . levy a collateral attack 'upon the orders, rules and regulations of the [OCC]," it also held that such a collateral attack is not occurring in the present case.⁴³

39. *Ladra*, 353 P.3d at 532.

40. *Id.* (internal citations omitted).

41. *Rogers v. Quiktrip Corp.*, 230 P.3d 853, 857 (Okla. 2010); *see also* tit. 17, § 52 (again, covering the OCC's authority).

42. *Grayhorse Energy, LLC v. Crawley Petroleum Corp.*, 245 P.3d 1249, 1257 (Okla. Civ. App. 2010); *Tenneco Oil Co. v. El Paso Nat. Gas Co.*, 687 P.2d 1049, 1053-54 (Okla. 1984).

43. *Ladra*, 353 P.3d at 531 (citing OKLA. STAT. tit. 52, § 111 (2016)).

Long before this case, the Supreme Court of Oklahoma defined a collateral attack as “an attempt to avoid, defeat, evade, or deny the force and effect of a final order or judgment in an incidental proceeding other than by appeal, writ of error, certiorari, or motion for new trial.”⁴⁴ Accordingly, the only power a district court has to question the validity of a judgment or order of the OCC is to discern whether the OCC even had jurisdiction to issue the order.⁴⁵ Furthermore, an OCC order “does not immunize the operator, or other parties connected to the pooling order, from lawsuits in the district courts.”⁴⁶

Thus, in the case of *Ladra v. New Dominion*, New Dominion cannot hide behind the claim that the OCC should assert, or already has asserted, its exclusive jurisdiction over the matter. The courts have the authority to ascertain whether the OCC should have jurisdiction, as well as the ability to declare that the OCC was not the proper entity to hear the case. In *Ladra*, they did just that, and found that the OCC is not the proper venue because the issues of the case concern a private matter. This means that *Ladra*, and all others who may assert claims against the oil and gas industry as a whole, have the right to present their case to a judge or jury, rather than to a regulatory agency.

V. LIKELIHOOD OF FUTURE SUCCESS FOR THIS AND SIMILAR TORT ACTIONS

The jurisdictional issue of this case having been resolved, the remaining question for Sandra *Ladra* and other alleged victims of fracking/injection-associated earthquakes is whether they would actually win their case. The appellate case, itself, *Ladra v. New Dominion*, was a case of first impression; no other court in the country had provided precedent on whether an injured party can seek damages in district court for harm resulting from seismic activity caused by fracking and wastewater disposal processes. While numerous other cases have arisen in the time since *Ladra* first

44. *Nilsen v. Ports of Call Oil Co.*, 711 P.2d 98, 101 n.5 (Okla. 1985).

45. *Pelican Prod. Corp. v. Wishbone Oil & Gas, Inc.*, 746 P.2d 209, 212 (Okla. Civ. App. 1987).

46. *Grayhorse*, 245 P.3d at 1254.

made her claim, they have not produced definitive judgments.⁴⁷ Thus, there remains no precedent providing guidance on whether such a claim would even succeed.⁴⁸

Potential enlightenment on this issue comes from a few previous, albeit distantly related, cases. For example, in *Hiser v. XTO Energy*, a jury initially ruled in favor of a plaintiff seeking damages for, among other things, damaging “vibrations” to her home.⁴⁹ However, this ruling was almost overturned when it became apparent that some members of the jury had used outside information relating to fracking to arrive at their verdict (fracking had not been mentioned in the case, itself, and was not strictly at issue).⁵⁰ Other fracking-related cases typically allege contamination of water supply, nuisance claims, and land use violations, but not damage from earthquakes.⁵¹ Given the lack of direction from other courts on how to handle this case, the ultimate decision in *Ladra v. New Dominion*, may be a novel one.

In her claim, Ladra filed two counts against the defendant hydraulic fracturing companies. The first is one of absolute liability, wherein she states:

Defendants’ actions described above are ultra-hazardous activities that necessarily involve a risk of serious harm to a person that cannot be eliminated by the exercise of the utmost care and is not a matter of common usage. As a direct and proximate result of Defendants’ ultra-hazardous activities, plaintiff sustained personal injuries, to which Defendants are strictly liable.⁵²

The second count is one of negligence:

47. See, e.g., *Cooper v. New Dominion, LLC*, No. CJ-2015-24 (D. Lincoln Cty., Okla. Feb. 10, 2015); *Sierra Club v. Chesapeake Operating, LLC*, No. 5:16-cv-00134 (W.D. Okla. Feb. 16, 2016).

48. Walter H. Boone & Mandie B. Robinson, *Whole Lotta Shakin’ Going On: Recent Studies Link Fracking and Earthquakes*, 82 DEF. COUNS. J. 68, 74 (2015).

49. *Hiser v. XTO Energy*, No. 4:11CV00517 KGB, 2013 WL 5467186, at 3 (E.D. Ark. Sept. 30, 2013).

50. *Id.* at *8, *11.

51. See Boone & Robinson, *supra* note 48, at 74-75 (explaining the type of fracking cases that have arisen in the past, and outlining their varying rates of success).

52. Petition at 5, *Ladra v. New Dominion, LLC*, 353 P.3d 529 (Okla. 2015) (No. C3-2014-115).

The Defendants owed a duty to Plaintiff to use ordinary care and not to operate or maintain their injection wells in such a way as to cause or contribute to seismic activity. Defendants, experienced in these operations, were well aware of the connection between injection wells and seismic activity, and acted in disregard of these facts. As a direct and proximate result of these facts, omissions, and fault of the Defendants, the Plaintiff suffered injuries reasonably foreseeable to the Defendants.⁵³

As these two claims form the basis of Ladra's complaint, they will form the basis of this case note's analysis of potential liability for extractors of natural gas. Note, however, that there exist other theoretical avenues for liability, such as nuisance, trespass, etc.⁵⁴

A. Ladra's absolute liability claim may succeed.

For the claim of absolute liability to succeed, Ladra must prove, by a preponderance of the evidence,⁵⁵ that the activity engaged in by the defendants was abnormally dangerous, and that it was the proximate cause of her injuries. To establish that the activity was abnormally dangerous is not difficult. Oklahoma courts have simply applied the factor test seen in the Restatement of Torts.⁵⁶ To qualify as abnormally dangerous, one must consider whether the activity qualifies as any of the following:

- a) existence of a high degree of risk of some harm to the person, land or chattels of others;
- b) likelihood that the harm that results from it will be great;
- c) inability to eliminate the risk by the exercise of reasonable care;

53. *Id.*

54. *See, e.g.*, Lucas Saterlee, *Shattered Nerves: Addressing Induced Seismicity Through the Law of Nuisance*, 46 ENVTL. L. REP. NEWS & ANALYSIS 10326, 10331 (2016).

55. "The 'preponderance of the evidence' means evidence sufficient to satisfy the trier of fact that the proposition on which the party has the burden of proof is more probably true than not true." 7 EMMA V. ROLLS, JEAN E. GILES & LAURIE W. JONES, OKLAHOMA PRACTICE SERIES, TRIAL PRACTICE § 5:6 (2009). Or, in laymen's terms, the "preponderance of the evidence" standard is met when there is evidence sufficient to convince a judge or jury that the allegations or facts asserted by the party with this burden are more likely than not to be true.

56. *See* Reece v. AES Corp., No. CIV-12-0457-JH, 2014 WL 61242, at 7 n.15 (E.D. Okla. Jan. 8, 2014).

- d) extent to which the activity is not a matter of common usage;
- e) inappropriateness of the activity to the place where it is carried on; and
- f) extent to which its value to the community is outweighed by its dangerous attributes.⁵⁷

Of these six, the first and second factors arguably support Ladra's claim, and additional arguments could possibly be made for the remaining four, pending more information concerning the manner in which New Dominion and other injection well operators in the area operate.⁵⁸ Ladra may argue that there is inherently a high degree of risk involved in the oil and gas drilling industry, especially given the sheer magnitude of the dangerous materials and equipment in use during the fracking process. In addition, she could claim that, given for the growing evidence that earthquakes are caused by fracking activities, it follows that the likelihood harm will result from fracking or operating injection wells is great. However, the other factors listed in the Restatement, as well as the weight of legal precedent, undermine, or at least fail to support, Ladra's claim.

For an activity to be abnormally dangerous due to a high risk of harm: "The harm threatened must be major in degree, and sufficiently serious in its possible consequences. It is not enough that there is a recognizable risk of some relatively slight harm,

57. RESTATEMENT (SECOND) OF TORTS: ABNORMALLY DANGEROUS ACTIVITIES § 520 (AM. LAW INST. 1977). One should note however, that this test is not absolute. It only provides guidance for the court, which is to consider all of these factors and come to a conclusion. An activity that arguably meets all of the factors need not be determined as ultrahazardous, just as an activity that only meets one factor could be deemed ultrahazardous.

58. It is worth noting that there is anecdotal evidence suggesting that the risk of earthquakes can be decreased or eliminated as per factor "c":

In Youngstown, Ohio, in 2011, after dozens of smaller quakes culminated in a 4.0, a nearby disposal well was shut down, and the earthquakes stopped. Around the same time, in Arkansas, a series of earthquakes associated with four disposal wells in the Fayetteville Shale led to a ban on disposal wells near related faults. Earthquakes were also noted in Colorado, Kansas, and Texas. There, too, relevant disposal wells were shut down or the volume of fluid injected was reduced and the earthquakes abated.

Galchen, *supra* note 10. However, these cases speak neither to the situation in Oklahoma, nor to the reasonableness of the measures taken to reduce or eliminate those risks.

even though that risk might be sufficient to make the actor's conduct negligent."⁵⁹ The defendants' activities will likely not meet this standard, though they may still be satisfactory for the negligence claim. Fracking and the use of injection wells are widespread activities that are viewed as dangerous by environmental advocates, but have not actually yielded significant, extensive harm sufficient to label them as abnormally dangerous.⁶⁰ Common examples of ultra-hazardous activities include those involving storage of explosives or the use of atomic energy; the relatively minor earthquakes primarily associated with fracking, though damaging to property, have not yet reached this level of danger.⁶¹

Furthermore, while the Oklahoma courts have yet to explicitly rule on whether fracking and oil drilling activities are ultra-hazardous, a myriad of other courts have come to the conclusion that they are not abnormally dangerous *per se*.⁶² However, it is important to note that previous cases dealt with worries over water pollution, hazardous waste, and explosions related to fracking. There is no precedent concerning induced earthquakes as they relate to fracking's qualification as an ultra-hazardous activity. Regardless, the Oklahoma courts could see the dramatic rise in the frequency and magnitude of Oklahoman earthquakes as a harbinger for further seismic risk related to fracking and injection wells. If they decide that fracking and waste injection is accordingly ultra-hazardous, the courts could provide a new means for strict liability claims to proceed.

Even if Ladra were able to convince a reasonable fact-finder that the fracking operations near her home are abnormally dangerous activities that necessarily fall under the purview of absolute

59. RESTATEMENT (SECOND) OF TORTS § 520.

60. *See* Boone & Robinson, *supra* note 48.

61. RESTATEMENT (SECOND) OF TORTS § 520.

62. *See, e.g.*, *Ely v. Cabot Oil & Gas Corp.*, 38 F.Supp.3d 518, 529 (M.D. Pa. 2014) (wherein the court adopted the findings of a magistrate judge that the risks from a properly drilled, cased, and fractured well are minimal); *Armes v. Petro-Hunt, LLC*, No. 4:10-cv-078, 2012 WL 1493740 at *3 (D.N.D. Apr. 27, 2012) (District Court for the northwest division of North Dakota stated that plaintiff did not present sufficient evidence that hydraulic fracturing is an abnormally dangerous activity even after plaintiff was injured by an explosion at a fracking/injection well site); *Williams v. Amoco Prod. Co.*, 734 P.2d 1113, 1123 (Kan. 1987) (Supreme Court of Kansas held that the operation of natural gas wells is not, in itself, abnormally dangerous, even when that operation may pollute neighboring farms' water).

liability, her claim would not yet be complete. There remains the issue of whether or not she can demonstrate that fracking and wastewater injection were the proximate cause of her injuries. This question requires a great deal of analysis and will be discussed later on in this section.

B. Ladra's negligence claim may succeed.

To successfully establish negligence on behalf of New Dominion and the other defendants, Ladra must show that each of the following four common law elements of negligence are met:

The actor is liable for an invasion of an interest of another, if:

- a) the interest invaded is protected against unintentional invasion, and
- b) the conduct of the actor is negligent with respect to the other, or a class of persons within which he is included, and
- c) the actor's conduct is a legal cause of the invasion, and
- d) the other has not so conducted himself as to disable himself from bringing an action for such invasion.⁶³

Ladra should have no trouble proving the first element for a cause of action for negligence. The destruction of her home and harm to her person surely qualifies as an interest that is protected against unintentional invasion. While the second and fourth elements are not quite so easily met, they also should not pose a significant barrier to the claim. Parties have a general duty to use reasonable care in their activities so as not to cause significant harm to others.⁶⁴ In this case, Ladra alleges that the defendants have a duty "not to operate their injection wells in such a way as to cause or contribute to seismic activity," which could, in turn, cause serious harm to others.⁶⁵ Arguments aside over whether or not fracking can cause or contribute to seismic activity, it is reasonable to assert that fracking and injection well operators have a duty to conduct their activities in a manner that will not trigger

63. RESTATEMENT (SECOND) OF TORTS: STATEMENT OF THE ELEMENTS OF A CAUSE OF ACTION FOR NEGLIGENCE § 281 (AM. LAW. INST. 1977).

64. See RESTATEMENT (SECOND) OF TORTS: ACTS DANGEROUS INTRINSICALLY OR BECAUSE OF MANNER OF PERFORMANCE § 297 (AM. LAW. INST. 1977).

65. Petition at 5, *Ladra v. New Dominion, LLC*, 353 P.3d 529 (Okla. 2015) (No. C3-2014-115).

significant earthquakes. In addition, if one concedes the notion that fracking and injection can contribute to seismic activity, then those operating the wells ought to be aware of this connection given their experience in the field and the increasing awareness of a link between these activities and earthquakes. This, in turn, adds to the claim that the defendants were negligent (or possibly even grossly negligent) because they continued to operate the injection wells despite knowing of the relationship between fracking and earthquakes. Therefore, the three out of the four elements outlined above can be met. This leaves a fact-finder with the same question remaining as in the absolute liability claims: whether or not a plaintiff can establish proximate cause between fracking operations and the earthquakes that damaged their person or property.

C. A plaintiff can conceivably establish a causal link between the operation of fracking and injection wells and increases in the frequency and magnitude of earthquakes.

Oklahoma and its surrounding states have long been considered part of a geologically stable area, with little or no significant seismic activity.⁶⁶ However, beginning circa 2001, and especially after 2009, there has been a steady rise in the prevalence and magnitude of earthquakes in the mid-continent region.⁶⁷ While this increased frequency could simply be a naturally occurring cluster, which is not an unheard of possibility for intraplate earthquakes,⁶⁸ that conclusion is not supported by a thorough study of the Oklahoma earthquake signatures.⁶⁹

The showing of a causal link between fracking and these earthquakes would be of particular significance for Oklahoma, as

66. McGarr et al., *supra* note 17, at 830 (describing the seismic activity of Oklahoma and the surrounding region over the last several decades).

67. *Id.*

68. See, e.g., Dan Clark, Andrew McPherson & Russ Van Dissen, *Long-term Behaviour of Australian Stable Continental Region (SCR) Faults*, 566 TECTONOPHYSICS 1 (2012).

69. Andrea L. Llenos & Andrew J. Michael, *Modeling Earthquake Rate Changes in Oklahoma and Arkansas: Possible Signatures of Induced Seismicity*, 103(5) BULL. SEISMOLOGICAL SOC'Y AM. 2850 (2013) (showing that the seismic data related to these earthquakes indicates that they are more likely of anthropogenic origin than simply natural phenomena; this will be discussed further on *infra* notes 78, 79).

it has seen a greater increase in the incidence and magnitude of earthquakes in the last decade than any other state in the continental U.S.⁷⁰ Though there is not yet a complete consensus within the scientific community, with the publication of numerous new studies over the last several years, there is a prevalent and growing belief that fracking and earthquakes are indeed related.⁷¹

Earthquakes are typically caused by the shifting of Earth's tectonic plates, specifically when the forces on either side of a fault (a planar fracture in the rock comprising the earth's surface) grow too large and cause the land on either side of the fault to "slip," or slide along or past each other.⁷² In addition to this natural phenomenon, earthquakes can also be caused by human activity, such as the retaining of massive amounts of water in dams, mining coal, drilling for oil, and, perhaps, operating fracking rigs and injection wells.⁷³ Thus, while earthquakes were previously thought of solely as acts of God, a greater increase in the understanding of their causes over the last several decades has revealed that that is not always the case.⁷⁴

70. Richard A. Oppel & Michael Wines, *As Quakes Rattle Oklahoma, Fingers Point to Oil and Gas Industry*, N.Y. TIMES, Apr. 3, 2015, at A1; see William L. Ellsworth, *Injection-Induced Earthquakes*, 341 SCI. 142 (2013) (showing the dramatic rise in seismicity in the past several years compared to historic rates).

71. See, e.g., AUSTIN HOLLAND, OKLAHOMA GEOLOGICAL SURVEY, EXAMINATION OF POSSIBLY INDUCED SEISMICITY FROM HYDRAULIC FRACTURING IN THE EOLA FIELD, GARVIN COUNTY, OKLAHOMA (2011), http://www.ogs.ou.edu/pubsscanned/openfile/OF1_2011.pdf [<https://perma.cc/HL3G-E3HY>].

72. See *Earthquakes Overview*, PAC. NW. SEISMIC NETWORK, <http://pnsn.org/outreach/about-earthquakes> [<https://perma.cc/U9DM-P7VE>].

73. See Pradeep Talwani & Steve Acree, *Pore Pressure Diffusion and the Mechanism of Reservoir-Induced Seismicity*, 122 PURE & APPLIED GEOPHYSICS 947 (1985) (outlining the manner in which the storage of large amounts of water in reservoirs can induce earthquakes); see also S. K. GUHA, *INDUCED EARTHQUAKES* (2000) (describing the effect that mineral mining can have on area seismicity); Susan E. Hough & Morgan Page, *A Century of Induced Earthquakes in Oklahoma?*, 105(6) BULL. SEISMOLOGICAL SOC'Y AM. 2863 (2015) (describing the relationship between fracking activity, particularly with respect to wastewater disposal in injection wells, and seismic activity); Mark D. Zobak & Jens C. Zinke, *Production-induced Normal Faulting in the Valhall and Ekofisk Oil Fields*, 159 PURE & APPLIED GEOPHYSICS 403 (2002) (describing how more traditional oil drilling can induce seismic activity).

74. See 1 AM. JUR. 2D *Act of God* § 1 (2015).

A 2014 study links four of Oklahoma's most prolific injection wells to a cluster of 2,547 small earthquakes.⁷⁵ The scientists who authored the paper state that they believe the increase in Oklahoman earthquakes can be attributed to the disturbance to rock formations caused by fracking and the disposal of fracking wastewater in injection wells, and that these wells can increase seismicity.⁷⁶ And while previous studies have failed to account for the much larger magnitude earthquakes that have occurred in recent years (early models predicted fracking-induced earthquakes would not exceed a magnitude of 2.0),⁷⁷ this study provides an explanation for how fracking results in damaging earthquakes of significant magnitude:

We view the expanding Jones earthquake swarm as a response to regionally increased pore pressure from fluids primarily injected at the SE OKC wells. As the pressure perturbation expanded and encountered faults at various orientations, critically stressed, optimally oriented faults are expected to rupture first. Additional faults at near-optimal orientations may rupture after further pressure increase. As fluid pressure continues to propagate away from the wells and disturbs a larger and larger volume, the probability increases that fluid pressure will encounter a larger fault and induce a larger-magnitude earthquake.⁷⁸

In laymen's terms, the added stress and fissures caused by the injection of wastewater into these wells increases the pressure of the liquid in the rock formation. This, in turn, lubricates nearby faults in the rock, making them more likely to succumb to tectonic stress and slip. As fluid pressure in the rock continues to build and these minor slips propagate away from the original injection site, they are more likely to encounter and weaken a larger fault and

75. Nick Ramsey, *New Study Links Oklahoma Earthquakes to Fracking*, MSNBC (July 8, 2014, 7:33 PM), <http://www.msnbc.com/the-last-word/oklahoma-earthquakes-linked-fracking-study> [<https://perma.cc/FST9-VYTG>]; see K. M. Keranen et al., *Sharp Increase in Central Oklahoma Seismicity Since 2008 Induced by Massive Wastewater Injection*, 345 SCI. 448 (2014).

76. Keranen et al., *supra* note 75, at 451. "Modern, very high-rate injection wells can therefore affect regional seismicity and increase seismic hazard." *Id.*

77. See F. Rall Walsh III & Mark D. Zoback, *Oklahoma's Recent Earthquakes and Saltwater Disposal*, 1 SCI. ADVANCES 1 (2015).

78. Keranen et al., *supra* note 75, at 450-51.

contribute to a much greater slip. That slip releases potential energy stored on either side of the fault and produces a significant, and greater than expected, earthquake.⁷⁹

The 2014 study accounts for the unexpected increase in the magnitude of earthquakes in particularized regions due to injection well activity.

Keranen *et al.*, show the steep rise in earthquakes in Oklahoma, USA, is likely caused by fluid migration from wastewater disposal wells. Twenty percent of the earthquakes in the central United States could be attributed to just four of the wells. Injected fluids in high-volume wells triggered earthquakes over 30 km away.⁸⁰

Additionally, Keranen offers an explanation for the increase in frequency of seismic activity in some areas but not others.

The absence of earthquakes in regions above the critical pressure threshold may result from either a lack of faults or lack of well-oriented, critically stressed faults. Alternatively, fluid flow may preferentially migrate along bedding structure (Fig. 2A).⁸¹

The above study is only one example of the increased understanding of how fracking and seismicity interact, a connection that has been theorized for decades, but only recently supported with intense modeling based on detailed datasets rather than just demonstrations of correlations between earthquakes and certain activities.⁸² As science progresses, understanding of this relationship will only increase.

D. Ladra can establish proximate cause between local

79. See generally William Ellsworth, Jessica Robertson & Christopher Hook, *Science Features: Man-Made Earthquakes Update*, USGS (Jan. 17, 2014, 1:00 PM), http://www.usgs.gov/blogs/features/usgs_top_story/man-made-earthquakes [<https://perma.cc/XVU6-XYU>].

80. K. M. Keranen *et al.*, *Water Disposal Linked to Earthquakes*, *SCI.* (July 25, 2014), <http://science.sciencemag.org/content/345/6195/448?keytype=ref&siteid=sci&ijkey=3dn.4mOXpb5fM> [<https://perma.cc/2S55-EN26>].

81. Keranen *et al.*, *supra* note 75, at 451.

82. See, e.g., K. M. Keranen *et al.*, *Potentially Induced Earthquakes in Oklahoma, USA: Links Between Wastewater Injection and the 2011 M_w 5.7 Earthquake Sequence*, 41 *GEOLOGY* 699 (2013); D. E. McNamara, *Efforts to Monitor and Characterize the Recent Increasing Seismicity in Central Oklahoma*, 34(6) *LEADING EDGE* 628 (2015); Danielle F. Summy *et al.*, *Observations of Static Coulomb Stress Triggering of the November 2011 $M_{5.7}$ Oklahoma Earthquake Sequence*, 119 *J. GEOPHYSICAL RES.* 1904 (2014).

fracking activities and the injury to her person and property.

There still remains the question of whether individual earthquakes, rather than just a growing trend of seismic activity, can be attributed to fracking operations. For the *Ladra* case, the question is specifically whether one can show that the Prague Earthquake was caused by nearby fracking operations, and whether the parties responsible for the earthquake must be held liable for the damage it caused. In order to do so, *Ladra* must show that the well operators *proximately caused* the earthquake that caused her injury. It is not enough for the fracking or disposal to have set off some string of events leading to the injury, rather “[t]he connection between the [fracking activity] and the injury must be a direct and natural sequence of events, unbroken by intervening, efficient causes, so that, by various tests, it can be said that the [activity] was the proximate cause of the injury.”⁸³ In addition, Oklahoma law allows for proof of causation via circumstantial evidence, however, that evidence must have “sufficient probative force to constitute the basis for a legal inference, rather than mere speculation.”⁸⁴ *Ladra* must show that the defendants’ actions brought about the earthquake, that it resulted from a natural, uninterrupted series of events, and that there were no intervening causes that resulted in *Ladra*’s injury. Given the geological data available on the Prague earthquake in particular, and the manner in which courts tend to interpret questions of proximate cause, it is likely that this element of *Ladra*’s negligence and strict liability claims can be met.

1. The connection between the defendants’ actions and *Ladra*’s injury is a direct and natural sequence of events.

The central issue of the *Ladra* case, whether the fracking operations caused *Ladra*’s injury, is one for a trier of fact— that is, a judge or jury. For *Ladra*’s claims to succeed, she must first establish by a preponderance of the evidence that the defendants significantly contributed to the seismic activity in question. This can be done by showing the compelling relationship between rates of

83. 57 AM. JUR. 2D *Negligence* § 417 (2015).

84. *Stroud v. Arthur Andersen & Co.*, 37 P.3d 783, 791 (Okla. 2001).

fracking and injection well use versus rates of seismicity, or by demonstrating that this particular earthquake was human-induced rather than a natural occurrence. Showing a strong correlation between increased seismicity and fracking is not difficult,⁸⁵ but may prove less convincing than the latter- that this specific earthquake had an anthropogenic origin. Showing that an individual earthquake was caused by fracking is a much greater challenge.

To properly demonstrate that the earthquake's origin is anthropogenic would require expert testimony in the fields of geology, seismology, hydrology, petroleum engineering, and statistics. However, a basic illustration of the argument can be done using simple statistics. Comparing the background seismicity rate of Oklahoma (i.e., the prevalence of earthquakes in the state) before and after the surge in fracking activity in 2009 shows a marked difference.⁸⁶ Scientific models and statistical tests indicate that the difference in seismicity is statistically significant, and that there very likely must have been a change to a parameter affecting seismicity in the region to cause the difference in rates of seismicity.⁸⁷ The statistics on the subject are compelling and seen in many established publications,⁸⁸ but the fact remains that this is just a general correlation between trends in fracking and earthquakes, not specific to individual events.

Assigning manmade causes to specific seismological activity is not a new practice in the scientific community. "The first observation of possible reservoir-induced seismicity (RIS) was noted for

85. See, e.g., Hough & Page, *supra* note 73.

86. Llenos & Michael, *supra* note 69, at 2850.

87. *Id.* at 2852-54. Significance is demonstrated by *p*-value of 0.0009, when the significance threshold is $p < 0.05$. Thus making it extremely unlikely that this increase in seismicity is the result of random chance and not an underlying change to the factors that cause earthquakes.

88. See, e.g., *id.*; PETER FOLGER & MARY TIEMANN, CONGRESSIONAL RESEARCH SERVICE, HUMAN-INDUCED EARTHQUAKES FROM DEEP-WELL INJECTION: A BRIEF OVERVIEW (2015), <https://www.fas.org/sgp/crs/misc/R43836.pdf> [<https://perma.cc/9ZNV-BCYP>]; William L. Ellsworth et al., *Are Seismicity Rate Changes in the Midcontinent Natural or Manmade?*, 83 SEISMOLOGICAL RES. LETTERS 403 (2012); S. Horton, *Deep Fluid Injection Near the M 5.6 Oklahoma Earthquake of November, 2011*, 83 SEISMOLOGICAL RES. LETTERS 420 (2012); S. Horton, *Disposal of Hydrofracking Waste Fluid by Injection Into Subsurface Aquifers Triggers Earthquake Swarm in Central Arkansas with Potential for Damaging Earthquake*, 83 SEISMOLOGICAL RES. LETTERS 250-60 (2012).

Algeria's Quedd Fodda Dam in 1932; the first extensive study of the correlation between increased earthquake activity and variations in reservoir depth was made in the 1940s for Hoover Dam.⁸⁹ Assigning fracking and injection wells as the cause of individual earthquakes has been theorized for decades, but there was little evidence other than statistical correlation between the rise in earthquakes and an increase in fracking at the time.⁹⁰ This changed with the advent of new technology and seismicity monitoring techniques that allow seismologists to compare the precise location, time, and shaking patterns of different types of earthquakes. Using this data, seismologists can now determine whether or not an earthquake was likely anthropogenically induced or of a purely tectonic in origin.⁹¹

The data for the Prague earthquake indicates that it was induced by fracking and injection operations. By measuring an earthquake's aftershocks, seismologists are able to determine which faults ruptured and in which order. Data for the Prague earthquake shows it originated within 200 meters of active injection wells and within one kilometer of the surface.⁹² This location is significant because induced earthquakes tend to occur near well sites and in relatively shallow faults.⁹³ In addition, comparing the intensity and specific shaking patterns of the Prague earthquake to known induced earthquakes and prediction models for induced earthquakes yields datasets that are "*indistinguishable*."⁹⁴ This shows that the Prague earthquake was indeed the result of human activity, specifically the operation of fracking and injection wells in

89. PATRICK McCULLY, *SILENCED RIVERS: THE ECOLOGY AND POLITICS OF LARGE DAMS* 112 (1996). *See also* D. W. Simpson, *Triggered Earthquakes*, 14 ANN. REV. EARTH PLANETARY SCI. 21, 22 (1986) (explaining how the damming of the Colorado River to form Lake Mead was believed to have triggered earthquakes in the 1930s).

90. *See* J. H. Healy et al., *The Denver Earthquakes*, 161 SCI. 1301 (1968) (theorizing that earthquakes in the 1960s may be connected to waste injection, a practice not dissimilar to the those associated with fracking).

91. *See, e.g.*, Susan E. Hough, *Shaking Intensity From Injection-Induced Versus Tectonic Earthquakes in the Central-Eastern United States*, 34(6) LEADING EDGE 690 (2015); Susan E. Hough, Short Note, *Shaking from Injection-Induced Earthquakes in the Central and Eastern United States*, 104(5) BULL. SEISMOLOGICAL SOC'Y AM. 2619 (2014).

92. Keranen et al., *supra* note 82, at 699.

93. Hough & Page, *supra* note 73, at 2868.

94. *Id.* (emphasis added).

the vicinity of Prague, Oklahoma. Accordingly, it follows that the operators of those wells (such as New Dominion and the other defendants) caused the earthquake that injured Ladra, and may therefore be subject to liability.

2. Defendants cannot claim that the initial earthquake was an “act of God” for which they cannot be held liable.

Accepting that liquid injection from fracking and wastewater disposal caused the Prague earthquake, Ladra still must show that the specific actions of New Dominion and the other defendants directly caused her injury without any intervening steps that would allow them to escape liability. There is a semantic argument to be made that the defendants did not actually cause the earthquake itself, on the contrary there was the “intervening step” of the natural state of the rock formation itself. The source of the energy release that we define as an earthquake was not created by the defendants. Rather, the scientific “cause” of that energy release was the tectonic stress already present in the rock on either side of the fault where the earthquake occurred.⁹⁵ From a literal standpoint, the defendants did not cause the circumstances that allowed said energy build-up to occur, and, thus, did not cause the earthquake. They still may have contributed to the earthquake, but they can argue that the cause of the earthquake itself was an act of God.

This argument, while grounded in scientific fact, is legally flawed. Triggering or contributing to an event has long been acknowledged as a significant cause of the event itself. For example, in *The Salton Sea Cases*, the Ninth Circuit held that an act of God must be unanticipated and be *solely* due to a natural disaster.⁹⁶ In *The Salton Sea Cases*, the “act of God” was the flooding of a large area of the plaintiff’s land when, after rainfall, an unexpectedly large amount of water entered diversion channels erected by the defendant and then escaped uncontrolled onto the plaintiff’s property.⁹⁷ This flooding was alleged by the defendant to be an act of God, but the court rejected that argument because it was not just

95. See *Earthquakes Overview*, *supra* note 72.

96. *Salton Sea Cases*, 172 F. 792, 819 (9th Cir. 1909).

97. *Id.* at 792-94.

the natural force that caused the damage, but rather the defendant's releasing of that force. "No one is responsible for that which is merely the act of God or inevitable accident. But when human agency is *combined* with it, and neglect occurs in the employment of such agency, a liability for damages results from such neglect."⁹⁸

In *Ladra*, the "act of God" in question was the earthquake, but more specifically the development and escalation of stress between the two plates located at the fault. While the defendant may argue that they did not create the plate stress itself, they cannot argue that they did not contribute to its release (just as the defendants in *The Salton Sea Cases* contributed to the release of the water). Consequently, an "act of God" defense will fail because New Dominion's "human agency" *combined* with the act of God in order to bring about the damage.

3. Defendants may not claim they only triggered the first of a series of seismic events in order to escape liability.

The final hurdle for *Ladra's* assertion that the defendants caused her injury is whether or not the defendants can be held liable for the entire series of seismological events that comprised the Prague earthquake. Assuming, *arguendo*, that the defendants' actions caused the initial earthquake, there remains the question of whether they are also responsible for the subsequent seismic events. These events can result from further fault failures that are separate from the initial earthquake, but only occurred because the fault was weakened by that earthquake.⁹⁹ In the present matter, there was the initial earthquake ("A") followed by two more seismic events, "B" and "C", which may have been triggered by the initial quake or only faulted due to natural stress (i.e., the defendants caused the initial quake by lubricating the fault line, and that quake then added stress to other fault lines that were not directly affected by the defendants).¹⁰⁰ While studies of the two subsequent events indicate that they may have been the partially result of injection, that explanation does not fully explain their magnitude or

98. *Id.* at 819 (citing *Chidester v. Consol. Ditch Co.*, 59 Cal. 197, 203 (1881)) (emphasis added).

99. Keranen et al., *supra* note 82, at 702.

100. *Id.*

occurrence.¹⁰¹ Therefore, it seems that they were the result of preexisting faults that likely only slipped due to added stress from the first earthquake.

This begs the question, since the defendants did not directly weaken the faults that slipped during events “B” and “C”, should they not be held responsible for damage caused by those events? If that were the case, then Ladra would have to prove that the damage to her house and person was the result of only the initial earthquake, not either of the subsequent ones.¹⁰²

Fortunately for Ladra, that argument necessarily fails. In the seminal torts case, *Anderson v. Minneapolis, St. Paul and Sault Ste. Marie Railroad Company*, sparks from the defendant’s train started a fire that, thanks to high winds and drought, quickly spread and damaged property.¹⁰³ The defendant requested instructions that the unusual wind and weather conditions on the date of the event were “such an efficient and independent cause of plaintiff’s damage as to relieve defendant from liability.”¹⁰⁴ The court in *Anderson* refused this request, reasoning that, though neither the drought nor the wind could have caused the damage without the fire, the end result was “one which might reasonably be anticipated as a natural consequence” of the defendant’s actions.¹⁰⁵ Thus, even if the drought and high winds were, themselves, proximate causes of the damage to the plaintiff’s property, “the fire was a material concurring cause, without which there would have been no damage to plaintiff.”¹⁰⁶

This case is analogous to the situation presented *Ladra*. Just as there were independent, exacerbating circumstances that

101. E. S. Cochran et al., *Coulomb Stress Modeling of the 2011 M5.7 Oklahoma Earthquake Sequence*, AM. GEOPHYSICAL UNION (2012), <http://adsabs.harvard.edu/abs/2012AGUFM.S53L..05C> [<https://perma.cc/X878-YMN9>].

102. Given the timing of Ladra’s injury, it is almost certain that the primary earthquake was the one that damaged her house, but that fact still must be properly established to rebut this defense.

103. *Anderson v. Minneapolis, St. Paul and Sault Ste. Marie Ry. Co.*, 179 N.W. 45, 46 (Minn. 1920) (the case also involved another, unrelated fire that merged with the one in question to cause a greater conflagration. However, for the purposes of the natural aspect of the “Act of God” instruction requested by the defense in the case, the other fire is irrelevant, nor does the other fire have any bearing on *Anderson*’s significance for the *Ladra* case).

104. *Id.* at 48.

105. *Id.*

106. *Id.*

greatly increased the damaging effect of the fire in *Anderson* (drought and high winds), so too were there independent circumstances that increased the damaging effect of New Dominion's actions (pre-existing stress in nearby faults that allowed for subsequent seismic activity after the first earthquake). These existing faults, and the effect that the first earthquake would have on them were circumstances which might reasonably be anticipated as a natural consequence.¹⁰⁷ Accordingly, even if the existing faults and tectonic stresses were themselves proximate causes of the damage done to Ladra during the Prague earthquake (as they caused the subsequent seismic events), the defendant-induced earthquake was still a "material concurring cause, without which there would have been no damage to the plaintiff."¹⁰⁸

Therefore, any defense that New Dominion should escape liability because events "B" and "C" were not directly caused by them will likely fail. For those with knowledge in the field of geology, the subsequent seismic events were foreseeable consequences of the original earthquake. Furthermore, in cases such as this, aftershocks and subsequent earthquakes are so closely associated with the primary earthquake that they are often viewed by geologists as one overarching seismic event.¹⁰⁹

VI. IMPLICATIONS FOR INDUSTRY

While the case against New Dominion and the other defendants is not overwhelmingly strong, victory for Ladra remains a distinct possibility. Natural gas extraction companies cannot hope to hide behind precedent, or lack thereof, indefinitely. In any individual case, a court may find that the manner in which the defendants

107. Keranen et al., *supra* note 82, at 702 (explaining the basic mechanism for how "small- to moderate-sized injection-induced events may result in release of additional tectonic stress."); *see also, generally*, Susan Hough, Seismologist for the U.S. Geological Survey, Incorporated Research Institutions for Seismology and the Seismological Society of America Lecture Series: The Very Long Reach of Very Large Earthquakes (2005) (explaining how inducing seismic activity is known to produce further seismic activity via "remote triggering").

108. *Anderson v. Minneapolis, St. Paul and Sault Ste. Marie Ry. Co.*, 179 N.W. 45, 48 (Minn. 1920).

109. *See* Keranen et al., *supra* note 82, at 700 (referring to the three events as the Prague Earthquake or Earthquake Sequence).

operated their own injection wells was negligent or that the activity itself is ultra-hazardous. This, in conjunction with growing evidence showing a causal link between fracking waste injection and an increase in the incidence in earthquakes, forecasts a potential future wherein injured parties may regularly succeed in private tort claims against operators of fracking and injection wells. As studies regarding the potential dangers of fracking increase, these well operators are put on notice, and their operations may become more apparently hazardous.

Additionally, well operators cannot hope to hide behind the fact that there are many different parties potentially contributing to the situation.¹¹⁰ As illustrated previously, seismological monitoring techniques are becoming increasingly more accurate in determining the precise location of an earthquake's hypocenter, which, in turn, aids in determining which party's wells most likely contributed to the earthquake.¹¹¹ Furthermore, even if it were impossible to determine which wells in an area contributed to an earthquake, courts could easily employ a market-share liability model.

Assuming that it is established that fracking and waste injection cause earthquakes in an area, courts could resolve uncertainty as to which individual parties may have caused a specific earthquake by assigning liability to all operators in the area based on the extent of their activities. This model would be akin to the one established in *Sindell v. Abbott Laboratories*. In *Sindell*, the plaintiffs could not determine which of several pharmaceutical companies distributed the specific doses of a drug consumed by their mothers, which, in turn, caused harm to the plaintiffs while in the

110. In her article, *Shake, Rattle, and Palsgraf: Whether an Actionable Negligence Claim Can Be Established in Earthquake Litigation*, Professor Meredith Wegener makes a compelling argument that liability on behalf of fracking companies may be avoided because, despite the increasing scientific belief that injection well use and earthquakes are related, it may prove impossible to determine which *specific well* or which *specific entities* caused Ladra's harm. See Meredith Wegener, *Shake, Rattle, and Palsgraf: Whether an Actionable Negligence Claim Can Be Established in Earthquake Litigation*, 11 TEX. J. OIL, GAS, & ENERGY L. 115 (2016). However, studies do indicate which wells were most likely to cause the harm, and suggest that earthquakes may be caused by injection wells in the general area. Walsh & Zoback, *supra* note 77, 2, 9. It is based on this more general contribution theory that the following "market-share" argument will be made.

111. M. Weingarten et al., *High-Rate Injection is Associated with the Increase in U.S. Mid-Continent Seismicity*, 348 SCI. 1336, 1336-37 (2015).

womb.¹¹² The Court determined that the various alternative theories of liability presented to the court were inappropriate or infeasible.¹¹³ Instead, it proffered its own, holding that “each defendant will be held liable for the proportion of the judgment represented by its share of that market unless it demonstrates that it could not have made the product which caused plaintiff’s injuries.”¹¹⁴ In the case of induced earthquakes, courts could use a similar model to assign a share of the damages to each operator of injection wells in the area.

This model would hold each defendant roughly liable for the extent to which they may have contributed to any particular seismic activity. Using technology described in the previous section of this note, plaintiffs could determine which well operators were more likely to have contributed to a given earthquake. This would focus primarily on determining the precise location of the earthquake’s hypocenter,¹¹⁵ and then analyzing the injection activities of all parties in the area (within approximately thirty-five kilometers of the hypocenter).¹¹⁶ Using this data, along with the parties’ records on the location and use of their wells, one could determine which parties likely contributed most to the weakening of specific faults.¹¹⁷ Accordingly, there do not seem to be issues of assessing and assigning damages despite the many potential defendants.

112. *Sindell v. Abbott Labs.*, 607 P.2d 924, 924-26 (Cal. 1980).

113. *Id.* at 936-37.

114. *Id.* at 937.

115. For the Prague earthquake, which caused Ladra’s injuries, an accurate location of its origin was determined. *See Keranen et al.*, *supra* note 82, at 700.

116. The thirty-five kilometer standard comes from research demonstrating that injection-induced seismicity has occurred up to thirty-five kilometers away from disposal wells. Keranen et al., *supra* note 75, at 451. This would be a good threshold with which to start.

117. Data on the use of the wells would be vital for this process, as the amount of fluid injected would correspond to how likely the defendant is to have contributed to the earthquake. “Large volumes of injected wastewater may be required for an earthquake response that includes events large enough to be felt, or even damaging. The magnitudes of the largest induced earthquakes in some sequences correlate with the volume of injected fluid.” McGarr et al., *supra* note 17, at 830. Furthermore, injection volumes are reported to the state and the Oklahoma Corporation Commission. *See Oil & Gas Data Files*, OKLA. CORP. COMM’N, <http://www.oceweb.com/og/ogdatafiles2.htm> [<https://perma.cc/445A-ED8K>].

Thus, in order to avoid future liability, those operating injection wells must reassess their practices and establish new procedures compliant with the now known danger associated with fracking. Others have argued that these earthquakes were not reasonably foreseeable in the past, and while that may lessen Ladra's chances of success in her case¹¹⁸, that argument can no longer succeed given the increasing awareness of the connection between the use of these wells and induced seismicity; injection well operators now know of the connection and should act accordingly. This may include limits on how aggressively, and with what frequency they fracture rock from, or store waste with, certain wells. It could also include limits on how closely they cluster injections wells, especially if those wells are near known fault lines. It is up to those parties to decide if, and how, they will amend their practices, and there are likely many solutions that are beyond the scope of both this note and current scientific understanding of seismology. However, if these companies seek to escape liability, they must to act in some capacity.

VII. CONCLUSION

Despite this being the first such claim in the country to go to court, Ladra may succeed in her claim that local industry caused the earthquake that injured her. A growing set of data on, and analysis of, the Prague earthquake indicates that the seismic events of November 2011 were at least partially of anthropogenic origin. This apparent causation may have been the final obstacle to fall in bringing successful negligence claims in cases like Ladra's. In addition, recognition of this proximate causation may lead future courts to finding that the use of fracking and waste disposal wells is an inherently ultra-hazardous activity. More research is needed to further substantiate these claims, but the success of this case would be a significant first step towards curbing irresponsible fracking and waste injection practices. If this were to occur, the manner in which natural gas extraction companies and local property owners look at the effects of fracking and fracking waste disposal would change substantially. Hopefully this change will lead to a greater degree of care in fracking, more caution in the

118. See Wegener, *supra* note 110.

subterranean disposal of waste, and a greater provision of justice for victims of induced seismicity.

While many environmental advocates may welcome the ruling in *Ladra v. New Dominion* as opening the gateway to a myriad of new claims against fracking companies (and hopefully suspending those companies' operations), the case has not guaranteed any sort of victory for the environment. The case opens the door for new claims, but each party still must prove their own case. In fact, given the opportunity that this case presents to provide further precedent, it may actually be a triumph for operators of injection wells throughout Oklahoma. A loss for the Sandra Ladra may signify the closing of the door to strict liability and negligence claims for future earthquake victims. Regardless, due to the continued dramatic rise in earthquake frequency, this case will undoubtedly be cited in many future earthquake-related actions as either a defense or the very model for basing a claim.